HIOKI

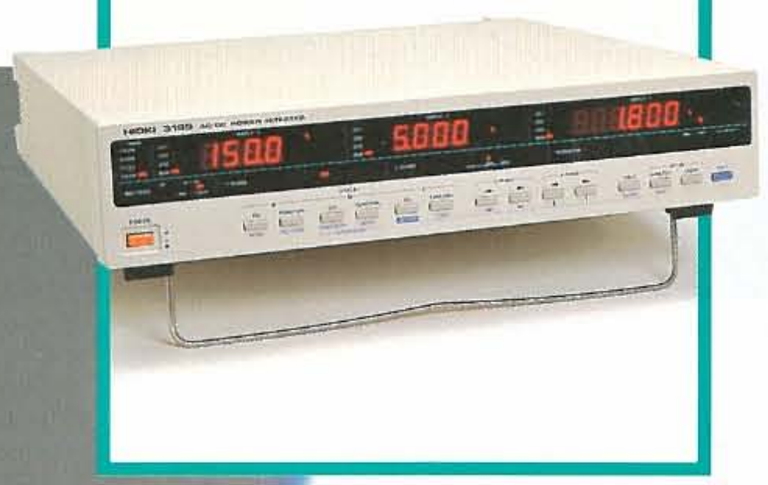
Power Measuring Instruments 2000

3188 3189

AC/DC POWER HiTESTER

Basic accuracy ±0.35%; wide frequency range from DC to 20 kHz

Three-phase AC/DC powermeters capable of simultaneous positive and negative integration



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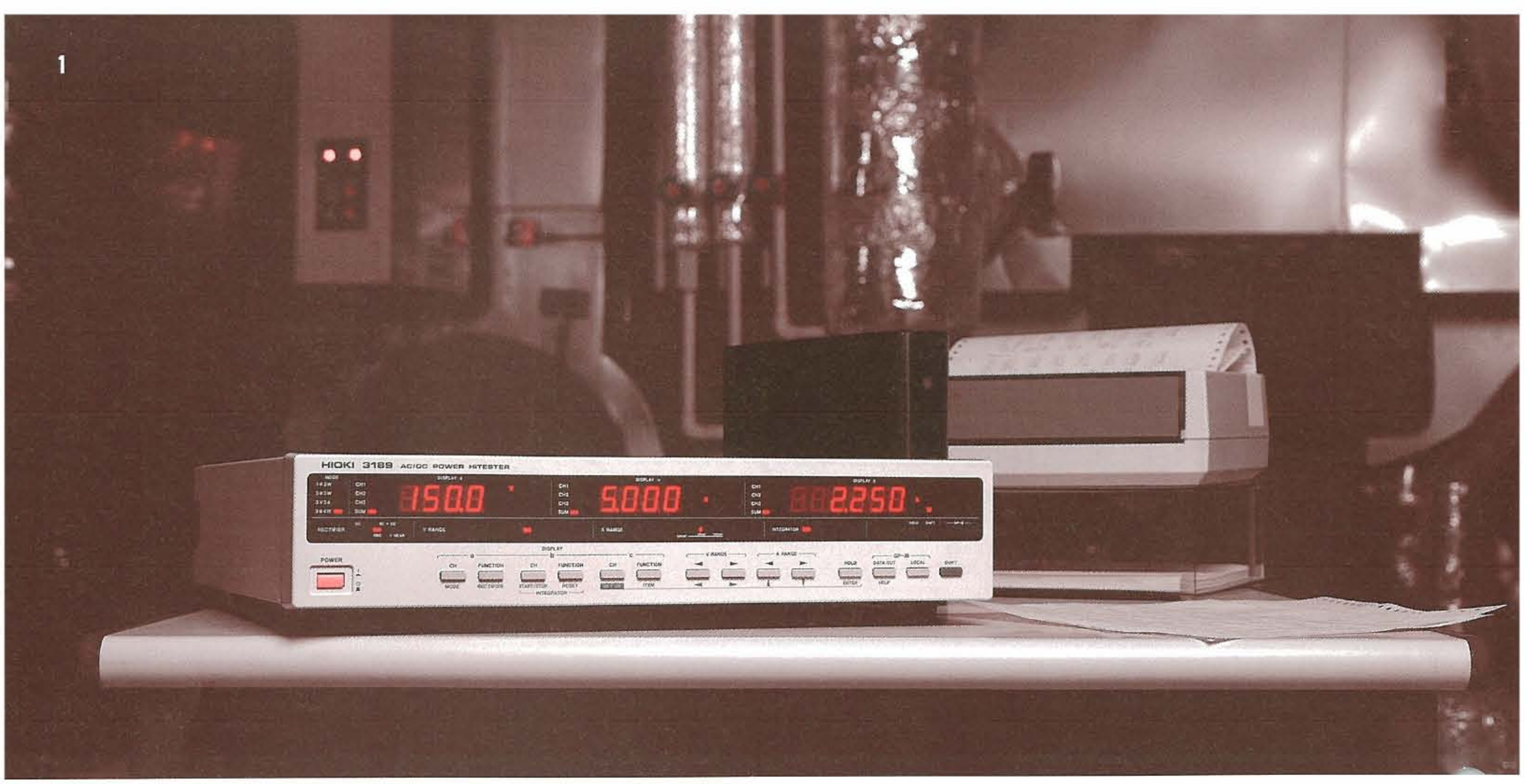


