HIOKI

Power Measuring Instrument 1993

3195

DIGITAL POWER ANALYZER

Accurate transient capture and monitoring of harmonics
Enhanced power analyzer capabilities include an AC/DC direct input unit


HIOKI 3195 DIGITAL POWER ANALYZER

The 5-4/1 inch floppy disk shown on the cover is the 9554 harmonic current analysis software. Note that this package is only available in a Japanese-language version, and is not distributed outside Japan.

Supports DC measurement, and AC from single-phase to three-phase four-wire

Power analyzer with waveform, harmonics and transient capture capabilities

Coping with harmonics is the problem of today

With the exponential development of semiconductor devices, and growth in the use of equipment using such devices, the harmonics produced by such devices are increasingly apparent as voltage distortion in power distribution systems. The result is more frequent occurrences of overheating or fire in phase synchronizing devices (power capacitors and reactors), and other damage to transformer stations. Even the provision of more power supply facilities for important customers has an effect, making it essential to carry out intermittent measurement of harmonics. In Europe, the limits to harmonic currents are already specified in IEC555-2, and the trend is now likely to be toward overall restriction targets for harmonics, and independent regulation standards for each device.
These developments make it even more important to have measuring equipment which can monitor harmonics.

Not only harmonics
All-in-one analysis functions to meet a variety of needs

The 3195 DIGITAL POWER ANALYZER accepts inputs over a broad band from DC upward, and includes high-speed A/D conversion technology and digital signal processing, to provide power measurement, harmonic analysis, and further waveform monitoring functions. This is an all-in-one device, with a wide range of applications, from inspection and maintenance of power supply systems, to a tests on a variety of equipment.

Harmonic measurement

The unit stores voltage and current values in memory, and features an instantaneous FFT calculation and display function for harmonics. By searching for the area of interest, then specifying the section of waveform to be analyzed, it is possible to go through a complete analysis and display cycle in about one second.

Measurement of steady power values and also of transients

Power values saved in memory can be searched, to determine transient values which cannot be detected using conventional measuring equipment. The unit also, however, functions as a conventional unit for monitoring steady power values.

Waveform measurement

The 3195 captures voltage and current waveforms, and can display them on a time axis. This allows direct measurement of voltages up to 600 V AC and currents up to 200 A AC (using a clamp-on sensor).

- Supports power systems from single phase two wire to three phase four wire.
- The 9488 AC/DC DIRECT INPUT UNIT provides support for special waveforms such as half-wave rectified AC or waveforms with a superimposed DC component.
- Either direct input or clamp-on sensor for current measurement (9488 unit only supports direct connection).
- Provides simultaneous display of voltage, current, active power, reactive power, apparent power, power factor (phase angle) and frequency.
- Waveform storage in memory allows power measurement for transients and for a specified number of cycles.
- The sampling method uses a phase-locked loop, to eliminate leakage errors.
- Harmonic analysis for voltage, current, power, and impedance measurements extends to the 49th harmonic.
- The comparator print function and interval print function enable intermittent monitoring of harmonics.
- Voltage and current transformer ratio multiplication functions.
- Equipped with a 3.5-inch floppy disk drive.

I want to measure harmonics, but FFT is so complex...
I want to measure power-on rush powers...
I want to see waveforms, not just numbers...

This is not an FFT system, it is a harmonic measurement system.

The 3195 is basically a power meter. Since the three inputs are totally isolated, the danger of breakdown from excess voltages is eliminated - another advantage over conventional FFT systems.
The sampling frequency is also critical; a fixed sampling frequency allows calculations from irregular waveforms to produce spurious answers. The 3195 uses a phase-locked loop sampling circuit to ensure perfect synchronization with the input, and give reliable and accurate values for harmonics.

Simple measurement of power-on rush powers

Conventional power meters required a second or two for response time, making it impossible for them to be applied to equipment power-on rush powers or power changes to welder burst state. The 3195 stores voltage and current waveforms to memory and supports power calculation while observing the waveform on the display, eliminating response time problems.

Waveform observation and recording

Conventional power meters require waveform check on oscilloscopes and value check on analog and digital meters.
The 3195 measures and stores voltage and current waveforms for digital processing. Waveforms are viewed, recorded, and displayed on the screen - all in a single system.

Powerful features - answering three common needs

Wide-band isolation amplifier

The wide-band isolation amplifier has both voltage and current input circuits. The newly-developed 9488 AC/DC DIRECT INPUT UNIT has flat response characteristics from DC to 10 kHz, and the 9487 INPUT UNIT from 5 Hz to 10 kHz, and harmonic analysis is possible up to a base frequency of 150 Hz. The 9487 also supports both direct input and clamp-on sensor input for current measurement. The clamp-on sensor design employs the AC zero-flux method for high accuracy over a broad band, making measurement of even large currents straightforward.

High-performance through the latest digital signal processing

Massive number-crunching performance is required for realtime harmonic measurement, which is why we use the DSP (Digital Signal Processor). The A/D converted data is processed at high speed, and the results displayed.
The A/D conversion cycle is PLL synchronized for an accurate 512-points splitting of input cycle, eliminating leakage error in digital calculation.

