HIOKI

3184

Instruction Manual

DIGITAL POWER HiTESTER

EN

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3184A981-02 96-10H

Contents

Introduction

Thank you for purchasing this HIOKI "3184 DIGITAL POWER HiTESTER." To get the maximum performance from the unit, please read this manual first, and keep this at hand.

Inspection

When the unit is delivered, check and make sure that it has not been damaged in transit. In particular, check the accessories, panel switches, and connectors.
If the unit is damaged, or fails to operate according to the specifications, contact your dealer or HIOKI representative.

Accessories

Fuse M0.5 A/250 V (20×5.2 dia. mm arc-quencing midget)	1
Power cord	1
Instruction Manual	1

Safety Notes

⚠WARNING **Incorrect measurement procedures could result in injury or death, as well as damage to the equipment. Please read this manual carefully and be sure that you understand its contents before using the equipment. The manufacturer disclaims all responsibility for any accident or injury except that resulting due to defect in its product.**

This Instruction Manual provides information and warnings essential for operating this equipment in a safe manner and for maintaining it in safe operating condition. Before using this equipment, be sure to carefully read the following safety notes.

Safety symbols

	In the manual, this mark indicates explanations which it is particularly important that the user read before using the equipment.

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

⚠ DANGER	Indicates that incorrect operation presents extreme danger of accident resulting in death or serious injury to the user.
⚠WARNING	Indicates that incorrect operation presents significant danger of accident resulting in death or serious injury to the user.
⚠CAUTION	Indicates that incorrect operation presents possibility of injury to the user or damage to the equipment.
NOTE	Denotes items of advice related to performance of the equipment or to its correct operation.

Notes on Use

In order to ensure safe operation and to obtain maximum performance from the unit, observe the cautions listed below.

⚠ DANGER

- **Always connect the voltage cable to the secondary side of a breaker. On the secondary side of a breaker, even if the lines are shorted the breaker can trip and prevent an accident. On the primary side, however, the current capacity may be large, and in the event of a short-circuit there may be a serious accident.**
- **This unit cannot be used on voltage lines of 500 Vrms. If the voltage exceeds 500 VAC, there will be a short-circuit accident or an electrocution accident.**

⚠WARNING

- **Be sure to connect the voltage input terminals and current input terminals correctly. Measurement which is attempted with the wiring connected incorrectly may cause damage to the unit or a short-circuit.**
- **To prevent an electric shock and a short-circuit accidents, shut off the power to the line to be measured before connecting the load to the terminals.**
- **To avoid electric shock when replacing the fuse, turn the power switch off, disconnect the power code from the connector, and remove the input cable from the object to be measured.**
  M0.5 A/250 V 20 mm×5.2 mm dia.

⚠WARNING **Only use fuses of the specified type that is rated for the specified current and voltage. Using a fuse that does not meet the specifications or shorting the fuse holder may cause an accident that might result in injury or death.**

⚠CAUTION

- Do not store or use the unit where it will be exposed to direct sunlight, high temperatures, high humidity, or condensation. If exposed to such conditions, the unit may be damaged, the insulation may deteriorate, and the unit may no longer satisfy its specifications.
- To avoid electric shock, the wiring which is used for making the connections to the current input terminals should have sufficient current carrying capacity and insulation.
- To avoid damage to the unit, do not short the analog output terminal and the GP-IB connector terminal and do not input voltage to them.
- To avoid damage to the unit, do not subject the equipment to vibrations or shocks during transport or handling. Be especially careful to avoid dropping the equipment.
- Before using the unit, make sure that the sheathing on the leads is not damaged and that no bare wire is exposed. If there is damage, using the unit could cause electric shock.

NOTE

- Accurate measurement may be impossible in locations subject to strong external magnetic fields, such as transformers and high-current conductors, or in locations subject to strong external electric fields, such as radio transmission equipment.
- When a measuring device such as a recorder or voltmeter is connected to the analog output terminals, there is a possibility of oscillatioin due to the input capacitance of the measuring device.
  If such oscillation occurs, insert a resistor (100 ohms or thereabouts) in series between the analog output terminals and the measuring device.

Chapter 1
Overview

1.1 Features

The 3184 is a 3-phase power meter designed to measure voltage, current, and power in single-or-3-phase circuits. The meter's internal circuit converts voltage and current measurements to true rms value, giving it the capability to accurately measure the special waveforms produced by thyristors and other semiconductor switching devices. The basic instrument is provided with an analog output terminal, and models are available equipped with and GP-IB interface (3184-02).