The 3188 (three-phase three-wire) and 3189 (three-phase four-wire) are the definitive AC/DC powermeters, capable of handling applications from industrial power supplies and domestic appliances to DC power supplies.

With a basic accuracy of ±0.35%, they cover DC for battery-operated equipment and a frequency range from 10 Hz to 20 kHz. As well as measuring apparent power, reactive power, power factor, phase angle and frequency these units now provide the previously unobtainable polarity discrimination for DC measurements. This thus distinguishes between the equipment charging or discharging. These units also now allow separate integration of the two DC polarities.

Measurement results include simultaneous analog outputs for voltage, current and power, and the GP-IB interface allows all data to be output simultaneously to a printer with a listen-only function. These features all aid upgrading to automated operation.

- Single-phase to three-phase three-wire operation (3188)
  Single-phase to three-phase four-wire operation (3189)
- Basic accuracy ±0.35%
- Wide frequency range: DC and 10 Hz to 20 kHz
- Current and power integration functions (plus independent positive and negative integration)
- Wide measurement ranges: 15 V to 600 V, 0.5 A to 20 A
- Support for 50/100 mV shunt input
- V, A and W analog outputs (levels); V and A monitor outputs (waveforms)
- DC measurement function (plus V and A polarity discrimination)
- Frequency measurement up to 50 kHz
- Calculation functions for apparent power, reactive power, power factor and phase angle
- Lead/lag indications for reactive power and power factor
- Isolated voltage and current terminals
- Correct simultaneity of all data
- GP-IB interface fitted as standard
  Can be connected to a printer with a listen-only function (manual printing, time interval printing and help function printing); simultaneous output for all data.

Basics

High ±0.35% basic accuracy, wide range, and IEC348* conformance.
A light and compact unit embodying HIOKI reliability.

* IEC348: The international safety standard applying to electronic measurement equipment. The 3188 and 3189 comply with every detail of this standard.

Wide frequency range: DC and 10 Hz to 20 kHz

A wide frequency range from battery measurements to capturing distortion waveforms of power supplies.

High basic ±0.35% accuracy

The 150 V and 5 A ranges used most commonly with voltage or current transformers have a high basic accuracy of ±0.35%.

Wide measurement ranges

The ranges extend from 15 V to 600 V, and from 0.5 A to 20 A.

Low ranges are provided, particularly with battery measurements in mind. For measurement of large currents, the external shunt terminals are also provided.