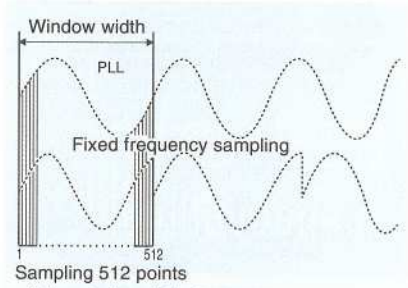
Large-capacity waveform memory

The waveform memory offers three channels, each with 64k words of capacity. For sampling in the PLL mode, this means storage of 128 waveform cycles. The desired portion can be searched from this data on screen and the power and other values displayed through cursor measurement, making it possible to capture equipment rush powers and instantaneous power levels. And of course it can also print out.

Phase-locked loop and fixed sampling

The 3195sampling the waveform within the window at 512 points, and carries out analysis based on a repetition of this input waveform cycle. Therefore, the phase-locked loop sampling used to synchronize with this cycle makes accurate calculation possible, with no leakage errors. On the other hand, since the phase-locked loop synchronizes to the zero cross point, it cannot cope with special waveforms such as DC or half-rectified AC, and synchronization is not possible outside the range of 5 Hz to 150 Hz for the base frequency. In cases such as these, fixed sampling can be used to save captured data in memory, and then even special waveforms can be analyzed by specifying the section to be processed, using the cursor.

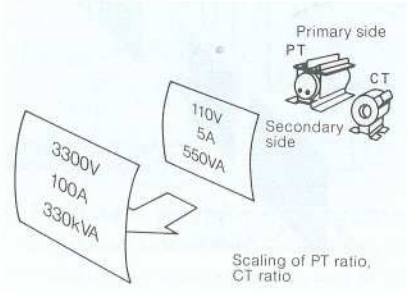
* Note that fixed sampling is only available in storage mode.



If the window width does not correspond to one cycle, the spurious analysis shown above can occur.

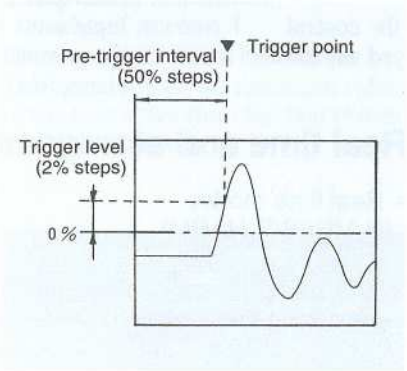
Explicit information on harmonic phase

The analog design, with its emphasis on capturing not only the amplitude but also the phase of harmonics, provides numerical values for the phase angle and polarity for each harmonic, however small its amplitude, and a bar-graph indication. This makes it easy from looking at the power supply polarity to determine the trend of the harmonic progression, providing more information to enable the source of the harmonics to be found.



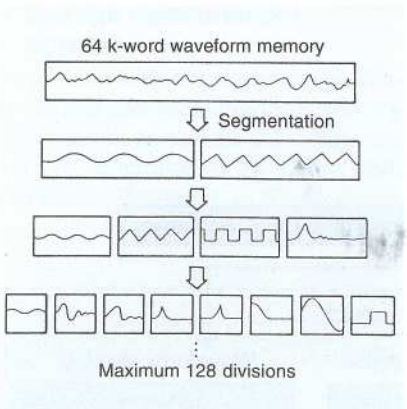
Trigger functions

The trigger levels can be set in 2% steps, and the hysteresis is also variable, allowing optimum selectivity to avoid triggering by noise. The pre-trigger interval, that is, the portion of the captured waveform segment before the trigger point, is adjustable from -100% to +100% in 50% steps, making for easy analysis of events before and after a transient.



Memory segmentation function

The waveform memory can be segmented into 1, 2, 4, 8, 16, 32, 64 or 128 partitions. This allows the unit to capture up to 128 independent event in memory.

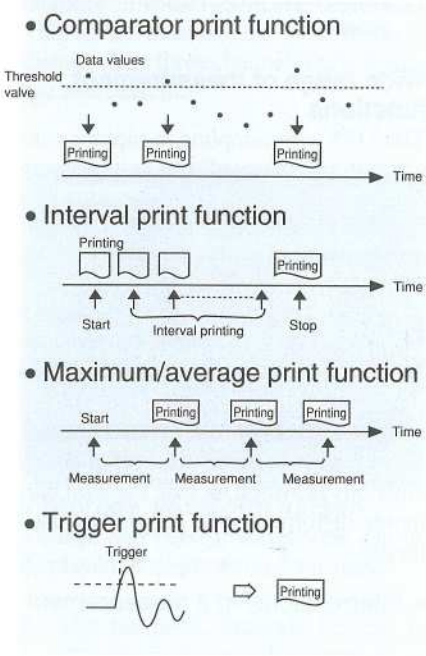


Handy scaling function

A large range of voltage and current are handled in power measurement, including 3300V and 6600V high-voltage lines. Normally measurement of these lines is performed with PT and CT, requireing conversion of the displayed readings. On the 3195 you can set PT and CT ratios for direct reading off the primary side.

Printer

The printer provides a direct screen copy function, and also a range of other functions, including a comparator print function, for intermittent monitoring of harmonics, an interval print function, and a function for printing maximum and average values of harmonics, for effective monitoring of lines with heavy fluctuation. There is also a trigger print function which operates when values exceed a selectable trigger level.

