HIOKI

INSTRUCTION MANUAL

3167

AC/DC CLAMP ON POWER HiTESTER

HIOKI E. E. CORPORATION

Contents

Introduction

Thank you for purchasing the HIOKI "3167 AC/DC CLAMP ON POWER HiTESTER". To obtain maximum performance from the product, please read this manual first, and keep it handy for future reference.

For Safety

⚠ DANGER

Mishandling this product during use could result in injury or death, as well as damage to the product. Be certain that you understand the instructions and precautions in the manual before use. We disclaim any responsibility for accidents or injuries not resulting directly from product defects.

This manual contains information and warnings essential for safe operation of the product and for maintaining it in safe operating condition. Before using the product, be sure to carefully read the following safety notes.

Safety symbols

⚠	● The ⚠ symbol printed on the product indicates that the user should refer to a corresponding topic in the manual (marked with the ⚠ symbol) before using the relevant function. ● In the manual, the ⚠ symbol indicates particularly important information that the user should read before using the product.
|	Indicates the ON side of the power switch.
○	Indicates the OFF side of the power switch.
⏚	Indicates a grounding terminal.
⎓	Indicates DC (Direct Current).
≂	Indicates both DC (Direct Current) and AC (Alternating Current).

The following symbols in this manual indicate the relative importance of cautions and warnings.

⚠ DANGER	Indicates that incorrect operation presents an extreme hazard that could result in serious injury or death to the user.
⚠ WARNING	Indicates that incorrect operation presents a significant hazard that could result in serious injury or death to the user.
⚠ CAUTION	Indicates that incorrect operation presents a possibility of injury to the user or damage to the product.
NOTE	Advisory items related to performance or correct operation of the product.

Before Use

Inspection

When you receive the product, inspect it carefully to ensure that no damage occurred during shipping. In particular, check the accessories, panel switches, and connectors. If damage is evident, or if it fails to operate according to the specifications, contact your dealer or Hioki representative.

Standard accessories		
Accessory	Model number or rating	Number provided
Instruction manual	————————	1
Power cord	————————	1
Voltage cord	9179 VOLTAGE CORD	1
AC adapter	9418-10 AC ADAPTER (PSA-30U-120, PHIHONG)	1
Spare fuse (for voltage cord)	M 0.3 A/250 V arc quenching	1

Shipment

Use the original packing materials when reshipping the product, if possible.
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) 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. If required, secure the case with shipping twine.

⚠

Important Notes on Using the Power Meter

Follow these precautions to ensure safe operation and to obtain the full benefits of the various functions.

Preliminary check

Before using the product the first time, verify that it operates normally to ensure that the no damage occurred during storage or shipping. If you find any damage, contact your dealer or Hioki representative.

Before use

⚠ DANGER

The maximum input voltage (maximum sustainable input) is 600V DC/AC. Attempting to measure voltage in excess of the maximum input could destroy the product and result in personal injury or death.

⚠ WARNING

- When the unit is using a DC power supply, the voltage is 12 V±2 V. When using the supplied AC adapter, the voltage is 100 to 240 V AC (50/60 Hz). Using other voltage supplies may cause damage to the unit or an accident.
- To avoid electric shock and ensure safe operation, connect the power cord to a grounded (3-contact) outlet.

Making power meter connections

⚠ DANGER

Connect the clamp-on sensors or voltage cords to the product first, and then to the active lines to be measured.

Observe the following to avoid electric shock and short circuits.

- **Clamp sensor and Voltage cord should only be connected to the secondary side of a breaker, so the breaker can prevent an accident if a short circuit occurs. Connections should never be made to the primary side of a breaker, because unrestricted current flow could cause a serious accident if a short circuit occurs.**
- **Do not allow the voltage cord clips to touch two wires at the same time. Never touch the edge of the metal clips.**
- **When the clamp sensor is opened, do not allow the metal part of the clamp to touch any exposed metal, or to short between two lines, and do not use over bare conductors.**
- **To avoid short circuits and potentially life-threatening hazards, never attach the clamp sensor to a circuit that operates at more than AC 600Vrms, or over bare conductors.**

⚠ WARNING

- **To avoid electric shock accident, before removing or replacing an interface, power cord, and clamp sensor, confirm that the instrument is turned off and that the power cord are disconnected.**
- **The mounting screws must be firmly tightened or the input unit may not perform to specifications, or may even fail.**
- **Before using the product, make sure that the insulation on the sensor and power cord is undamaged and that no bare conductors are improperly exposed. Using the product under such conditions could result in electrocution. Replace the sensor and voltage cord (9179) specified by Hioki.**

⚠ CAUTION

- Avoid stepping on or pinching the cable, which could damage the cable insulation.
- Keep the cables well away from heat sources, as bare conductors could be exposed if the insulation melts.

Others

⚠ CAUTION

- Do not store or use the product where it could be exposed to direct sunlight, high temperature or humidity, or condensation. Under such conditions, the product may be damaged and insulation may deteriorate so that it no longer meets specifications.
- To avoid damage to the product, do not short-circuit the output terminal and do not input voltage to the output terminal.
- To avoid damage to the product, protect it from vibration or shock during transport and handling, and be especially careful to avoid dropping.
- Note that the product may be damaged if the applied voltage or current exceeds the measurement range.

NOTE

- Accurate measurement may be impossible in the presence of strong magnetic fields, such as near transformers and high-current conductors, or in the presence of strong electromagnetic fields such as near radio transmitters.
- 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.
- Integration values produced by the 3167 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 the 3167.
- For accurate measurement, allow the unit to warm up for more than half an hour before starting operation.

- When the input is less than 0.4% of the measurement range, the indication is forcibly set to zero.
- The 3167 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.
- 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.)
- 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 the 3167 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 its 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 the 3167 unit in order to minimize the disturbing effects upon measurement of the external magnetic field which it generates.
- Ensure that any instrument (recorder, digital multimeter, oscilloscope,etc.) connected to the output terminal either has an insulated input or is battery powered. Use of an instrument with uninsulated input will result in a loop between ground, the 3167, the instrument, and ground, affecting the 3167’s analog ground level (the reference potential) and rendering measurements and waveform observations inaccurate.

Chapter Summary

The various chapters of this manual deal with the following subjects.
Follow the introduction to Chapter 1, which describes precautions on use, overview, and features of this unit.

Chapter 1	Overviews and identification of indicators Overview of the unit and its features and identification of indicators.
Chapter 2	Specifications Specifications for the main unit, and measurement ranges.
Chapter 3	Before measurement Describes setup and preparation for using the unit and important points to note.
Chapter 4	Basic operation Illustrates handling and basic unit operation with illustration and example for each function or mode.
Chapter 5	Applied operation Illustrates handling and applied unit operation with illustration and example for each function or mode.
Chapter 6	Interface GP-IB, RS-232C Describes summary of optional interfaces (GP-IB and RS-232C) and commands.
Chapter 7	Maintenance and service Covers maintenance and notes on ultimate disposal.
Chapter 8	Appendices Collects range correspondence table, list of error massages and command summary as appendices.

Chapter 1
Overview and Identification of Controls and Indicators

1.1 Overview of the 3167

The 3167 AC/DC CLAMP ON POWER HiTESTER is a single phase power tester suitable for measuring the electrical power consumption of low power equipment such as domestic electrical products.
With this one unit, it is possible to measure voltage, current, active power, apparent power, reactive power, the power factor, phase angle, frequency and integrated value.

1.2 Features

(1) Wide broad band DC, from 10 Hz to 50 kHz.

(2) In reactive power and the power factor indication, it is possible to recognize the phase is lead or lag.

(3) The voltage range and current range are wide. (from 15 V to 600 V, from 2 A to 500 A)

(4) Simultaneous three-channel analog output for voltage, current, and active power is provided.

(5) Simultaneous three-channel monitor output (wave form output) for voltage, current and active power is provided.

(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) The terminal for voltage measurements are insulated. Current measurement is insulated in the clamp-on sensor.

(9) All measurement data has synchronism.

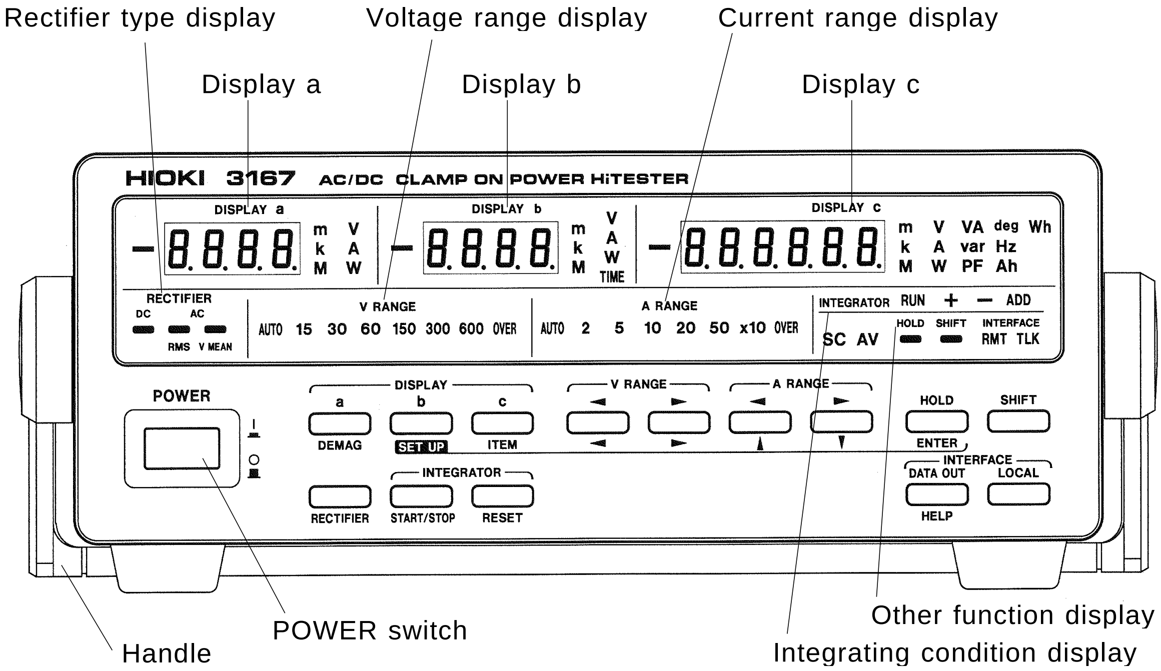
(10) GP-IB interface (option) is equipped. When connect GP-IB listen only printer, manual printing of measurement data, time interval printing which synchronize with integration measurement and help printing of setting items are possible.

(11) RS-232C interface (option) is equipped. When connect RS-232C printer, manual printing of measurement data, time interval printing which synchronize with integration measurement and help printing of setting items are possible.

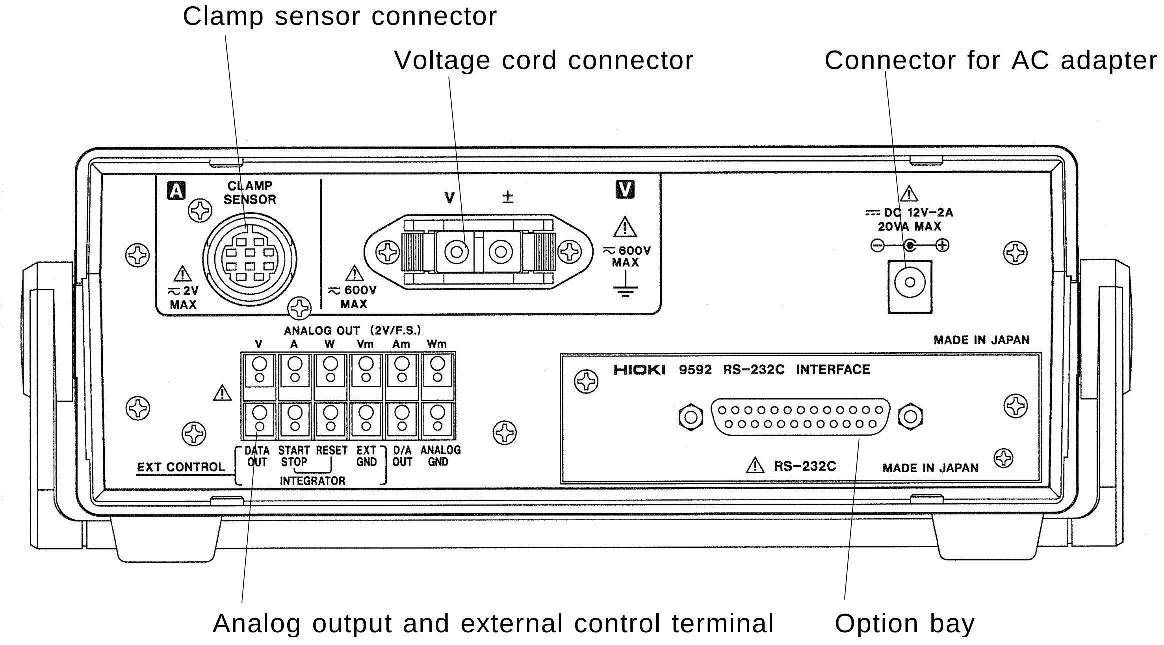
(12) It is possible to change one of the apparent power, reactive power, power factor, phase angle, frequency and integration value to direct voltage from D/A output terminal in 2 V f.s..

(13) Small-sized and light weight.

1.3 Identification of Controls and Indicators



Front panel



Rear panel

1.4 Explanation for keys

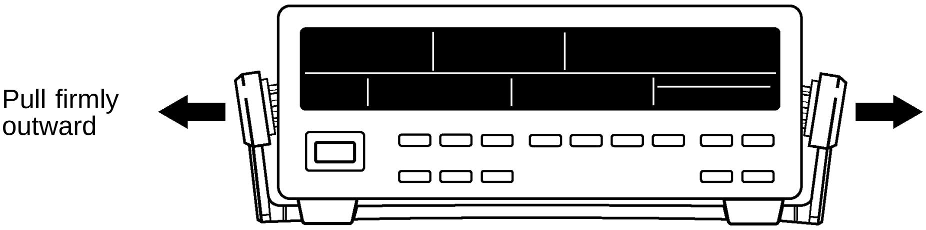
Key	Notation on the instruction manual	Summary	Section
a DEMAG	a	Switches over the display a.	4.2
	DEMAG	In combination with the SHIFT key, this demagnetizes the sensor.	4.5
b SET UP	b	Switches over the display b.	4.2
	SET UP	In combination with the SHIFT key, this switches between the setting display and the measurement display.	5
c ITEM	c	Switches over the display c.	4.2
	ITEM	Changes items of setting display.	5
◄ ◄	◀	Switches over the voltage range.	4.3
		Moves the cursor to the left in the setting display.	5
► ►	▶	Switches over the voltage range.	4.3
		Moves the cursor to the right in the setting display.	5
◄ ▲	◀	Switches over the current range.	4.3
	▲	Changes setting value of setting display.	5
► ▼	▶	Switches over the current range.	4.3
	▼	Changes setting value of setting display.	5
HOLD ENTER	HOLD	Holds display value.	4.4
	ENTER	Confirms setting value of setting display.	5
SHIFT	SHIFT	Validates the lower indicated function for that key (Shift lamp lights).	4 - 6
RECTIFIER	RECTIFIER	In combination with the SHIFT key, changes rectifier type.	4.1
START/STOP	START/STOP	In combination with the SHIFT key, executes integration start or stop.	5.4
RESET	RESET	In combination with the SHIFT key, resets integration value.	5.4
DATA OUT HELP	DATA OUT	Outputs the measuring value to the printer.	6.8
	HELP	In combination with the SHIFT key, outputs the measuring value to the printer.	6.8
LOCAL	LOCAL	Releases the remote state under interface.	6.3

1.5 Handle Operation

⚠ CAUTION When using the handle as a stand for the 3167, pressing down on the unit will damage the handle.

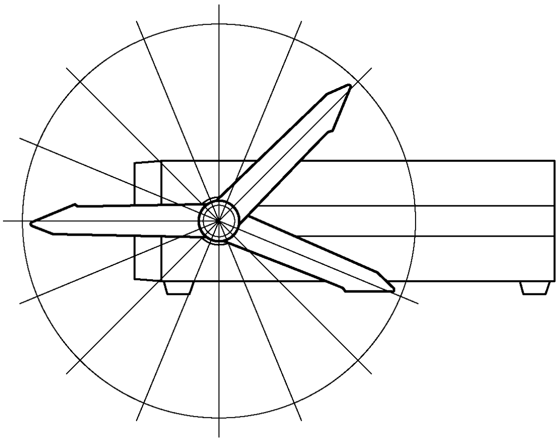
Adjust the handle angle as follows.

1. Grip the ends of the handle with both hands and pull them away from the handle retaning notches.



2. Maintaining outward pressure on the end of the handles, turn the handles to the desired angle.

3. Reset the handle ends to the retaining notches.



NOTE The handle angle is adjustable in increments of approximately 22 degrees.

⚠ CAUTION When using the handle as a stand for the device, do not press down too hard on the device as this can damage the handle.

Chapter 2
Specifications

2.1 General Specifications

■ Measuring line	Single phase, two conductor (1φ2 W)	
■ Measuring items	Voltage, current, active power, apparent power, reactive power, power factor, phase angle, frequency, current integration and power integration	
■ Display type	LED display	
	display・a	Voltage, current, active power (4 digits display)
	display・b	Voltage, current, active power, integrate passage time (4 digits display)
	display・c	Voltage, current, active power, apparent power, reactive power, power factor, phase angle, frequency, integrate value (Integrate value is displayed in 6 digits, the other is 4 digits.)
	Unit	m, k, M, V, A, W, VA, var, Hz, Ah, Wh (PF, deg and TIME show displaying items)
■ Sample rate	5 times/sec.	
■ Temperature and humidity ranges for operation	0 ℃ to 40 ℃, 80 % RH with no condensation	
■ Temperature and humidity ranges for storage	-10 ℃ to 50 ℃, 80 % RH with no condensation	

Voltage, current, active power measurement

■ Measuring range	Voltage 15.00/30.00/60.00/150.0/300.0/600.0 V Current 2.000/5.000/10.00/20.00 A (Uses clamp sensor rated at 20 A) 20.00/50.00/100.0/200.0 A (Uses clamp sensor rated at 200 A) 50.00/100.0/200.0/500.0 A (Uses clamp sensor rated at 500 A) Active power according to combination of voltage and current Includes auto and manual ranging
■ Maximum sustainable input	Voltage 600 V active value, 848 V peak Current according to specifications for clamp-on sensor However, maximum sustainable input of clamp-on sensor connector portion is 5.6 V, effective value is 8 V peak.
■ Maximum crest factor	Less than 3
■ Input resistance (DC)	Voltage 1 MΩ±5 % Current according to specifications for clamp-on sensor Only input resistance of main unit is 200 kΩ±10 %
■ Influence on power factor	Less than ±0.3 % rdg. (In 45 Hz to 66 Hz, PF=0.5)
■ Input type	Voltage resistive potential divided or isolated amplifier Current Clamp sensor (1) UNIVERSAL CLAMP ON CT (AC/DC) 9277, 9278, 9279 (2) CLAMP ON SENSOR (AC) 9270, 9271, 9272
■ 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 Active power real effective value measurement by analog treatment
■ Effective input limit	10 to 100 % for range (only 600 V range) 10 to 110 % for range (V or A range except above)
■ Display limit	0.4 to 130 % for range (resolution 4 digit)
■ Temperature coefficient	Less than ± 0.05 % f.s./℃
■ External magnetic field influence	According to specifications for clamp-on sensor

■ In-phase voltage influence	Less than ± 0.2 %f.s. (Voltage input terminal short, provides 600 V AC rms and 50/60 Hz between voltage input terminal or clamp-on sensor and ground.)	
■ Maximum in-phase voltage	600 Vrms (DC, 50 /60 Hz) for voltage output terminal	
■ Analog output	Output voltage	±2 V DC f.s. outputs voltage, current and active power simultaneously
	Output accuracy	measurement accuracy ± 0.1 %f.s.
	Response time	less than 1.1 sec. (suddenly change to 0 % to 90 % and 100 % to 10 % for range)
	Output resistance	100 Ω±5 %
■ Monitor output	Output voltage	2 Vf.s. outputs voltage, current and active power simultaneously (wave form output)
	Output accuracy	voltage, current: measurement accuracy ±0.5 %f.s. (effective value level) active power: measurement accuracy ±2.0 %rdg. ±0.5 %f.s. (averaging value level)
	Output resistance	100 Ω±5 %

Apparent power, reactive power and power factor measurement

■ Measurement type	Apparent power	computed from voltage and current (for computing equation refer to table 2.3)
	Reactive power	computed from active power and apparent power (for computing equation refer to table 2.3)
	Power factor	computed from active power and apparent power (for computing equation refer to table 2.3)
■ Measurement range	Both apparent power and reactive power are same as active power (however, units are VA and var respectively) Power factor (measurement limit): 0.000 to ± 1.000 (with polarity of lead or lag)	
■ Effective input limit	Same as the effective input limits of voltage, current and active power	

Phase angle measurement

■ Measurement type	Computed from power factor
■ Measurement limit	+ (lag) 90.00 deg. to - (lead) 90.00deg.
■ Effective input limit	Same as the effective input limits of voltage, current and active power

Frequency measurement

■ Measurement type	Reverse operation from input wave form cycle (reciprocal method)
■ Measurement range	500 Hz/50 kHz (Includes auto and manual ranging)
■ Measurement limit	0.8 % to 100 % for range (4 Hz to 500 Hz/400 Hz to 50 kHz)
■ Effective input limit	Same as the input limits of voltage and current
■ Accuracy	±0.1 %rdg. ±1 dgt. (0 ℃ to 40 ℃, 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 and current) Filter changing linked with range (cut off frequency is 100 % for range)

Current integration and power integration

■ Measurement type	Computed from measurement value of current and active power
■ Measurement limit	0 to ± 999999 MAh/MWh (Integrate time exists within 10000 hours)
■ Effective input limit	Same as the input limits of current and active power
■ Accuracy	Measurement accuracy for current and active power is ± 1 dgt.
■ Accuracy of integration time	±100 ppm ±1 sec. (in 0 ℃ to 40 ℃)
■ Timer setting limit	1 minute to 10000 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 integrate elapsed time (0 minute to 10000 hours) Add and integration by repeat of start and stop Back up of integrate value and integrate 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 true RMS value)
	AC RMS	AC (For both voltage and current, display true RMS value)
	AC+V MEAN	AC (voltage is displayed as average rectifier effective value, current is displayed as true RMS value)
■ Scaling	Direct reading by setting of PT and CT ratio	
	Setting limit	PT 1.000 to 9999 CT 0.01 to 9999
■ Average	Display by moving and averaging the sampling data	
	Number of averaging	OFF, 8, 16, 32 and 64
■ Over input warning	When the input wave form peak value is 3 times for range, warning lamp lights	
■ 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 measurement values	

D/A output

■ Constitution	16 bits D/A converter, 1ch (polarity +15 bits)
■ Accuracy	Measurement accuracy ±0.2 %f.s. (23 ℃±3 ℃)
■ Temperature coefficient	Less than ±0.05 %f.s./℃
■ Sample rate	5 times/sec.
■ Output voltage	DC ±2 Vf.s.
■ Output contents	Apparent power, reactive power, power factor, phase angle, frequency, current integration and power integration
■ Output resistance	100 Ω±5 %

Other

■ Dielectric strength	2.2 kVAC, 50/60 Hz, 1 minute Between voltage input terminal and case, output terminal, external control terminal, power supply When using 9418-10 AC ADAPTER (PSA-30U-120, PHIHONG): 1.5 kVAC, 50/60 Hz, 1 minute Between primary power supply and case, output terminal, external control terminal

■ Insulation resistance	In 500 V DC more than 100 MΩ Between voltage input terminal and case, output terminal, external control terminal, power supply When using 9418-10 AC ADAPTER (PSA-30U-120, PHIHONG): In 500 VDC more than 20 M Ω Between primary power supply and case, output terminal, external control terminal
■ Power supply	12 V DC±2 V When using AC adapter: 100 AC to 240 V 50/60 Hz
■ Power consumption	20 VA Max. (when the optional interface is fitted) At rated input level: 13 VA Max. (when the optional interface is fitted)
■ Mass	Approx. 2.4 kg (only main unit, but includes an option)
■ External dimensions	Approx. 215 (W) × 80 (H) × 280 (D) mm (without projections such as buttons and supporting leg)
■ Accessories	Instruction manual 1 9418-10 AC ADAPTER (PSA-30U-120, PHIHONG) 1 Power cord 1 9179 VOLTAGE CORD 1

Options

■ 9588 GP-IB INTERFACE	Based on IEEE-488.1 1987 and refer to IEEE-488.2 1987 SH1, AH1, T5, L4, SR1, RL1, PP0, DC1, DT1, C0 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 100 hours. Synchronized with integration starting)
■ 9592 RS-232C INTERFACE	Start-stop transmission Baud rate 1200, 2400, 4800, 9600 bps Data length 7 or 8 bits Parity NONE, ODD or EVEN Stop bits 1 or 2 bits Manual output using printer mode, time interval output and help output functions are contained. (External control is possible for manual output) (It is possible to set the interval with unit in 10 seconds from 10 seconds to 100 hours. Synchronized with integration starting)
■ 9270 (20A), 9271 (200A), 9272 (20A/200A)	CLAMP ON SENSOR (for AC)
■ 9277 (20A), 9278 (200A), 9279 (500A)	UNIVERSAL CLAMP ON CT (for AC/DC)

■ 9290	CLAMP ON ADAPTER (for 1500 A AC)
■ 9442	PRINTER (using with 9592 RS-232C INTERFACE)
■ 9443-03	AC ADAPTER for printer (for U.S.A)
9443-02	AC ADAPTER for printer (for EU excluding Switzerland)
9443-01	AC ADAPTER for printer (for JAPAN)
■ 9446	CONNECTION CABLE (for printer)
■ 1196	RECORDING PAPER
■ 9151-02	GP-IB CONNECTOR CABLE (2 m)
9151-04	GP-IB CONNECTOR CABLE (4 m) (using with the 9588 GP-IB INTERFACE)

Table 2.1 Range correspondence table

Table 2.1-1 When using Clamp sensor rated at 20 A

A V	2.000 A	5.000 A	10.00 A	20.00 A
15.00 V	30.00 W	75.00 W	150.0 W	300.0 W
30.00 V	60.00 W	150.0 W	300.0 W	600.0 W
60.00 V	120.0 W	300.0 W	600.0 W	1.200 kW
150.0 V	300.0 W	750.0 W	1.500 kW	3.000 kW
300.0 V	600.0 W	1.500 kW	3.000 kW	6.000 kW
600.0 V	1.200 kW	3.000 kW	6.000 kW	12.00 kW

Table 2.1-2 When using Clamp sensor rated at 200 A

A V	20.00 A	50.00 A	100.0 A	200.0 A
15.00 V	300.0 W	750.0 W	1.500 kW	3.000 kW
30.00 V	600.0 W	1.500 kW	3.000 kW	6.000 kW
60.00 V	1.200 kW	3.000 kW	6.000 kW	12.00 kW
150.0 V	3.000 kW	7.500 kW	15.00 kW	30.00 kW
300.0 V	6.000 kW	15.00 W	30.00 kW	60.00 kW
600.0 V	12.00 kW	30.00 kW	60.00 kW	120.0 kW

Table 2.1-3 When using Clamp sensor rated at 500 A

A V	50.00 A	100.0 A	200.0 A	500.0 A
15.00 V	750.0 W	1.500 kW	3.000 kW	7.500 kW
30.00 V	1.500 kW	3.000 kW	6.000 kW	15.00 kW
60.00 V	3.000 kW	6.000 kW	12.00 kW	30.00 kW
150.0 V	7.500 kW	15.00 kW	30.00 kW	75.00 kW
300.0 V	15.00 kW	30.00 kW	60.00 kW	150.0 kW
600.0 V	30.00 kW	60.00 kW	120.0 kW	300.0 kW

NOTE In apparent power and reactive power, the unit W in above table must be considered as VA or var.

2.2 Measurement Accuracy

Measurement accuracy Period of guaranteed accuracy: 6 months (23 ℃±3 ℃, PF=1, warm-up time=30 min.)			
Frequency	Voltage	Current	Effective power
DC	±0.4 %rdg. ±0.3 %f.s.	±0.5 %f.s.	±0.4 %rdg. ±0.3 %f.s.
10 Hz to 20 Hz	±1.5 %f.s.	±1.0 %f.s.	±1.5 %f.s.
20 Hz to 45 Hz	±0.4 %rdg. ±0.4 %f.s.	±0.3 %f.s.	±0.4 %rdg. ±0.4 %f.s.
45 Hz to 66 Hz	±0.4 %rdg. ±0.1 %f.s.	±0.3 %f.s.	±0.4 %rdg. ±0.1 %f.s.
66 Hz to 4k Hz	±0.4 %rdg. ±0.4 %f.s.	±0.3 %f.s.	±0.4 %rdg. ±0.4 %f.s.
4 kHz to 10 kHz	±1.4 %f.s.	±1.0 %f.s.	±1.4 %f.s.
10 kHz to 50 kHz	±3.0 %f.s.	±1.0 %f.s.	±3.0 %f.s.

2.3 Measuring Item and Compulating Equation

Table 2.3 Compulating equation

Apparent power (VA)	Reactive power (var)	Power factor (PF)	Phase angle (deg)
$\mathrm{VA} = \mathrm{V} \times \mathrm{A}$	$\mathrm{var} = \mathrm{s}\sqrt{\mathrm{VA}^2 - \mathrm{W}^2}$	$\mathrm{PF} = \mathrm{s}\left\lvert\frac{\mathrm{W}}{\mathrm{VA}}\right\rvert$	$\mathrm{deg.} = \mathrm{s}\ \cos^{-1}\left\lvert\frac{\mathrm{W}}{\mathrm{VA}}\right\rvert$

NOTE

- V means voltage measurement value, A means current measurement value and W means active power measurement value. (In this case, rounding error for display ±1 dgt. is not included.)
- s means the polarity which become -1 when the current phase against voltage is lead and +1 when it is lag.
- Compulating accuracy is ±1 dgt. for the calculate value from measurement value on display.