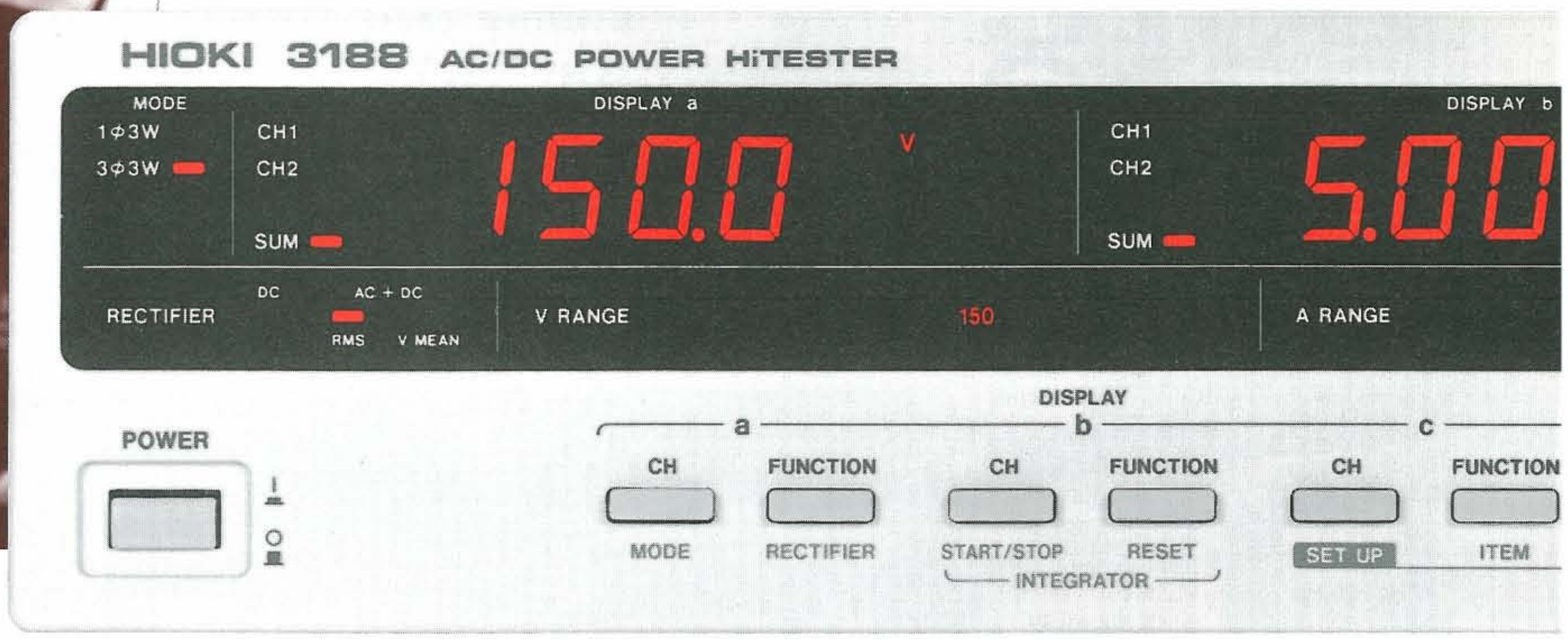
Frequency measurement

The frequency measurement range extends from 4 Hz to 50 kHz.

DC power measurement

By means of a special-purpose rectifier circuit, these units now provide the previously unobtainable polarity discrimination for DC measurements. This thus distinguishes between charging or discharging in a DC circuit. In the AC + DC mode, power measurement is possible with either a half-wave rectified or full-wave rectified waveform.

Compact powermeters for versatile appl



Features

Packed with useful functions -- independent positive and negative integration, lead/lag indications and many more. Ease of operation and data handling.

High resolution integration functions up to 1000 hours

The maximum six-digit display means high resolution. For example, integrating 150 W over one hour in the 150 W range (150 V, 1 A ranges) yields an indicated value of 150.000 Wh. Again, the maximum integration time of 1000 hours enables long-term integration.

Independent positive and negative integration

For both current and power, integration values can be obtained for either positive or negative values only, or for the total. For battery measurements, the charging and discharging currents can be integrated separately.

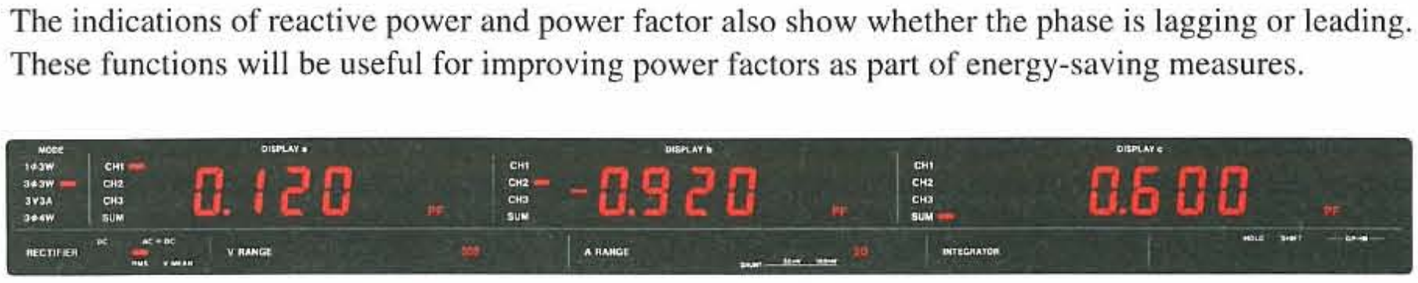
Positive integration indication

Negative integration indication

Total integration indication

Lead/lag discrimination for phase angle

The indications of reactive power and power factor also show whether the phase is lagging or leading. These functions will be useful for improving power factors as part of energy-saving measures.