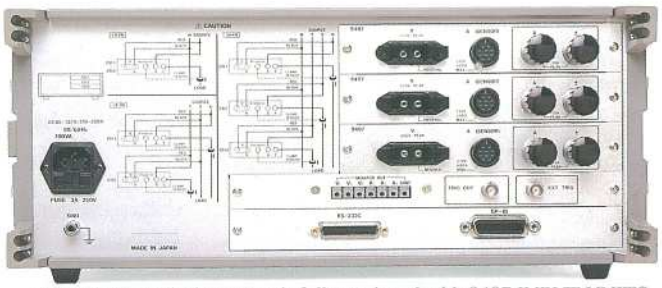


Optimum Operation Environment Centered on the CPU

The 5-inch EL display and the 110mm. wide thermal printer make measurement and recording simpler than ever. 3.5-inch floppy disks can be used for external storage, supporting measurement data management and computer-based analysis and processing. The GP-IB and RS-232C interface also enable easy data transfer and operation. (except floppy disk control.)

Multi-faceted distortion analysis—power measurement, harmonic analysis and waveform display

Front control panel
All operations can be controlled through the control panel keys and the function keys displayed on the screen.



*The photograph shows a unit fully equipped with 9487 INPUT UNITS

Rear panel I/O terminals
Input units up to three channels can be mounted for measurement of everything from single-phase to triple-phase, four-line systems.

Wide range of measurement functions

The 3195 uses sampling to capture voltage and current waveforms as its primary data, then provides a range of calculation functions to derive and display secondary data values.
The MEAS mode provides measurement of voltage, current, power and power factor, and the HARM mode provides analysis results from the amplitude and phase of each harmonic of the voltage and current waveforms, to power, power factor and impedance values. Other calculations provided include the total harmonic distortion up to a specified harmonic.

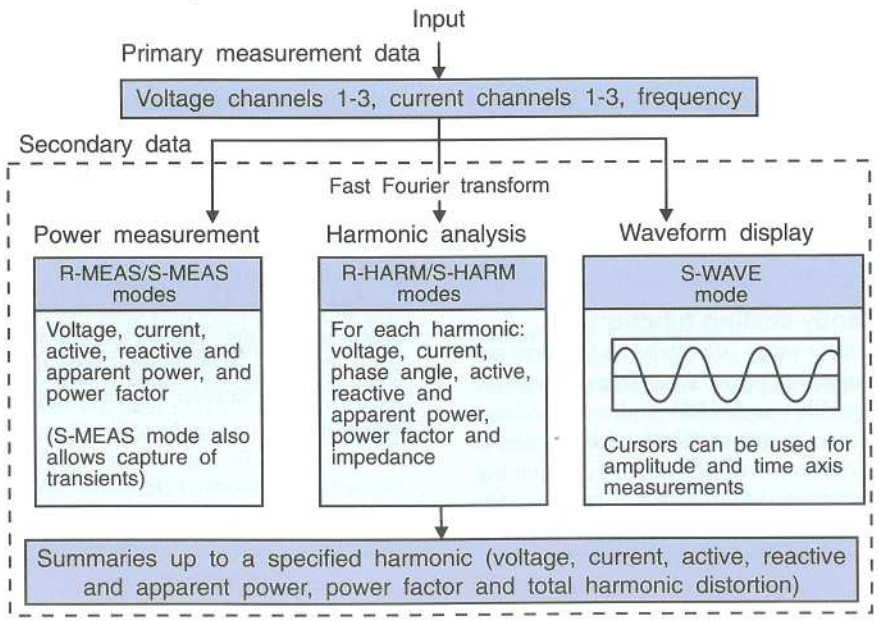
Real time and storage modes

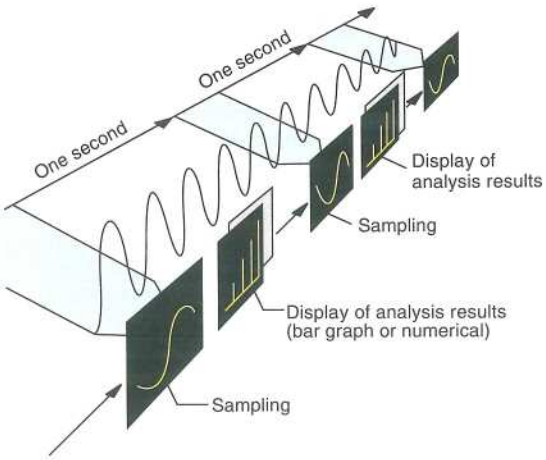
• Real time modes (R-MEAS/R-HARM)
The real time modes comprise the R-MEAS mode, for conventional power measurement, and the R-HARM mode, which provides analysis for any harmonic of the input waveform, and a bar graph display, and measurement of the total harmonic distortion. Both modes use phase-locked loop sampling, and are capable of a complete measurement and display cycle approximately once every second.

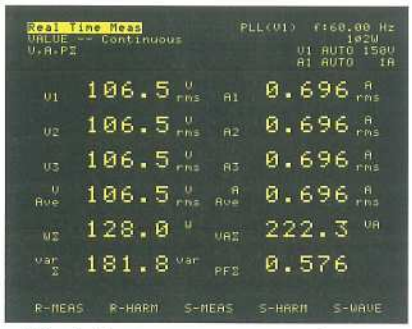
• Storage modes (S-MEAS/S-HARM/S-WAVE)
In the storage modes, a selected segment of the waveforms captured in memory is used for analysis: in the S-MEAS mode for measurement of the voltage, current, power, and power factor, in the S-HARM for harmonic analysis, and in the S-WAVE mode for waveform display. For derived calculations, any section of the waveform saved in memory can be selected.