2.4 Internal Configuration

- Figures 2.4-1 and 2.4-2 show the internal configuration of the 3167.
- The measurement voltage is insulated in the input unit. The measurement current is insulated in the clamp-on sensor. The input signals are amplified to the required signal level, and output as monitor signals. At the same time, they are input to the power calculation circuit and effective value conversion circuit. In DC mode, however, without passing through the effective value conversion circuit, the signals pass through a mean value rectification circuit. The analog outputs are output with a full scale value of ±2 V DC. In the AC mode, the DC component is eliminated.
- In the effective value conversion circuit, using a dedicated analog calculation IC, conversion to an effective value by the effective value computation (true RMS) or mean value rectified effective value computation (voltage only) is carried out.

  The outputs converted to effective values are smoothed, and output as 2 V DC full-scale analog signals to the digital circuits and output terminals.
- In the power calculation circuit, a multiplier multiplies the voltage and current, and the result is output as a 2 V DC full-scale analog signal to the digital circuits and output terminals. The multiplied waveform is also amplified and output as a monitor signal.
- For frequency measurement the voltage and current waveforms are shaped by a filter, and output to the digital circuits.
- The peak detection circuit checks whether the voltage and current values exceed the circuit operation levels, and if so outputs an "out-of-range" signal to the digital circuits.
- The digital circuits perform A/D conversion of the analog output signals for voltage, current, and active power, then transfer the A/D converted values to the CPU, where these values are used for computational derivation of the apparent power, reactive power, power factor, phase angle, and integrated value.

  The signal for frequency goes to a frequency counter where its frequency is measured and calculated in the CPU. Signals input from the I/O port are used for the calculation expression and lighting the LEDs. The I/O port is also used for output of the signals (range signals and so forth) controlling the analog circuits.
- The digital circuits also carry out external control, D/A conversion output, and interface processing.

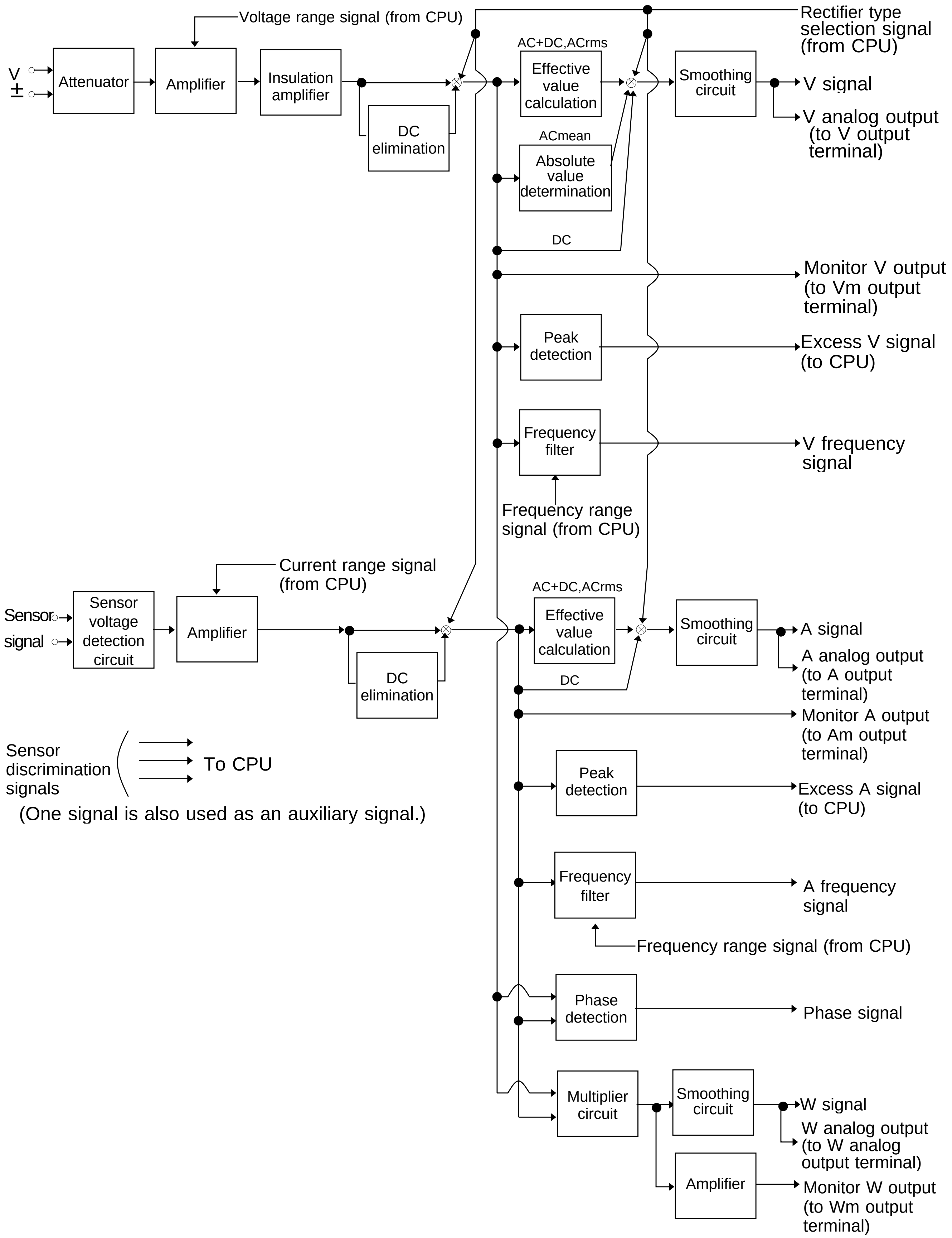

V
±
Attenuator
Amplifier
Voltage range signal (from CPU)
Insulation amplifier
DC elimination
AC+DC,ACrms
Effective value calculation
ACmean
Absolute value determination
DC
Smoothing circuit
Rectifier type selection signal (from CPU)
V signal
V analog output (to V output terminal)
Monitor V output (to Vm output terminal)
Peak detection
Excess V signal (to CPU)
Frequency filter
V frequency signal
Frequency range signal (from CPU)
Sensor signal
Sensor voltage detection circuit
Amplifier
Current range signal (from CPU)
DC elimination
AC+DC,ACrms
Effective value calculation
DC
Smoothing circuit
A signal
A analog output (to A output terminal)
Monitor A output (to Am output terminal)
Peak detection
Excess A signal (to CPU)
Frequency filter
A frequency signal
Frequency range signal (from CPU)
Phase detection
Phase signal
Multiplier circuit
Smoothing circuit
W signal
W analog output (to W analog output terminal)
Amplifier
Monitor W output (to Wm output terminal)
Sensor discrimination signals
To CPU
(One signal is also used as an auxiliary signal.)

Fig. 2.4-1 The analog circuit configuration

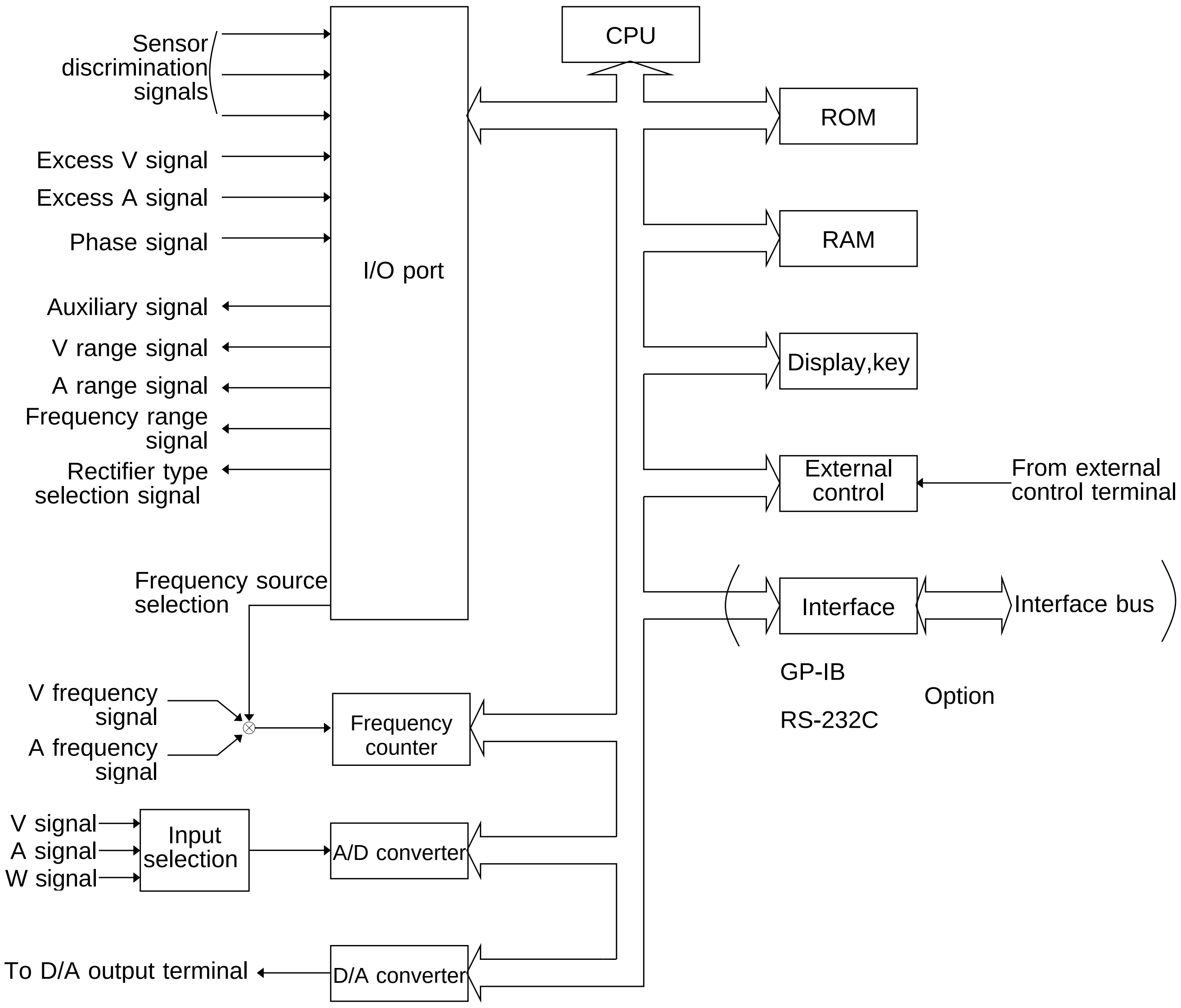


Fig. 2.4-2 The digital circuit configuration

Chapter 3
Before measurement

3.1 Basic Use

Step	Described in sections:
Fit of clamp-on sensor and voltage cord	Section 3.2 "Fitting Clamp-on Sensor and Voltage Cord"
Power on the 3167	Section 3.3 "When the Power is Turned On" 3.4 "Self Test"
Connect to measuring object	Section 3.5 "How to make the connections"
Select of rectifier type	Section 4.1 "Selecting the Rectifier Type"
Select of display items	Section 4.2 "Selecting the Display"
Select of measuring range	Section 4.3 "Selecting the Range"
Power on the measuring object	
Measurement	

⚠

3.2 Fitting Clamp-on Sensor and Voltage Cord

3.2.1 Compatible Sensor and Voltage Cord

(1) Clamp-on sensor

In this unit, uses CLAMP ON SENSOR (9270, 9271 or 9272) or UNIVERSAL CLAMP ON CT (9277, 9278 or 9279) for current input.
The clamp sensors are sold separately, so select a proper sensor.

Compatible sensor

- 9270 (rated at 20 A AC)
- 9271 (rated at 200 A AC)
- 9272 (rated at 20 A AC or 200 A AC, ranges are changeable)
- 9277 (rated at 20 A AC/DC)
- 9278 (rated at 200 A AC/DC)
- 9279 (rated at 500 A AC/DC)

(2) Voltage cord

Use attached 9179 VOLTAGE CORD.
A fuse is located in the voltage cord for additional protection.
Always use a fuse of the specified rating.

M0.3 A/250 V arc quenching fuse, 20 mm ×5.2 mm dia.

On care of cables, please keep following notes

⚠ WARNING

Before using the product, make sure that the insulation on the sensor and power cord is undamaged and that no bare conductors are improperly exposed. Using the product under such conditions could result in electrocution. Replace the sensor and voltage cord (9179) specified by Hioki.

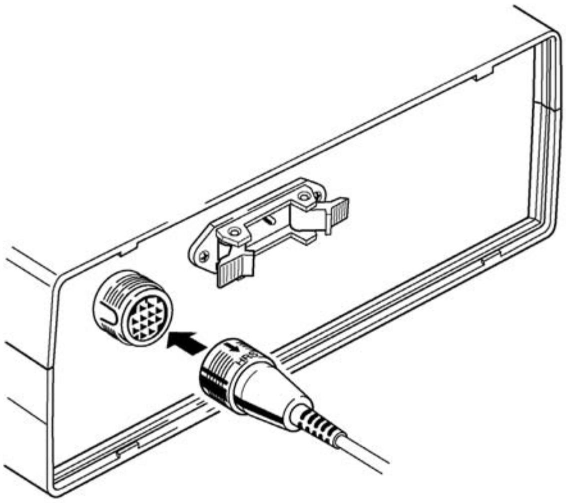
⚠ CAUTION

- Avoid stepping on or pinching the cable, which could damage the cable insulation.
- Keep the cables well away from heat sources, as bare conductors could be exposed if the insulation melts.

3.2.2 Fitting Method of Clamp-on Sensor and Voltage Cord

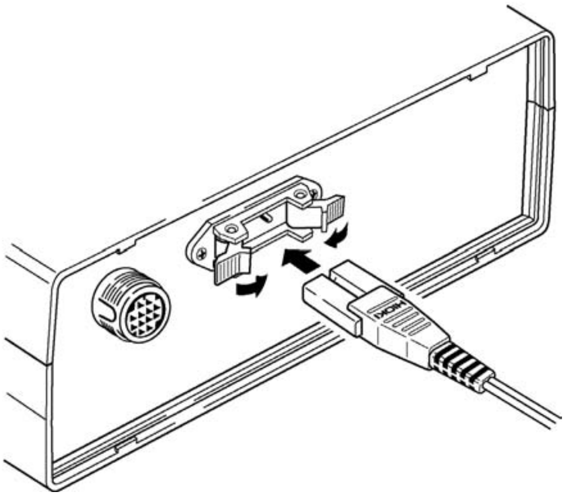
(1) Fitting method of clamp-on sensor

Connect a CLAMP ON SENSOR (9270, 9271 or 9272) or a UNIVERSAL CLAMP ON CT (9277, 9278 or 9279) to the clamp-on sensor connector. Push the connector in until you hear a click and it is securely locked.



(2) Fitting method of voltage cord

Insert the attached VOLTAGE CORD (9179) into the connector, then lock it securely with the arms.



NOTE Align the projection with the slot and insert.

3.3 When the Power is Turned On

3.3.1 When using the AC adapter

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

(2) Connect voltage cord and current sensor.

(3) Connect attached AC adapter to AC power inlet on rear panel.

(4) Connect power code to the power outlet

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

(6) All Indicators on front panel illuminate and begin self testing. (Refer to 3.4 "Self Test" for details.)
This test ends about for 10 seconds.

⚠ WARNING

Use only the supplied Model 9418-10 AC ADAPTER (PSA-30U-120, PHIHONG). AC adapter input voltage range is 100 to 240 VAC (with ±10% stability) at 50/60 Hz. To avoid electrical hazards and damage to the product, do not apply voltage outside of this range.

⚠ CAUTION

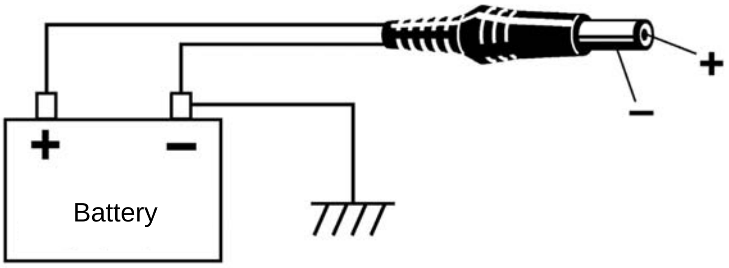
When power is turned off, do not apply voltage or current to the voltage input terminal and clamp-on sensor. Doing so may damage the product.

NOTE

Before measuring, please perform a warm-up at least for 30 minutes after the power is turned on.

3.3.2 When a DC Power Supply Is Used

When a battery or other DC power supply is used, use a connector plug with the positive terminal on the inside.

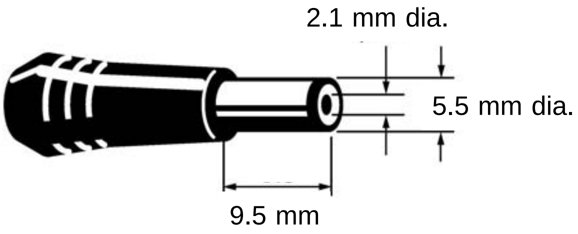


To prevent accidents, ground the negative side or connect it to the frame.

(1) When the test sample is grounded, connect the negative side to ground.
(For example: testing power lines indoors or outdoors, connect the negative side to ground.)

(2) When the test sample is on a chassis ground isolated from ground, connect the negative side to the chassis ground.
(For example: for vehicle-borne measurements, for testing vehicle parts when the vehicle frame is taken as ground for the measurement, connect the negative side to the frame.)

The power connector dimensions:



The 3167 does not detect the battery voltage, so during long-term operation, it is necessary to carry out separate checks on the battery.

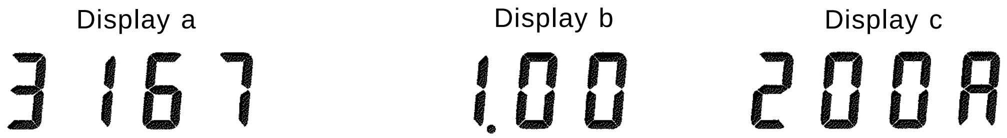
3.4 Self Test

Indications in self test shifts as follows:

(1) All indicators illuminate

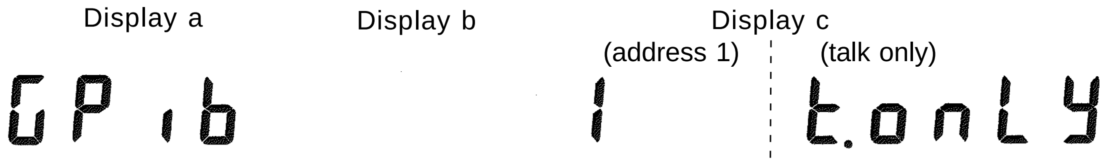
(2) Display a 3167
Display b Software version number
Display c The rating of clamp-on sensor (when sensor is not connected, "none" is displayed.)

Display example

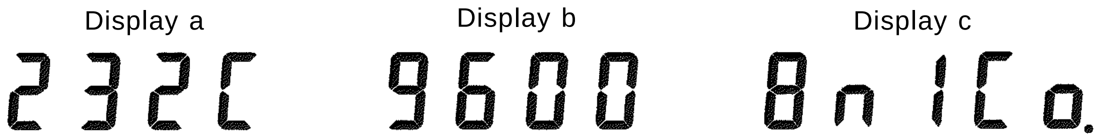


(3) When the optional interface is fitted, displayed as follows:
Display a Option name
(9588:GP-IB INTERFACE, 9592:RS-232C INTERFACE)
Display b baud rate (In GP-IB, nothing is displayed)
Display c Setting contents (GP-IB:address, RS-232C:data length, parity, stop bits, control mode)

Display example of GP-IB



Display example of RS-232C



(4) After self checking, errors are indicated in case that unusual matter is founded.

(5) Nothing is displayed for two seconds.

(6) Enter normal measurement state.
For error indications, refer to 5.14.3 "Error indications".

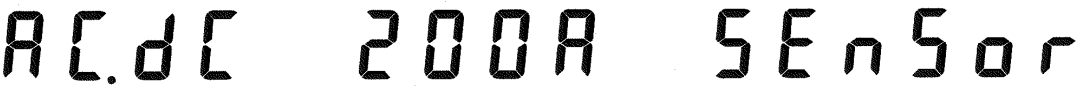
NOTE

- 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.

If the clamp-on sensor is different from the one which was connected when the unit was last powered off, after self-tests (1), (2) and (3) have been displayed, the clamp-on sensor rating display flashes.

Display example of 200 A AC/DC sensor



At this point, press any key one time to confirm the sensor. (display lights) When clamp sensor is not connected or is pulled out, displayed as shown below:

At this point, connect clamp sensor after the power is turned off.

⚠ CAUTION In order to prevent damages of this unit and the sensor, never plug in or unplug the sensor connector when the power is turned on.

NOTE

Settings or operations depend on the sensor change as shown below:

1. Rectifier type	AC+DC RMS (AC RMS in sensor dedicated for AC)
2. Current range	Maximum range
3. Integration	Stops forcibly or data reset

If the same sensor is connected, the integration calculation is forcibly stopped, but other settings remain unchanged.

3.5 How to make the connections

Explains how to make the connection of this unit.

- After fitting the clamp sensor and voltage cord and power is turned on, make connection.
- To measure accurately, the leads should connect correctly.
- Erroneous wiring may cause an accident. Please pay particular attention to the following points.

3.5.1 Before connection to circuit

⚠ DANGER

The maximum input voltage (maximum sustainable input) is 600V DC/AC. Attempting to measure voltage in excess of the maximum input could destroy the product and result in personal injury or death.

⚠ WARNING

Before using the product, make sure that the insulation on the sensor and power cord is undamaged and that no bare conductors are improperly exposed. Using the product under such conditions could result in electrocution. Replace the sensor and voltage cord (9179) specified by Hioki.

⚠ CAUTION

- Check the measurement range before taking measurements.
  Note that the product may be damaged if the applied voltage or current exceeds the measurement range.
- A fuse is located in the voltage cord for additional protection.
- In the event this fuse is blown replace it with a fuse of the specified rating. (M0.3 A/250 V arc quenching fuse 20 mm ×5.2 mm dia.)
- Turn on the power and make sure that the power meter does not display "Err".

NOTE

Accurate measurement may be impossible in the presence of strong magnetic fields, such as near transformers and high-current conductors, or in the presence of strong electromagnetic fields such as near radio transmitters.

3.5.2 Notes When making the Connections

When the unit is connected to the live line, please pay particular attention to the following points:

Safety gear

⚠ DANGER

- **Clamp sensor and voltage cord should only be connected to the secondary side of a breaker, so the breaker can prevent an accident if a short circuit occurs. Connections should never be made to the primary side of a breaker, because unrestricted current flow could cause a serious accident if a short circuit occurs.**
- **Do not allow the voltage cord clips to touch two wires at the same time. Never touch the edge of the metal clips.**
- **When the clamp sensor is opened, do not allow the metal part of the clamp to touch any exposed metal, or to short between two lines, and do not use over bare conductors.**

⚠ WARNING

To avoid electric shock when measuring live lines, wear appropriate protective gear, such as insulated rubber gloves, boots and a safety helmet.

Cable handling

⚠ CAUTION

- Avoid stepping on or pinching the cable, which could damage the cable insulation.
- Do not use the damaged cables.
- Keep the cables well away from heat sources, as bare conductors could be exposed if the insulation melts.

Clamp sensor handling

⚠ CAUTION

- To avoid damage to the product, protect it from vibration or shock during transport and handling, and be especially careful to avoid dropping.
- Never disconnect the clamp sensor from the connecter of the main unit which is connected to the live lines. Since power is supplied from the main unit, damage to the unit is possible. If disconnects the sensor from the connector, applying input without power supply may damage the unit.
- Use only specified clamp-on sensor or voltage cord.
- Taking the sensor apart may damage the open-close mechanism that could result in and inoperative unit.

Notes when using CT

⚠ DANGER

While supplying electricity to the current transformer, if the secondary is open-circuited an extremely high voltage appears across the secondary terminals, destroying the insulation and causing an electrical accident. This unit can carry out measurement with a clamp-on sensor without open-circuiting the secondary side, but when connecting it to other instruments, to avoid the possibility of an electrical accident, short-circuit the secondary side.

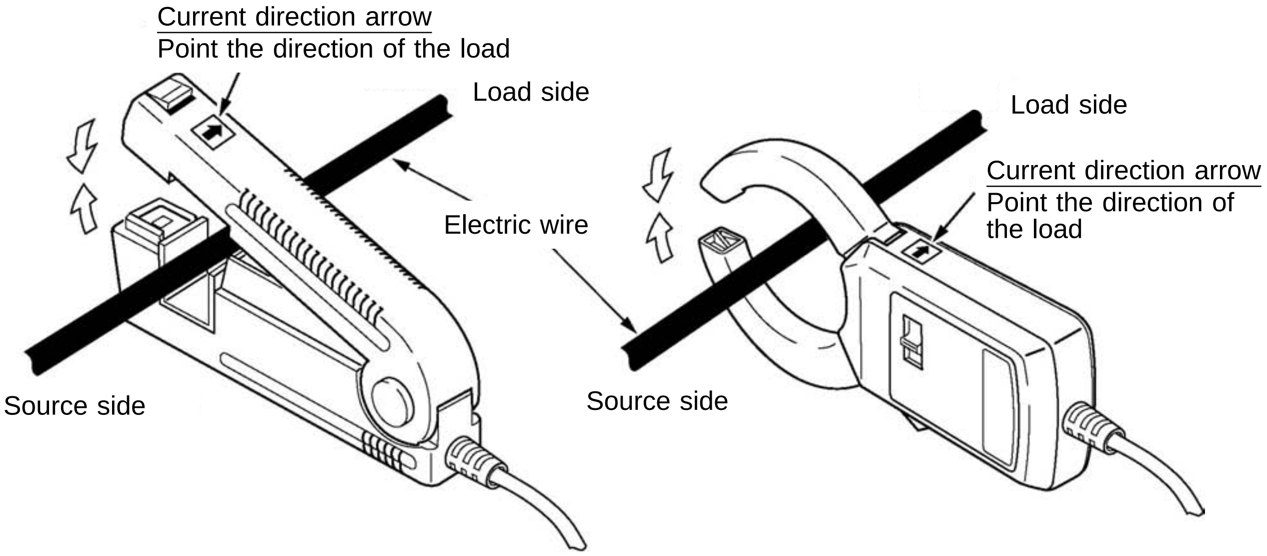
How to clamp the clamp sensor to the line

⚠ DANGER

- **To avoid short circuits and potentially life-threatening hazards, never attach the clamp sensor to a circuit that operates at more than AC 600Vrms, or over bare conductors.**

NOTE

- ➡ mark is on the core section of clamp-on sensor.
- Position the sensor so that the ➡ mark points the direction of the load, and then close the core section (with the lever)



3.5.3 How to make connections

Procedure

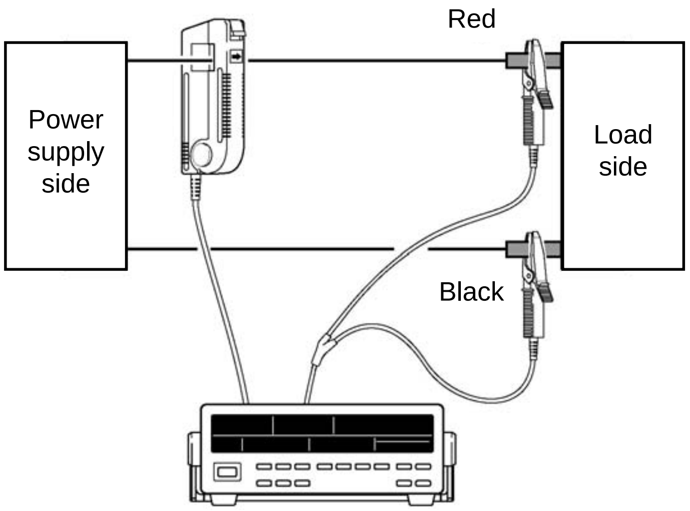
(1) Connect the clamp-on sensor to the clamp-on sensor connector on the rear panel

(2) Plug the voltage cord into the voltage cord connector with the correct polarity and lock the arms securely.

(3) Turn on the power.

(4) Connect the red and black voltage cord to the conductor to be measured.

(5) Clamp the clamp sensor to the line to which the red voltage cord is connected with the ➡ mark facing from the power supply toward the load.



Chapter 4
Basic Operation

4.1 Selecting the Rectifier Type

(1) This equipment equips four way type rectifier circuit. It is necessary to select one rectifier type before start measuring. However, when using AC clamp-on sensor, selection may not be possible.

① DC	Measure DC only. (AC clamp-on sensor cannot be selected)
② AC+DC (RMS)	Measure AC only or true RMS value AC and DC mixed. (AC clamp-on sensor cannot be selected)
③ AC (RMS)	Measure AC only or true RMS value.
④ AC (V MEAN)	Measure AC only average rectifier effective value converted for voltage, true RMS value for current.