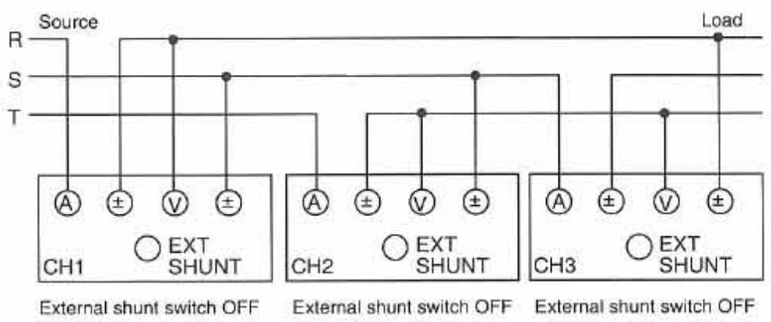


Simultaneity of all 30 data values

All data values can be captured simultaneously. Using the hold function all of the measurements at one time can be displayed in turn by simple switching operations, and simultaneous output of all the values is also possible.

Isolated terminals

The voltage and current measurement terminals are mutually isolated. On a three-phase three-wire line, the three-voltage three-current measurement method can be used.



External shunt switch OFF External shunt switch OFF External shunt switch OFF

Expandability

Enhanced system operation using data output for more effective use

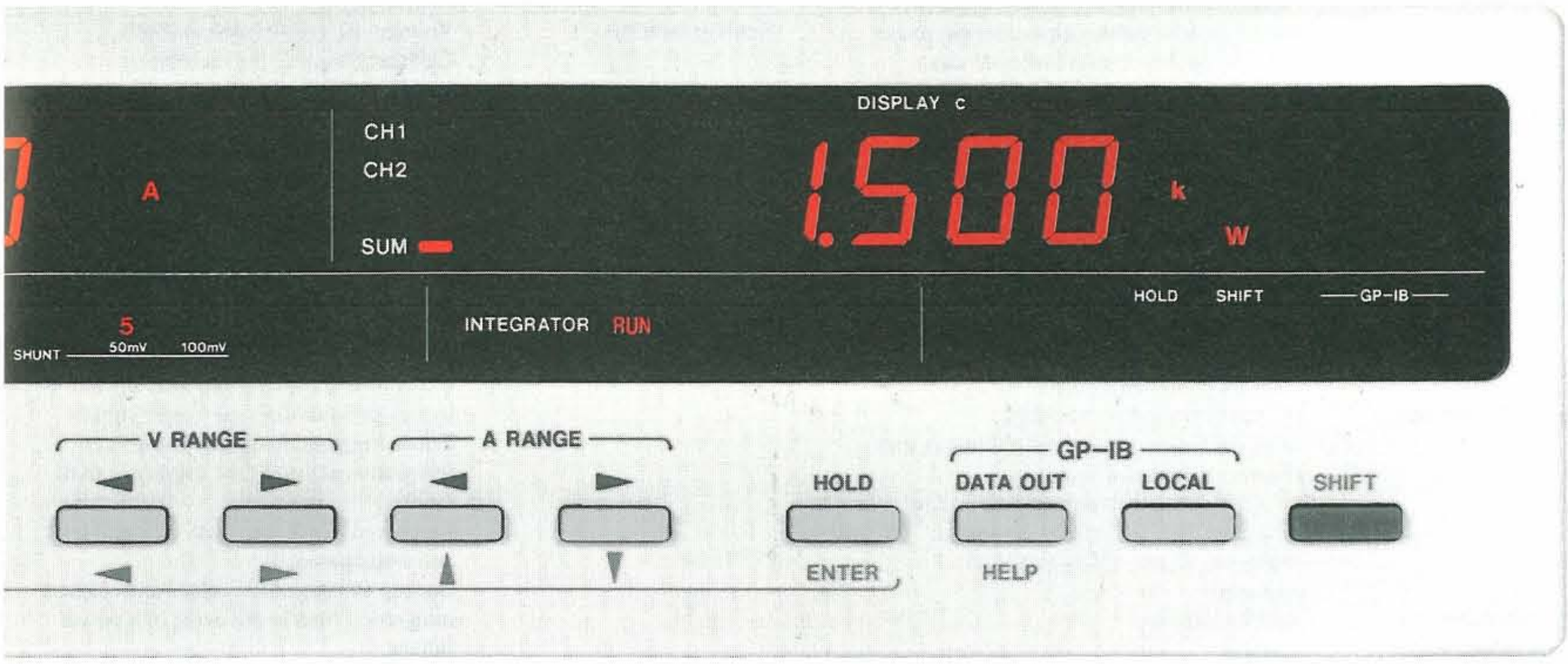
GP-IB interface fitted as standard

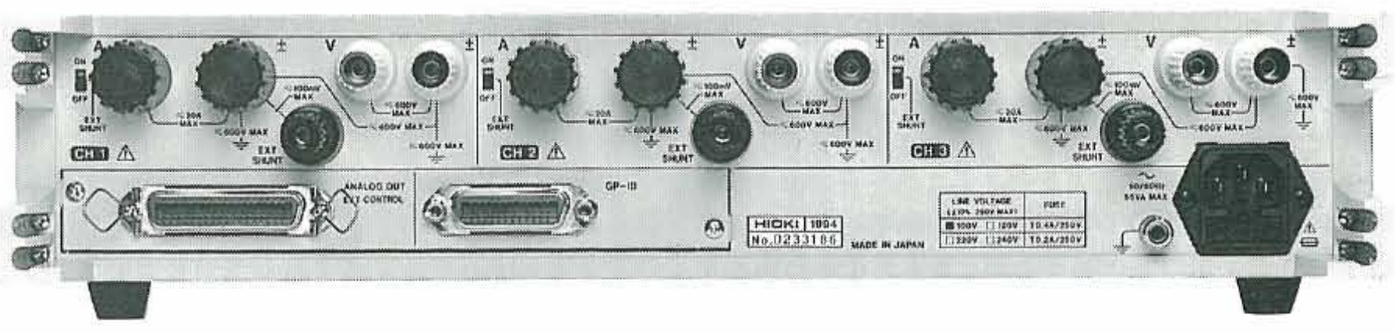
By connecting a printer with a listen-only function, all dat
Additionally, manual printing of measurement data and tir
integration interval are available, plus the help function, w

```
INTEGRATOR START

0000:00:00
            V          A          W          VA
  ch1     250.0      10.03     1.235k     2.507
  ch2     250.0      10.03     1.236k     2.508
  ch3     250.1      10.02     1.235k     2.505
  sum     250.1      10.02     3.706k     7.519
  FREQ    60.01 Hz
  Integrator          Time          Plus(+)
    Total        0000:00:00    0.00000kWh   -0.
    Interval     0000:00:00    0.00000kWh   -0.

0000:10:00
            V          A          W          VA
  ch1     250.0      10.02     1.235k     2.504
  ch2     249.9      10.03     1.236k     2.507
  ch3     250.1      10.02     1.235k     2.504
  sum     250.0      10.02     3.707k     7.515
  FREQ    60.02 Hz
  Integrator          Time          Plus(+)