• Real time measurement concept
In real time measurement, as shown below, one input waveform cycle is captured approximately every second, and the voltage, current, power, harmonics and other values can be calculated and displayed at one-second intervals.

• Interrelationship if measurement modes

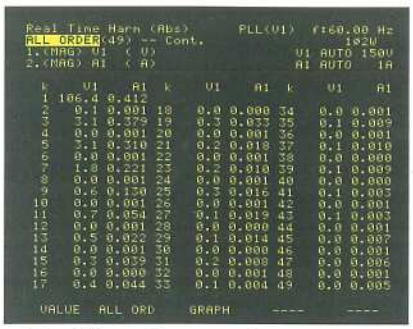






- **Real time measurement screen**

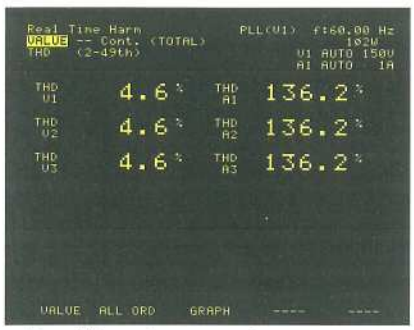
The screen shows the voltage, current and power values for each channel, and in addition the active power, reactive power, apparent power, and power factor can be displayed for each three channels.



- **Real time harmonic analysis screen 1**

Display of individual harmonics

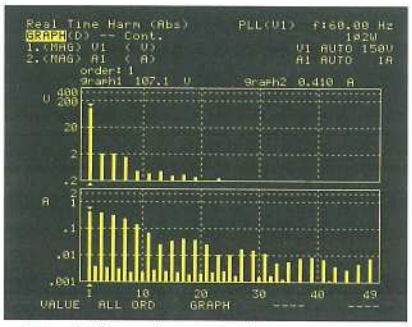
This screen shows the numerical values of the harmonics from the first (fundamental) to the 49th.



- **Real time harmonic analysis screen 2**

Display of total harmonic distortion

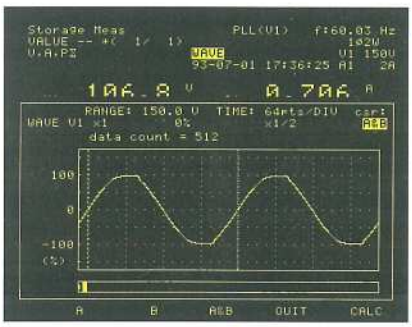
This screen indicates the total harmonic distortion for three channels each of voltage and current.



- **Real time harmonic analysis screen 3**

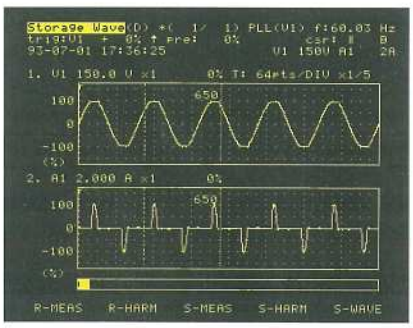
Bar graph display

This screen shows the values of the harmonics from the first (fundamental) to the 49th in a bar graph format. There are also selectable single and dual display formats, and the y-axis can be linear or logarithmic.



- **Storage measurement screen**

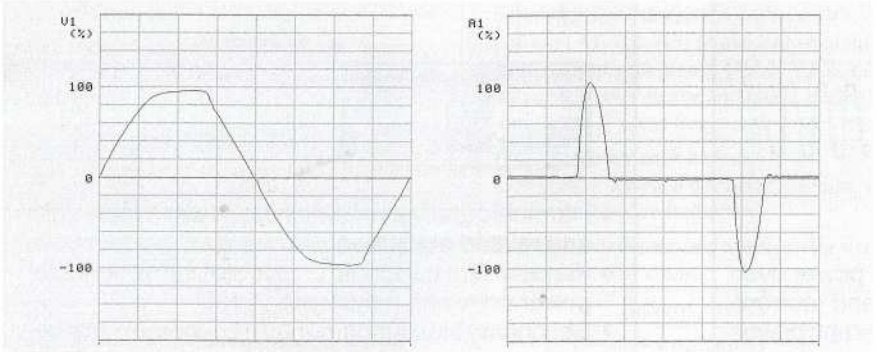
In addition to the display corresponding to the real time measurement mode, it is also possible to monitor the voltage and current waveforms on the screen while calculating the power, as shown above.



- **Storage waveform screen**

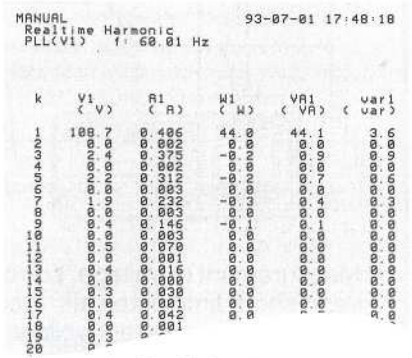
Voltage and current waveforms can be displayed in single or dual formats.

* The harmonic analysis screens in storage mode are the same as in real time mode.



- **Time axis waveform recording**

Using phase-locked loop sampling, a printout of one cycle each of voltage and current waveforms for three channels can be obtained.