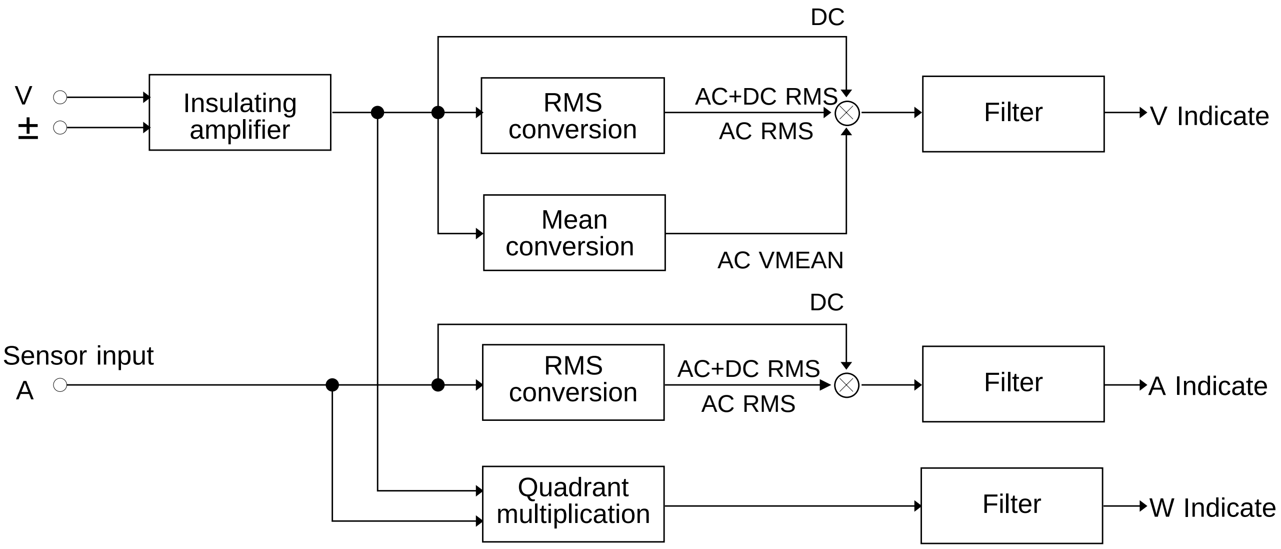


Fig. 4.1-1 Rectifier type overview

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

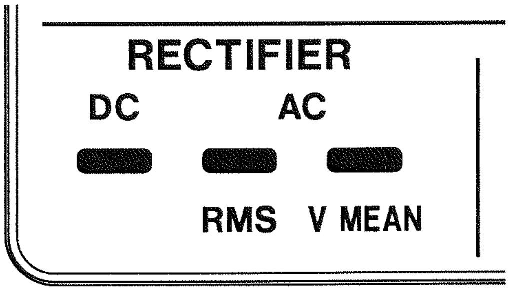


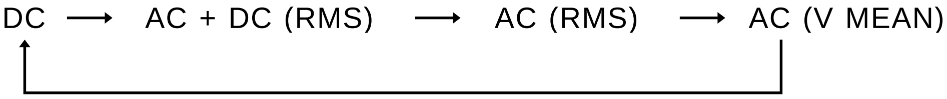
Fig. 4.1-2 Rectifier display

(3) To change the type execute as follows.

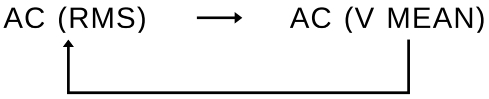
① Press the **SHIFT** key to illuminate the shift lamp (Shift condition).
② Press the **RECTIFIER** key, the rectifier type is changed and shift lamp puts out.

Select suitable rectifier type repeating these operation. In this operation, shift condition is canceled with every key operation after that.

AC/DC Clamp Sensor



AC Clamp Sensor



NOTE

- When selecting DC, it is possible to display the polarity of voltage and current.
- When selecting AC+DC or AC the displayed value of voltage and current become always plus.
- For sine wave, 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.
- After starting integration, rectifier cannot change until the integration data is reset. Also cannot change when display is under holding state.

4.2 Selecting the Display

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

Voltage (V) → Current (A) → Active power (W)

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

Voltage (V) → Current (A) → Active power (W) → Integrate elapsed time (TIME)

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

Voltage (V)→Current (A)→Active power (W)→Apparent power (VA)→
Reactive 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)

(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

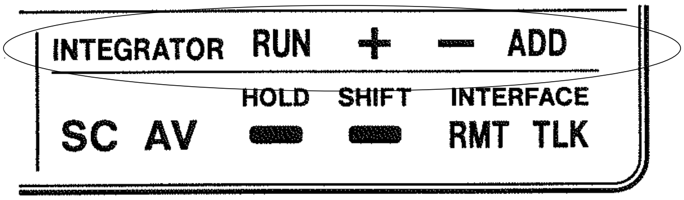
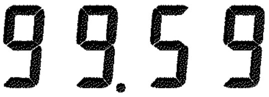


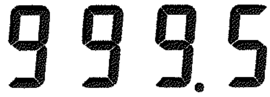
Fig. 4.2 Integration display

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

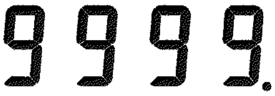
From 0 minute to
99 hours and 59 minutes



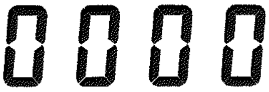
From 100 hours to
999 hours and 59 minutes



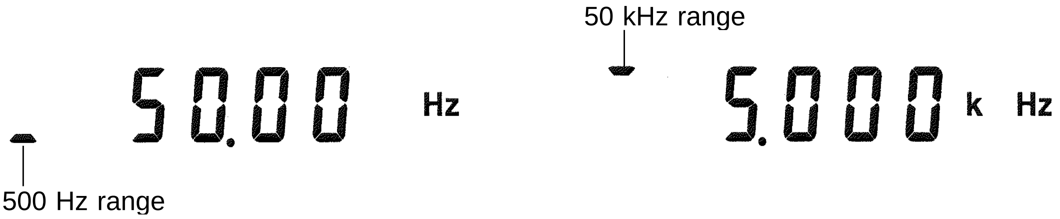
From 1000 hours to
9999 hours and 59 minutes



10000 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 5 "Applied Operation" when measuring current input or frequency over 500 Hz.

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

4.3 Selecting the Range

(1) Setting limits

Voltage range

15 V, 30 V, 60 V, 150 V, 300 V, 600 V

Current range (Range setting limit differs according to the rating of the clamp-on sensor.)

Sensor rated at 20 A (9270, 9272, 9277)	2 A, 5 A, 10 A, 20 A
Sensor rated at 20 A (9271, 9272, 9278)	20 A, 50 A, 100 A, 200 A
Sensor rated at 500 A (9279)	50 A, 100 A, 200 A, 500 A

Active power, reactive power and apparent power are combined with voltage and current range. Refer to table 2.1 in Section 2.1 "Specifications".

Active input limit (accuracy assuring limit) is 10 % to 110 % for range. (10 % to 100 % only in 600 V range)

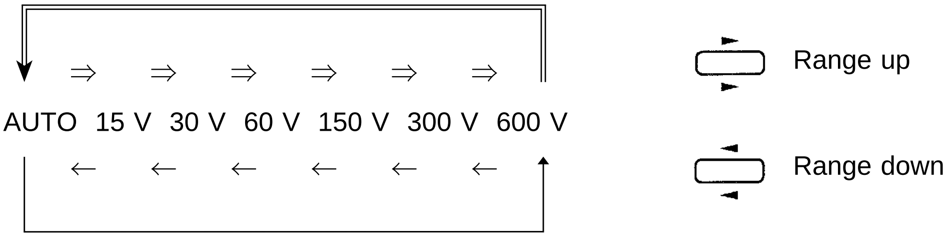
Indicatable limit is 0.4 % to 130 % for range. In case of over this limit, following mark is displayed (this means out of range).

NOTE

- After starting integration, rectifier cannot change until the integration data is reset. Also cannot change when display is under holding state.
- When the "o.r" indication appears, other display values may be affected; change to an appropriate range.

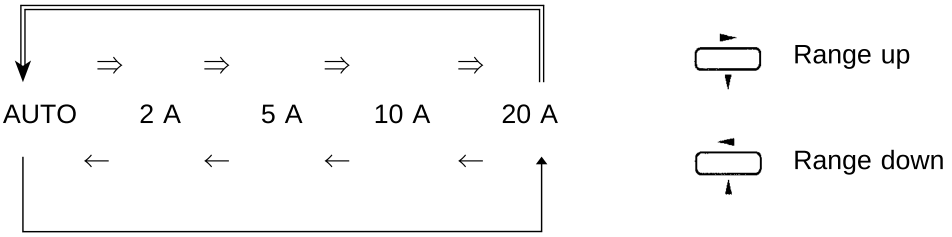
(2) Settings

Voltage range

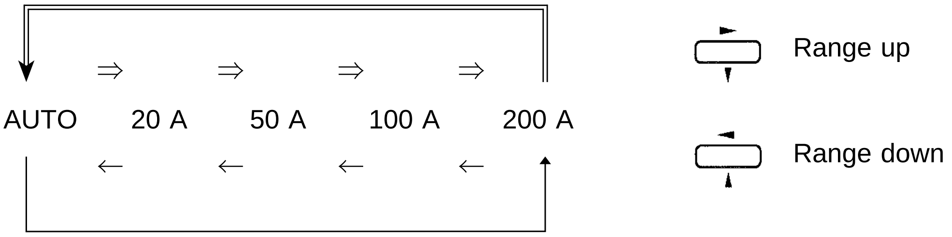


Current range

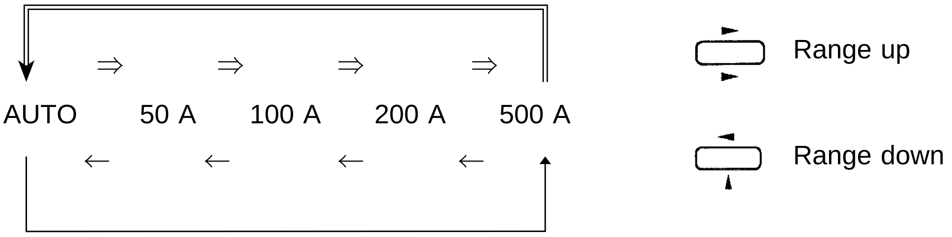
9270, 9272, 9277
(Sensor rated at 20 A)



9271, 9272, 9278
(Sensor rated at 200 A)



9279
(Sensor rated at 500 A)



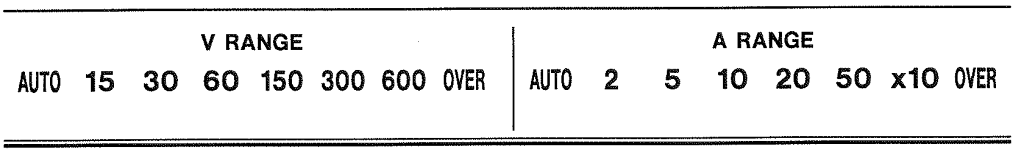


Fig. 4.3 Range display

(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 illuminated ┘— Range up
When measuring value is less than 30% for range — Range down

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

NOTE

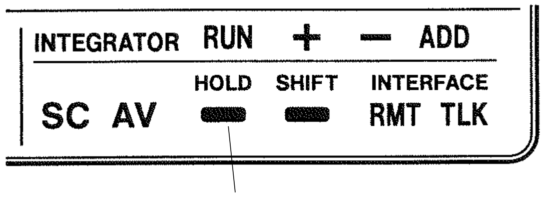
- In auto-ranging function sometimes range goes on up and down according to distortion of input wave or size of measuring value. In this case, release auto-ranging function and select range manually.
- OVER lamp illuminates when peak value of voltage input and current input waveform are over three times 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. Reactive power, power factor and phase angle shows out of range when either active power and apparent power shows same display. Power factor and phase angle shows out of range when apparent power is 0.

⚠ DANGER

Do not apply input that exceeds the maximum sustainable input. Doing so may damage the unit or cause an accident that might result in injury or death. Stop measurement promptly.

4.4 Holding the Display

Press the **HOLD** key, holding lamp is illuminated and preserve all measuring value at that point. (Hold state)
Press the **HOLD** key again, this lamp is turned off, and return normal measuring condition.



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 5. "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 averaging	Au
⑥ Selecting D/A output items	d-A oUt

4.5 Demagnetizing

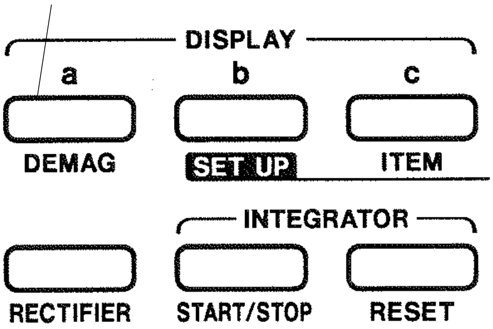
When using an AC/DC clamp-on sensor to measure DC, the sensor may become magnetized. Always carry out demagnetizing before beginning measurement operations.

Demagnetizing method

(1) Disconnect the clamp-on sensor from measurement line and close the core section tightly.
(2) Press the SHIFT key to light shift lamp.
(3) Press the DEMAG key to carry out demagnetization.
(4) During demagnetizing, "---- ---- ------" is displayed and measurement is not executed for about 4 seconds.

NOTE

- Ensure that no input is applied while carrying out demagnetization.
- When using an AC sensor, demagnetizing is not executed.
- During integrating, demagnetizing cannot be executed.
- When demagnetizing is executed by pressing the demagnetizing key on the Universal clamp-on CT, numerical value is displayed on the display of the main unit.
- During demagnetizing, various waveforms may appear on the analog output and monitor output, but this is not a malfunction.


Demagnetizing key

Chapter 5
Applied Operation

5.1 Items Set by Setup Keys

Following items require setting 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 averaging	Au
⑥ Selecting D/A output items	d-A oUt
⑦ Setting GP-IB address	GPib
Setting RS-232C	232C 9600 8n1Co.
⑧ Selecting printing items for GP-IB listen only printer or RS-232C printer	dAtA oUt
⑨ Setting printing interval time for GP-IB listen only printer or RS-232C printer	dAtA oUt

⑦ to ⑨ are applied to this setting when 9588 GP-IB INTERFACE or 9592 RS-232C INTERFACE (provided as an option) is equipped.

5.2 Operating Setup Keys

"Setup key" means every key shown in figure 5.2 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.

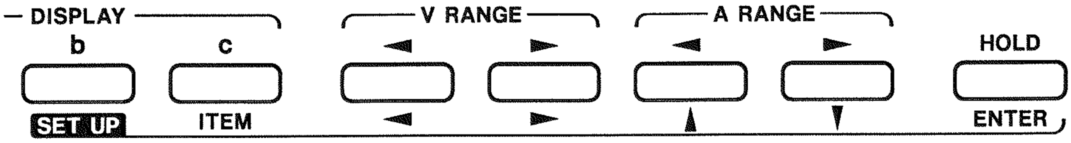
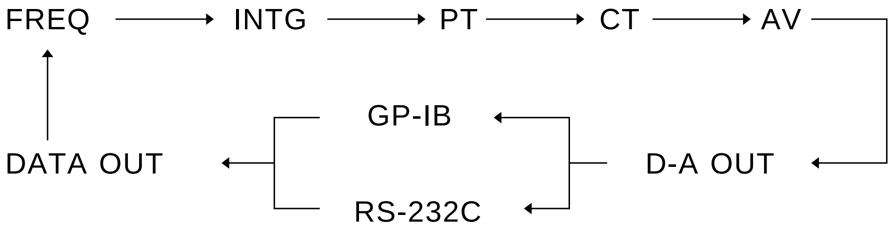


Fig. 5.2 Setup keys

Function of those keys are shown with blue letters or marks under them. Overview for operating is as follows;

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

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



Setting items and present setting condition and so on are displayed. Changeable 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 the ENTER key. At this time flashing stops. (light becomes normal condition)

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

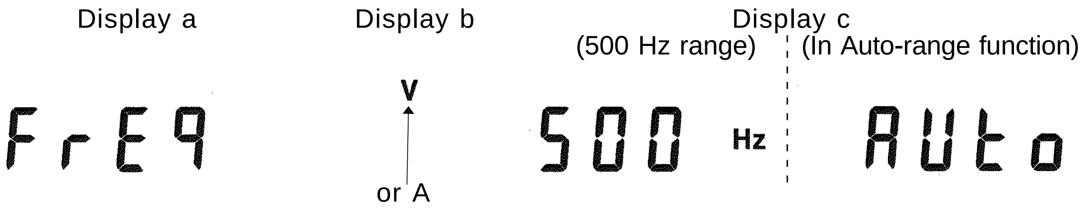
(6) Press the SET UP key, return to normal measuring condition.

NOTE

During integrating (for RUN lump is lightening,) it cannot be changed to setting display. (For invalid key operation error No.012 is displayed.)
To move to setting stop integrating by pressing the SHIFT , START/STOP key.
Refer to 5.4 "Integration" for details.

5.3 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 frequency source press ▲ , ▼ key during display b is flashing. (V or A)

To select range press ◀ , ▶ key during display c is flashing. Pressing ◀ , ▶ key can exchange flashing of display b for display c. (500 Hz, 50 kHz or AUTO)

(3) Pressing the 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 the SET UP key.

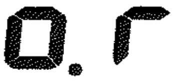
(6) To move to integration setting press the ITEM key.

NOTE

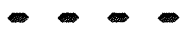
- When there is no flashing indication, setting cannot be changed (during holding display). At this time, press the SET UP key to return to measurement and press the HOLD key to release holding condition.
- Frequency is able to measure in following limits.

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 displayed. (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:

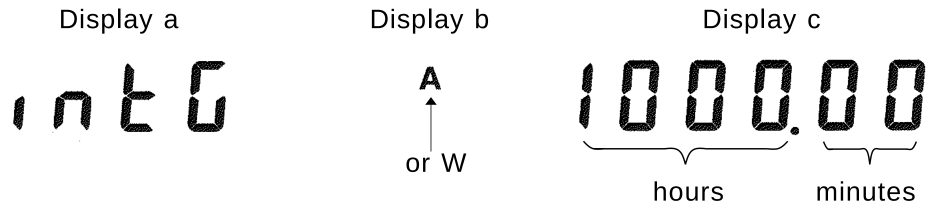


- The 3167 has a low-pass filter to remove harmonics which exceed the upper limit of measurement and ensure that the target frequency can be measured correctly. The cut-off frequency of this filter is switched together with the range.

5.4 Integration

5.4.1 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 10000 hours. To set 10000 hours, set values to zero in all digits.

(3) Pressing the 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 the SET UP key.

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

NOTE When there is no flashing indication, setting cannot be changed (during holding display or integrating). At this time, press the SET UP key to return to measurement and press the HOLD key to release holding condition or press the SHIFT and RESET keys to reset integrating data.

5.4.2 Integrating

(1) Integrating can start by following two way.

① By key operation

② By external control signal (Refer to 5.13.2 "External Control Terminal")

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

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

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

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

(6) Integrating would stop under following condition.

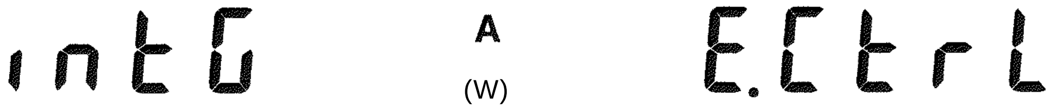
① When achieving integrate time.
② When stopped by key operation. (or by ":INTEGrate:STATe STOP" command of GP-IB or RS-232C)
③ When integrate time achieve 10000 hours.
④ When integrate value achieve ±999999 MAh (MWh).
⑤ When disconnects clamp-on sensor from this unit or changes of the rating of the clamp-on sensor. (While outputting to the printer, prints integrate elapsed time and an error comment of "SENSOR ERROR".

NOTE

- 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 reset) range and rectifier are unable to change. (error No.012 is displayed) As following table, one of setup keys function are invalid. And in case of holding display under this condition, changeable items are limited.

Items	Display	Change	Change in holding condition
① Selecting frequency measurement source and range	Yes	Yes	No
② Setting integrate time and selecting integrate items	Yes	No	No
③ Setting PT ratio	Yes	No	No
④ Setting CT ratio	Yes	No	No
⑤ Selecting the number of averaging	Yes	Yes	No
⑥ Selecting D/A output items	Yes	Yes	No
⑦ Setting GP-IB address	Yes	Yes	Yes
Setting RS-232C	Yes	Yes	Yes
⑧ Selecting printing items for GP-IB listen only printer or RS-232C printer	Yes	Yes	Yes
⑨ Setting printing interval time for GP-IB listen only printer or RS-232C printer	Yes	Yes	Yes

- 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 or RS-232C) 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 5.4.1 "Settings". After all, integration stops in following cases.

① Stopped by external control signals.
② When the integrate time achieves 10000 hours.
When the integrate value achieves ±999999 MAh (MWh).
③ When disconnects clamp-on sensor from this unit or changes of the rating of clamp-on sensor. (While outputting to the printer, prints integrate elapsed time and an error comment of "SENSOR ERROR".)

But, integrate elapsed time can display normally same as key operating.

- During displaying "S. Err", integrating cannot start (error No.013 is displayed). In this case, change PT ratio and CT ratio. Refer to Section 5.5 "PT Settings" or 5.6 "CT Settings".
- When the integrate value achieves "999999M" or when the integrate time achieves 10000 hours, integrating cannot restart. (Error 014) In this case, press the SHIFT and RESET keys to reset integrating data.
- When equip 9588 GP-IB INTERFACE provided as an option, set the unit to printer mode and connect GP-IB listen only printer, measuring value which is set in 5.11 "Selecting the Printing Items" are able to print according to every certain interval simultaneously as starting integration.
- When equip 9592 RS-232C INTERFACE provided as an option, set the unit to printer mode and connect RS-232C printer, measuring value which is set in 5.11 "Selecting the Printing Items" are able to print according to every certain interval simultaneously as starting integration.
- When doing system resetting, integrating is stopped and the equipment is reset to initial condition. For system resetting refer to 5.14.2 "System Resetting".
- When the clamp-on sensor is disconnected from the unit and a different clamp-on sensor connected, or when the rating of the clamp-on sensor is changed, the new clamp-on sensor rating is displayed flashing. At this point, any key input, or the receipt of a GP-IB or RS-232C command, resets the integration value. On returning to the original clamp-on sensor or original rating, the integration value is not reset.
- When the power is cut off during integrating, integration starts again after returned. If during printing, print integrate elapsed time and power cut comment "POWER FAILURE".

5.4.3 Display Format of Integrating Value.

Format in integration reset are showed in table 5.4-1 and 5.4-2.
Digits of integrate value and integrate range format carry up or down simultaneously. (However, digits do not carry down in integration reset format.)

Table 5.4-1 Constitution of current integrate range

9270, 9272, 9277 (Sensor rated at 20 A)

A range	2.000 A	5.000 A	10.00 A	20.00 A
Reset value	0.00000 Ah	0.00000 Ah	00.0000 Ah	00.0000Ah

9271, 9272, 9278 (Sensor rated at 200 A)

A range	20.00 A	50.00 A	100.0 A	200.0 A
Reset value	00.0000 Ah	00.0000 Ah	000.000 Ah	000.000 Ah

9279 (Sensor rated at 500 A)

A range	50.00 A	100.0 A	200.0 A	500.0 A
Reset value	00.0000 Ah	000.000 Ah	000.000 Ah	000.000 Ah

Table 5.4-2 Constitution of power integrate range

9270, 9272, 9277 (Sensor rated at 20 A)

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

9271, 9272, 9278 (Sensor rated at 200 A)

V \ A	20.00 A	50.00 A	100.0 A	200.0 A
15.00 V	000.000 Wh	000.000 Wh	0.00000 kWh	0.00000 kWh
30.00 V	000.000 Wh	0.00000 kWh	0.00000 kWh	0.00000 kWh
60.00 V	0.00000 kWh	0.00000 kWh	0.00000 kWh	00.0000 kWh
150.0 V	0.00000 kWh	0.00000 kWh	00.0000 kWh	00.0000 kWh
300.0 V	0.00000 kWh	00.0000 kWh	00.0000 kWh	00.0000 kWh
600.0 V	00.0000 kWh	00.0000 kWh	00.0000 kWh	000.000 kWh

9279 (Sensor rated at 500 A)

V \ A	50.00 A	100.0 A	200.0 A	500.0 A
15.00 V	000.000 Wh	0.00000 kWh	0.00000 kWh	0.00000 kWh
30.00 V	0.00000 kWh	0.00000 kWh	0.00000 kWh	00.0000 kWh
60.00 V	0.00000 kWh	0.00000 kWh	00.0000 kWh	00.0000 kWh
150.0 V	0.00000 kWh	00.0000 kWh	00.0000 kWh	00.0000 kWh
300.0 V	00.0000 kWh	00.0000 kWh	00.0000 kWh	000.000 kWh
600.0 V	00.0000 kWh	00.0000 kWh	000.000 kWh	000.000 kWh

What is integration resetting value ?

Display format of current range and active power range applies to integrate value format under reset condition.

Example

Range	Display format	Integrating value format	Reset value
30 W	30.00 W	30.0000 Wh	00.0000 Wh
1.5 kW	1.500 kW	1.50000 kWh	0.00000 kWh

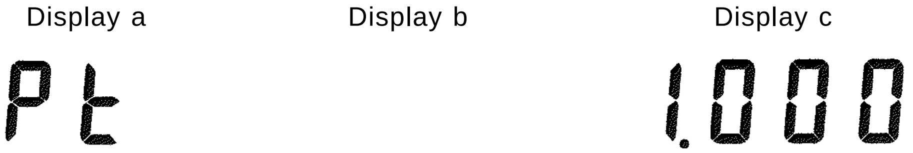
Also in scaling display format applies to integrating value format.

Example

Range	Display format	Integrating value format	Reset value
30 W×5(CT)	150.0 W	150.000 Wh	000.000 Wh

5.5 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;



(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, decimal point flashes by pressing ◀ key. When right side digit is flashing decimal point flashes by pressing ▶ key. When decimal point is flashing it can move by ▲ , ▼ key.

(4) Pressing the **ENTER** key stops flashing and decide settings. As long as this key is pressed, internal settings unable to change. Scaling lamp is lit when PT is except 1. (Refer to figure 5.5)

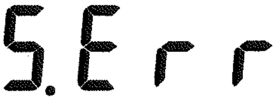
(5) When changing settings again, press ◀ , ▶ , ▲ , ▼ key. Flashing indication appears.

(6) To return to normal measuring condition press the **SET UP** key.

(7) To move to CT setting press the **ITEM** key.

NOTE

- When there is no flashing indication, setting cannot be changed (during holding display or integrating). At this time, press the **SET UP** key to return to measurement and press the **HOLD** key to release holding condition or press the **SHIFT** and **RESET** keys to reset integrating data.
- Setting limit of PT ratio is 1 to 9999. When display PT ratio less than 1 and press the **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 active and apparent power become scaling error, reactive power, power factor, phase angle and power integrate value display this error too. However, when becomes out of range, "o.r" is displayed.

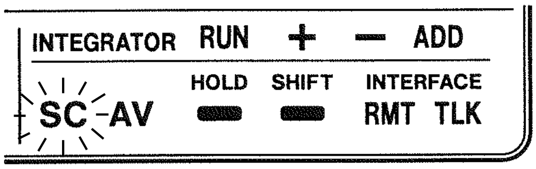
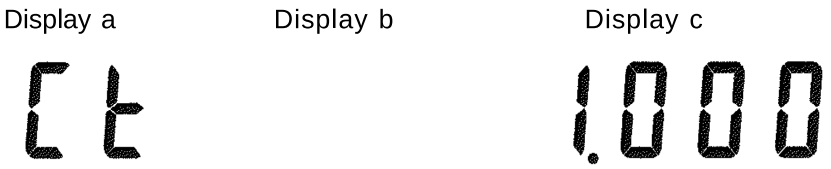


Fig. 5.5 Scaling lamp

5.6 CT Settings

(1) When using external CT, upstream value can read directly by operating with setup key. (Scaling function)

Display example under setting condition would be as follows;



(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, decimal point flashes by pressing ◀ key. When right side digit is flashing, decimal point flashes by pressing ▶ key. When decimal point is flashing it can move by ▲ , ▼ key.

(4) Pressing the **ENTER** key stops flashing and decide 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 figure 5.5)

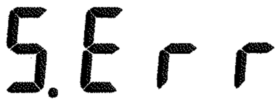
(5) When changing settings again, press ◀ , ▶ , ▲ , ▼ key. Flashing indication appears.

(6) To return to normal measuring condition press the **SET UP** key.

(7) To move to average setting press the **ITEM** key.

NOTE

- When there is no flashing indication, setting cannot be changed (during holding display or integrating). At this time, press the **SET UP** key to return to measurement and press the **HOLD** key to release holding condition or press the **SHIFT** and **RESET** keys to reset integrating data.
- Setting limit of CT ratio is 0.01 to 9999. When display CT ratio less than 0.01 and press the **ENTER** key, "0.010" is set forcibly.
- As result of scaling, if values is over the maximum value "9999M", following mark is displayed. (Means scaling error)



- When active and apparent power become scaling error, reactive power, power factor, phase angle, current and power integrate value display this error too. However, when out of range is showed, "o.r" is displayed.

5.7 PT and CT Setting Samples

Confirm whether hold lamp is turned off and integrate data is reset. (For integration refer to 5.4 "Integration".)
When hold lamp is lit, setting is out of order. During integrating or in case of not reset integrate data in spite of stopping integration, setting is also unable.