    Total        0000:10:00    0.61775kWh   -0.
    Interval     0000:10:00    0.61775kWh   -0.

0000:20:00
            V          A          W          VA
  ch1     249.9      10.02     1.234k     2.504
  ch2     249.9      10.03     1.236k     2.506
  ch3     250.0      10.02     1.235k     2.504
  sum     249.9      10.02     3.704k     7.514
  FREQ    60.03 Hz
  Integrator          Time          Plus(+)
    Total        0000:20:00    1.23542kWh   -0.
    Interval     0000:10:00    0.61766kWh   -0.

INTEGRATOR STOP

HELP          HIOKI  3189 V1.00
  MODE        3P4W
  Rectifier   AC+DC(RMS)
  Range       300V        10A
  Frequency   Source: V1     Range: 500Hz
  Integrator  Source: Wsum   Time:  0001:00:00
  PT ratio    1.000
  CT ratio    1.000
  Averaging   OFF
  D/A out     ADD INTEG
  Data out    Interval: 0000:10:00
```

Example of HELP printout

cation – portable or system-integrated





put -- all values can be

es can be output simultaneously.
erval printing synchronized to the
prints the current settings of the unit.

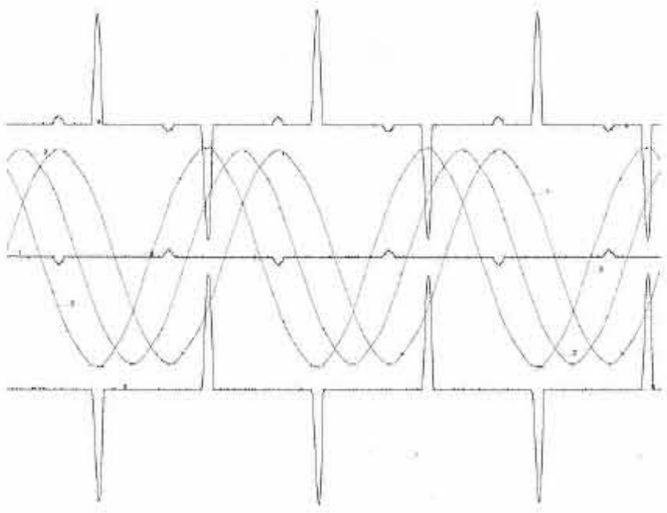
```
 var        PF        deg
.181k     0.493      60.46
.182k     0.493      60.46
.180k     0.493      60.46
.542k     0.493      60.46

-)          Add
Wh     0.00000kWh
Wh     0.00000kWh

 var        PF        deg
.178k     0.493      60.46
.181k     0.493      60.46
.179k     0.493      60.46
.538k     0.493      60.46

-)          Add
Wh     0.61775kWh
Wh     0.61775kWh

 var        PF        deg
.178k     0.493      60.46
.180k     0.493      60.46
.179k     0.493      60.46
.537k     0.493      60.46

-)          Add
Wh     1.23542kWh
Wh     0.61766kWh
```