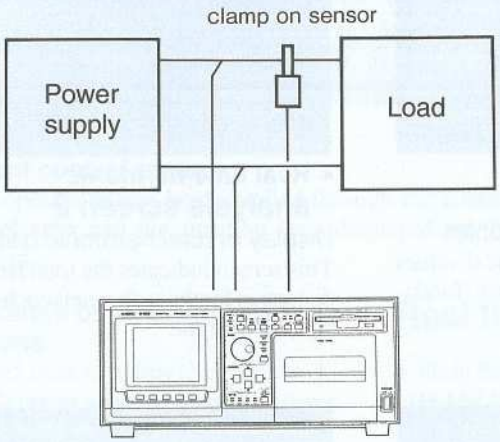


- **Numerical printout**

This provides a listing of the numerical values for each of the harmonics from the fundamental to the 49th harmonic.

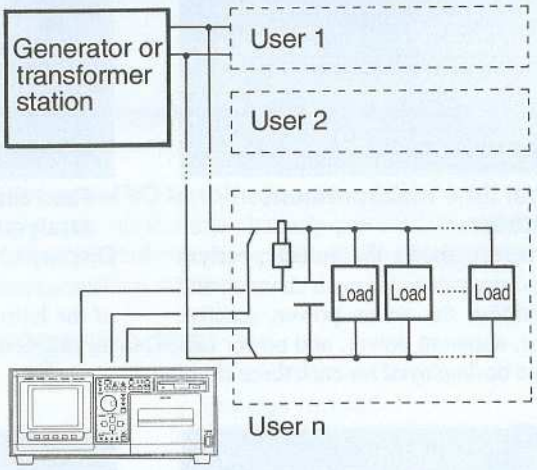
Some of the many applications of the 3195

Conventional voltage, current and power measurement



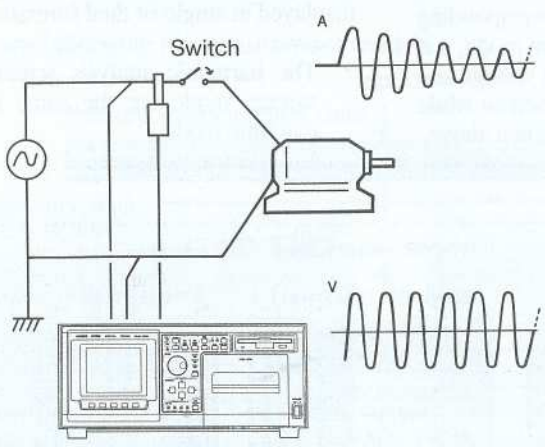
- Measurement operation as for a conventional power meter (voltage, current and power)

Harmonic analysis of power supply system



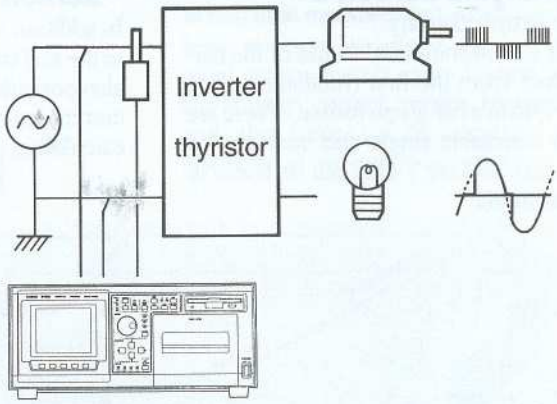
- Analysis of power quality at generating station
- Problem analysis of harmonics for phase synchronizing equipment
- Finding sources of harmonics

Near-instantaneous measurement



- Measurement of voltage, current and power over very short time intervals (voltage and current waveform recording and voltage, current and power measurement at device power-on)

Equipment evaluation



- Harmonic analysis of switching power supply units and related equipment
- Primary side harmonic analysis of semiconductor power conversion systems
- Secondary side fundamental frequency measurement of semiconductor power conversion systems