Setting samples

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

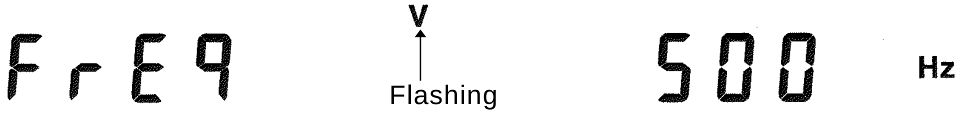
PT: Upstream	6,600 V	Downstream	110 V (PT ratio 6,600÷110=60)
CT: Upstream	2,000 A	Downstream	5 A (CT ratio 2,000÷5=400)

Uses clamp-on sensor (9270) rated at 20 A

Procedure

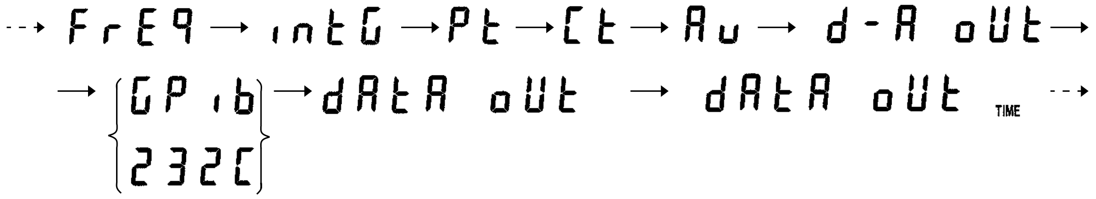
(1) Press the SHIFT key and lighten shift lamp.

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

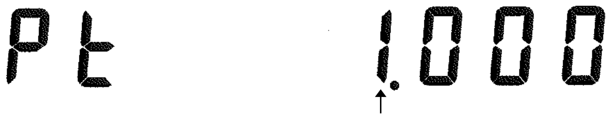


If this equipment is changed from initial setting, which item of (3) is displayed.

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



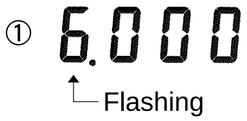
(4) Set PT. Press the ITEM key and display following marks.



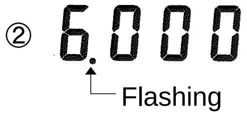
(When PT ratio except 1 is already set that value is displayed.) Not flashing the highest unit means during the display holding or not reset the integrate data. At this time press the SET UP key and return normal condition and release holding state by the HOLD key or reset data by the SHIFT or RESET key, and then repeat from (1).

(5) Set PT according to following order.

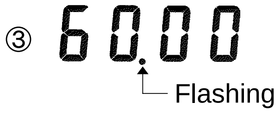
① Press ▲ key 5 times. Or press ▼ key 5 times.



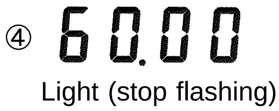
② Press ◀ key once. Or press ▶ key 4 times.



③ Press ▼ key once. Or press ▲ key 3 times

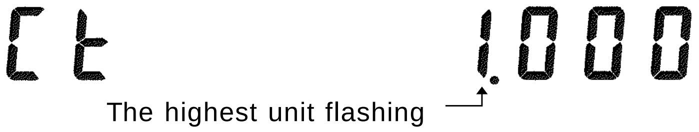


④ Finally press the **ENTER** key.
By above operation, PT ratio is decided at 60 and scaling lamp is lit.



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

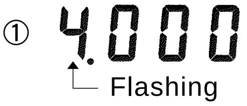
(6) Next, set CT. After previous operation press the **ITEM** key and display following marks.



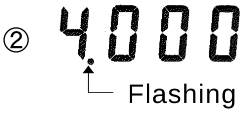
(When CT ratio except 1 is set that value is displayed)

(7) Set CT according to following order.

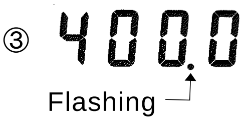
① Press ▲ key 3 times. Or press ▼ key 7 times.



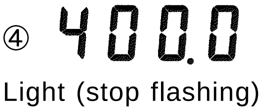
② Press ◀ key once. Or press ▶ key 4 times.



③ Press ▲ key 2 times Or press ▼ key 2 times



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



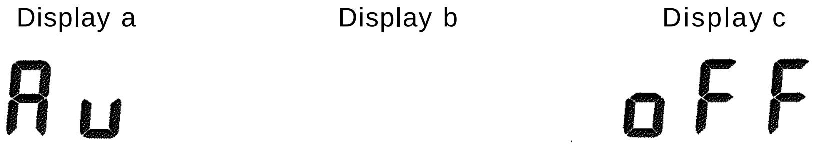
(8) Next, when press the **SET UP** key, shift lamp is turned off and return to normal measuring condition. Scaling lamp is still light.

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

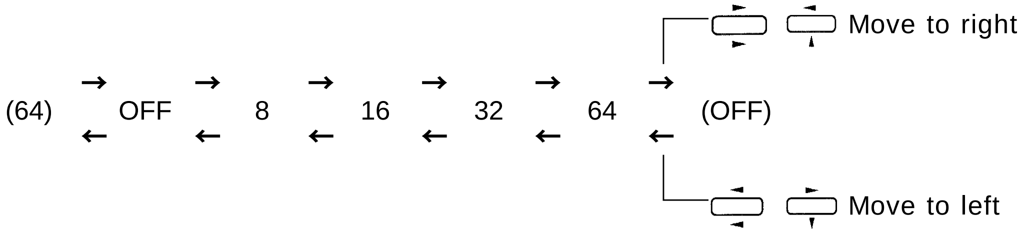
Voltage	9.000 kV (150 V ×60)
Current	2.000 kA (5 A ×400)
Active power	18.00 MW (150 V ×5 A ×60 ×400)
Apparent power	18.00 MVA
Reactive power	18.00 Mvar
Current integration	0.00000 kAh (On starting integration)
Power integration	0.0000 MWh (On starting integration)

5.8 Selecting the Number of Averaging

(1) Average function is good when the measuring value is hard to read for its instability. The 3167 performs movable averaging but can select its number. (For frequency measurement, this function is invalid.) Display example under setting condition would be as follows;



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



(3) Pressing the **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 figure 5.8)

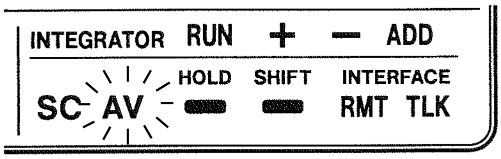


Fig. 5.8 Average lamp

(4) When changing settings again, press **◀**, **▶**, **▲**, **▼** key. Flashing indication appears.

(5) To return to normal measuring condition press the **SET UP** key.

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

NOTE

- When there is no flashing indication, setting cannot be changed (during holding display). At this time, press the **SET UP** key to return to measurement state and press the **HOLD** key to release holding condition.
- 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.

5.9 Selecting D/A output

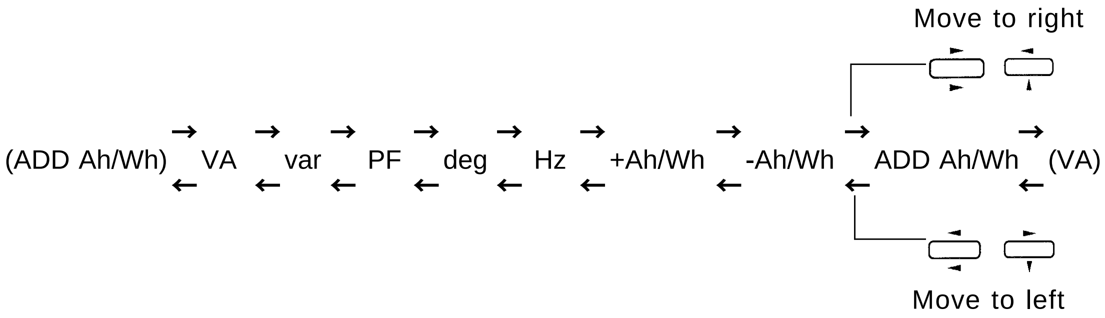
(1) By converting the measurement data to a DC voltage, and outputting it to a recorder, it is possible to monitor long-term changes at a glance. D/A output means the function which changes measuring data (digital value) to voltage (analog value). For voltage, current and active power use analog output. Both D/A and analog are output from rear panel connector. Refer to 5.13 "External Control Terminal and Output Terminal".

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

Display a	Display b	Display c
d-A	oUt	VA

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

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



(4) Pressing the **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 the **SET UP** key.

(7) To move to setting interface press the **ITEM** key. However, when 9588 GP-IB INTERFACE or 9592 RS-232C INTERFACE is not equipped, return to first frequency setting condition.

NOTE When there is no flashing indication, setting cannot be changed (during holding display or integrating). At this time, press the **SET UP** key to return to measurement state and press the **HOLD** key to release holding condition.

(8) For D/A output example refer to figures 5.9-1 to 5.9-5.

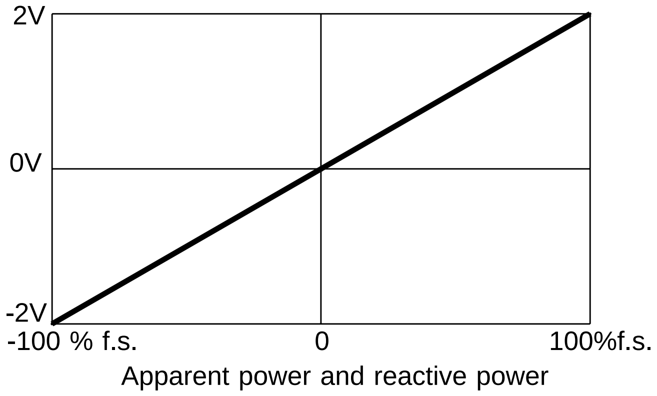


Fig. 5.9-1
D/A output of apparent
and reactive power

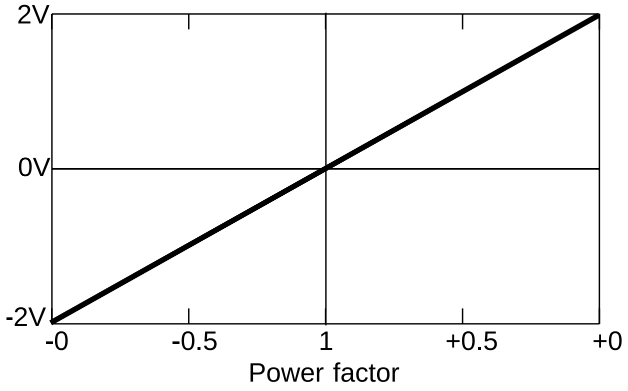


Fig. 5.9-2
D/A output of power factor

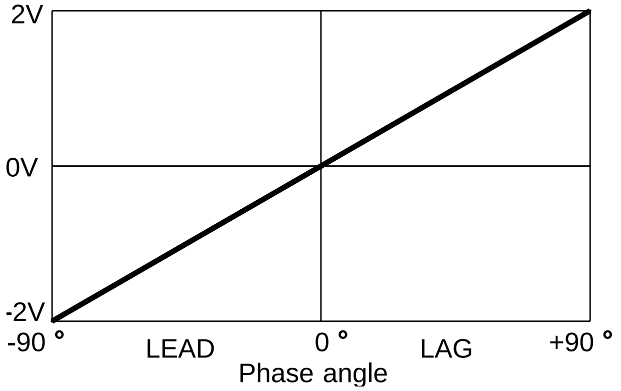


Fig. 5.9-3
D/A output of phase angle

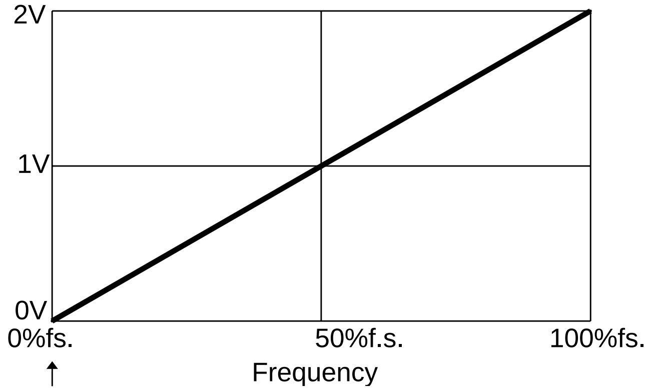


Fig. 5.9-4.
D/A output of frequency

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

In 500 Hz range, 500 Hz is 100 %
In 50 kHz range, 50 kHz is 100 %

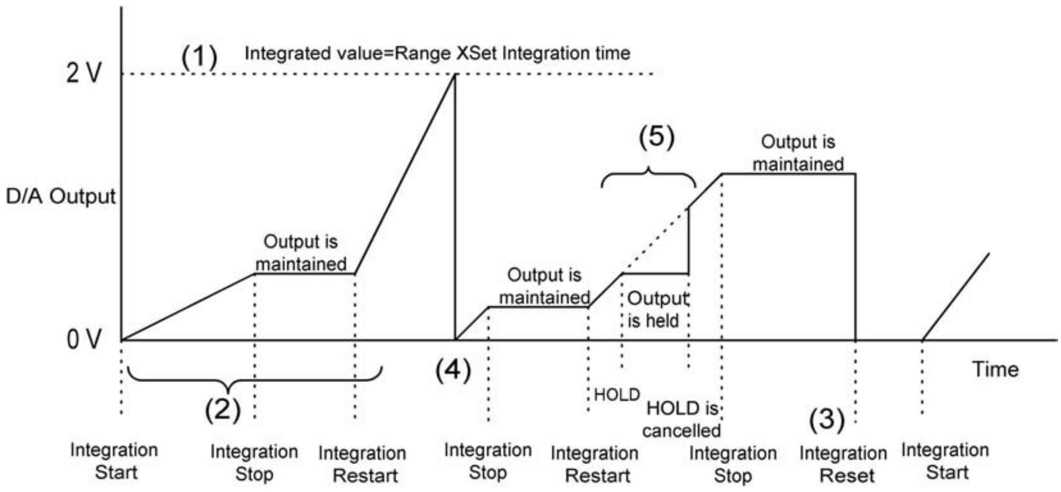


Figure 5.9-5 Examples of Chronological Changes of Integration D/A Output

(1) When the integrated value equals a multiple of "the measurement range multiplied by the set integration time", the D/A output of the integration value becomes 2V. For example, if the measurement range is 300W and the integration time is set to 24 hours, when the integrated value is 7.2kWh (300 x 24), 14.4kWh (300 x 24 x 2), 21.6kWh (300 x 24 x 3)··· its the D/A output will be 2V (when it is a multiple of -7.2kWh, the D/A output will be -2V).

(2) When integration has started, D/A output begins to change. When integration has stopped, the last D/A output is maintained. When integration has restarted, D/A output begins to change again.

(3) When the integration value is reset, D/A output returns to 0V.

(4) When the integration value exceeds ±2V, D/A output returns to 0V and then begins to change again.

(5) If the displayed value is held (by the HOLD function) during integration, the D/A output will be held, too. When the display HOLD is cancelled, D/A output begins to change again according to integration value.

NOTE

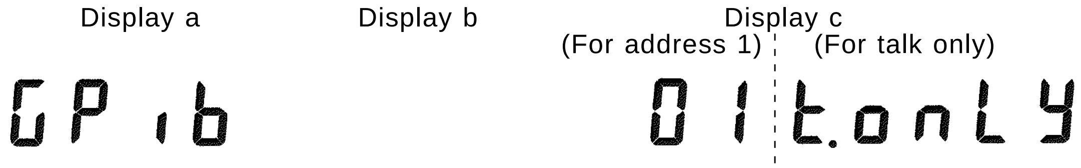
- About 3.3 V is output in plus out of range. About -3.3 V is output in minus out of range.
- In holding or averaging, value on display is output.
- D/A exchanging rate is about five times/second. There is filter in output circuit, and the response time is about a half seconds.
- When the display is under the holding state, D/A output items cannot be changed.
- When integrating by external control, integrate time to be set × range would be 2 Vf.s.. However, during external control, integration time set is not displayed. So check in advance.

5.10 Setting Interface

The settings displayed differ according to whether an optional 9588 GP-IB INTERFACE is fitted or an optional 9592 RS-232C INTERFACE is fitted.

5.10.1 Setting the GP-IB Address

(1) When equipped 9588 GP-IB INTERFACE provided as an option this equipment is able to remote control by GP-IB. 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;



(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 the **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 the **SET UP** key.

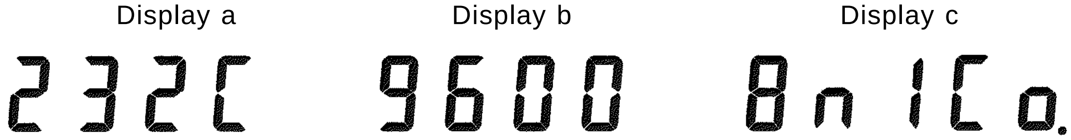
(6) To move to selecting the printing items press the **ITEM** key.

5.10.2 Setting the RS-232C Interface

(1) When equipped 9592 RS-232C INTERFACE provided as an option this equipment is able to remote control by RS-232C. Baud rate, data length, parity, stop bits, control mode are set by setup key. Setting value of each item are as follows:

Band rate	1200, 2400, 4800, 9600 bps
Data length	7,8 bits
Parity	none, odd, even
Stop bits	1,2 bits
Communications mode	Control mode (Co.), printer mode (Pr.)

Display example under setting condition would be as follows;



(2) To select baud rate press the ▲ , ▼ key during display b is flashing. (1200, 2400, 4800, 9600)

To select data length press the ▲ , ▼ key during left side numeral in display c is flashing. (7,8)

To select parity press the ▲ , ▼ key during the second character from left in display c is flashing. (n, o, E)

To select stop bits press the ▲ , ▼ key during the third numeral from left in display c is flashing. (1, 2)

To select communications mode press the ▲ , ▼ key during the first and second characters from right in display c are flashing. (Co, Pr)

Flashing can be moved by pressing the ◀ , ▶ key. Press the ▶ key to shift flashing according to the following cycle; baud rate - data length - parity - stop bits - communications mode - baud rate ⋯.
Press the ◀ key to shift flashing according to the following cycle; baud rate - communications mode - stop bits - parity - data length - baud rate ⋯.

(3) Pressing the 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 the ◀ , ▶ , ▲ , ▼ key. Flashing indication appears.

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

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

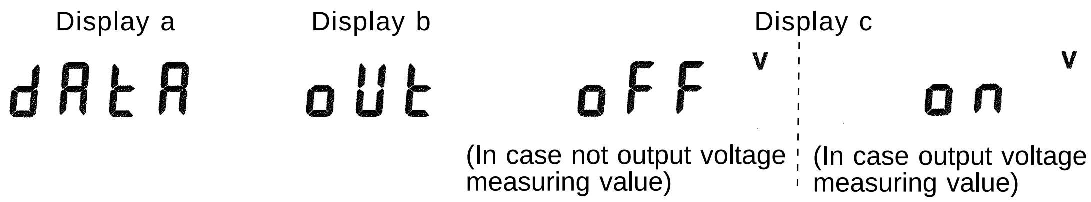
NOTE

When the unit is controlled by connection to a computer, set the communications mode to "Co." (control mode). Also, when connection to a printer, set to "Pr." (printer mode). If set to "Pr", TLK lamp lights.

5.11 Selecting the Printing Items

(1) When Equip 9588 GP-IB INTERFACE provided as an option, set address to talk only, and connect GP-IB listen only printer measuring value are able to print to printer. When Equip 9592 RS-232C INTERFACE provided as an option, set communications mode to printer mode, and connect RS-232C printer measuring value are able to print to printer.

Display example under setting condition would be as follows;


Display a
Display b
Display c
dAtA
oUt
oFF
V
on
V
(In case not output voltage measuring value)
(In case output voltage measuring value)

(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 the **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 the **SET UP** key.

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

NOTE

When all the printing items are set to "OFF", the effect of pressing the **DATA OUT** key or of interval printing is to output the printer elapsed time and the values of the a, b and c displays. (Printing example: Section 6.8.8.)
The values of the a, b, and c displays are produced by the "MEAS?" command.

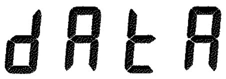
5.12 Setting the Print Interval Time

(1) When Equip 9588 GP-IB INTERFACE provided as an option, set address to talk only, and connect GP-IB listen only printer measuring value are able to print to printer. When Equip 9592 RS-232C INTERFACE provided as an option, set communications mode to printer mode, and connect RS-232C printer measuring value are able to print to printer.

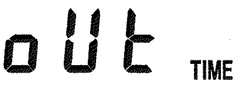
And at the same time of integration starting, in every certain intervals, measuring value which is set in 5.11 "Selecting the Printing Items" can print.

In this section, set that interval. Display example under setting condition would be as follows;

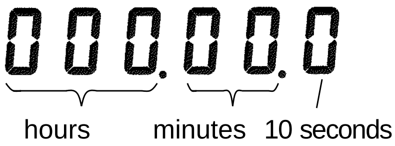
Display a



Display b



Display c



(2) Flashing unit can move with [◀] , [▶] key. Values of flashing unit can change with [▲] , [▼] key. The smallest unit of setting limit is 10 seconds and biggest is 100 hours. If input more times, it is set to 100 hours in force at pressing the **ENTER** key.

(3) Pressing the **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 the **SET UP** key key.

(6) To return to first condition of frequency measuring press the **ITEM** key.

NOTE If the printing interval is set to 0, printing is synchronized with the start of integration is not executed.

5.13 External Control Terminal and Output Terminal

5.13.1 Output Terminal

(1) Analog output (V, A, W terminals)

Outputs ±2 V DCf.s. direct voltage for range.
Outputs simultaneously for voltage(V), current(A) and active power(W).

(2) Monitor output (Vm, Am, Wm terminals)

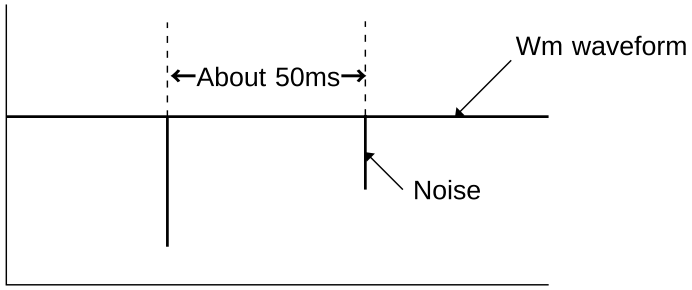
Waveform output 2 Vf.s. for range.
Outputs simultaneously for voltage(V), current(A) and active power(W).

(3) D/A output (D/A OUT terminal)

Refer to 5.9 "Selecting D/A output".
Output resistance of these terminals are about 100 Ω.

NOTE

- On the waveform of the monitor output for active power, there may be a noise signal present for approximately 50 ms.



- Use ANALOG GND terminal for common of output terminal.
- Ensure that any instrument (recorder, digital multimeter, oscilloscope,etc.) connected to the output terminal either has an insulated input or is battery powered. Use of an instrument with uninsulated input will result in a loop between ground, the 3167, the instrument, and ground, affecting the 3167's analog ground level (the reference potential) and rendering measurements and waveform observations inaccurate.

5.13.2 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, refer to Section 5.4 "Integration", and Sections 5.10 "Setting Interface" through 5.12 "Setting the Print Interval Time".

⚠ CAUTION

- Voltage applying except 0/5 V causes damages.
- If there is remarkable chattering in contact point signal sometimes controls become abnormally.
- Use EXT GND terminal for common of external control terminal.

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

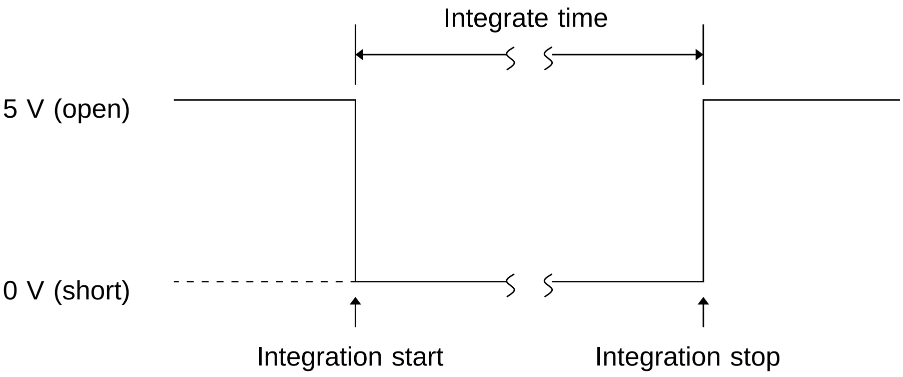


Fig. 5.13-1 Integration start/stop

(2) Reset integration (INTEGRATOR RESET terminal)

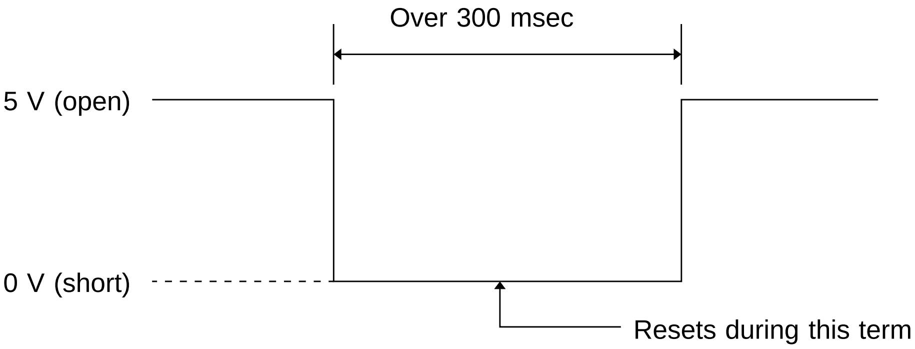


Fig. 5.13-2 Reset integration

(3) Data output (Manual printing)

(print order for GP-IB listen only printer or RS-232C printer)
(DATA OUT terminal)

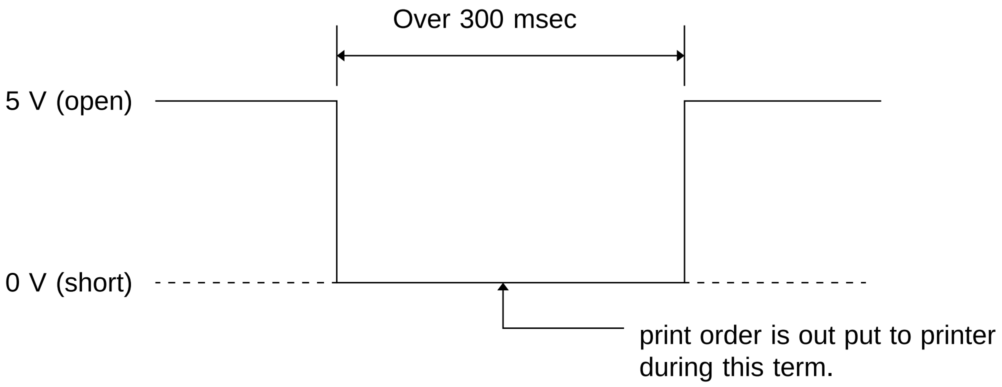


Fig. 5.13-3 Data output

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

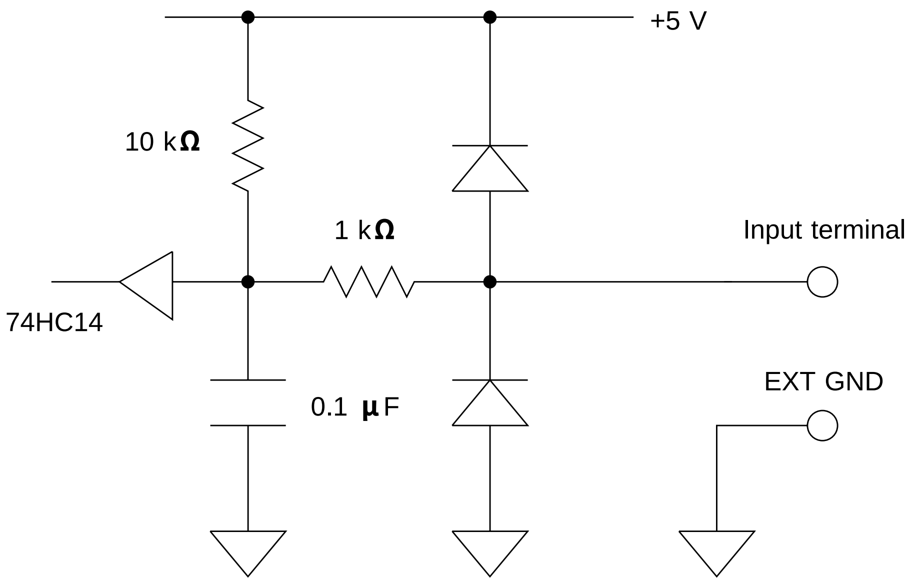


Fig. 5.13-4 Internal circuit

5.13.3 Making the Connections

(1) Use suitable wires bared at their ends for a length of about 10 mm.

(2) As shown in figure 5.13-5, depress the knob on the terminal with a screwdriver, and push the end of the wire into the connection hole.

(3) Release the screwdriver, and the wires will be locked into place.

(4) Use the same procedure to remove the wires.

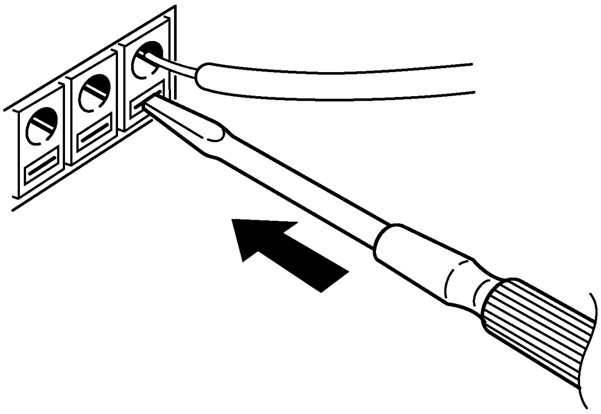


Fig. 5.13-5 Making the connections

Recommended wire size	Single strand 1.0 mm dia. (AWG #18) Multi-stranded 0.75 mm^2
Usable wire	Single strand 0.4 to 1.0 mm dia. (AWG 26 to 18) Multi-stranded 0.3 to 0.75 mm^2 (AWG 22 to 20) strand diameter at least 0.18 mm.
Strand stripping length	10 mm

⚠ CAUTION To prevent damage of this equipment, not apply input externally to output terminal.