Example of data printout

Monitor outputs

It is possible to output the voltage and current waveforms simultaneously for each channel. This makes it easy to monitor even the waveform of a high current line.

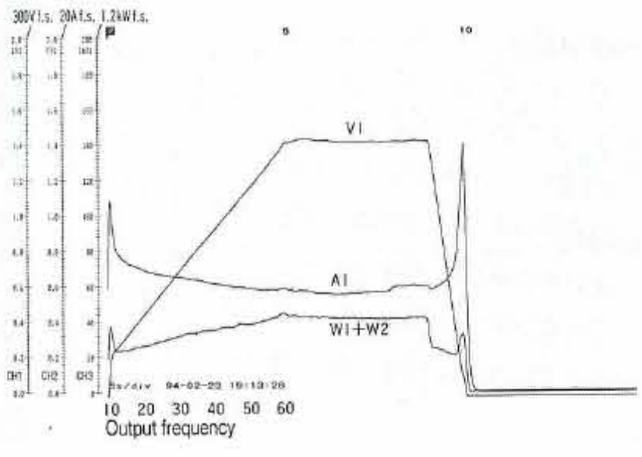
Example voltage and current waveforms of three-phase devices.



Analog outputs

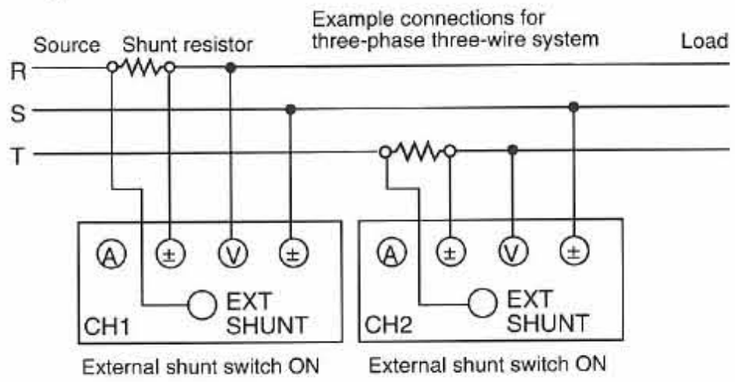
These can be output simultaneously for voltage, current and active power on all channels.

Example of analog output as an inverter output sweeps from 10 Hz to 60 Hz.



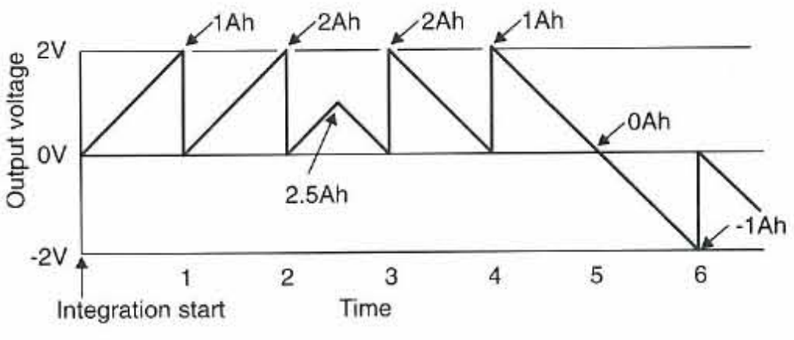
Input terminals for use with external shunt

Special terminals are provided for use with an external shunt: the input range is either 50 mV or 100 mV. Now even large current measurement is easy.



D/A converter outputs

Any one of the apparent power, reactive power, power factor, or phase angle for any channel or total, or the total of the voltage, current, active power, frequency or integration value can be fed through a D/A converter and output as a ±2 V f.s. DC voltage.



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

The output of 2 V f.s. corresponds to the range multiplied by the integration time.