Main unit specifications

Basic specifications	Measurement functions	① Realtime standard power measurement ② Realtime harmonic analysis ③ Storage standard measurement ④ Storage harmonic analysis⑤ Waveform measurement	
	Input method	plug-in input units (two single-phase lines/unit)	
	Input unit count	Max. 3 units (9487 and 9488 units cannot be mixed.)	
	Measured lines	single-phase 2W, single-phase 3W, triple-phase 3W (dual power meter method), triple-phase3W(triple power meter method), triple-phase 4W	
	A/D resolution	14 bit, linearity 12 bit	
	*Analysys precision	(harmonic componenet amplitude) ±0.045 × 100 ÷ a(% rdg.) (harmonic phased angle) ±0.0248 × 100 ÷ a(°)	
	Sampling speed	PLL mode (measurement signal synchronized to 5 to 150Hz base wave). Fixed clock mode(internal clock) 1kS/s to 100kS/s	
	Memory capacity	14 bits × 128k words/channel (64k words each for voltage and current)	
	Fandamental wave input range	5Hz to 150Hz (in PLL mode)	
	Frequency ranges	10.00 Hz/100.0 Hz/1.000 kHz/10.00 kHz (only auto-ranging, effective measurement range: 10% to 99.99% of range; display from 4.000 Hz to 10.05 kHz)	
	Frequency accuracy	±0.1% rdg. ±1 dgt. (23°C ±3°C; 5 Hz to 10 kHz full-scale input)	
	External control terminal	BNC terminal, trigger I/O, TTL Level signal	
	Monitor out terminal	7-pin terminal strip, 2V AC/f.s. output current about 10mA (V1, V2, V3, A1, A2, A3)	
	Operating environment	5°C to 40°C, 80% RH max. (no condensation)	
	Power supply	85 to 132V AC/170 to 250VAC (50/60Hz), automatic switching	
	Power consumption	190VA max.	
	Dimensions and weight	approx. 178H × 430W × 420D mm., approx. 12kg. (excluding input units)	
	Accessories	Power cord 1, power supply plug 1, recording paper 1, roll paper shafts two, spare fuse 1	
Trigger	Trigger method	8 bit digital comparison	
	Trigger source	Measurement voltage (V), measurement current (A), EXT, or MANUAL	
	Trigger mode	Single, repeat, 1loop	
	Trigger level	Analog input: *Digital set in 2% steps from -200% to +200%, EXT: TTL level (CMOS possible) (*varies with hysteresis)	
	Hysteresis width	2, 4, 8, 16 or 32%	
	Pretrigger	0, 50, 100, -50, or -100% (of recording length)	
	Trigger output	TTL level (active low) pulse width about 50µs	
Measurement functions		**Realtime measurement**	**Storage measurement**
	Measurement items	Voltage (V1, V2, V3) (Vave-only realtime measurement), current (A1, A2, A3) (Aave-only realtime measurement), active power (W1, W2, W3, Wsum), apparent power (VA1, VA2, VA3, VAsum), reactive power (var1, var2, var3, varsum), power factor and phase angle (PF1/θ1, PF2/θ2, PF3/θ3, PFsum/θsum), fandamental wave frequency	
	Display	Numeric (all measured values)	Numeric (all measured values)/ Waveform can be observed and calculation start point specified.
	Memory division function	—	Maximum of 128 divisions of voltage and current waveform storage to memory
	Display refresh rate	Approx. once/s	—
		Realtime harmonic analysis	**Storage harmonic analysis**
	Analysis items	(Total through a specified harmonic) Total harmonic distortion, voltage (V1, V2, V3) (Vave-only realtime measurement), current (A1, A2, A3) (Aave-only real time measurement), active power (W1, W2, W3, Wsum), apparent power (VA1, VA2, VA3, VAsum), reactive power (var1, var2, var3, varsum), power factor and phase angle (PF1/θ1, PF2/θ2, PF3/θ3. PFsum/θsum), fandamental wave frequency	
		(Processing for each harmonic) Component for each harmonic, voltage, current, power, phase angle, impedance and fandamental wave frequency	
	Max and Ave functions	Displays maximums and averages for items for the sprcified count.	—
	Display refresh rate	Approx. once/s	—
	Simultaneous wafeform display	Not supported	Supported

*In the expressions defining analysis precision, a indicates the input level as a percentage (a minimum of 1%) of range full scale.

Measurement functions	**Realtime/storage harmonic analysis**	
	Analysis data count	512 points (one input signal waveform cycle)
	Analyzed harmonics	Through the 49th
	Bar graph display	Supported
	Window	Rectangular
	Anti-aliasing filter	Internal
	Waveform measurement	
	Time axis	(PLL mode) Automatic setting of base wave from 5Hz to 150Hz
		(fixed clock mode) 600µs, 1.2ms, 3ms, 6ms, 12ms, 30ms, 60ms/DIV
	Maxmum data storage time	See reference data below
	Time axis compression	×1~×1/100
	Waveform scroll	Supported
	Grid	on/off
Display and recorder	Display method	5-inch EL display (320 × 256 dot)
	Printer	Thermal line dot printout
	Recording paper	110mm. × 30m, thermally sensitive roll paper
	Recoding speed	1.2cm/s max.
Auxiliary functions	Printout functions	Display copy, manual print, auto-print (comparator, trigger, interval, maximum, average)
	Cursor measurement functions	Vertical axis level, level difference and horizontal axis time difference in bar graph display and waveform measurement display
	Clock function	Auto calendar, automatic leap year adjustment, 24-hour clock
	Clock accuracy	100ppm 25°C
	Scaling function	Direct reading of measured value by setting PT ratio, CT ratio and coefficient
	True rms/averaging display	Digital operation selection possible (V, A)
	Panel set functions	Beep on/off 3-position setting for rotary knob speed
	External storage	3.5-inch floppy disk, 2DD type MS/DOS format to 720KB or 640KB, 112 files, can store parameters and waveform data
	File operations	Load, save, delete, rename, format
	Interface	GP-IB (IEEE488-1978), RS-232C (start-stop synchronization) standard

Reference data

PLL mode: maximum 128 cycles independent of sampling rate
Fixed clock mode: table below

Sampling rate (kS/s)	Maximum storage time (s)
1	65.5 approx.
2	32.8 approx.
5	13.1 approx.
10	6.6 approx.
20	3.3 approx.
50	1.3 approx.
100	0.66 approx.