(1) Voltage, current, single-and 3-phase power measurement capability

(2) Voltage and current quantified as true rms values

(3) Good frequency response characteristics

(4) Minimum metering losses

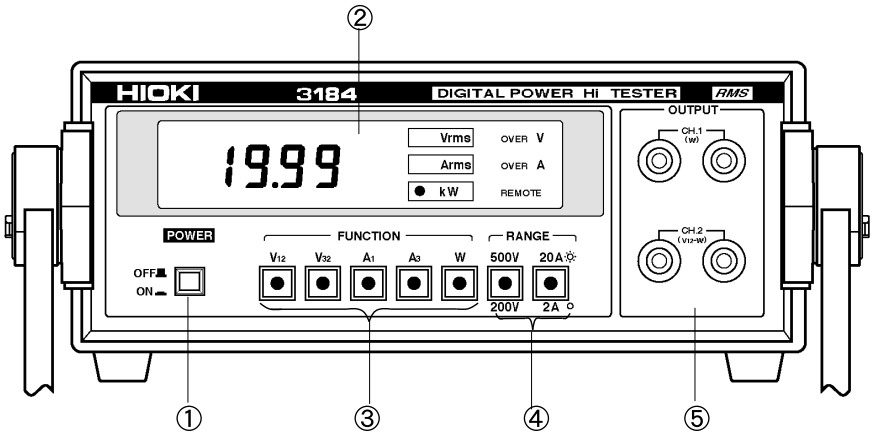
(5) Overvoltage, overcurrent warning indicators provided

(6) Analog outputs provided for power and selected function

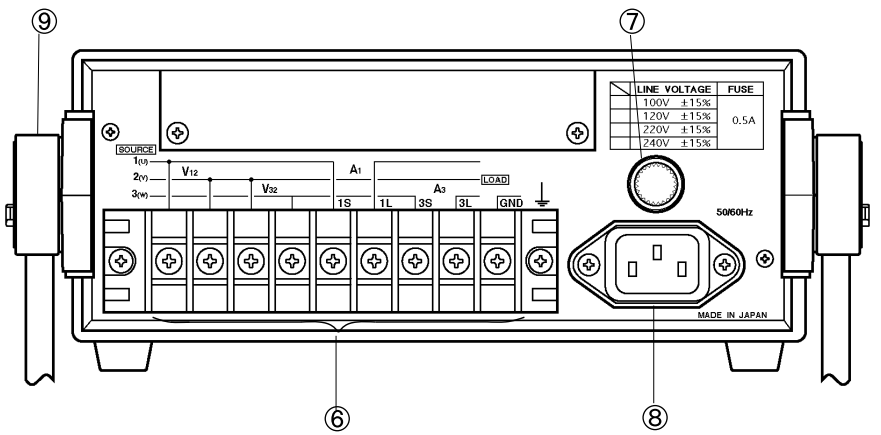
(7) Optional models with GP-IB interface capability available

(8) Lightweight, compact

1.2 Names and Functions of Parts



Front Panel



Rear Panel

① POWER switch

Always turn the power switch ON before a measurement. Allow the instrument approximately 5 minutes of warm-up.

② Display panel

3-1/2 digits LED display with a maximum display capability of 1999. Measurement unit annunciators are coupled to function switch operation, with the measurement value of V_{12} to W, and the unit displayed. At power ON, the display reading is 0000, and an overrange input is indicated by "1" in the MSD column, with all other digits blanked. OVER V and OVER A are the overvoltage and overcurrent warning indicators. These light when peak-value of the input exceeds the crest-factor of the meter circuit. The REMOTE lamp is functional only when the instrument is used in a optional automatic measurement system, and lights to indicate that function and range settings are under remote-control.

③ Function switches (V_{12}, V_{32}, A_1, A_3, W)

Used to select the display function. At power ON, the non-select state is entered automatically. When selection is made, the selected function switch LED lights.

④ Range switches (500V/200V, 20A/2A)

Selects the range for voltage and current measurements. At power ON, both ranges are set to Lo (indicator OFF). Range switch Hi ↔ Lo changes each time the button is pressed. The range for power measurements is a combination of voltage and current range settings, determined as follows.