■ Basic specification

Power systems measured:	3188/3189 Single-phase three-wire (1ϕ3W), three-phase three-wire (3ϕ3W) 3189 only Three-phase three-wire (3V3A), three-phase four-wire (3ϕ4W)
Values measured:	Voltage, current, active power, apparent power, reactive power, power factor, phase angle, frequency, current integral and power integral.
Displays:	a: Any channel or total -- V, A, W, VA, var, PF or deg b: Any channel or total -- V, A, W, VA, var, PF or deg , TIME c: Any channel or total -- V, A, W, VA, var, PF, deg, Hz, Ah or Wh
Measurement ranges:	Voltage, current and active power: see separate table of ranges. Shunt input 50/100 mV Frequency: 500 Hz/50 kHz
Rectification methods:	DC rectification measurement AC + DC rms measurement (V and A true effective values displayed) AC + DC mean measurement (V: mean value rectified current effective value displayed; A: true effective values displayed)
Range selection:	Auto or manual
Sampling rate:	5 times/s
Input resistances:	Voltage - approx. 1 MΩ Current - direct input approx. 10 mΩ Shunt input approx. 100Ω
Maximum sustainable inputs:	Voltage 650 V rms, 920 V peak Current - direct input 30 A rms, 45 A peak shunt input 1 V rms, 1.5 V peak
Maximum common mode voltage:	Voltage and current shunt input terminals: 600 V rms (DC and 50/60 Hz)
Analog outputs:	Simultaneous outputs of voltage, current and power for each channel, and W1+W2 and W1+W2+W3, 2V DC f.s., responce time 1.6s approx.
Monitor outputs:	Simultaneous outputs of voltage and current for each channel (waveform signal) 2V f.s.
Backup function:	Internal settings held in memory
Crest factor:	3 or less
Input method:	Voltage: resistance divider Current: shunt resistor
Effective input range:	10% to 110% of the set range
Temperature coefficient:	Less than ±0.05% f.s./°C
Power factor influence:	±0.4% rdg (at 45 to 66 Hz and a power factor of 0.5)
External magnetic field influence:	±1.5% f.s. or less (in a magnetic field of 400 A/m AC, 50/60Hz)
Influence of common mode voltage:	Less than ±0.2% f.s. (with voltage, current and shunt input terminals short-circuited, and 600 V rms, 50/60 Hz, applied between the voltage, current, shunt input terminals and the frame)
Scaling factors:	Voltage: PT ratio (1.000 to 9999) Current: CT ratio (0.01 to 9999)
Averaging function:	Displays computed moving average (off, 8, 16, 32 and 64)

[Integration functions]

Integration range:	0 to ±999999 MAh/MWh (max. integration time 1000h)
Accuracy:	Measurement accuracy ±1 dgt.
Integration time:	1 m to 1000 h (settable in 1-minute steps) ±100 ppm ±1 s (at 0 to 40 °C)
Functions:	Separate integration (displays positive and negative components and total value) Integration start, stop and reset operations by key press or external trigger signal Timer-triggered integration stop Integration elapsed time display (1 m to 1000 h) Continued integration with repeated start and stop operations Backup of integration values and elapsed integration time in the event of a power failure Intergration restart on power restoration after a power failure

[D/A output functions]

Configuration:	1 D/A conversion output channel (16-bit: polarity bit +15 bits)
Accuracy (23 °C ± 3°C):	Measurement accuracy ±0.2% f.s.
Temperature coefficient:	Less than ±0.05% f.s./°C
Sampling rate:	5 times/s
Output voltage:	2 V DC f.s.
Output values:	Apparent power, reactive power, power factor, phase angle, frequency, current integral and power integral, total - voltage, current, power.

[GP-IB interface]

(Conformance to IEEE 488.1-1987; with reference to IEEE 488.2-1987)

[Frequency measurement functions]

Measurement range:	0.8% to 100% of set range (4 Hz to 50 kHz)
Range settings:	500 Hz, 50kHz
Accuracy:	±0.1% rdg. ±1 dgt at 0 to 40 °C (with sine wave input)
Measurement cycle:	2 to 5 times/s (depending on measured frequency; display updated 5 times/s)

■ General specification

Operating temp. and humidity:	0°C to 40°C, 80% R.H. max. (no condensation
Insulation resistance:	More than 100 MΩ at 500V DC Input terminals - Frame, output terminals, external control terminals, and power supply Voltage input terminals - Current and shunt input terminals Power supply - Frame, output terminals, external control terminals
Withstand voltage:	2.2 kV AC, 1 minute Input terminals - Frame, output terminals, external control terminals, and power supply Voltage input terminals - Current and shunt input terminals 1.5 kV AC, 1 minute Power supply - Frame, output terminals, external control terminals
Power supply:	100/120/220/240 VAC ±10%, 50/60 Hz (specify at order)
External dimensions:	88 H × 430 W × 410 D mm 6.8 kg approx. (3188) 7.5 kg approx. (3189)
Accessories:	Power cord, plug adaptor, connector

Ranges

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

* The units for reactive power and apparent power should be changed to var and VA.