Optional specifications

		NEW 
	9487 INPUT UNIT	**9488 AC/DC DIRECT INPUT UNIT**
Input type	Voltage: direct input (floating) Current: direct input (floating) or clamp-on sensor	Voltage: direct input (floating) Current: direct input only (floating)
Voltage ranges	150.0/300.0/600.0 V	30.00/60.00/150.0/300.0/600.0 V
	Manual or auto ranging; effective measurement range: 10 to 120% of range selection, except maximum 100% in 600.0 V range	
Current ranges	200.0/500.0mA/1.000/2.000/5.000/10.00/20.00A	
	2.000/5.000/10.00/20.00/50.00/100.0/200.0A (clamp-on sensor 200 A range)	—
	Manual or auto ranging; effective measurement range: 10 to 120% of range selection	
	20 A, 200 A ranges to 150%	20 A range to 100%, display to 150%
Power ranges	Combination of voltage and current ranges (auto ranging only; effective measurement range: 10 to 120% of range selection	
Temperature coefficient	±0.05% f.s. / °C or less	
Power factor influence	±1.0% rdg. or less (55 Hz, power factor = 0.5)	±0.5% rdg. or less (55 Hz, power factor = 0.5)
Common mode voltage influence	—	±0.05% f.s. or less (with 600 Vrms applied between voltage/current input terminals and frame), except ±0.6% f.s. in 200 mA and 500 mA ranges
Crest factor	2.3 (maximum permitted input or less) for voltage.current and power	
Voltage input impedance	Approx. 1 MΩ	1 MΩ ±1% (DC)
Current input impedance	Approx. 0.2 mΩ or less (direct input connection) Approx. 1 MΩ (clamp-on sensor input terminals)	12 mΩ ±10% (DC)
Maximum permitted inputs	850 V peak (voltage input terminals) 50 A rms (direct input terminals) 12 V peak (clamp-on sensor input terminals)	600 V rms AC/DC (850 V peak) 35 A rms AC/DC (50 A peak)
Insulation resistance and withstand voltage	100 MΩ minimum at 500 V DC; 2200 V AC for 1 minute (1 mA) (Between voltage input terminals and frame and other metal terminals; between current direct input terminals and frame and other metal terminals) 1500 V AC for 1 minute (20 mA) (Between power supply and trigger input terminals, monitor out terminals and frame)	
Approximate external dimensions and weight	33 mm (H) × 191 mm (W) × 305 mm (D); 1 kg	33 mm (H) × 191 mm (W) × 305 mm (D); 0.9 kg
Standard accessories	9179 voltage input cable (3 m) - 1 set, spare fuse (0.3 A) -1	—

■ Specifications for 9270, 9271, 9272 CLAMP ON SENSORS and 9290 CLAMP ON ADAPTOR (sold separately)

		9270	9271	9272		9290
						
Rated current f.s. (output/range)		20A AC (2V/20A)	200A AC (2V/200A)	20A AC (2V/20A)	200A AC (2V/200A)	1000A AC (CT ratio 10:1)
Accuracy (23°C ± 3°C / 45 to 65Hz)	Vibration amplitude	±0.5% rdg. ±0.05% f.s.				±1.5% rdg.
	phase	±0.2° max.				±1.0° max.
Frequency characteristics (vibration amplitude, phase) (deviation from the basic accuracy)		at 10Hz to 20kHz ±1.0%, ±0.5° max. at 5Hz to 50kHz ±2.5%, ±1.0° max.		at 10Hz to 1kHz ±1.0%, ±0.5° max. at 5Hz to 10kHz ±2.5%, ±2.0° max.		at 40Hz to 1kHz ±1.0% rdg. ±1° max. at 20Hz to 4kHz ±2.5% rdg. ±3° max.
Operating input range		0 to 50 Arms	0 to 300 Arms	0 to 60 Arms	0 to 300 Arms	0 to 1000 Arms
Max. permissible input (continuous)		100 Arms	500 Arms	400 Arms (for 10 min.)		1500 A (5 minutes max.)
Input resistance		Less than 0.2 mΩ	Less than 0.02 mΩ	Less than 0.02 mΩ		—
Temperature coefficient		Less than ±0.05% f.s./°C				—
Effect of conductor position		±0.3% max.		±1.5% max.		±1.5% max.
Effect of external magnetic fields		20mA equivalent typ	200mA equivalent typ	2.5A equivalent typ		0.8A equivalent typ
Max. circuit voltage		600V AC				
Measurable conductor diameter		ϕ 20mm max.		ϕ 46mm or 50 × 20mm bus bar max.		ϕ 55mm or 80mm width bus bar. Secondary coil ID 27 × 27mm
Dimensions weight (approx.)		60H × 145W × 33D mm, 230g		174H × 62W × 33D mm, 420g		194H × 99W × 33D mm, 500g
Cable length		3 m				

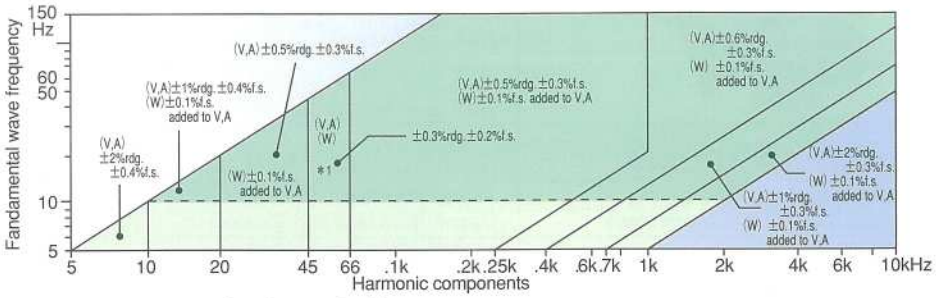
■Accuracy (23°C ±3°C, power factor=1, PLL mode, anti-aliasing filter off)