NOTE

- Analog output voltage is ±2 V DCf.s. for each range. Monitor output is 2 Vf.s. for each range. When using PT･CT, range multiplied by value of those is 2 V.
- 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 1.1 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.

5.14 Other Functions

5.14.1 When the power is cut off

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

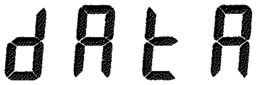
(2) When the power is cut off during equipped 9588 GP-IB INTERFACE provided as an option and using listen only printer, or equipped 9592 RS-232C INTERFACE as an option and using RS-232C printer, after returned,

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

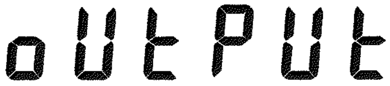
② When it is cut off during integrating, print integrate elapsed time and power cut comment "POWER FAILUR".

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

Display b



Display c



5.14.2 System Resetting

After power turning on, press the **SHIFT** and **RESET** key continuously during self testing, you can do system resetting. (For self testing, refer to 3.4 "Self Test.")

By above-stated operation, settings are reset following initial condition. (On shipping each settings are set under initial condition.) Integrate elapsed time or integrate value and so on are also reset.

Items		Settings
Display a		Voltage
Display b		Current
Display c		Active power
Voltage range		600 V
Current range		Sensor rated at 20 A : 20 A Sensor rated at 200 A : 200 A Sensor rated at 500 A : 500 A
Rectifier type		AC Clamp-on sensor AC RMS AC/DC Clamp-on sensor AC+DC RMS
Frequency range		500 Hz
Frequency measurement source		Voltage
Integrate time		1000:00 (1,000hours)
Integrate items		Active power
PT ratio		1.000
CT ratio		1.000
D/A output items		Apparent power
The number of averaging		OFF (No averaging)
Printing items		All items
Print interval time		000:00:00 (No interval printing)
GP-IB address		1
RS-232C	Baud rate	9600 bps
	Data length	8 bits
	Parity bits	none
	Stop bits	1 bit
	Communications mode	Control mode (Co.)

5.14.3 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	25
101	ROM error	Requires repair
102	RAM error	Requires repair
103	I/O port error	Requires repair
104	Frequency measurement circuit error	Requires repair
105	A/D and D/A converter error	Requires repair
106	Display and key control circuit 1 error	Requires repair
107	Display and key control circuit 2 error	Requires repair
108	Interrupt handler fault	Requires repair
109	RS-232C circuit error	Requires repair
110	Clamp sensor is disconnected	25
011	Integration key operation and external control used together	46
012	Integration invalid key press during integration operation	45
013	Integration integration started while scaling error has	46
014	Integration restarted from maximum integration count or occurred integration elapsed time	46
015	Integration integration reset carried out during integration	46
016	Invalid key press during display hold	38
017	Invalid key press during setting	38
021	Interface data out or help operation carried out while not set to "talk only" (GP-IB) or "printer mode" (RS-232C) Data out or help operation carried out when interface or is not installed	163, 164
022	Interface no space left in internal data buffer	152
023	Interface not connected printer, timeout occurred	163, 164

NOTE

- Error 001: When there is a backup error, pressing any key frees the display and returns to the normal measurement state. The 3167, however, undergoes a system reset. (Refer to Section 5.14.2 "System Resetting".)
  This error happens when internal lithium battery is used up. Please contact your nearest service representative for battery change. The battery would run down after six years.
- Errors 101 to 109 indicate internal problems with the 3167. If these error indications appear, the unit requires repair.
- Error 110 is displayed when sensor is disconnected. This is released by connecting the sensor. However, before installing the sensor, turn off the power switch.
- If the sensor fitted is different from the one which was previously used, after a power-on, after the self-tests have been completed, the clamp sensor rating display flashes. At this point, press any key to confirm the sensor.

  Settings or operations depend on the sensor change, as indicated below.

1. Rectifier type	AC+DC RMS (AC RMS in sensor dedicated for AC)
2. Current range	Maximum range
3. Integration	Stops forcibly or data reset

If the same sensor is connected, the integration calculation is forcibly stopped, but other settings remain unchanged.

Chapter 6
Interface
GP-IB
RS-232C

6.1 Specifications

6.1.1 GP-IB

IEEE-488.1 1987
IEEE-488.2 1987

NOTE

On the 9588, 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.)

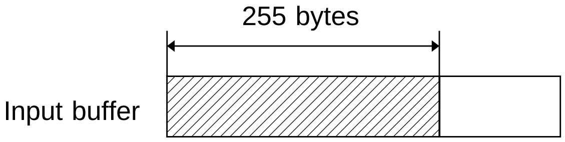
Interface functions provided

SH1	All source handshake functions
AH1	All acceptor 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.

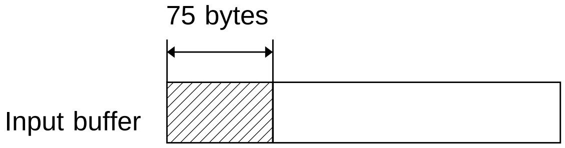
ASCII codes are used.

6.1.2 RS-232C

■ Transfer system	Start-stop synchronization
■ Baud rate	1200, 2400, 4800, 9600 bps
■ Data length	7 or 8 bits
■ Parity	Even, odd or none
■ Stop bits	1 or 2 bits
■ XON/XOFF	Can be transmitted and received. (Set with the RS232c:HANDshake command)



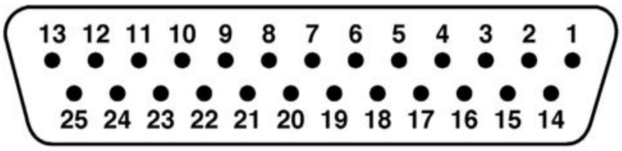
An XOFF (13 H) code is transmitted when the input buffer is 3/4 full (255 bytes).



An XON (11H) code is transmitted when the input buffer is 1/4 full (75 bytes).

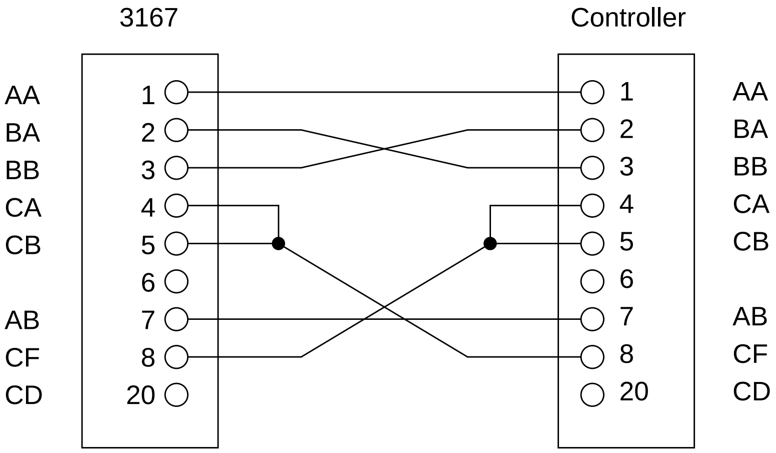
■ Hardware handshake	Can be transmitted and received. (Set with the RS232c:HANDshake command)
■ Execution confirmation messages	After analyzing and executing one line of data (data up to the terminator) from the controller, a numeric data value (ASCII) is returned. (Set with the RS232c:ANSWer command) Transmitted data 000 no error nnn error detected in item nnn of the received program code In the case of a query command, the transmission is appended after the response message.
■ Electrical characteristics	Input voltage levels +5 V to +15 V on -15 V to -5 V off Output voltage levels (load impedance 3 kΩ to 7 kΩ) +5 V to +9 V on -9 V to -5 V off

Connector pin assignment and function



Pin No	RS-232C	CCITT	Signal name
①	AA(GND)	101	Frame Ground
②	BA (TXD)	103	Send Data
③	BB (RXD)	104	Receive Data
④	CA (RTS)	105	Request to Send
⑤	CB (CTS)	106	Clear to Send
⑦	AB (GND)	102	Signal Ground
⑧	CF (DCD)	109	Data channel receive carrier detect

(1) Connect to the Controller



Example of RS-232C cable connecting

(2) Connect to the printer

There are two types of printer: ones with pin 2 of the RS-232C interface for "receive data" (BB), and ones with pin 3 for "receive data" (BB).

For a printer with pin 2 for "receive data", use a "straight" cable (with same-numbered pins connected).
For a printer with pin 3 for "receive data", use a cable with pin connections as shown above.

6.2 Installing and Removing the Interface Option

⚠ WARNING

- **To avoid electric shock accident, before removing or replacing an interface, power cord, and clamp sensor, confirm that the instrument is turned off and that the power cord are disconnected.**
- **The mounting screws must be firmly tightened or the input unit may not perform to specifications, or may even fail.**
- **To avoid the danger of electric shock, never operate the product with an 9588 GP-IB INTERFACE/9592 RS-232C INTERFACE. To use the product after removing an interface, install a blank panel over the opening of the removed module.**

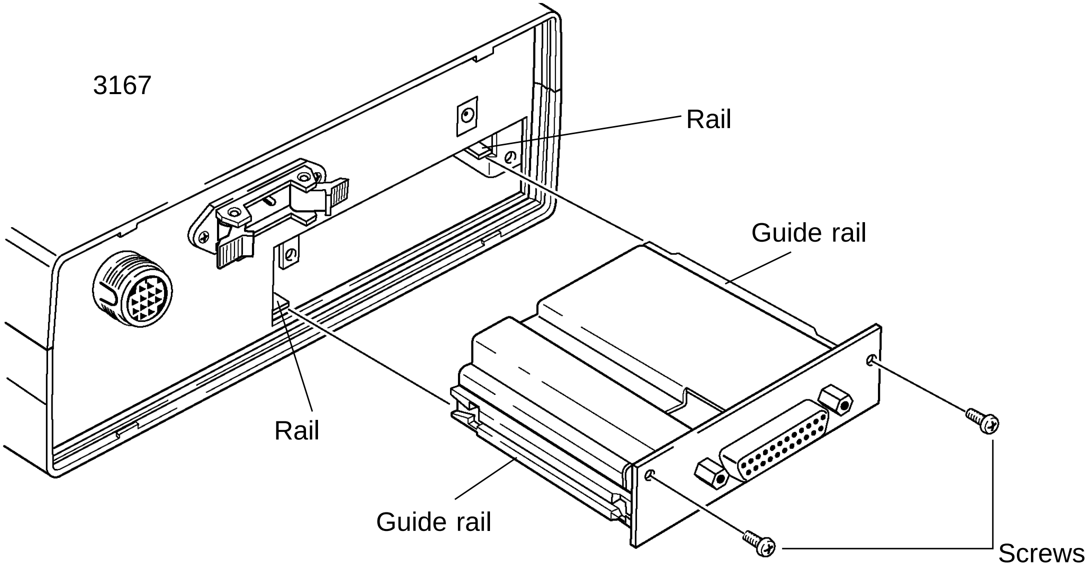
The space for fitting the 9588 GP-IB INTERFACE or the 9592 RS-232C INTERFACE in the rear panel of the 3167 is covered with a blanking plate. Follow these three steps to install the interface:

(1) Remove the fixing screws, and take off the blanking plate. (Be careful not to lose the screws.)

(2) Insert the interface option into the exposed slot in the rear of the 3167 by sliding its guide rails along the rails provided on the sides of the inside of the slot. (See the figure below)

(3) Push the interface option firmly into place, and fix with the screws removed in step (1).

NOTE Ensure that the fixing screws for the interface are fastened securely. Loose screws can lead to added susceptibility to noise, and operational errors.

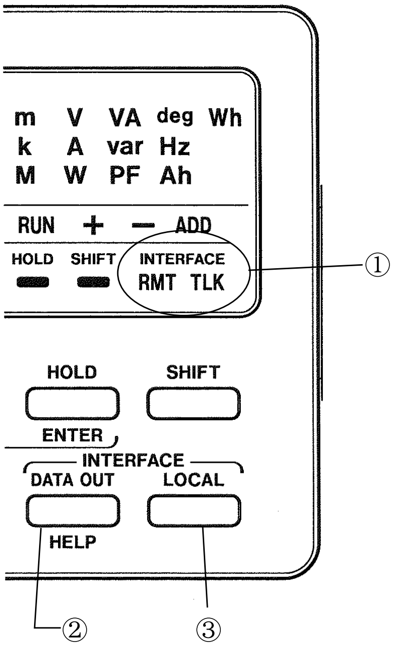


⚠ WARNING

- **To avoid the danger of electric shock, never operate the 3167 unit with an input unit such as GP-IB or RS-232C interface removed.**
- **If you should wish to use the unit after removing an input unit, fit a blanking panel over the opening of the removed unit.**

NOTE Ensure that the screws for the interface cable are fastened securely.

6.3 Identification of Controls and Indicators



① Interface status display

When 9588 GP-IB INTERFACE is fitted
These indicators show the GP-IB control state:

RMT: Remote
TLK: Talker
When 9592 RS-232C INTERFACE is fitted
These indicators show the RS-232C control state:

RMT: Remote
TLK: Printer Mode (Pr.)

② Data out/help output key (DATA OUT / HELP)

When using GP-IB in talk only mode or RS-232C in printer mode, measuring value or setting state can output with this key.

③ LOCAL key (LOCAL)

Press this key to release the remote state of the GP-IB or RS-232C 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 lock out state. (Only when GP-IB is fitted.)

NOTE

When communications are carried out by means of a controller, both the GP-IB and RS-232C interfaces go into the remote mode, and key input is not accepted. To execute key input, release the remote state with the LOCAL key.

6.4 Setting Interface

Refer to 5.10 "Setting Interface".

NOTE

- When connecting to a controller, set as follows:

GP-IB	any address
RS-232C	Control mode (Co.)

- When connecting to a printer, set as follows:

GP-IB	Talk only
RS-232C	Printer mode (Pr.)

6.5 Introduction to the Interface

6.5.1 Features

(1) All of the functions of the 3167 main unit, except for powering on, can be controlled.

(2) The unit can be reset.

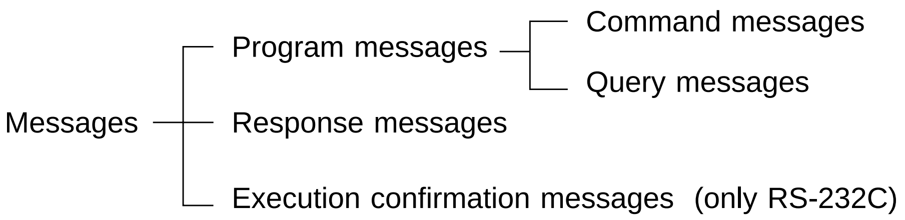
(3) In the hold state, single-shot measurement is possible.

(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 or printer mode.

6.5.2 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 ";".

A space is represented by "_" in this manual.

Headers on	"V_+101.2 E+0;A_+1.200 E-3"
Headers off	"+101.2 E+0;+1.200 E-3"
	↓
Headers off	"+101.2 E+0,+1.200 E-3"

(3) Execution confirmation message

Execution confirmation message is the numeric data (ASCII) created by analyzing and executing one line of data (data up to the terminator) from the controller. This numeric data is returned to the controller. The controller and this unit are synchronized by means of this data.
(Refer to 6.1.2 "RS-232C".)

6.5.3 Command Syntax

The names of commands for the 3167 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 the 3167 are in long form and in upper case letters.

6.5.4 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 Standard 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?

6.5.5 Message Terminators

The 3167 recognizes,
(1) linefeed character (0AH) (GP-IB, RS-232C) ,
(2) EOI signal (GP-IB only),
(3) LF with EOI (GP-IB only),
as message terminators.

To terminate a response message, the 3167 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:

	GP-IB	RS-232C
(1)	LF with EOI (linefeed only)	LF
(2)	CR + LF with EOI (carriage return plus linefeed)	CR + LF

The initial selection is (1).
A detailed explanation of the "TRANsmit:TERMinator" command is given in Section 6.6.2, "Commands specific to the 3167."

6.5.6 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 $\boxed{;}$:SCALe:CT_4 $\boxed{;}$: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?_V $\boxed{,}$ A $\boxed{,}$ W $\boxed{,}$ VA"

6.5.7 Data Formats

The 3167 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 the 3167 are always in upper case letters.

Example ":DISPlay_$\boxed{V}$, $\boxed{A}$, $\boxed{W}$"

(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 the 3167 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, -2.3 E+4

The term "NRf format" includes all these three formats.
When the 3167 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"

6.5.8 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 the 3167, there are nine possible current paths:
":VOLTage:", ":CURRent:", ":SCALe:", ":TRANsmit:", ":FREQuency:", ":INTEGrate:", ":DATAout:", ":RS232c:" and ":STATus:"

6.5.9 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 a query error is generated.

The 3167 has an output queue of 1000 bytes capacity. If the response messages overflow this limit of 1000 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.

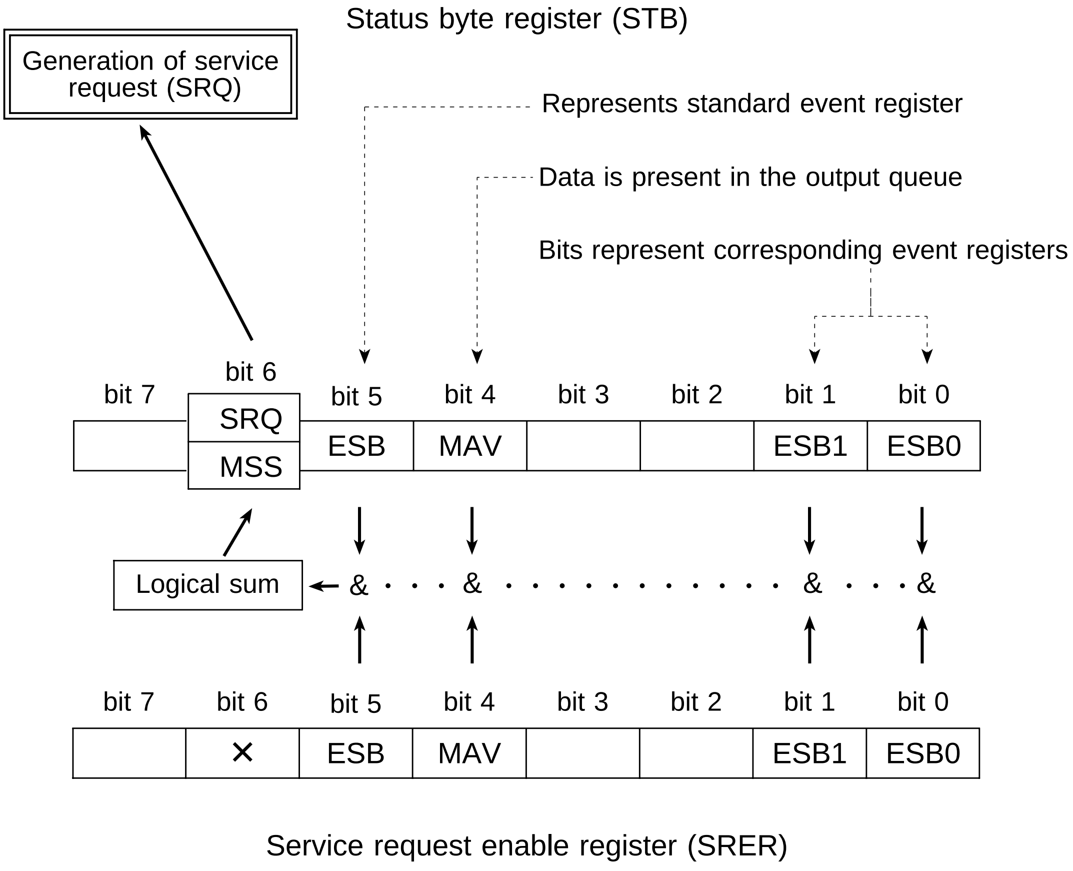
6.5.10 Input Buffer

The 3167 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.
In case of RS-232C interface, if the buffer becomes full, its data is thrown away untill the analysis of input buffer is completed. (When XON, XOFF control or hardware handshake is invalid.)

6.5.11 Status Model

In its implementation of the serial polling function using service requests, the 3167 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


Status byte register (STB)
Generation of service request (SRQ)
Represents standard event register
Data is present in the output queue
Bits represent corresponding event registers
bit 7
bit 6
bit 5
bit 4
bit 3
bit 2
bit 1
bit 0
SRQ
MSS
ESB
MAV
ESB1
ESB0
Logical sum
&
&
&
&
bit 7
bit 6
bit 5
bit 4
bit 3
bit 2
bit 1
bit 0
×
ESB
MAV
ESB1
ESB0
Service request enable register (SRER)

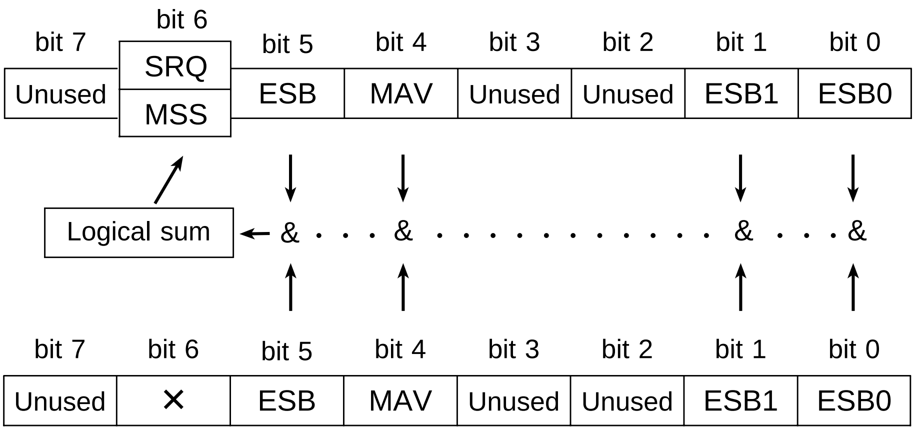
The status byte register holds information relating to the event registers and the output queue. It is further possible to use the service request enable register as a mask to select the items required. If any of the bits selected by the mask becomes 1, bit 6 (the master summary status or MSS bit) is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

6.5.12 Status Byte Register

(1) Status byte register (STB)

The status byte register is an 8-bit register whose contents are output from the 3167 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.

Status byte register (STB)



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 Shows a 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	Unused.
Bit 2	Unused.
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

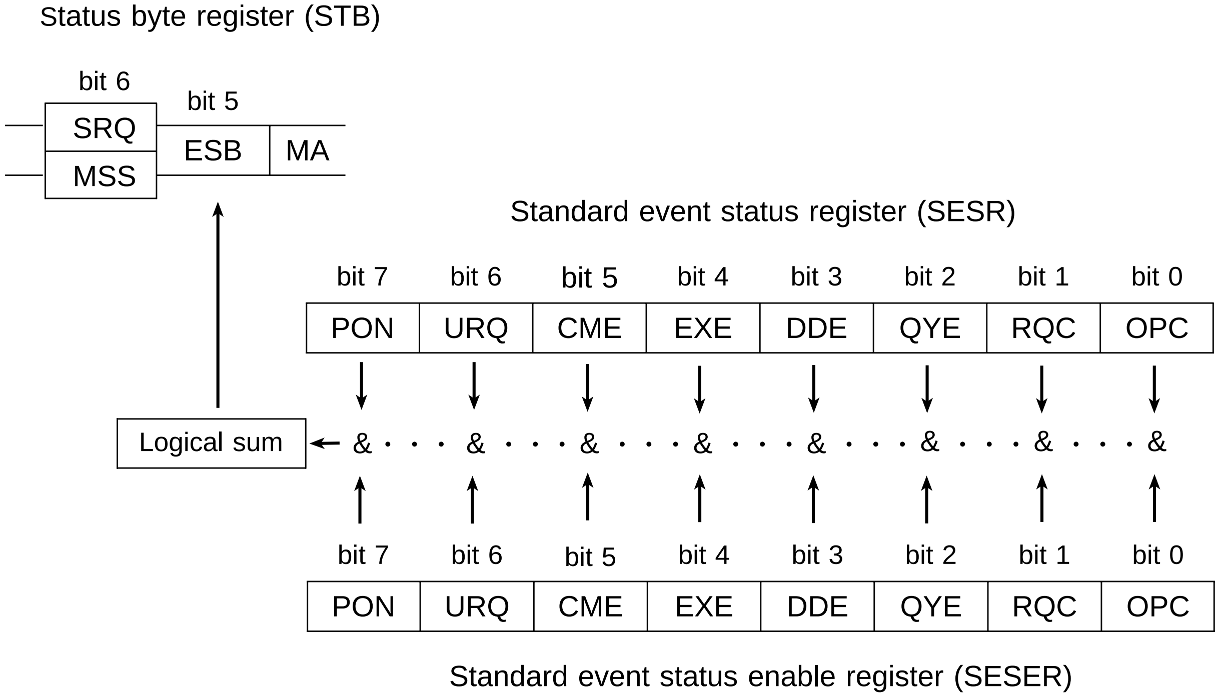
(2) Service request enable register (SRER)

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.

6.5.13 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.



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.

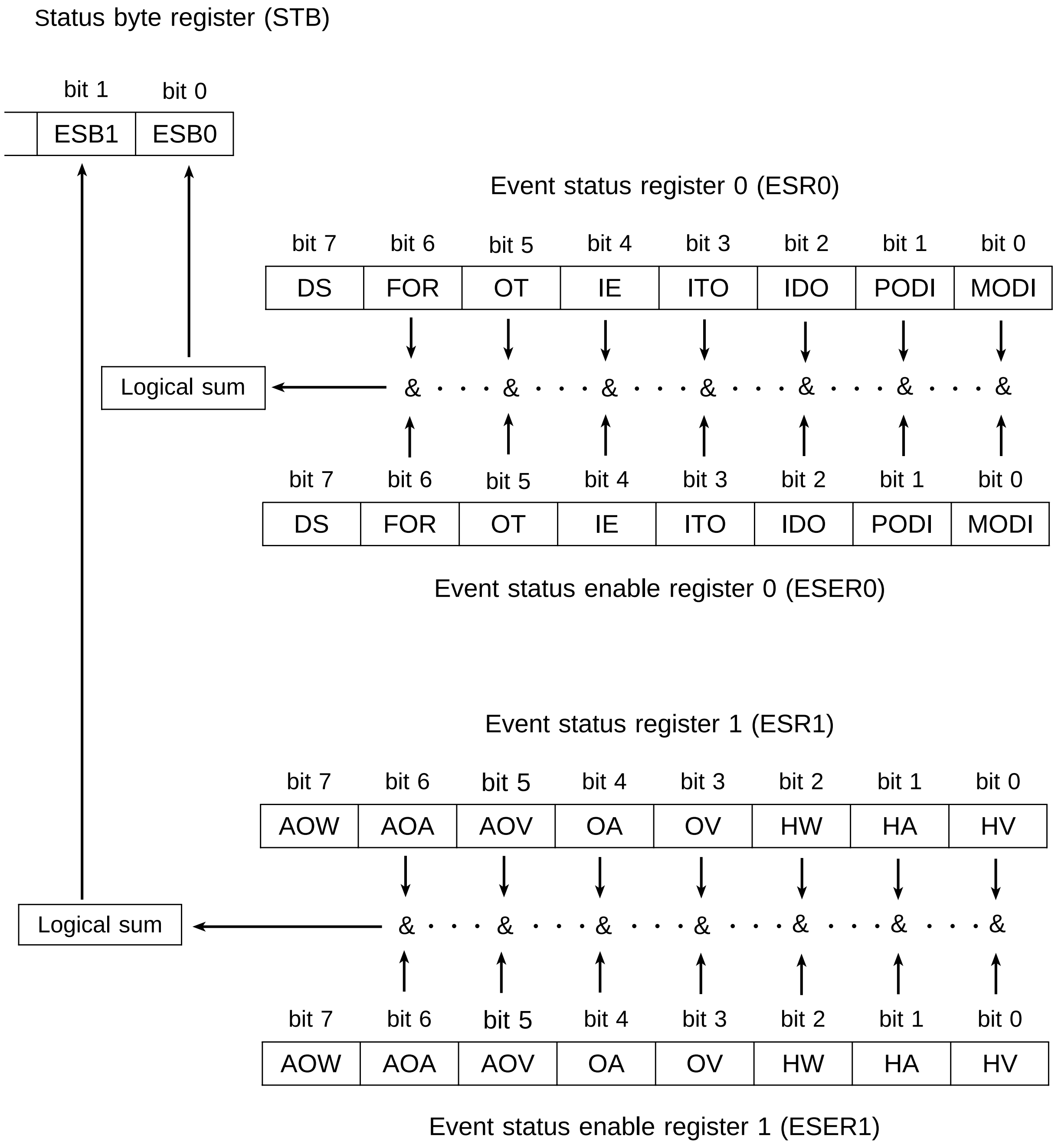
Standard event status register (SESR) bit assignments

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 the 3167.
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 the 3167. ・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 the 3167. ・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?" or a "STATus:CLAMp?" query.
Bit 1 RQC	Request for controller authority. Not used by the 3167.
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 the 3167 (ESR0 and ESR1)

Two 8-bit event status registers are provided for managing events on the 3167. 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.



Event status register 0 and event status register 1 are cleared in the following three situations:

① When a "*CLS" command is received.

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

③ When the unit is powered on.