V range / A range	Lo (200 V)	Hi (500 V)
Lo (2 A)	0.2 kW	2 kW
Hi (20 A)	2 kW	20 kW

⑤ Output Terminals

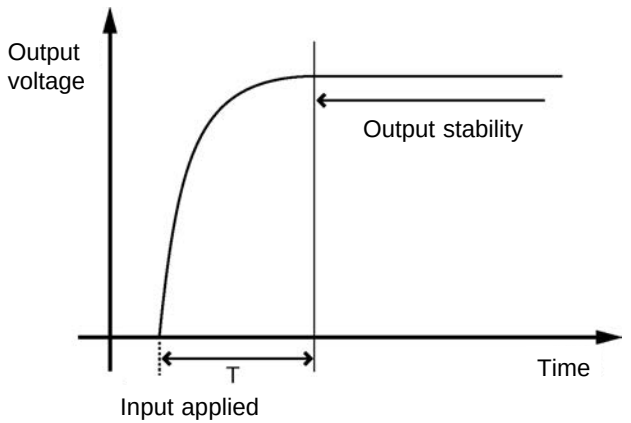
Output is a DC voltage value equivalent to the measurement value (2 VDC/f.s.).

CH1: Power only (continually outputs regardless of selected function).

CH2: Outputs the value for the displayed function.

⚠CAUTION	To avoid damage to the unit, do not short the output terminal and do not input voltage to the output terminal.

The response waveform for analog output appears as follows.



Voltage, current: T 1.2 s (when input is 95 % of full-scale)

Power: T 1.4 s (when input is 95 % of full-scale)

These figures are also applicable when function or range changes are made.

⑥ Measurement Terminal Board

The rear panel terminal board is used to connect the device under test with the power source. Connection cables should have sufficient capacity ratings, and be connected securely (and neatly) to avoid accidental short-circuits.

⑦ Fuse Holder

The instrument takes a 0.5 A/250 V arc-quencing, midget type fuse. Unplug the power cord when changing the fuse.

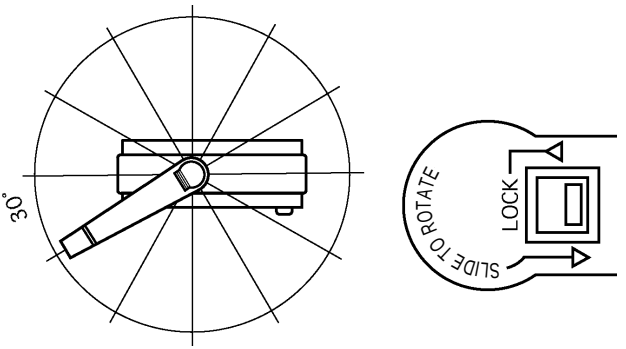
⑧ AC Inlet

This receptacle is used to connect the instrument to the AC power supply (AC mains). Use the power cord provided with the instrument. The power source rating for your particular instrument is marked in the table above the fuse holder. Make sure that this rating agrees with the power source being used.

⑨ Handle

As shown in figure on the next page, the handle may be rotate by sliding the grip at the sides of the handle in the direction of the SLIDE TO ROTATE arrow. When the proper position has been attained, push the slide in the LOCK arrow direction. The handle may be set at 30° detents to fix it in position.

⚠CAUTION	The handle can be used as a stand to incline the instrument. Force should not be applied to the instrument from above when using it in this manner.



Handle

Chapter 2
Specifications

2.1 General Specifications

Measurement functions	AC voltage, AC current (true rms), single-and 3-phase active (real) power	
Measurement range	V_{12}, V_{32} A_1, A_3 W	200 V/500 V 2 A/20 A 0.2 kW/2 kW/20 kW
Maximum display value	V_{12}, V_{32} A_1, A_3 W	199.9 V/500 V 1.999 A/19.99 A .1999 kW/1.999 kW/19.99 kW
Crest factor	V_{12}, V_{32} A_1, A_3 W	2 or less at full-scale 2 or less at full-scale Same as voltage and current
Meter losses (typical values, at 55 Hz)	V_{12}, V_{32} A_1, A_3	0.017 VA at 200 V, 0.12 VA at 500 V 0.012 VA at 2 A, 1.3 VA at 20 A
Maximum allowable input (continuous)	V_{12}, V_{32} A_1, A_3	600V 30 A
Display	3-1/2 digit LED display (1999 max)	
Sampling rate	Approximately 2.5 samples-per-second	
Accuracy (23°±5°, 50/60 Hz)	V_{12}, V_{32} A_1, A_3 W	±0.5% rdg. ±6 dgt. ±0.5% rdg. ±6 dgt. ±0.5% rdg. ±6 dgt. (power-factor=1.0)
Frequency response	V_{12}, V_{32} A_1, A_3	within ±0.5% rdg., 40 Hz to 1 kHz within ±0.5% rdg., 40 Hz to 1 kHz (≦18 A) within ±0.5% rdg., 45 Hz to 1 kHz (>18 A)