• Accuracy indications

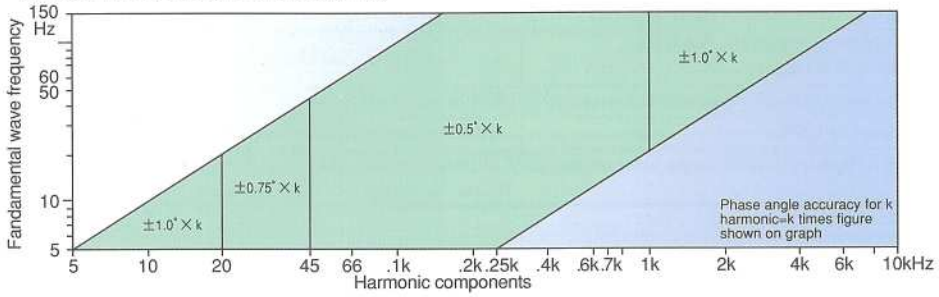
Read off the fundamental frequency on the vertical axis, and draw a horizontal line to the right, then find the frequency of the required harmonic on the horizontal axis, and draw a vertical line from it - the intersection of these two lines gives the accuracy.

9487 INPUT UNIT

Measurement Accuracy for Voltage (V), current (A), & Active Power (W) (For a fundamental frequency of less than 10 Hz, the accuracy for power measurement is not specified.)

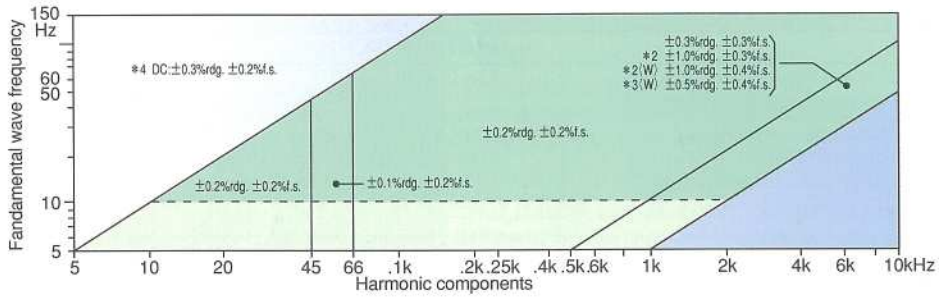


Measurement accuracy for phase angle (θ)

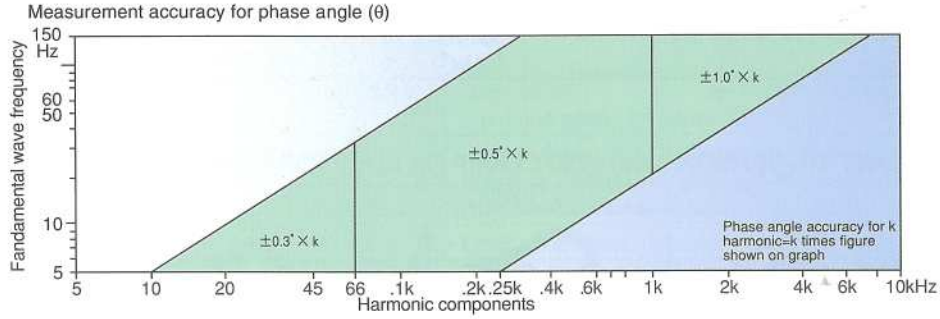


9488 AC/DC DIRECT INPUT UNIT

Measurement Accuracy for Voltage (V), current (A), & Active Power (W) (For a fundamental frequency of less than 10 Hz, the accuracy for power measurement is not specified.)



Measurement accuracy for phase angle (θ)



Notes

* 1 To the measurement accuracy for active power measurement (W) for a fundamental frequency of 45 to 66 Hz, in the 0.2/0.5 A ranges (2/5 A ranges using a 200 A clamp), add ±0.1% f.s. * 2 Using the 0.2/0.5 A ranges. * 3 Using 1 A to 20 A current ranges.

1. For harmonic analysis, add the tolerance of the 3195 main unit. 2. When using a clamp on sensor, add the respective tolerance. 3. For the accuracy of apparent power, reactive power and power factor, add ±1 dgt. to the tolerance for active power. 4. For the accuracy of Wsum, VAsum, varsum, and PFsum, add ±3 dgt. to the tolerance for active power.

Ordering information

3195 DIGITAL POWER ANALYZER

* The 3195 alone cannot be used for testing; order the necessary number of 9487 INPUT UNITS, or 9488 AC/DC DIRECT INPUT UNITS. If using a clamp on sensor with the 9487, this must also be ordered separately.

Note that 9487 and 9488 INPUT UNITS cannot be mixed in a single system, and also that it is not possible to use a clamp on sensor with the 9488.

• Options

Products which can be installed at factory shipment or by the user.

9487	INPUT UNIT
9270	CLAMP ON SENSOR (with case)
9271	CLAMP ON SENSOR (with case)
9272	CLAMP ON SENSOR (with case)
9290	CLAMP ON ADAPTOR (with case)
9488	AC/DC DIRECT INPUT UNIT

• Optional accessories

9221	RECORDING PAPER (30m, 10 rolls)
9151-02	GP-IB CONNECTOR CABLE (2m)
9151-04	GP-IB CONNECTOR CABLE (4m)
9165	TRIGGER CORD
9360	CARRYING CASE (for three clamp on sensors)

HIOKI E.E. CORPORATION

DISTRIBUTED BY

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All information correct as of Sep. 22, 1993. All specifications are subject to change without notice.

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