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

Bit 7 DS	Data Set	Sets at every time the display data (measuring value) is made.
Bit 6 FOR	Frequency Out of Range	Sets when frequency becomes o.r.
Bit 5 OT	Output Time	Sets when achieved output time during integrating. Sets when integrating has been started and stopped. Not set when output time is 000:00:00.
Bit 4 IE	Integrate End	Sets when integrating has been stopped.
Bit 3 ITO	Integrate Time Over	Sets at every time sampling is performed during displays 10000 hours.
Bit 2 IDO	Integrate Data Over	Sets at every time sampling is performed during integrate data has been over (±999999 M)
Bit 1 PODI	Plus Over Data Integrate	Sets when the plus over data (o.r) is added to integrate value.
Bit 0 MODI	Minus Over Data Integrate	Sets when the minus over data (-o.r) is added to integrate value.

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

Bit 7 AOW	AVERAGE OVER-W	Average active power value includes input out of range data.
Bit 6 AOA	AVERAGE OVER-A	Average current value includes input out of range data.
Bit 5 AOV	AVERAGE OVER-V	Average voltage value includes input out of range data.
Bit 4 OA	OVER-A	Peak value of current input out of range
Bit 3 OV	OVER-V	Peak value of voltage input out of range
Bit 2 HW	HIGH-W	Active power input out of range
Bit 1 HA	HIGH-A	Current input out of range
Bit 0 HV	HIGH-V	Voltage input out of range

AOV, AOA and AOW is set when the display has been renewed.

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

NOTE Each of the registers has no battery backup. Set the data every time the unit is powered on.

6.5.14 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 single-shot sampling processing.

6.6 Command Reference

(1) Command reference

① Standard command : refer to Section 6.6.1
② Commands specific to the 3167 : refer to Section 6.6.2

(2) Format of command explanations

Syntax	Specifies the syntax of 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.
Error	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. Transmission : command sent by the controller Response : command received by the controller

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

NOTE Settings made by the following commands have no battery backup. When the unit is powered on, this is reset, so it is necessary to make the setting again.

Command	Reset data
∗ESE, ESE0, ESE1, ∗SRE	0
HEADer	ON
RS232c:ANSWer	OFF
RS232c:HANDshake	HARD
TRANsmit:SEParator	0 (semicolon)
TRANsmit:TERMinator	0 (LF)

6.6.1 Standard Commands

∗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).

NOTE
- This has no effect upon the output queue, the various enable registers, or bit 4 (the MAV bit) of the status byte register.
- This command is executed even in the event of a system error.

∗ESE

■ Sets the standard event status enable register (refer to Section 6.5.13).

Syntax ∗ESE <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.

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

Standard event status enable register (SESER)

NOTE When the power is turned on, and when a reset has taken place upon key input, the data is reinitialized to 0.

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 1000 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	**"*ESE?"**	**"*ESE?"**
Response	**"*ESE 36"**	**"36"**

∗ESR?

■ Reads out the contents of the standard event status register (SESR) (refer to Section 6.5.13).

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

Standard event status register (SESR)

NOTE

- 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 1000 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.

NOTE

- 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, 3167, 0, V1. 00"

First field	Manufacturer’s name
Second field	Model name
Third field	Not used - always "0"
Fourth field	Software version

Errors

- If the response message is longer than 1000 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, 3167, 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.

Error 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 V,A,W"`**

When the entire action of the commands *RST and MEAS? has been completed, the designated 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.

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

Response syntax Whether headers are on or off "1"

Errors
- If the response message is longer than 1000 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. (System reset)

Syntax ∗RST

Function Resets the 3167 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	V, A, W
Rectifier type	ACrms (AC sensor), AC+DC (AC/DC sensor)
Voltage range	600 V (if auto ranging is off)
Current range	Table below (if auto ranging is off)
Frequency source, range	V, 500 Hz
PT ratio, CT ratio	1.000, 1.000
Number of averaging	OFF (1)
INTEG items, INTEG time	W, 1000:00
Output interval	000:00:00
Output items	All items
D/A output items	VA
HOLD	OFF
Response data header	ON
Data separator	semicolon ";"

Current range

Clamp-on sensor	Reset value
9270, 9272-20 A, 9277	20 A
9271, 9272-200 A, 9278	200 A
9279	500 A

(2) Items which are not reset.

- Interface functions
- GP-IB device address
- Setting the RS-232C (baud rate, data length, parity, stop bits and control mode)
- The output queue
- The input buffer
- The terminator for query messages
- The various event registers (SESR, ESR0, and ESR1)
- The various enable registers (SRER, SESER, ESER0, and ESER1)

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

Errors In the event of system error 001 (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) (refer to Section 6.5.12).

Syntax *SRE_<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.

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	Unused	Unused	ESB1	ESB0

Service request enable register (SRER)

NOTE

- The unused bits (bits 2, 3, and 7) and bit 6 are disregarded.
- When the power is turned on, and when a reset has taken place upon key input, the data is reinitialized to 0.

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: 0 to 3, 16 to 19, 32 to 35, and 48 to 51.

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 1000 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	`"*SRE?"`	`"*SRE?"`
Response	`"*SRE 34"`	`"34"`

*STB?

■ Queries the status byte register (refer to Section 6.5.12).

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.

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	Unused	Unused	ESB1	ESB0

Status byte register (STB)

NOTE

- Bit 6 is the MSS bit.
- Even if service requests are cleared by serial polling, the MSS bit is not cleared. (GP-IB only)
- 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 1000 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 (single-shot measurement).

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? A;*TRG;:MEAS? A"**
Response	**"A +2.120E+0;A +2.240E+0"**

*TST?

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

Syntax *TST?

Function Causes the 3167 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 error
102	RAM error
103	I/O port error
104	Frequency measuring circuit error
105	A/D and D/A converter error
106	Display/key control circuit 1 error
107	Display/key control circuit 2 error
108	CTC interrupt error
109	RS-232C circuit error
110	Clamp sensor disconnecting error

NOTE

- 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>"

Errors

- If the response message is longer than 1000 bytes, a query error is generated.
- If this command is executed other than integration reset continuous display, a device dependent 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.

NOTE

- 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.

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

Example

Transmission	**":HOLD OFF;:MEAS? V;*WAI;:MEAS? V"**
Response	"V +100.1E+0;V +101.2E+0"

6.6.2 Commands specific to the 3167

AOUT

■ Sets the items of D/A output.

Syntax AOUT_<data>

<data> VA, VAR, PF, DEG, FREQ, INTEG, PINTEG, MINTEG : character data

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) In the event of a system error (the command is not executed).
(2) During integrating
(3) During the hold state

Example Transmission `":AOUT VA"`

The items of D/A output are set to VA.

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 longer than 1000 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	`":AOUT?"`	`":AOUT?"`
Response	`":AOUT VA"`	`"VA"`

AVERaging

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

Syntax AVERaging_<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.

NOTE
- 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, an execution 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

Example 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 (<data>) 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 1000 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	**":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 1000 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	**":CURR?"**	**"CURR?"**
Response	**":CURRENT:RANGE 10;AUTO ON"**	**"10;ON"**

CURRent:AUTO

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

Syntax CURRent:AUTO_<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 (including integrating stopping state).

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 1000 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	**":CURR:AUTO?"**	**":CURR:AUTO?"**
Response	**":CURRENT:AUTO ON"**	**"ON"**

CURRent:RANGe

■ Sets the current (amperage) range.

Syntax CURRent:RANGe_<data>

<data> 2, 5, 10, 20, 50, 100, 200 or 500 : numerical data in NR1 format

Function
- Sets the current (amperage) 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
- The range can be set differs according to clamp-on sensor type.
- If the value specified is not a valid range setting ×100 %, the next largest range is selected.

Clamp-on sensor	The range can be set
9270	2, 5, 10, 20 A
9271	20, 50, 100, 200 A
9272 (20 A)	2, 5, 10, 20 A
9272 (200 A)	20, 50, 100, 200 A
9277	2, 5, 10, 20 A
9278	20, 50, 100, 200 A
9279	50, 100, 200, 500 A

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 (including integrating stopping state).

Example Transmission **":CURR:RANG 2.004"**

The range is set to 2 A.

Transmission **":CURR:RANG 2.005"**

The range is set to 5 A.

CURRent:RANGe?

■ Queries the current (amperage) range.

Syntax CURRent:RANGe?

Function Returns the presently set current (amperage) range as a numerical value (<data>) in NR1 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 1000 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	**":CURR:RANG?"**	**":CURR:RANG?"**
Response	**":CURRENT:RANGE 10"**	**"10"**

DATAout?

■ Queries the printer output.

Syntax DATAout?

Function

- Returns the printer output items as two NR1 values of <data1> and <data2>, and the interval setting as three NR1 values of <data3>, <data4> and <data5>.
- The interval setting is returned as hours, minutes and seconds.

NOTE

- Refer to DATAout:ITEM command for contents of <data1> and <data2>
- 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 ":DATAOUT:ITEM_<data1>,<data2>;TIME_<data3>, <data4>, <data5>"
If headers are off "<data1>, <data2>;<data3>,<data4>,<data5>"

Errors

- If the response message is longer than 1000 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	**":DATA?"**	**":DATA?"**
Response	**":DATAOUT:ITEM 255,0;TIME 10,10,10"**	**"255,0;10,10,10"**

DATAout:ITEM

■ Sets printer output item (:MEASure? output item).

Syntax DATAout:ITEM_<data1>,<data2>

<data> <data1>, <data2> 1 to 255 : numerical data in NR 1

	128 bit 7	64 bit 6	32 bit 5	16 bit 4	8 bit 3	4 bit 2	2 bit 1	1 bit 0
<data 1>	FREQ	deg	PF	var	VA	W	A	V
<data 2>					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> and <data2> 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> and <data2> 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 `":DATA:ITEM 255, 0"`

Set V, A, W, VA, var, PF, deg 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>, <data2>) 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 ":DATAOUT:ITEM_<data1>,<data2>"

If headers are off "<data1>,<data2>"

Errors

- If the response message is longer than 1000 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	**":DATA:ITEM?"**	**":DATA:ITEM?"**
Response	**":DATAOUT:ITEM 255,0"**	**"255,0"**

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.

Example 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 printer 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 1000 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	**":DATA:TIME?"**	**":DATA:TIME?"**
Response	**":DATAOUT:TIME 10,10,10"**	**"10,10,10"**

DEMag

■ Executes demagnetization

Syntax DEMag

Function Carries out demagnetization

NOTE
- When 9270, 9271 or 9272 CLAMP ON SENSOR (AC clamp-on sensor) is connected, a demagnetizing signal is not sent.
- When 9277, 9278 or 9279 UNIVERSAL CLAMP ON CT (AC/DC clamp-on sensor) is connected, a pulse signal for demagnetizing is sent to the sensor.

Errors
- In the event of a system error, this command is not executed, and a device dependent error is generated.
- During integrating, a device dependent error is generated.
- When using the clamp-on sensor especially for AC, a device dependent error is generated.

Example Transmission **":DEM"**

Carries out demagnetization.

Display

■ Sets the items displayed.

Syntax DISPlay_<data1>,<data2>,<data3>

<data>

<data1> V, A, W : character data

<data2> V, A, W, TIME : character data

<data3> V, A, W, VA, VAR, PF, DEG, 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.

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 V,A,W"**

Display a is set to show voltage, display b current and display c active power.

DISPlay?

■ Queries the items displayed.

Syntax DISPlay?

Function Returns as <data1>, <data2> and <data3> 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 1000 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.

Example

	If headers are on	If headers are off
Transmission	**":DISP?"**	**":DISP?"**
Response	**":DISPLAY V,A,W"**	**"V,A,W"**

ESE0

■ Sets event status enable register 0 (refer to Section 6.5.13).

Syntax ESE0_<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.

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

Event status enable register 0 (ESER0)

NOTE Directly after the power has been switched on, or after a 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 contents of event status enable register 0 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 ":ESE0_<data>"
If headers are off "<data>"

Errors
- If the response message is longer than 1000 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	**":ESE0?"**	**":ESE0?"**
Response	**":ESE0 1"**	**"1"**

ESE1

■ Sets event status enable register 1 (refer to Section 6.5.13).

Syntax ESE1_<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.

128	64	32	16	8	4	2	1
bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
AOW	AOA	AOV	OA	OV	HW	HA	HV

Event status enable register 1 (ESER1)

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

Syntax ESE1?

Function Returns the value of event status enable register 1 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 1000 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	**":ESE1?"**	**":ESE1?"**
Response	**":ESE1 48"**	**"48"**

ESR0?

■ Reads out event status register 0 (refer to Section 6.5.13).

Syntax ESR0?

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

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

Event status register 0 (ESR0)

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 1000 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 (refer to Section 6.5.13).

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.

128	64	32	16	8	4	2	1
bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
AOW	AOA	AOV	OA	OV	HW	HA	HV

Event status register 1 (ESR1)

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 1000 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 (OV) and peak current out of range flag (OA) 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>).

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	":FREQUENCY:SOURCE_<data1>;RANGE_<data2>;AUTO_<data3>"
If headers are off	"<data1>;<data2>;<data3>"

Errors
- If the response message is longer than 1000 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

Transmission	**":FREQ?"**
Response	**":FREQUENCY:SOURCE V;RANGE +500.0E+0;AUTO ON"**

If headers are off

Transmission	**":FREQ?"**
Response	**"V;+500.0E+0;ON"**

FREQuency:AUTO

■ Sets the frequency auto range.

Syntax	FREQuency:AUTO_<data>
<data>	ON/OFF : character data
Function	Sets the frequency auto range either 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)In 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: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.
Errors	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 1000 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	**":FREQ:AUTO?"**	**":FREQ:AUTO?"**
Response	**":FREQUENCY:AUTO ON"**	**"ON"**

FREQuency:RANGe

■ Sets the frequency range.

Syntax FREQuency:RANGe_<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 fifth 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, 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.

Example

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.

Response syntax

If headers are on ":FREQUENCY:RANGE_<data>"

If headers are off "<data>"

Errors

- If the response message is longer than 1000 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	**":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> V, A : 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 V"**

Sets the frequency measuring item to V.

FREQuency:SOURce?

■ Queries the frequency measuring items.

Syntax FREQuency:SOURce?

Function Returns as V and A (<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 1000 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	**":FREQ:SOUR?"**	**":FREQ:SOUR?"**
Response	**":FREQUENCY:SOURCE V"**	**"V"**

HEADer

■ Turns response headers on or off.

Syntax HEADer_<data>

<data> ON or OFF : character data

Function This sets whether or not the 3167 will prefix headers to its response messages.

NOTE In any case, responses to the queries *IDN?, *ESR?, *STB?, *TST?, ESR0?, ESR1? and STATus:CLAMp? 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 1000 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	**":HEAD?"**	**":HEAD?"**
Response	**":HEADER ON"**	**"OFF"**

HOLD

■ Sets the display hold on or off.

Syntax HOLD_<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 1000 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 outputs "10000,0" 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 1000 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

Transmission	**":INTEG?"**
Response	**":INTEGRATE:SOURCE W;TIME 100,0;STATE START"**

If headers are on

Transmission	**":INTEG?"**
Response	**"W;100,0;START"**

INTEGrate:STATe

■ Set the integrate meter condition

Syntax INTEGrate:STATe_<data>

<data> START/STOP/RESET : character data

Function Sets the integrate meter condition (start, stop or reset).

Errors
- A device dependent error is generated according to condition.

<data>		Key input (GP-IB, RS-232C)		External control	
	RESET	RUN	STOP	RUN	STOP
START	Yes	No	Yes	No	No
STOP	No	Yes	No	No	No
RESET	Yes	No	Yes	No	Yes

Yes : The command is executed.
No : 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.

Example 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 1000 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:STAT?"**	**":INTEG:STAT?"**
Response	**":INTEGRATE:STATE START"**	**"START"**

INTEGrate:SOURce

■ Sets the integrate items.

Syntax INTEGrate:SOURce_<data>

<data> A, W : character data

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 (including integrating stopping state).

Example Transmission **":INTEG:SOUR A"**

Sets the integrate item to A (current).

INTEGrate:SOURce?

■ Queries the integrate items.

Syntax INTEGrate:SOURce?

Function Returns as character 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 1000 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 A"**	**"A"**

INTEGrate:TIME

■ Sets the integrate timer.

Syntax **INTEGrate:TIME_**<data1>,<data2>

<data>

<data1> 0 to 10000 : numerical data in NR1

<data2> 0 to 59 : numerical data in NR1

- Sets the integration time in NR1 format as two values <data1> and <data2>, hours and minutes respectively. Setting limit is from one minute to 1000 hours.
- <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 (including integrating stopping state).

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.
- With this query, if any error occurs, no response message is produced.
- During external control, outputs "10000.0".

Response syntax

If headers are on ":INTEGRATE:TIME_<data1>,<data2>"

If headers are off "<data1>,<data2>"

Errors

- If the response message is longer than 1000 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?_ data1>,<data2>,<data3>,...

<data> V, A, W, VA, VAR, PF, DEG, FREQ, INTEG, PINTEG, MINTEG, TIME : character data

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.

NOTE
- 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 displays "----", outputs previous value.
- If all output items are set to OFF by Section 5.11 "Selecting the Printing Items" or "DATA and :ITEM command, the measured values of the a, b and c displays are produced by the "MEAS?" command (no <data> is specified).

Response syntax

Header portion	Data portion
V, A, W, VA, VAR, PF, DEG, FREQ	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	V, A, W, VA, VAR, PF, DEG, FREQ	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 1000 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).

Example

	If headers are on	If headers are off
Transmission	`":MEAS? V,A,W"`	`":MEAS? V,A,W"`
Response	`"V +150.0E+0;A +20.00E+0; W +3.000E+3"`	`"+150.0E+0;+20.00E+3; +3.000E+3"`

RECTifier

■ Sets the rectifier type.

Syntax RECTifier_<data>

<data>

1	DC	numerical data in NR1
2	AC+DC : Vrms, Arms	
3	AC RMS: Vrms, Arms	
4	AC V MEAN: Vmean, Arms	

Function Sets the rectifier type.

Errors

- If <data> is other than setting range, 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. (including integration stopping state)
(4) When DC or AC+DC is designated when using the clamp-on sensor especially for AC.

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 (<data>) 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 ":RECTIFIER_<data>"
If headers are off "<data>"

Errors

- If the response message is longer than 1000 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	**":RECTIFIER 1"**	**"1"**

RS232c? (Query especially for the RS-232C)

■ Queries the setting for the RS-232C communications handshake.

Syntax RS232c?

Function Returns the current setting for the RS-232C communications handshake as X, HARD or OFF in (<data1>), the setting for execution confirmation message as ON or OFF in (<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 ",".
- Even if a system error occurs, this query is executed.

Response syntax

If headers are on ":RS232C:HANDSHAKE_<data1>;ANSWER <data2>"

If headers are off "<data1>;<data2>"

Errors

- If the response message is longer than 1000 bytes, a query error is generated.
- If this command is executed when using GP-IB interface, an execution error is generated.

Example

	If headers are on	If headers are off
Transmission	`":RS232?"`	`":RS232?"`
Response	`":RS232C:HANDSHAKE OFF; ANSWER OFF"`	`"OFF;OFF"`

RS232c:ANSWer (Command especially for the RS-232C)

■ Sets whether or not the execution confirmation message

Syntax RS232c:ANSWer_<data>

<data> On or OFF : character data

Function
- Sets the execution confirmation message either on or off.
- When set to ON, outputs the execution confirmation message. (refer to section 6.1.2)

NOTE
- Even if a system error occurs, this command is executed.
- When set to ON, if this message is not accepted the operation may become unstable.

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.
- If this command is executed when using GP-IB interface, an execution error is generated.

Example

```
                                   Results
PRINT #1,":RS232:ANSW ON"
INPUT #1.A$
PRINT A$                           000                OK
PRINT #1,"V:RNG 100"
INPUT #1.A$
PRINT A$                           001                "V:RNG" is error
PRINT #1,"VOLT:RANG?"
INPUT #1,A$
PRINT A$                           :VOLTAGE:RANGE 15;000  Query data is OK
```

RS232c:ANSWer? (Query especially for the RS-232C)

■ Queries whether or not execution confirmation messages are enabled.

Syntax RS232c:ANSWer?

Function Returns the current setting for the execution confirmation messages as ON or OFF.

NOTE

- With this query, if any error occurs, no response message is produced.
- Even if a system error occurs, this query is executed.

Response syntax

If headers are on ":RS232C:ANSWER_<data>"

If headers are off "<data>"

Errors

- If the response message is longer than 1000 bytes, a query error is generated.
- If this command is executed when using GP-IB interface, an execution error is generated.

Example

	If headers are on	If headers are off
Transmission	**":RS232:ANSW?"**	**":RS232:ANSW?"**
Response	**":RS232C:ANSWER OFF"**	**"OFF"**

RS232c:ERRor? (Query especially for the RS-232C)

■ Queries whether or not the RS-232C communications error information are enabled.

Syntax RS232c:ERRor?

Function Returns the RS-232C communications error information as a numerical data value (<data>) in NR1 format taken from the set :0 to 7.

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	Unused	Unused	Unused	Unused	Overrun	framing	parity

- Overrun error
- Framing error
- Parity error

NOTE
- With this query, if any error occurs, no response message is produced.
- Even if a system error occurs, this query is executed.
- The response message has no header.
- This query clears the communications error information.

Response syntax If headers are on or off "<data>"

Errors
- If the response message is longer than 1000 bytes, a query error is generated.
- If this command is executed when using GP-IB interface, an execution error is generated.

Example

Transmission	**":RS232:ERR?"**
Response	**"4"**

An overrun error has occurred.

RS232c:HANDshake (Command especially for the RS-232C)

■ Sets the RS-232C communications handshake

Syntax RS232c:HANDshake_<data>

<data> X, HARD or OFF : character data

Function Select the type of handshake specified by <data>:

(1) X software handshake (XON/XOFF)
(2) HARD hardware handshake
(3) OFF no handshake

NOTE Even if a system error occurs, this query is executed.

Errors

- If <data> is set to character data other than "X", "HARD" or "OFF", an execution error is generated.
- If <data> is other than character data, a command error is generated.
- If this command is executed when using GP-IB interface, an execution error is generated.

Example Transmission **":RS232:HAND X"**

Sets to software handshake (XON/XOFF).

RS232c:HANDshake? (Query especially for the RS-232C)

■ Queries the setting for the RS-232C communications handshake.

Syntax RS232c:HANDshake?

Function The value of the communications handshake is returned as character data (X, HARD or OFF) .

NOTE

- With this query, if any error occurs, no response message is produced.
- Even if a system error occurs, this query is executed.

Response syntax

If headers are on ":RS232C:HANDSHAKE_<data>"
If headers are off "<data>"

Errors

- If the response message is longer than 1000 bytes, a query error is generated.
- If this command is executed when using GP-IB interface, an execution error is generated.

Example

	If headers are on	If headers are off
Transmission	**":RS232:HAND?"**	**":RS232:HAND?"**
Response	**":RS232C:HANDSHAKE X"**	**"X"**

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.

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 ":SCALE:PT_<data1>;CT_<data2>"

If headers are off "<data1>;<data2>"

Errors

- If the response message is longer than 1000 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	**":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. (including integration stopping state)

Example 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 1000 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	**":SCAL:CT?"**	**":SCAL?"**
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. (including integrating stopping state)

Example

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 1000 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	**":SCAL:PT?"**	**":SCAL:PT?"**
Response	**":SCALE:PT 2.000"**	**"2.000"**

STATus:CLAMp?

■ Queries the clamp sensor

Syntax STATus:CLAMp?

Function Returns the model number (<data1>), rating (<data2>) and type (<data3>) of the clamp sensor currently in use, as an ASCII string.

NOTE

- The "STATus:CLAMp?" query is the last message in the program/messages. Therefore, if a subsequent query is detected, a query error results, and no response messages are output after the "STATus:CLAMp?" query.
- The response message has no header.
- If any error results from this query, the response message to this query is not created.
- When there is no sensor, "0,0,NONE" is output, and when there is an ID error, "0,0,ERROR" is output.
- Even if there is a system error, this query is executed.

Response syntax If headers are on or off "<data1>,<data2>,<data3>".

Error If the response message exceeds 1000 bytes, a query error results.

Example

Transmission	**"STAT:CLAM?"**
Response	**"9277,20,AC/DC"**

A 9277 UNIVERSAL CLAMP ON CT (AC/DC clamp-on sensor, rated at 20 A) is connected.

TRANsmit:SEParator

■ Sets the message unit separator for response messages.

Syntax TRANsmit:SEParator_<data>

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

Function

- The messages unit separator 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.

NOTE

- 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.
- Even if there is a system error, this command is executed.

Error If <data> is other than NRf format, a command error is generated.

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 1000 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	**":TRAN:SEP?"**	**":TRAN:SEP?"**
Response	**":TRANSMIT:SEPARATOR 1"**	**"1"**

TRANsmit:TERMinator

■ Sets the data terminator for response messages.

Syntax TRANsmit:TERMinator_<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.

NOTE
- 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.

Errors 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 1000 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	**":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 1000 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	**":VOLT?"**	**":VOLT?"**
	Response	**":VOLTAGE:RANGE 300;AUTO ON"**	**"300;ON"**

VOLTage:AUTO

■ Turns voltage auto ranging on and off.

Syntax VOLTage:AUTO_<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 (including integrating stopping state).

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 1000 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	**":VOLT:AUTO?"**	**":VOLT:AUTO?"**
	Response	**":VOLTAGE:AUTO ON"**	**"ON"**

VOLTage:RANGe

■ Sets the voltage range.

Syntax VOLTage:RANGe_<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.
- <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 (including integrating stopping state).

Example

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 1000 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	**":VOLT:RANG?"**	**":VOLT:RANG?"**
Response	**":VOLTAGE:RANGE 300"**	**"300"**

6.7 Sample Programs

As examples of interface, shows sample programs.
The contents of programs: Setting of range, scaling and rectifier type and displaying to get integrate elapsed time and integrate value at regular intervals (a minute at this point).
The sample programs of GP-IB and RS-232C are the same contents.
The sample programs of GP-IB are written in HP-BASIC (by Hewlett Packard) and of RS-232C are written in Quick BASIC (by Microsoft).

6.7.1 GP-IB

Program list

```
10  DIM A$[100]
20  CLEAR 701
30  OUTPUT 701;"*RST"
40  OUTPUT 701;"TRAN:TERM 1"
50  OUTPUT 701;"VOLT:RANG 30;AUTO OFF"
60  OUTPUT 701;"CURR:RANG 20;AUTO OFF"
70  OUTPUT 701;"SCAL:PT 3;CT 2"
80  OUTPUT 701;"RECT 2"
90  OUTPUT 701;"INTEG:TIME 1,0;SOUR W"
100 OUTPUT 701;"*ESE 0;ESE0 32;ESE1 0"
110 OUTPUT 701;"DATA:TIME 0,1,0"
120 OUTPUT 701;"*CLS"
130 OUTPUT 701;"INTEG:STAT START"
140 OUTPUT 701;"*STB?"
150 ENTER 701;A$
160 IF A$<>"1" THEN 140
170 OUTPUT 701;"MEAS? TIME,INTEG,PINTEG,MINTEG"
180 ENTER 701;A$
190 PRINT A$
200 OUTPUT 701;"INTEG:STAT?"
210 ENTER 701;A$
220 IF A$=":INTEGRATE:STATE STOP" THEN 250
230 OUTPUT 701;"*CLS"
240 GOTO 140
250 OUTPUT 701;"INTEG:STAT RESET"
260 END
```

Program Comments

10 Declare character arrays
20 Initialize the interface
30 Initialize the 3167
40 Set delimiter to "CR+LF"
50 Set ranges to 30 V
60 Set ranges to 20 A
70 Set PT ratio to 3, CT ratio to 2
80 Set rectifier type to "AC+DC"
90 Set integration time to an hour, integration item to W
100 Validate only bit 5 (OT) of ESE0
110 Set data output time to a minute
120 Clear event registers
130 Start integration
140 Query contents of status byte
150 Get contents of status byte
160 Branches to line 140 when "OT" flag is not raised
170 Query integrate passage time or each integrate value data
180 Get data
190 Display data
200 Query integrate condition
210 Get integrate condition
220 Branches to line 250 when integration stops
230 Clear event registers
240 Branches to line 140
250 Reset integrate value
260 End of program

Execution results

```
TIME 00000,00,00;INTEG +0.00000kWh;PINTEG +0.00000kWh;MINTEG -0.00000kWh
TIME 00000,01,00;INTEG +0.06000kWh;PINTEG +0.06000kWh;MINTEG -0.00000kWh
TIME 00000,02,00;INTEG +0.12000kWh;PINTEG +0.12000kWh;MINTEG -0.00000kWh
TIME 00000,03,00;INTEG +0.18000kWh;PINTEG +0.18000kWh;MINTEG -0.00000kWh
TIME 00000,04,00;INTEG +0.24000kWh;PINTEG +0.24000kWh;MINTEG -0.00000kWh
TIME 00000,05,00;INTEG +0.30000kWh;PINTEG +0.30000kWh;MINTEG -0.00000kWh
TIME 00000,06,00;INTEG +0.36000kWh;PINTEG +0.36000kWh;MINTEG -0.00000kWh

TIME 00000,56,00;INTEG +3.36000kWh;PINTEG +3.36000kWh;MINTEG -0.00000kWh
TIME 00000,57,00;INTEG +3.42000kWh;PINTEG +3.42000kWh;MINTEG -0.00000kWh
TIME 00000,58,00;INTEG +3.48000kWh;PINTEG +3.48000kWh;MINTEG -0.00000kWh
TIME 00000,59,00;INTEG +3.54000kWh;PINTEG +3.54000kWh;MINTEG -0.00000kWh
TIME 00001,00,00;INTEG +3.60000kWh;PINTEG +3.60000kWh;MINTEG -0.00000kWh
```

6.7.2 RS-232C

Program list

```
10  OPEN "COM1:9600,N,8,1,LF" FOR RANDOM AS #1
20  PRINT #1,"*RST"
30  PRINT #1,"TRAN:TERM 1"
40  PRINT #1,"VOLT:RANG 30;AUTO OFF"
50  PRINT #1,"CURR:RANG 20;AUTO OFF"
60  PRINT #1,"SCAL:PT 3;CT 2"
70  PRINT #1,"RECT 2"
80  PRINT #1,"INTEG:TIME 1,0;SOUR W"
90  PRINT #1,"*ESE 0;ESE0 32;ESE1 0"
100 PRINT #1,"DATA:TIME 0,1,0"
110 PRINT #1,"*CLS"
120 PRINT #1,"INTEG:STAT START"
130 PRINT #1,"*STB?"
140 LINE INPUT #1,A$
150 IF VAL(A$)<>1 THEN 130
160 PRINT #1,"MEAS? TIME,INTEG,PINTEG,MINTEG"
170 LINE INPUT #1,A$
180 PRINT A$
190 PRINT #1,"INTEG:STAT?"
200 LINE INPUT #1,A$
210 IF INSTR(A$,"STOP")<>0 THEN 240
220 PRINT #1,"*CLS"
230 GOTO 130
240 PRINT #1,"INTEG:STAT RESET"
250 CLOSE #1
```

Program Comments

10 Open the RS-232C circuit file
20 Initialize the 3167
30 Set delimiter to "CR+LF"
40 Set range to 30 V
50 Set range to 20 A
60 Set PT ratio to 3, CT ratio to 2
70 Set rectifier type to "AC+DC"
80 Set integration time to an hour, integration item to W
90 Validate only bit 5 (OT) of ESE0
100 Set data output time to a minute
110 Clear event registers
120 Start integration
130 Query contents of status byte
140 Get contents of status byte
150 Branches to line 130 when "OT" flag is not raised
160 Query integrate passage time or each integrate value data
170 Get data
180 Display data
190 Query integrate condition
200 Get integrate condition
210 Branches to line 240 when integration stops
220 Clear event registers
230 Branches to line 130
240 Reset integrate value
250 End of program

Execution results

```
TIME 00000,00,00;INTEG +0.00000kWh;PINTEG +0.00000kWh;MINTEG -0.00000kWh
TIME 00000,01,00;INTEG +0.06000kWh;PINTEG +0.06000kWh;MINTEG -0.00000kWh
TIME 00000,02,00;INTEG +0.12000kWh;PINTEG +0.12000kWh;MINTEG -0.00000kWh
TIME 00000,03,00;INTEG +0.18000kWh;PINTEG +0.18000kWh;MINTEG -0.00000kWh
TIME 00000,04,00;INTEG +0.24000kWh;PINTEG +0.24000kWh;MINTEG -0.00000kWh
TIME 00000,05,00;INTEG +0.30000kWh;PINTEG +0.30000kWh;MINTEG -0.00000kWh
TIME 00000,06,00;INTEG +0.36000kWh;PINTEG +0.36000kWh;MINTEG -0.00000kWh
```

```
TIME 00000,56,00;INTEG +3.36000kWh;PINTEG +3.36000kWh;MINTEG -0.00000kWh
TIME 00000,57,00;INTEG +3.42000kWh;PINTEG +3.42000kWh;MINTEG -0.00000kWh
TIME 00000,58,00;INTEG +3.48000kWh;PINTEG +3.48000kWh;MINTEG -0.00000kWh
TIME 00000,59,00;INTEG +3.54000kWh;PINTEG +3.54000kWh;MINTEG -0.00000kWh
TIME 00001,00,00;INTEG +3.60000kWh;PINTEG +3.60000kWh;MINTEG -0.00000kWh
```

6.8 Printer Output Function

6.8.1 Talk Only Function

For the 3167, 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 5.10 "Setting Interface".