Frequency response	W	within ±1.0% rdg., 40 Hz to 1 kHz (When current input ≦ 18 A, and power-factor = 1.0) within ±1.0% rdg., 45 Hz to 1 kHz (When current input > 18 A, and power-factor = 1.0)
Affect of power factor on accuracy (50/60 Hz)	0.2 kW range within ±1.0% rdg., power factor=0.5 2 kW range within ±0.8% rdg., power factor=0.5 20 kW range within ±0.8% rdg., power factor=0.5	
Temperature characteristics	Within ±2.0% rdg. at 0 to 40 °	
Analog output	CH1 power only (continual output), 2 VDC/f.s. CH2 selected function, 2 VDC/f.s.	
Dielectric strength	2.2 kVAC/1 min (between input terminals and case), 1.5 kVAC/1 min (between power terminals and case)	
Rated supply voltage	100/120/220/240 VAC (specify one) 50/60 Hz (voltage fluctuations of ±15% from the rated supply voltage are taken into account)	
Affect of power source voltage	Accuracy of above specifications assured within specified power source range.	
Rated power	Approximately 5.5 W at 100 V, 60 Hz (7 VA approximately) (3184-02: approximately 9.5 W (11 VA approx.))	
Dimensions	250 (W) × 85 (H) × 220 (D) mm	
Mass	2.9 kg (3184-02: 3.0 kg)	
Accessories	Fuse (M0.5 A/250 V arc-quencing midget 20 mm ×5.2 mm dia.) ×1 Power cord ×1 Instruction manual ×1	
Options	9084 CARRYING CASE 9149 CARRYING CASE	

Chapter 3
Basic Operating Principle

3.1 Active Power Measurements

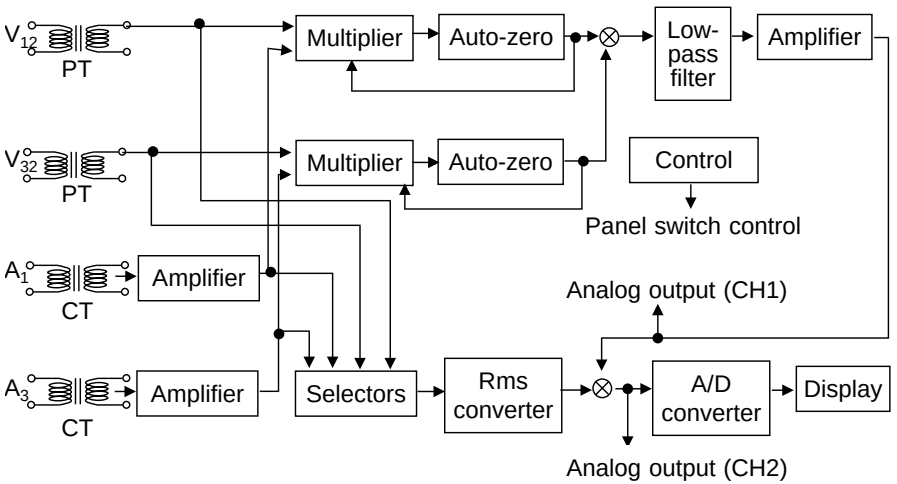


Figure 3.1-1 Circuit Block Diagram

A block diagram of the various circuits contained in the 3184 is shown in Figure 3.1-1. As shown in the figure, supply voltage and current of the device under test is sensed by the PT and CT respectively. These values are converted to a 2 V/f.s. signal for application to the multipliers where power is calculated.

The DC component of the calculated waveform is proportional to active power. Output is obtained by extracting this DC component and adjusting it to a 2 VDC/f.s. level.

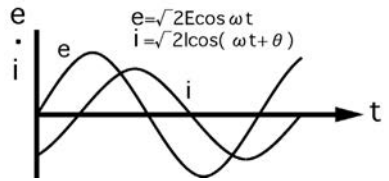


Figure 3.1-2
Voltage-Current Waveforms

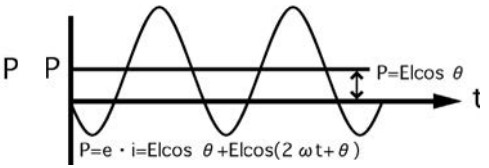


Figure 3.1-3
Power Conversion Waveform

3.2 Voltage and Current Measurements

In conventional measuring instruments, the method of measuring an AC signal is to sense its average value, then make the necessary calculations to convert it to an rms value. However, using this method does not account for waveform distortion, or non-true sine waves, normally resulting in an inaccurate measurement. These instruments use special rms converters that work by sampling the instantaneous value of the signal, and thus produce a true rms reading of the signal.