Accuracy (23°C ± 3°C, power factor 1, after 60 minutes warm-up, in 150 V, 5 A, 50 mV ranges)

Frequency	Accuracy
DC	Basic accuracy ±0.2% f.s.
10 Hz - 20 Hz	±1.5% f.s.
20 Hz - 45 Hz	±0.4% rdg. ±0.4% f.s.
45 Hz - 66 Hz	±0.25% rdg. ±0.1% f.s. (basic accuracy) *
66 Hz - 4 kHz	±0.4% rdg. ±0.4% f.s.
4 kHz - 10 kHz	±1.4% f.s.
10 kHz - 20 kHz	±3.0% f.s.

* The basic accuracy for the 15 V, 30 V, 60 V, 300 V and 600 V ranges, and 500 mA, 1 A, 2 A, 10 A, 20 A and 100 mV ranges is ±0.4% rdg. ±0.1% f.s.

* The accuracy for active power is determined by the combination of voltage and current ranges, as the lower of the two tolerance values.

Computation expressions

		Voltage (V)	Current (A)	Power (W)	Apparent power (VA)	Reactive power (var)	Power factor (PF)	Phase angle (deg)
Channel i, (1 ≦ i ≦ 3)		Vi	Ai	Wi	Vi Ai	$si\sqrt{(ViAi)^2 - Wi^2}$	$si\left\lvert\frac{Wi}{ViAi}\right\rvert$	$si\ COS^{-1}(\lvert PFi\rvert)$
Total	1 φ 3W	$\frac{V1+V2}{2}$	$\frac{A1+A2}{2}$	W1 +W2	$\sqrt{(\Sigma var)^2 + (\Sigma W)^2}$	$s1\sqrt{(V1A1)^2 - W1^2} + s2\sqrt{(V2A2)^2 - W2^2}$	$su\left\lvert\frac{\Sigma W}{\Sigma VA}\right\rvert$	$su\ COS^{-1}(\lvert\Sigma PF\rvert)$
	3 φ 3W	$\frac{V1+V2}{2}$	$\frac{A1+A2}{2}$	W1 +W2	$\sqrt{(\Sigma var)^2 + (\Sigma W)^2}$	$s1\sqrt{(V1A1)^2 - W1^2} + s2\sqrt{(V2A2)^2 - W2^2}$	$su\left\lvert\frac{\Sigma W}{\Sigma VA}\right\rvert$	$su\ COS^{-1}(\lvert\Sigma PF\rvert)$
	3V3A	$\frac{V1+V2+V3}{3}$	$\frac{A1+A2+A3}{3}$	W1 +W2	$\sqrt{(\Sigma var)^2 + (\Sigma W)^2}$	$s1\sqrt{(V1A1)^2 - W1^2} + s2\sqrt{(V2A2)^2 - W2^2}$	$su\left\lvert\frac{\Sigma W}{\Sigma VA}\right\rvert$	$su\ COS^{-1}(\lvert\Sigma PF\rvert)$
	3 φ 4W	$\frac{V1+V2+V3}{3}$	$\frac{A1+A2+A3}{3}$	W1 +W2+ W3	$\sqrt{(\Sigma var)^2 + (\Sigma W)^2}$	$s1\sqrt{(V1A1)^2 - W1^2} + s2\sqrt{(V2A2)^2 - W2^2} + s3\sqrt{(V3A3)^2 - W3^2}$	$su\left\lvert\frac{\Sigma W}{\Sigma VA}\right\rvert$	$su\ COS^{-1}(\lvert\Sigma PF\rvert)$

1. V, A and W are the internally computed values of voltage, current and power respectively (which do not include the rounding error of ±1 dgt. which occurs when the values are displayed.)
   Therefore, values of apparent power, reactive power and power factor calculated from the displayed values of voltage, current and active power may differ slightly from the values calculated by the unit.
2. si is the sign of the phase angle: -1 if the current leads the voltage and +1 if the current lags the voltage.
3. su is the sign of the reactive power: -1 if the total var value is negative and +1 if the total var value is positive.
4. For V and A the "total" figure indicates the average.
5. If because of measurement tolerances or an unbalanced load (the modulus of) the apparent power is less than (the modulus of) the active power, this is forced to values such that | VA | = | W |, var = 0, and PF = 1.
6. Sigma notation refers to the total for all channels.
7. The phase angle (deg) is computed from the displayed value of power factor (PF).

Related products

Single-phase powermeter

3187 AC/DC Power HiTester

Optional accessories

9151-02 GP-IB connector cable (2 m)

9151-04 GP-IB connector cable (4 m)

HIOKI

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