6.8.2 Printer Mode Function

For the 3167, when setting RS-232C interface to printer mode, measuring value and settings can be printed by the printer connected to RS-232C.
For how to set this function, refer to 5.10 "Setting Interface".

6.8.3 Type of Printing

There are three types of printing for the 3167.

(1)Manual printing
Pressing the **DATA OUT** key can print measuring value at that point.
The 3167 is also able to print by external control.

(2)Interval printing
Synchronized with integration on the 3167, printer output appears at the interval set using the procedure described in Section 5.12 "Setting the Print Interval Time".

(3)Help printing
Internal settings of the 3167 are printed by the **SHIFT** key, after illuminate shift lamp by the **HELP** key.

6.8.4 Selecting Printing Items and Setting Printing Interval Time

Refer to 5.11 "Selecting the Printing Items" and 5.12 "Setting the Print Interval Time".
When no printing items are selected, printer elapsed time and items which is displayed in display a, b and c are printed.

6.8.5 Printer Output Buffer

Printer output buffer of the 3167 consists of 1000 bytes.
When buffer exceeds the capacity, "Err. 022" is printed and data which are obtained after that become invalid.

6.8.6 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.

6.8.7 Sensor Error Printing

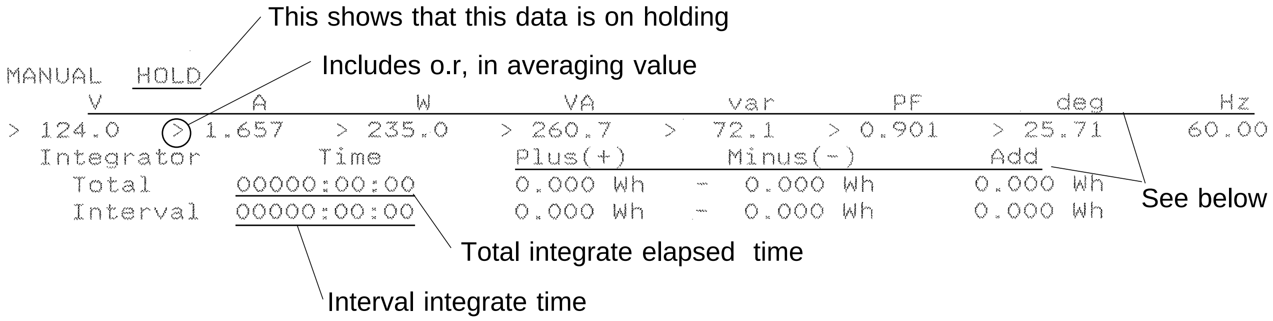
When the sensor error occurs (sensor is disconnected or sensor rating is changed) during interval printing, integrate elapsed time and "*** SENSOR ERROR ***" are printed and stops integration.
On returning to the original sensor (the sensor used for integration) it is possible to continue with the integration.
Note carefully that when a different clamp sensor is fitted, and the sensor is confirmed, the integration value is reset.

NOTE Use the printer which is able to print at least eighty words for a line.

6.8.8 Printing Example

(1) Explanations for printing 1

① Manual printing



```
MANUAL  HOLD
    V           A          W          VA          var         PF          deg         Hz
> 124.0     > 1.657    > 235.0    > 260.7    >   72.1    > 0.901    > 25.71      60.00
  Integrator          Time            Plus(+)         Minus(-)            Add
    Total      00000:00:00        0.000 Wh    -   0.000 Wh       0.000 Wh
    Interval   00000:00:00        0.000 Wh    -   0.000 Wh       0.000 Wh
```

This shows that this data is on holding

Includes o.r, in averaging value

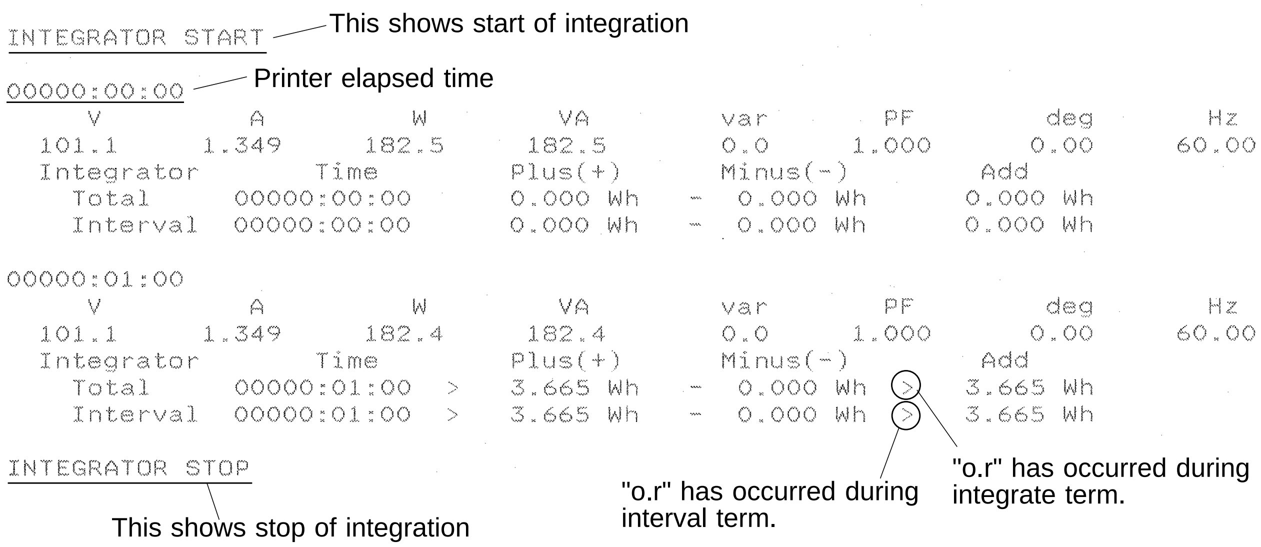
See below

Total integrate elapsed time

Interval integrate time

V	Voltage value
A	Current value
W	Active power value
VA	Apparent power value
var	Reactive power value
PF	Power factor
deg	Phase angle
Hz	Frequency
Plus (+)	Integrate value of plus side
Minus (-)	Integrate value of minus side
Add	Integrate value add plus to minus.

② Interval printing



```
INTEGRATOR START

00000:00:00
     V           A          W          VA          var         PF          deg         Hz
   101.1      1.349      182.5      182.5        0.0        1.000        0.00       60.00
   Integrator          Time            Plus(+)         Minus(-)            Add
     Total      00000:00:00        0.000 Wh    -   0.000 Wh        0.000 Wh
     Interval   00000:00:00        0.000 Wh    -   0.000 Wh        0.000 Wh

00000:01:00
     V           A          W          VA          var         PF          deg         Hz
   101.1      1.349      182.4      182.4        0.0        1.000        0.00       60.00
   Integrator          Time            Plus(+)         Minus(-)            Add
     Total      00000:01:00   >    3.665 Wh    -   0.000 Wh   >   3.665 Wh
     Interval   00000:01:00   >    3.665 Wh    -   0.000 Wh   >   3.665 Wh

INTEGRATOR STOP
```

This shows start of integration

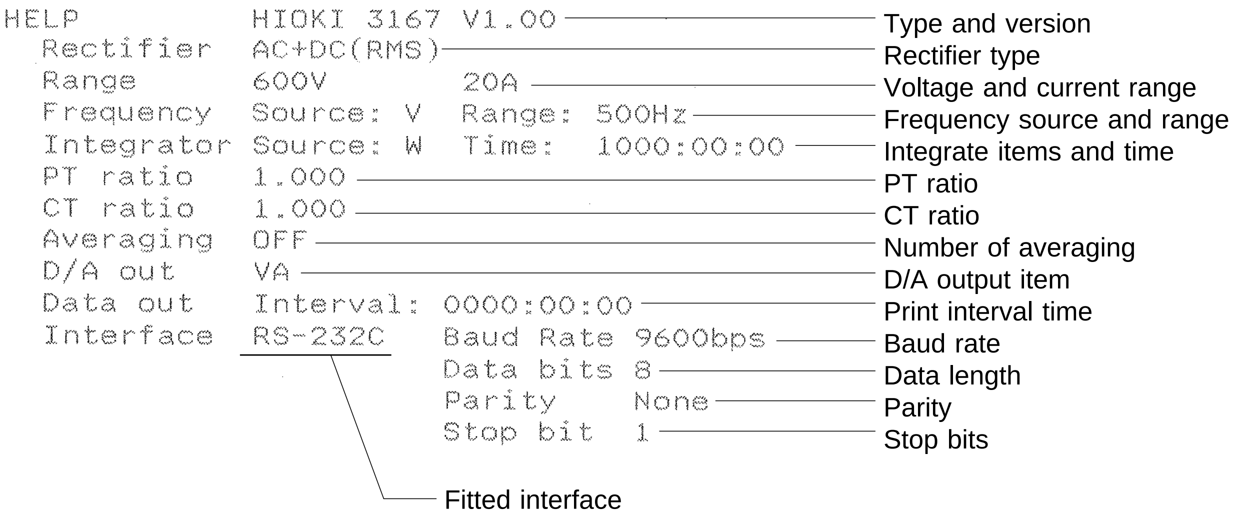
Printer elapsed time

"o.r" has occurred during integrate term.

"o.r" has occurred during interval term.

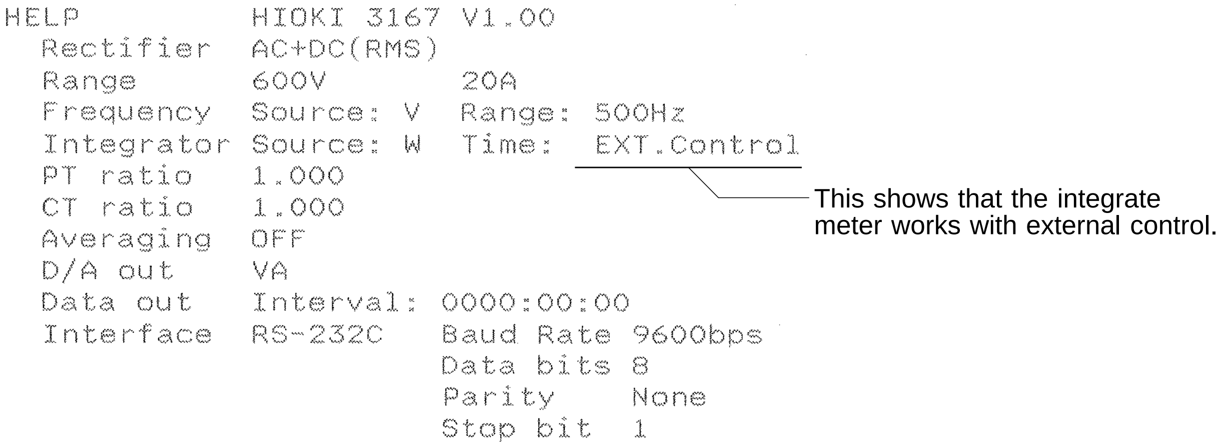
This shows stop of integration

③ Help printing



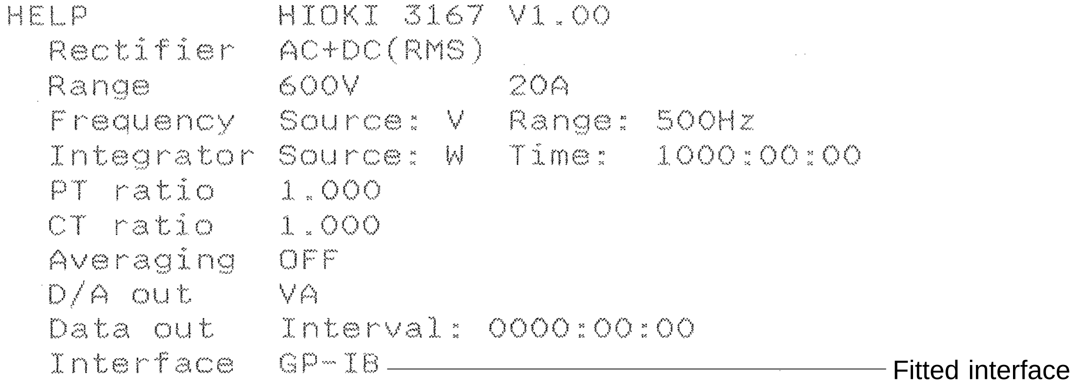
```
HELP          HIOKI 3167 V1.00
  Rectifier   AC+DC(RMS)
  Range       600V       20A
  Frequency   Source: V  Range: 500Hz
  Integrator  Source: W  Time:  1000:00:00
  PT ratio    1.000
  CT ratio    1.000
  Averaging   OFF
  D/A out     VA
  Data out    Interval: 0000:00:00
  Interface   RS-232C    Baud Rate 9600bps
                         Data bits 8
                         Parity    None
                         Stop bit  1
```

Type and version
Rectifier type
Voltage and current range
Frequency source and range
Integrate items and time
PT ratio
CT ratio
Number of averaging
D/A output item
Print interval time
Baud rate
Data length
Parity
Stop bits
Fitted interface



```
HELP          HIOKI 3167 V1.00
  Rectifier   AC+DC(RMS)
  Range       600V       20A
  Frequency   Source: V  Range: 500Hz
  Integrator  Source: W  Time:  EXT.Control
  PT ratio    1.000
  CT ratio    1.000
  Averaging   OFF
  D/A out     VA
  Data out    Interval: 0000:00:00
  Interface   RS-232C    Baud Rate 9600bps
                         Data bits 8
                         Parity    None
                         Stop bit  1
```

This shows that the integrate meter works with external control.

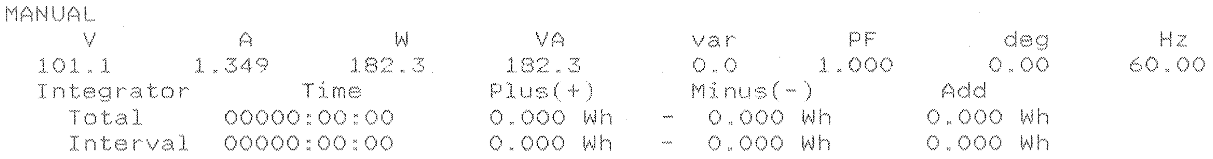


```
HELP          HIOKI 3167 V1.00
  Rectifier   AC+DC(RMS)
  Range       600V       20A
  Frequency   Source: V  Range: 500Hz
  Integrator  Source: W  Time:  1000:00:00
  PT ratio    1.000
  CT ratio    1.000
  Averaging   OFF
  D/A out     VA
  Data out    Interval: 0000:00:00
  Interface   GP-IB
```

Fitted interface

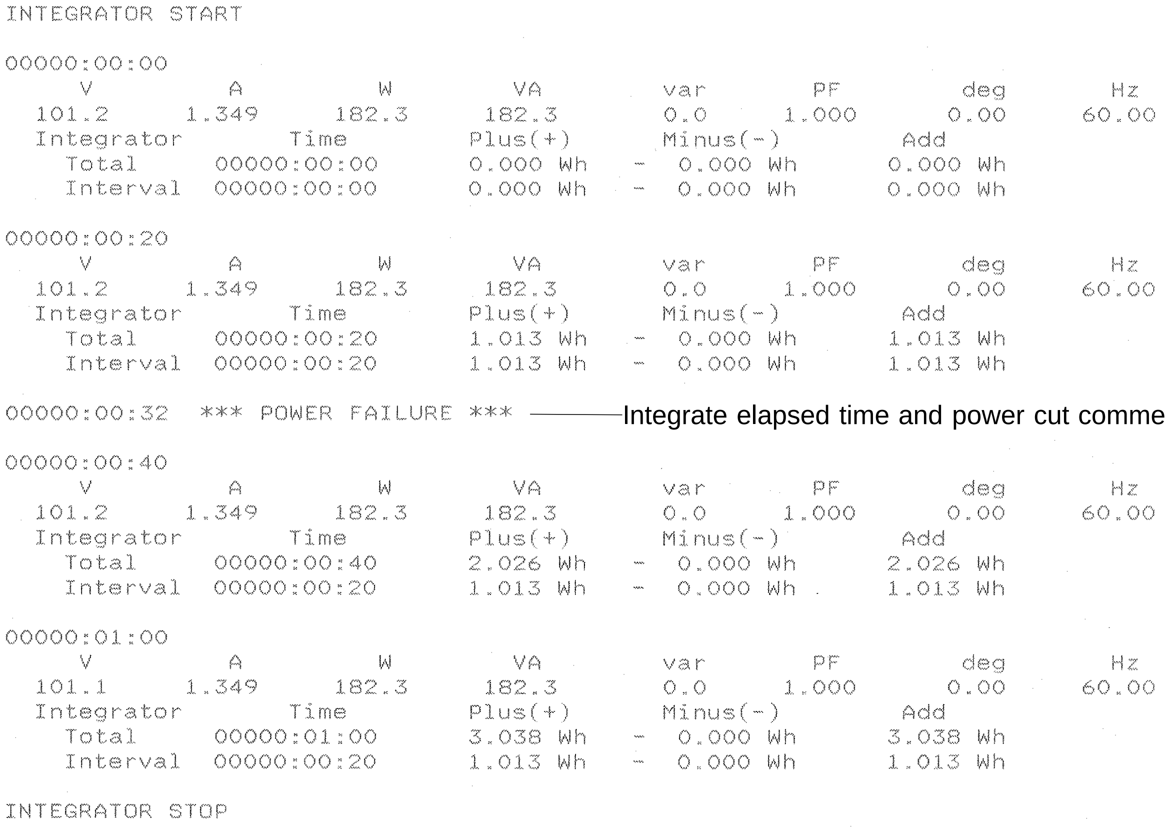
(2) Printing examples

① Manual printing



```
MANUAL
    V          A          W          VA         var        PF          deg        Hz
  101.1      1.349      182.3      182.3        0.0      1.000        0.00      60.00
  Integrator        Time          Plus(+)      Minus(-)         Add
    Total      00000:00:00       0.000 Wh   -   0.000 Wh       0.000 Wh
    Interval   00000:00:00       0.000 Wh   -   0.000 Wh       0.000 Wh
```

② Interval printing and power cut printing



```
INTEGRATOR START

00000:00:00
     V          A          W          VA         var        PF          deg        Hz
   101.2      1.349      182.3      182.3        0.0      1.000        0.00      60.00
   Integrator        Time          Plus(+)      Minus(-)         Add
     Total      00000:00:00       0.000 Wh   -   0.000 Wh       0.000 Wh
     Interval   00000:00:00       0.000 Wh   -   0.000 Wh       0.000 Wh

00000:00:20
     V          A          W          VA         var        PF          deg        Hz
   101.2      1.349      182.3      182.3        0.0      1.000        0.00      60.00
   Integrator        Time          Plus(+)      Minus(-)         Add
     Total      00000:00:20       1.013 Wh   -   0.000 Wh       1.013 Wh
     Interval   00000:00:20       1.013 Wh   -   0.000 Wh       1.013 Wh

00000:00:32  *** POWER FAILURE ***

00000:00:40
     V          A          W          VA         var        PF          deg        Hz
   101.2      1.349      182.3      182.3        0.0      1.000        0.00      60.00
   Integrator        Time          Plus(+)      Minus(-)         Add
     Total      00000:00:40       2.026 Wh   -   0.000 Wh       2.026 Wh
     Interval   00000:00:20       1.013 Wh   -   0.000 Wh       1.013 Wh

00000:01:00
     V          A          W          VA         var        PF          deg        Hz
   101.1      1.349      182.3      182.3        0.0      1.000        0.00      60.00
   Integrator        Time          Plus(+)      Minus(-)         Add
     Total      00000:01:00       3.038 Wh   -   0.000 Wh       3.038 Wh
     Interval   00000:00:20       1.013 Wh   -   0.000 Wh       1.013 Wh

INTEGRATOR STOP
```

Integrate elapsed time and power cut comment

③ Printing of display data

(In case of no printing items are selected, data on display is output.)

```
00000:00:00   101.2 V         13.49 A        1.817kW
00000:00:10   101.2 V         13.49 A        1.819kW
00000:00:20   101.2 V         13.49 A        1.817kW
00000:00:30   101.2 V         13.49 A        1.819kW
00000:00:40   101.2 V         13.49 A        1.818kW
00000:00:50   101.2 V         13.49 A        1.818kW
00000:01:00   101.2 V         13.49 A        1.818kW
00000:01:10   101.2 V         13.49 A        1.817kW
00000:01:20   101.2 V         13.49 A        1.818kW
00000:01:30   101.2 V         13.49 A        1.819kW
00000:01:40   101.2 V         13.49 A        1.817kW
00000:01:50   101.2 V         13.49 A        1.816kW
00000:02:00   101.2 V         13.49 A        1.817kW
00000:02:10   101.1 V         13.49 A        1.817kW
00000:02:20   101.1 V         13.49 A        1.816kW
00000:02:30   101.2 V         13.49 A        1.817kW
00000:02:40   101.2 V         13.49 A        1.815kW
00000:02:50   101.2 V         13.49 A        1.816kW
00000:03:00   101.2 V         13.49 A        1.816kW
00000:03:10   101.2 V         13.49 A        1.815kW
00000:03:20   101.2 V         13.49 A        1.815kW
00000:03:30   101.1 V         13.49 A        1.815kW
00000:03:40   101.2 V         13.49 A        1.816kW
00000:03:50   101.1 V         13.49 A        1.815kW
00000:04:00   101.2 V         13.49 A        1.815kW
00000:04:10   101.2 V         13.49 A        1.814kW
00000:04:20   101.2 V         13.49 A        1.814kW
00000:04:30   101.2 V         13.49 A        1.814kW
00000:04:40   101.2 V         13.49 A        1.814kW
00000:04:50   101.2 V         13.49 A        1.813kW
00000:05:00   101.2 V         13.49 A        1.813kW
00000:00:00   101.2 V         13.49 A        1.814kW
00000:00:00   101.2 V         13.49 A        101.2 V
00000:00:00   101.2 V         13.49 A        13.49 A
00000:00:00   101.2 V         13.49 A        1.813kW
00000:00:00   101.2 V         13.49 A        1.813kVA
00000:00:00   101.2 V         13.49 A        0.000kvar
00000:00:00   101.2 V         13.49 A        1.000 (PF)
00000:00:00   101.2 V         13.49 A         0.00 (deg)
00000:00:00   101.2 V         13.49 A        60.00 Hz
00000:00:00   101.2 V         13.49 A      0.00000kWh(+)
00000:00:00   101.2 V         13.49 A     -0.00000kWh(-)
00000:00:00   101.1 V         13.49 A      0.00000kWh(ADD)
00000:00:00   101.2 V     00000:00:00        101.2 V
```

Printer elapsed time

Integrate 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       Hz
  101.2     13.49     1.821k    1.821k    0.000k    1.000      0.00     60.00
  Integrator        Time         Plus(+)      Minus(-)        Add
    Total      00000:00:00    0.00000kWh   -0.00000kWh    0.00000kWh
    Interval  00000:00:00    0.00000kWh   -0.00000kWh    0.00000kWh

MANUAL
     V         A         W         VA         var       PF        deg       Hz
  101.2     13.49     1.821k    1.821k    0.000k    1.000      0.00     60.00
  Integrator        Time         Plus(+)      Minus(-)        Add
    Total      00000:00:00    0.00000kWh   -0.00000kWh    0.00000kWh
    Interval  00000:00:00    0.00000kWh   -0.00000kWh    0.00000kWh

MANUAL
     V         A         W         VA         var       PF        deg       Hz
  101.2     13.49     1.819k    1.819k    0.000k    1.000      0.00     60.00
  Integrator        Time         Plus(+)      Minus(-)        Add
    Total      00000:00:00    0.00000kWh   -0.00000kWh    0.00000kWh
    Interval  00000:00:00    0.00000kWh   -0.00000kWh    0.00000kWh

MANUAL
     V         A         W         VA         var       PF        deg       Hz
  101.2     13.49     1.819k    1.819k    0.000k    1.000      0.00     60.00
  Integrator        Time         Plus(+)      Minus(-)        Add
    Total      00000:00:00    0.00000kWh   -0.00000kWh    0.00000kWh
    Interval  00000:00:00    0.00000kWh   -0.00000kWh    0.00000kWh

MANUAL
     V         A         W         VA         var       PF        deg       Hz
  101.2     13.49     1.820k    1.820k    0.000k    1.000      0.00     60.00
  Integrator        Time         Plus(+)      Minus(-)        Add
    Total      00000:00:00    0.00000kWh   -0.00000kWh    0.00000kWh
    Interval  00000:00:00    0.00000kWh   -0.00000kWh    0.00000kWh

MANUAL
     V         A         W         VA         var       PF        deg       Hz
  101.2     13.49     1.820k    1.820k    0.000k    1.000      0.00     60.00
  Integrator        Time         Plus(+)      Minus(-)        Add
    Total      00000:00:00

Err. 022
```

Printer out put buffer over error

```
MANUAL
     V         A         W         VA         var       PF        deg       Hz
  101.2     13.49     1.819k    1.819k    0.000k    1.000      0.00     60.00
  Integrator        Time         Plus(+)      Minus(-)        Add
    Total      00000:00:00    0.00000kWh   -0.00000kWh    0.00000kWh
    Interval  00000:00:00    0.00000kWh   -0.00000kWh    0.00000kWh
```

⑤ Sensor error printing and integrate stopping

```
INTEGRATOR START

00000:00:00
     V         A         W         VA         var       PF         deg       Hz
  101.2     1.349     182.3     182.3       0.0     1.000       0.00     60.00
  Integrator       Time        Plus(+)      Minus(-)        Add
    Total     00000:00:00      0.000 Wh   -  0.000 Wh      0.000 Wh
    Interval  00000:00:00      0.000 Wh   -  0.000 Wh      0.000 Wh

00000:00:20
     V         A         W         VA         var       PF         deg       Hz
  101.2     1.349     182.3     182.3       0.0     1.000       0.00     60.00
  Integrator       Time        Plus(+)      Minus(-)        Add
    Total     00000:00:20      1.013 Wh   -  0.000 Wh      1.013 Wh
    Interval  00000:00:20      1.013 Wh   -  0.000 Wh      1.013 Wh

00000:00:40
     V         A         W         VA         var       PF         deg       Hz
  101.2     1.349     182.2     182.2       0.0     1.000       0.00     60.00
  Integrator       Time        Plus(+)      Minus(-)        Add
    Total     00000:00:40      2.025 Wh   -  0.000 Wh      2.025 Wh
    Interval  00000:00:20      1.012 Wh   -  0.000 Wh      1.012 Wh