3.3 Crest-Factor

In measuring instruments, the dynamic range of the meter circuit is expressed as a crest-factor. In measurements where peak-values are high relative to rms value, selecting a suitable range for the rms value will likely result in the waveform peaks exceeding the dynamic range of the signal. Crest-factor is the ratio of peak-value to rms value, defined as follows.

$$\text{Crest-factor} = \frac{\text{Peak-value}}{\text{Rms value}}$$

For these instruments, crest-factor is as follows.

AC voltage (V_{12}, V_{32}): Two or less at full-scale
AC current (A_1, A_3): Two or less at full-scale
Single-and 3-phase active power (W): Same as voltage and current.

For example, when measuring AC current in the Lo range with the 3184, maximum display value(full-scale) is 2 A, so maximum allowable peak-value input (maintaining accuracy) is as follows.

Peak-value = rms value $\times$ crest-factor
= 2 [A] $\times$ 2 = 4 [A]

When measuring AC voltage in the Hi range full-scale is 500 V, so 500 [V] $\times$ 2 = 1000 [V] (peak-value)
The overcurrent and overvoltage warning indicators will light when input value exceeds the peak-value in the table on the next page.

Function	Range	3184
Voltage	Lo	1000 V peak
	Hi	
Current	Lo	4 A peak
	Hi	40 A peak

NOTE If the crest factor in the specification is exceeded, the displayed data will not be accurate.

Chapter 4
Operating Instructions

4.1 Operating Procedure

⚠WARNING

- **In order to prevent electric shock and short-circuit accidents, shut off the power to the line to be measured before connecting the load or power supply to the terminals.**
- **In order to maintain safety and assure the stable operating performance of this unit, be sure to connect the ground terminal to a proper ground.**
- **Before turning on the power, make sure that the voltage of the power supply being used matches the supply voltage indicated on the rear panel of the unit.**
- **If an attempt is made to use an improper supply voltage, there is danger of damage to this unit and of life-threatening risk to the operator.**

⚠CAUTION

- To avoid damage to the unit, do not input a voltage/current exceeding the rated maximum to the terminals.
- Before measurement, check the position of the range switch. The unit may be damaged if current or voltage exceeds the measurement limit is applied for a long time.

NOTE

- Approximately two seconds is required for display to reach stability after applying input, or selecting function or range.
- Using the instrument in the presence of magnetic fields (and sometimes meter noise itself) will produce a reading of a few digits even though input is zero.
- For an indication of 1999, the analog output is 1.999 VDC (1 mV/dgt.). Therefore, when measuring 500 V the indication is 500, and the output is 500 mV.
- The 3184 uses a voltage transformer (PT) and current transformer (CT), which do not transmit DC. It is therefore not possible to measure a signal (for example full-wave or half-wave rectified) which includes a DC component.
- Because of characteristics of the internal circuit design, when measuring a load which includes a component of a certain frequency, the power indication may be unstable, with a periodic fluctuation.

(1) Turn the power switch ON, and allow the instrument approximately 5 minutes of warm-up prior to starting the measurement.
(2) Set the range switches according to the expected voltage and current of the device under test. When this is unknown, start with a Hi range setting.
(3) Connect the power source and device under test to the measurement terminal board as illustrated in Figure 4.1-1 and 4.1-2. Install the protective cover, and turn power ON to the power source and the device under test.
(4) Use the function switches to select the various functions for measurement and display.
(5) If the OVER V or OVER A lamps should light while in the Lo range, switch to the Hi range.

(6) When voltage or current in the device under test exceeds the measurement range of the instrument that you are using, reduce the level of the input signal using PTs and CTs connected as illustrated in figure 4.1-3. Note however, that PTs and CTs produce phase errors that adversely affect the accuracy of power measurements, and caution is advised when using this setup.