00000:00:58  *** SENSOR ERROR ***
00000:00:58
     V         A         W         VA         var       PF         deg       Hz
  101.1     1.349     182.2     182.2       0.0     1.000       0.00     60.00
  Integrator       Time        Plus(+)      Minus(-)        Add
    Total     00000:00:58      2.946 Wh   -  0.000 Wh      2.946 Wh
    Interval  00000:00:18      0.921 Wh   -  0.000 Wh      0.921 Wh

INTEGRATOR STOP
```

Integrate elapsed time and sensor error comment

6.9 Device Compliance Statement

(1) IEEE 488.1 interface functions

These are detailed in Section 2.1, "General 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 6.5.10 "Input Buffer".

(b) Queries to which multiple response message units are returned:

CURRent?	two	DATAout?	two
FREQuency?	three	INTEGrate?	three
MEASure?	from one to twelve	RS232c?	two
SCALe?	two	VOLTage?	two

(c) Queries producing responses as syntax checking is performed:
On the 3167, 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 Section 6.6 "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 6.8.8 "Printing Example".

(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 8.3 "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.

(18) Resources when the "∗RDT" command and the "∗RDT?" query are being used

The "*RDT" command and the "*RDT?" query are not used. Further, there is no user data storage area.

(19) Conditions which are influenced when "∗RST", "∗LRN?", "∗RCL?", and "∗SAV" are used

"∗LRN?", "∗RCL?", and "∗SAV" are not used. The "∗RST" command returns the 3167 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.

6.10 Notes on Interfaces

6.10.1 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 the 3167 set correctly?
	Does some other device have the same device address?
	Are all the devices powered on?
After transmission on the GP-IB bus, the keys on the 3167 freeze up and have no effect.	Press the LOCAL key on the front panel of the 3167 to release the remote state.
	Has a LLO (Local Lock-Out) command been transmitted? Transmit a GTL command to put the 3167 into the local state.
When attempting to read data using a HP-Basic ENTER statement, the GP-IB bus hangs.	Be sure to transmit one query before each Basic ENTER statement.
	Have any of these transmitted queries resulted in an error?
Although a command has been transmitted, nothing has happened.	Using the "∗ESR?" query, 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?", "STATUs:CLAMp?" query?

Symptom	Cause / Treatment
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.
The response message to a query differs from the display on the front panel of the 3167.	Due to the response message being produced at the instant that the 3167 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?
	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 the 3167 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.

6.10.2 Notes on RS-232C

Symptom	Cause / Treatment
The RS-232C has stopped working completely.	Are the cables properly connected?
	Are all the devices powered on?
	Are the cables properly connected?
Transmission on the RS-232C is not taking place properly.	Is the controller message terminator set correctly? (Refer to "Message Terminators")
	Is RS-232C (band rate, data length, parity, stop bits) set the same?
After transmission on the RS-232C, the keys on the 3167 freeze up and have no effect.	Press the LOCAL key on the front panel of the 3167 to release the remote state.

Symptom	Cause / Treatment
When attempting to read data using a Basic INPUT statement, the RS-232C hangs.	Be sure to transmit one query before each Basic INPUT statement.
	Have any of these transmitted queries resulted in an error?
Although a command has been transmitted, nothing has happened.	Using the "∗ESR?" query, 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?", "STATUs:CLAMp?" query?
The response message to a query differs from the display on the front panel of the 3167.	Due to the response message being produced at the instant that the 3167 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 printer mode has been set, printing has not work.	Check the pin for "receive data" of RS-232C on the printer. For a printer with pin 2 for "receive data", use a "straight" cable, also for a printer with pin 3 for "receive data", "cross" cable.
Although the printer mode has been set, printing has not work.	Has the printer been set to listen 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 RS-232C interface been equipped?
	Has the 3167 been set to printer mode?
Pressing DATA OUT key or HELP key displays "Err 023".	Has the printer been connected? In this case, confirm the connecting conditions.
	Has the printer been set in on-line state? In this case, set the printer in on-line state.

Chapter 7
Maintenance and Service

7.1 Changing the Power Fuse

(1) The power fuse

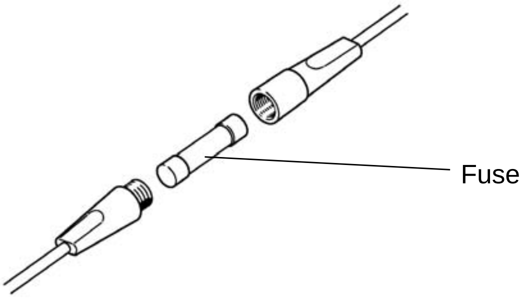
The power fuse is housed within the 3167. For changing the fuse, contact your nearest Hioki representative of service agent directly.

The fuse is rated at T2.5 A/250 V, 20 mm ×5.0 mm dia..

⚠ CAUTION When the power fuse may be blown, involves that the internal circuit is defective. In such case, contact your nearest Hioki representative of service agent directly.

(2) The voltage cord fuse

Change the voltage cord fuse as following figure.



⚠WARNING

- **To avoid electric shock, turn off the power switch and disconnect the AC adapter and voltage cords before replacing the fuse.**
- **Replace the fuse only with one of the specified characteristics and voltage and current ratings. Using a non-specified fuse or shorting the fuse holder may cause a life-threatening hazard.**

Fuse type: M0.3 A/250 V (with the arc-extinguishing material) 20 mm× 5.2 mm dia.

If the product seems to be malfunctioning, confirm that the power cord and fuse are not open circuited before contacting your dealer or Hioki representative.
When sending the product for repair, pack the product carefully so that it will not be damaged during shipment, and include a detailed written description of the problem. Hioki cannot be responsible for damage that occurs during shipment.

7.2 Disposing of the Unit

The 3167 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

- **To avoid electrocution, turn off the power switch and disconnect the AC adapter and voltage cords before removing the lithium battery.**
- **Handle and dispose of batteries in accordance with local regulations.**

(1) Tools needed to dismantle the 3167

· Phillips screwdriver	1
· Instrument pliers	1

(2) How to dismantle the unit:

① As shown in figure 7.2, remove the four retaining screws which hold on the upper case of the unit.
② Remove the upper case by lifting it straight upwards off the unit.
③ Cut away the coin-shaped lithium battery wrenching it out with the radio pliers.
④ Dispose of the lithium battery according to the manner prescribed by the competent authorities in your locality.

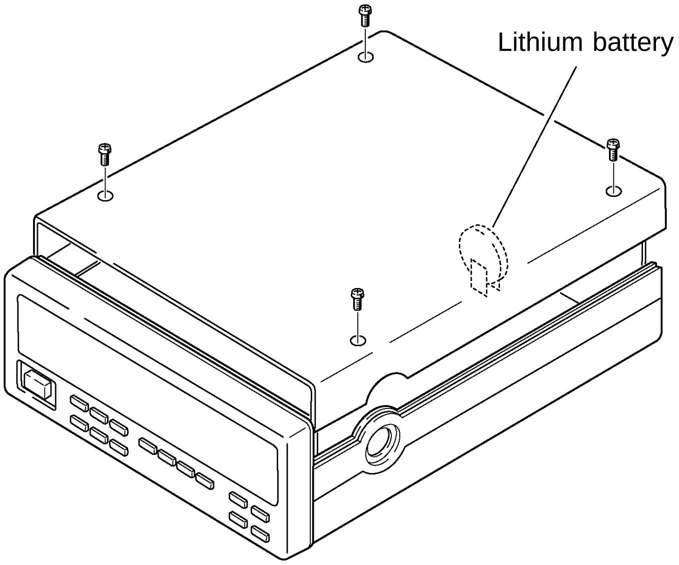


Fig. 7.2 Taking out the lithium battery

Chapter 8
Appendices

8.1 Range correspondence table

Table 8.1-1 When using Clamp sensor rated at 20 A

V \ A	2.000 A	5.000 A	10.00 A	20.00 A
15.00 V	30.00 W	75.00 W	150.0 W	300.0 W
30.00 V	60.00 W	150.0 W	300.0 W	600.0 W
60.00 V	120.0 W	300.0 W	600.0 W	1.200 kW
150.0 V	300.0 W	750.0 W	1.500 kW	3.000 kW
300.0 V	600.0 W	1.500 kW	3.000 kW	6.000 kW
600.0 V	1.200 kW	3.000 kW	6.000 kW	12.00 kW

Table 8.1-2 When using Clamp sensor rated at 200 A

V \ A	20.00 A	50.00 A	100.0 A	200.0 A
15.00 V	300.0 W	750.0 W	1.500 kW	3.000 kW
30.00 V	600.0 W	1.500 kW	3.000 kW	6.000 kW
60.00 V	1.200 kW	3.000 kW	6.000 kW	12.00 kW
150.0 V	3.000 kW	7.500 kW	15.00 kW	30.00 kW
300.0 V	6.000 kW	15.00 kW	30.00 kW	60.00 kW
600.0 V	12.00 kW	30.00 kW	60.00 kW	120.0 kW

Table 8.1-3 When using Clamp sensor rated at 500 A

V \ A	50.00 A	100.0 A	200.0 A	500.0 A
15.00 V	750.0 W	1.500 kW	3.000 kW	7.500 kW
30.00 V	1.500 kW	3.000 kW	6.000 kW	15.00 kW
60.00 V	3.000 kW	6.000 kW	12.00 kW	30.00 kW
150.0 V	7.500 kW	15.00 kW	30.00 kW	75.00 kW
300.0 V	15.00 kW	30.00 kW	60.00 kW	150.0 kW
600.0 V	30.00 kW	60.00 kW	120.0 kW	300.0 kW

NOTE In apparent power and reactive power, the unit in above table must be considered as W, VA or var.

8.2 Error messages

A list of error indications

Error number	Errors	Pages
001	Backup error	25
101	ROM error	Requires repair
102	RAM error	Requires repair
103	I/O port error	Requires repair
104	Frequency measurement circuit error	Requires repair
105	A/D and D/A converter error	Requires repair
106	Display and key control circuit 1 error	Requires repair
107	Display and key control circuit 2 error	Requires repair
108	Interrupt handler fault	Requires repair
109	RS-232C circuit error	Requires repair
110	Clamp sensor is disconnected	25
011	Integration key operation and external control used together	46
012	Integration invalid key press during integration operation	45
013	Integration integration started while scaling error has	46
014	Integration restarted from maximum integration count or occurred integration elapsed time	46
015	Integration integration reset carried out during integration	46
016	Invalid key press during display hold	38
017	Invalid key press during setting	38
021	Interface data out or help operation carried out while not set to "talk only" (GP-IB) or "printer mode" (RS-232C) Data out or help operation carried out when interface or is not installed	163, 164
022	Interface no space left in internal data buffer	152
023	Interface not connected printer, time out occurred	163, 164

8.3 Command Summary

8.3.1 Standard Commands

Command	Data format (number of data items)	Explanation	Page
∗CLS		Clears STB and ESR	94
∗ESE	NR1 numerical data (1)	Sets bitmask for ESR	94
∗ESE?		Queries bitmask for ESR	95
∗ESR?		Queries ESR	95
∗IDN?		Queries device ID	96
∗OPC		Issues service request after execution completion	96
∗OPC?		Queries execution completion	97
∗RST		Device initialization	98
∗SRE	NR1 numerical data (1)	Sets bitmask for STB	99
∗SRE?		Queries bitmask for STB	100
∗STB?		Queries STB	101
∗TRG		Performs sampling once	101
∗TST?		Queries the result of the self-test	102
∗WAI		Waits until sampling is fully completed	103

8.3.2 Commands Specific to the 3167

Command	Data format ( ): number of data items	Explanation	Page
AOUT	VA/VAR/PF/DEG/FREQ/INTEG/PINTEG/MINTEG	Sets D/A output items	104
AOUT?	—	Queries D/A output items	104
AVERaging	NR1 numerical data (1)	Sets averaging count	105
AVERaging?	—	Queries averaging count	106
CURRent?	—	Queries current settings	106
CURRent	—	—	—
:AUTO	ON/OFF	Sets current auto ranging	107
:AUTO?	—	Queries current auto ranging	107
:RANGe	NR1 numerical data (1)	Sets current range	108
:RANGe?	—	Queries current range	109
DATAout?	—	Queries printer output settings	109
DATAout	—	—	—
:ITEM	NR1 numerical data (2)	Sets printer output items	110
:ITEM?	—	Queries printer output items	111
:TIME	NR1 numerical data (3)	Sets printer output interval	111
:TIME?	—	Queries printer output interval	112
DEMag	—	Executes demagnetizing	112
DISPlay	V/A/W/VA/VAR/PF/DEG/FREQ/INTEG/PINTEG/MINTEG/TIME (3)	Sets display items	113
DISPlay?	—	Queries display items	114
ESE0	NR1 numerical data (1)	Sets bitmask for ESR0	115
ESE0?	—	Queries bitmask for ESR0	116
ESE1	NR1 numerical data (1)	Sets bitmask for ESR1	117
ESE1?	—	Queries bitmask for ESR1	118
ESR0?	—	Queries ESR0	119
ESR1?	—	Queries ESR1	120

Command	Data format (number of data items)	Explanation	Page
FREQuency?	——	Queries frequency settings	121
FREQuency	——	——	——
:AUTO	ON/OFF	Sets frequency auto ranging	122
:AUTO?	——	Queries frequency auto ranging	122
:RANGe	NR3 numerical data (1)	Sets frequency range	123
:RANGe?	——	Queries frequency range	124
:SOURce	V/A	Sets frequency items	124
:SOURce?	——	Queries frequency items	125
HEADer	ON/OFF	Sets header	125
HEADer?	——	Queries header	126
HOLD	ON/OFF	Sets the hold state	126
HOLD?	——	Queries the hold state	127
INTEGrate?	——	Queries settings of integrate meter	128
INTEGrate	——	——	——
:STATe	START/STOP/RESET	Sets integrate meter condition	129
:STATe?	——	Queries integrate meter condition	130
:SOURce	A/W	Sets integrate items	130
:SOURce?	——	Queries integrate items	131
:TIME	NR1 numerical data (2)	Sets integrate time	131
:TIME?	——	Queries integrate time	132
MEASure?	V/A/W/VA/VAR/PF/DEG/FREQ/INTEG/PINTEG/MINTEG/TIME	Queries designated measuring data	133
RECTifier	NR1 numerical data (1)	Sets rectifier type	134
RECTifier?	——	Queries rectifier type	134
RS232c?	——	Queries RS-232C setting item	135
RS232c	——	——	——
:ANSWer	ON/OFF	Sets execution confirmation messages	136
:ANSWer?	——	Queries execution confirmation messages	137
:ERRor?	——	Queries RS-232C communications error	138
:HANDshake	X/HARD/OFF	Sets RS-232C communications handshake	139
:HANDshake?	——	Queries RS-232C communications handshake	139

Command	Data format (number of data items)	Explanation	Page
SCALe?	————	Queries the setting of scaling	140
SCALe	————	————	——
:CT	NR2 numerical data (1)	Sets CT ratio	141
:CT?	————	Queries CT ratio	141
:PT	NR2 numerical data (1)	Sets PT ratio	142
:PT?	————	Queries PT ratio	142
STATus	————	————	——
:CLAMp?	————	Queries the clamp sensor on use	143
TRANsmit	————	————	——
:SEParator	NR1 numerical data (1)	Sets the separator	143
:SEParator?	————	Queries the separator	144
:TERMinator	NR1 numerical data (1)	Sets the terminator	144
:TERMinator?	————	Queries the terminator,	145
VOLTage?	————	Queries voltage settings	145
VOLTage	————	————	——
:AUTO	ON/OFF	Sets voltage auto ranging	146
:AUTO?	————	Queries voltage auto ranging	146
:RANGe	NR1 numerical data (1)	Sets voltage range	147
:RANGe?	————	Queries voltage range	147

8.3.3 Valid Command According to Condition (Standard Command)

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	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
∗ESE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
∗ESE?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
∗ESR?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
∗IDN?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
∗OPC	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
∗OPC?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
∗RST	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Partly
∗SRE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
∗SRE?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
∗STB?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
∗TRG	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
∗TST?	Yes	No	No	No	No	No	No	No	No	No	Yes
∗WAI	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No

Partly : 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 (continuous display)
HOLD	Display is on hold (HOLD indication)
System error	"Err" for 1, or 101 to 110 is displayed
Key	Integration started by key operation or GP-IB command
External control	Integration started by external control signal (START/STOP)

8.3.4 Valid Command According to Condition (Commands Specific to the 3167)

Cont : Continuous

Condition / Command	Integration reset		Key				External control				System error
			Integration RUN		Integration STOP		Integration RUN		Integration STOP		
	Cont	HOLD	Cont	HOLD	Cont	HOLD	Cont	HOLD	Cont	HOLD	
AOUT	Yes	No	No	No	Yes	No	No	No	Yes	No	No
AOUT?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
AVERaging	Yes	No	No	No	Yes	No	No	No	Yes	No	No
AVERaging?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
CURRent?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
CURRent	—	—	—	—	—	—	—	—	—	—	—
:AUTO	Yes	No	No	No	No	No	No	No	No	No	No
:AUTO?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
:RANGe	Yes	No	No	No	No	No	No	No	No	No	No
:RANGe?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
DATAout?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
DATAout	—	—	—	—	—	—	—	—	—	—	—
:ITEM	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes	No
:ITEM?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
:TIME	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes	No
:TIME?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
DEMag	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes	No
DISPlay	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
DISPlay?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
ESE0	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
ESE0?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
ESE1	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
ESE1?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
ESR0?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
ESR1?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No

Cont : Continuous

Condition / Command	Integration reset		Key				External control				System error
			Integration RUN		Integration STOP		Integration RUN		Integration STOP		
	Cont	HOLD	Cont	HOLD	Cont	HOLD	Cont	HOLD	Cont	HOLD	
FREQuency?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
FREQuency	–	–	–	–	–	–	–	–	–	–	–
:AUTO	Yes	No	No	No	Yes	No	No	No	Yes	No	No
:AUTO?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
:RANGe	Yes	No	No	No	Yes	No	No	No	Yes	No	No
:RANGe?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
:SOURce	Yes	No	No	No	Yes	No	No	No	Yes	No	No
:SOURce?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
HEADer	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
HEADer?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
HOLD	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
HOLD?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
INTEGrate?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
:STATe	–	–	–	–	–	–	–	–	–	–	–
START	Yes	Yes	No	No	Yes	Yes	No	No	No	No	No
STOP	No	No	Yes	Yes	No	No	No	No	No	No	No
RESET	Yes	Yes	No	No	Yes	Yes	No	No	No	No	No
:STATe?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
:SOURce	Yes	No	No	No	No	No	No	No	No	No	No
:SOURce?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
:TIME	Yes	No	No	No	No	No	No	No	No	No	No
:TIME?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
MEASure?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
RECTifier	Yes	No	No	No	No	No	No	No	No	No	No
RECTifier?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
RS232c?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
RS232c	–	–	–	–	–	–	–	–	–	–	–
:ANSWer	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
:ANSWer?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
:ERRor?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
:HANDshake	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
:HANDshake?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Cont : Continuous

Condition Command	Integration reset		Key				External control				System error
			Integration RUN		Integration STOP		Integration RUN		Integration STOP		
	Cont	HOLD	Cont	HOLD	Cont	HOLD	Cont	HOLD	Cont	HOLD	
SCALe?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
SCALe	—	—	—	—	—	—	—	—	—	—	—
:CT	Yes	No	No	No	No	No	No	No	No	No	No
:CT?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
:PT	Yes	No	No	No	No	No	No	No	No	No	No
:PT?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
STATus	—	—	—	—	—	—	—	—	—	—	—
:CLAMp?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
TRANsmit	—	—	—	—	—	—	—	—	—	—	—
:SEParator	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
:SEParator?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
:TERMinator	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
:TERMinator?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
VOLTage?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
VOLTage	—	—	—	—	—	—	—	—	—	—	—
:AUTO	Yes	No	No	No	No	No	No	No	No	No	No
:AUTO?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
:RANGe	Yes	No	No	No	No	No	No	No	No	No	No
:RANGe?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No

8.3.5 Execution Time of 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.

NOTE

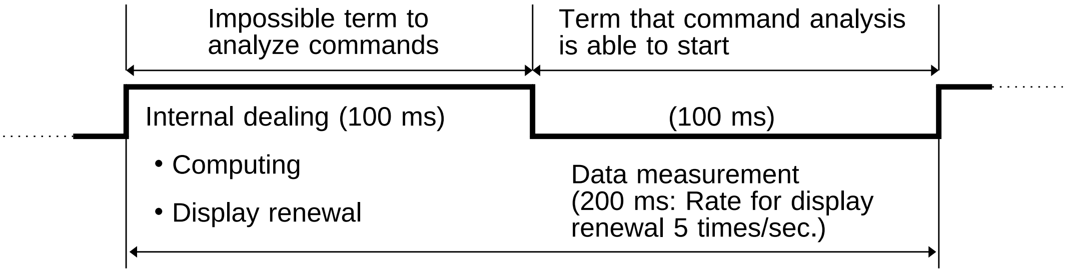
- For the 3167, from catching command to entering analysis, sometimes it lost 100 ms maximum because of the influence of internal dealing.
- In case of achieving the internal dealing time, display is not renewaled until analysis and dealing end.
- All commands are sequential type.
- When communicates with controller, it is necessary to add the data transfer time.

  However, the transfer time differs according to controller type.

  RS232C transfer rates for a data length of 8 bits, even parity, and 1 stop bit are as follows.

9600 bps	960 characters/sec.
4800 bps	480 characters/sec.
2400 bps	240 characters/sec.
1200 bps	120 characters/sec.

- Commands for setting needs some waiting time until stabilizing measurement after changing them.


Impossible term to analyze commands
Term that command analysis is able to start
Internal dealing (100 ms)
• Computing
• Display renewal
(100 ms)
Data measurement
(200 ms: Rate for display renewal 5 times/sec.)

Commands	Executing time
∗RST	Within 250 ms
∗TRG (include GET), ∗WAI, :MEASure?	Within 200 ms
:INTEGrate:STATe	Within 250 ms
:CURRent:RANGe :VOLTage:RANGe :INTEGrate:TIME :SCALe:CT,:SCALe:PT	Within 50 ms
∗TST?	10 s
:DEMag	5 s
Commands other than in the table above	Within 20 ms

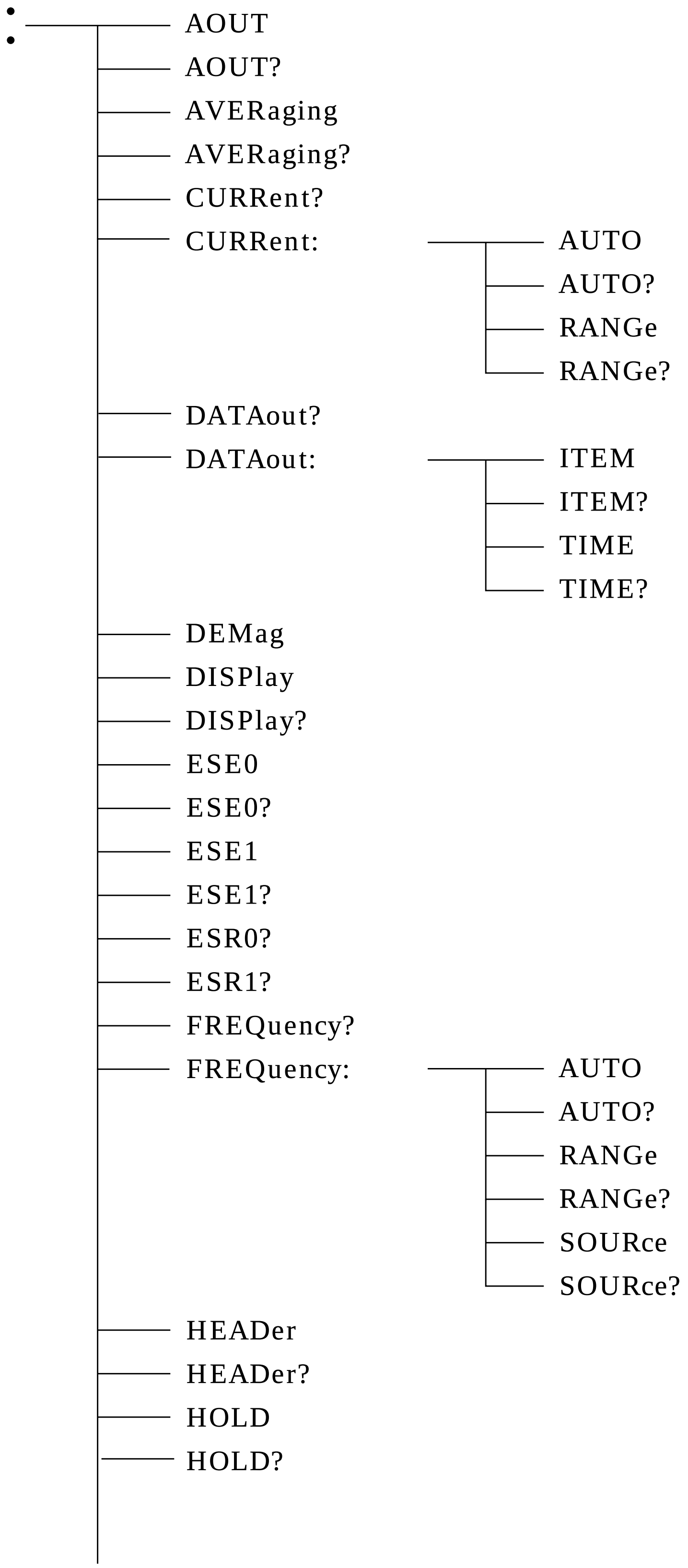
8.3.6 Initialization

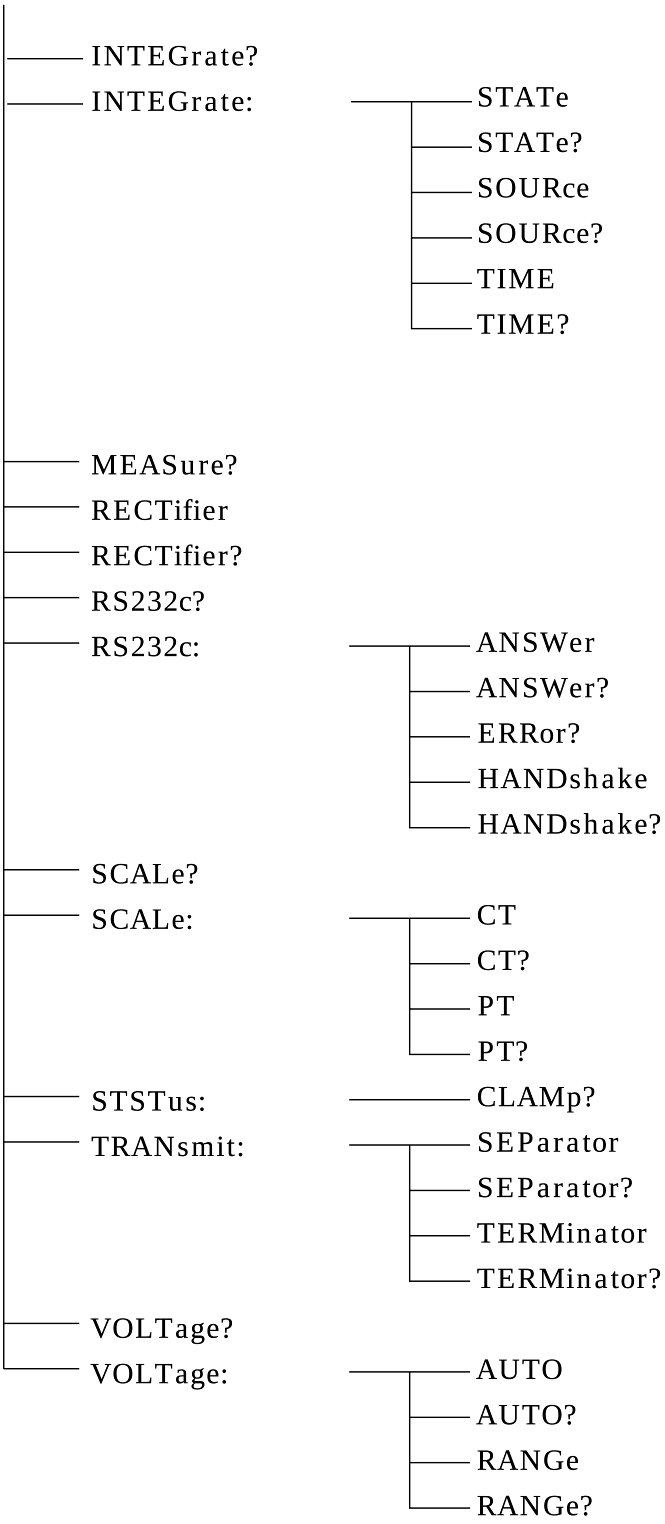
The following table shows which items are initialized and which not, under various conditions.

Initialize method Item	Power on	Keyboard reset	*RST command	Device clear	*CLS command
GP-IB device address	No	Yes	No	No	No
RS-232C settings	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).

8.3.7 3167 Specific Command Tree




INTEGrate?
INTEGrate:
STATe
STATe?
SOURce
SOURce?
TIME
TIME?
MEASure?
RECTifier
RECTifier?
RS232c?
RS232c:
ANSWer
ANSWer?
ERRor?
HANDshake
HANDshake?
SCALe?
SCALe:
CT
CT?
PT
PT?
STSTus:
CLAMp?
TRANsmit:
SEParator
SEParator?
TERMinator
TERMinator?
VOLTage?
VOLTage:
AUTO
AUTO?
RANGe
RANGe?

Index

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