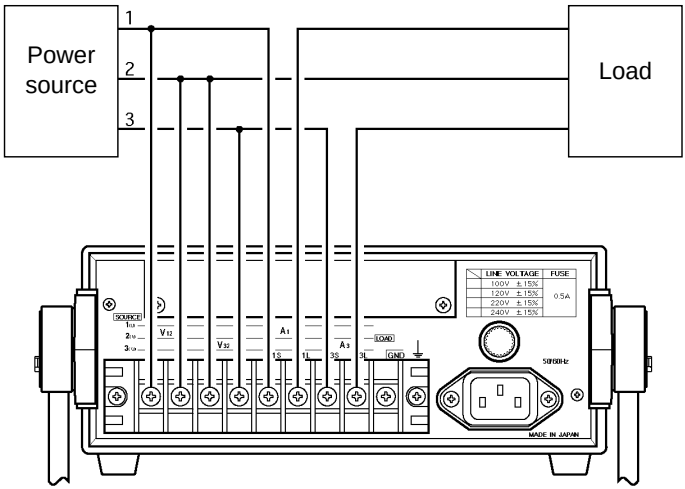


Figure 4.1-1 3-Phase, 3-Wire Connection Procedure

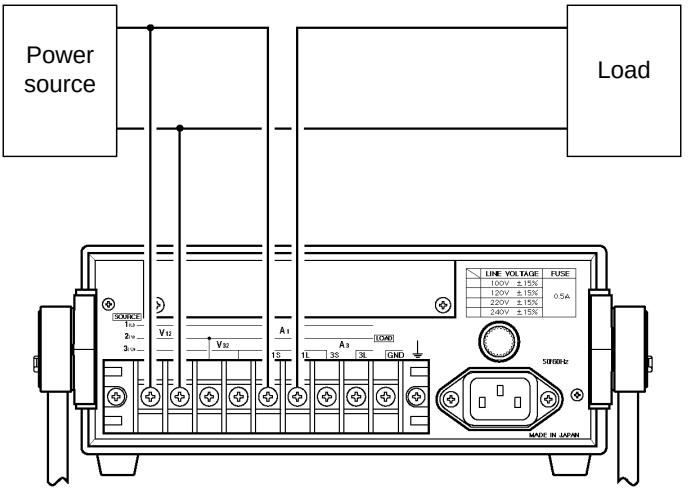


Figure 4.1-2 Single-Phase Connection Procedure

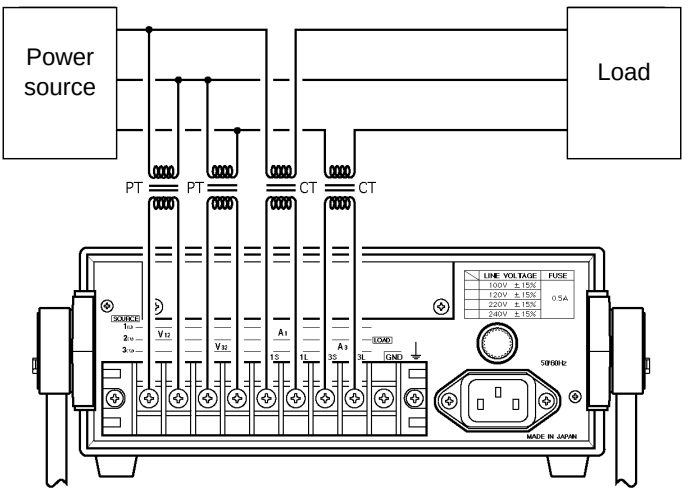


Figure 4.1-3 Connection Procedure Using PTs and CTs

Chapter 5
3184-02 GP-IB Specifications

5.1 Outline

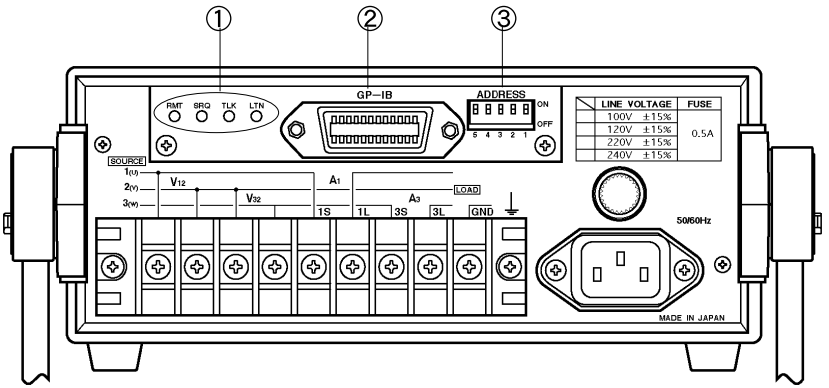
The 3184-02 feature built-in GP-IB interfaces. This allows the instruments to be connected to a GP-IB system for automated measurement data reading, and for program-control of function and range settings. Interface functions also include the ability to transmit a service request in the event of an overvoltage or overcurrent.

5.2 Interface Specifications

Applicable standard: IEEE 488-1978
Interface functions:

SH1	All SH functions.
AH1	All AH functions.
T6	Basic talker function, Serial poll function, Unaddress if MLA function. No talk-only mode function.
L4	Basic listener function, Unaddress if MTA function No listen-only mode function.
SR1	All SR functions.
RL2	Remote/Local switching function.
PP0	No PP function
DC1	All DC functions.
DT0	No DT function.
C0	No controller function.
(E1)	(Open-collector driver.)

5.3 Panel Description



① GP-IB status lamps

When operated under GP-IB system control, these lamps indicate present device status.

RMT Indicates that the device can be controlled externally.

SRQ Indicates that the device is transmitting a service request to the controller.

TLK Indicates that the device is transmitting data as the talker.

LTN Indicates that the device is receiving data as the listener.

② GP-IB connector

24-pin connector conforming to the IEEE 488 bus standard. Used with a standard bus cable.

③ Address switch

Used to set the device address for the GP-IB system. (Left-hand switch not usable.)

5.4 Talker Function

Output data format

AAA ±DDDDDE±D CR LF

(1) (2) (3)

(1) Measurement Functions

Header	Function
V_{12}	V_{12} (Voltage measurement)
V_{32}	V_{32} (Voltage measurement)
A_1	A_1 (Current measurement)
A_3	A_3 (Current measurement)
W	W (Power measurement)
NO	Indicates no setting has been made.
OVR	Overrange

(2) Measurement Values

Measurement function	Range	Mantissa	Exponent
V_{12}, V_{32}	200 V	+ddd.d	E+0
	500 V	+dddd.	E+0
A_1, A_3	2 A	+d.ddd	E+0
	20 A	+dd.dd	E+0
W	0.2 kW	±ddd.d	E+0 *
	2 kW	±d.ddd	E+3
	20 kW	±dd.dd	E+3

Note: Data marked by asterisk (*) is formatted different than the examples shown on the instrument's instruction label.
Output data for an overrange is as follows.
OVR 19999. E + 9

(3) Delimiter

"CR" and "LF" are sent as delimiters. An EOI is transmitted simultaneous with "LF".

5.5 Listener Functions

Programming code

(1) Function

F 0	Function not set.
F 1	V_{12}
F 2	V_{32}
F 3	A_1
F 4	A_3
F 5	W

(2) Range

Voltage range	V 0	Lo	200 V
	V 1	Hi	500 V
Current range	A 0	Lo	2 A
	A 1	Hi	20 A

(3) Service Request

S 0	No service request mode.
S 1	Service request mode set.

(4) Header Output

H 0	No header output mode.
H 1	Header output mode set.

Programming precautions

① Delimiter Usage

When receiving data as the listener, the incoming transmission will be interrupted for internal processing in the following two cases.

- When an "EOI" is received.
- When an "LF" is received.

This is disregarded for a "CR". (An unaccompanied "CR" is only effective in breaking the incoming transmission for internal processing when the LACS (Listener Active State) is terminated.)

Note also that when programmed backwards (i.e., "LF" "CR"), the break in transmission when "LF" is received leaves "CR" on the bus, and this is likely to lock the next handshake routine.

② Syntax Errors

When undefined codes, or strings of over 21 characters are received, the syntax error bit in the status byte will be set, and if the "S1" mode is programmed, a service request will be sent.

③ Setting Time Requirements

When setting function and range externally, these settings will be made after all codes have been received, requiring a maximum of 2.5 ms. Operation commands received during that interval will not be properly executed.

Note also that approximately 2 seconds is required for the display to stabilize after a voltage or current input, or whenever a function or range change is made. That amount of wait time must be allowed in the program. (Response time for analog output is noted in Section 1.2, "Names and Functions of Parts.")

5.6 Service Requests

When the "S1" mode is set, a service request will be sent in the event of an overvoltage or overcurrent input, or for programming errors such as undefined codes or format errors.

Following transmission of the service request, the controller sends a serial poll, and the device responds by transmitting its status byte and resetting the SRQ bit (bit 6).

When "S0" is set, a service request is not sent, but the status byte is transmitted.

The OVER V or OVER A bit (bit 0 and 1) will be reset with the serial poll, but a SYNTAX ERROR bit (bit 2) remains until the next time the device is designated as the listener, at which time it is reset.

Status Byte

Bit 7	6	5	4	3	2	1	0
0	SRQ	0	0	0	SYNTAX ERROR	OVER A	OVER V

Service request sent

Undefined code, or code containing over 21 characters received

Overcurrent input

Overvoltage input

		Binary	Decimal
ⓐ	Overvoltage input	01000001	65
ⓑ	Overcurrent input	01000010	66
ⓒ	Undefined code received	01000100	68
ⓓ	ⓐ, ⓑ, and ⓒ occurring together	01000111	71

5.7 Usage Precautions

(1) Address setting

The GP-IB address for the device with this interface is set using the rear panel DIP switch. Any address 0 thru 30 not used by another device in the system can be used. The ON side of the switch represents "1", and the OFF side "0". Addresses are set using the five right switches as shown in the following table.

Address	54321	Address	54321	Address	54321
0	00000	11	01011	21	10101
1	00001	12	01100	22	10110
2	00010	13	01101	23	10111
3	00011	14	01110	24	11000
4	00100	15	01111	25	11001
5	00101	16	10000	26	11010
6	00110	17	10001	27	11011
7	00111	18	10010	28	11100
8	01000	19	10011	29	11101
9	01001	20	10100	30	11110
10	01010				

NOTE The device address is read into the system when the power turned ON. Consequently, whenever address changes are made, power must be turned OFF, then back ON for the new address to be effective.

(2) Items Regarding Local and Remote Control

a. When switching between local and remote control, function and range settings remain the same.

b. In the remote status, all panel controls (except the power switch) are ineffective.

c. Measurement data is output according to function and range setting, and has no bearing on remote or local status.

5.8 Sample Programs

The program below is written for an HP-9816 computer. It assumes that the address for the 3184 is "1".

(1) HP-9816 serves to read the value for power from the power meter, and direct print-out.
Overvoltage and overcurrent is tested for each sample.

```
10    DIM A$[20], B$[4]
20    ON INTR 7 GOSUB 120
30    CLEAR 701
40    OUTPUT 701;"F5V1A0H1S1"
50    B$ = " "
60    ENABLE INTR 7:2
70    WAIT 2
80    ENTER 701;A$
90    PRINT A$.B$
100   GOTO 50
110   !
120   S=SPOLL (701)
130   IF S>64 THEN B$="OVER"
140   RETURN
150   END
```

Program Explanation

10 Defines the data area.
20 Defines the subroutine used when an OVER V/A interrupt occurs.
30 Initializes the power meter.
40 Sets W as function, range for voltage Hi, current Lo, header output, and service request mode.
50 Resets memory used for detecting OVER V/A.
60 Enables interrupt.
70 Wait for two seconds.
80 Reads data.
90 Prints out data.
100 Returns to line 50.
110 REM statement.
120 Polls the power meter, reads the status byte.
130 If OVER V/A has occurred, sets "OVER" in B$.
140 Returns to main routine.
150 Ends program.

(2) With this program, HP-9816 reads voltage, current, and power(single-phase) from the power meter and uses this data to calculate power-factor. Input is taken from V_{12} and A_1.

```
10    CLEAR 701
20    OUTPUT 701;"F1V0A0H0S0"
30    WAIT 2
40    ENTER 701;V
50    PRINT V;"V"
60    OUTPUT 701;"F3"
70    WAIT 2
80    ENTER 701;A
90    PRINT A;"A"
100   OUTPUT 701;"F5"
110   WAIT 2
120   ENTER 701;W
130   PRINT W;"W"
140   PRINT USING "14A,Z,2D"; "Power Factor", W/(V*A)
150   END
```

Program Explanation

10 Initializes the power meter.

20 Sets V_{12} as function, Lo range for both voltage and current. No header output, no service request.

30 Allows two seconds for display to stabilize.

40 Reads data.

50 Prints out data.

60 - 130 Data from A 1 and W processed like V_{12}.

140 Calculates power-factor, and prints out according to prescribed format.

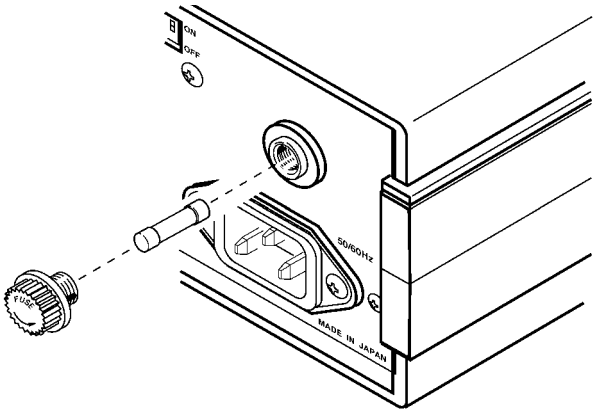
150 Ends program.

Chapter 6 Maintenance and Service

6.1 Fuse Replacement

⚠WARNING

- **To avoid electric shock, disconnect the power cord and the input cord from the connectors before replacing the fuse.**
- **Only use fuses of the specified type that is rated for the specified current and voltage. Using a fuse that does not meet the specifications or shorting the fuse holder may cause an accident that might result in injury or death.**
  M0.5 A/250 V (arc-quencing midget) 20 mm × 5.2 mm dia.



Replacing the Fuse

6.2 Service

⚠CAUTION If the unit is not functioning properly, check the batteries and fuse blowing. If a problem is found, contact your dealer or HIOKI representative. Pack the unit carefully so that it will not be damaged during transport, and write a detailed description of the problem. HIOKI cannot bear any responsibility for damage that occurs during shipment.

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