HIOKI

Single Phase through triple-phase four-line, in wired and clamp modes.

Upgradable Multi-function Power Meter

DIGITAL POWER Hi TESTER

3191

Digital Power Meter

Power Meter/Analysis Station with Unmat

Three new clamp-on sensors allow use as a high-performa

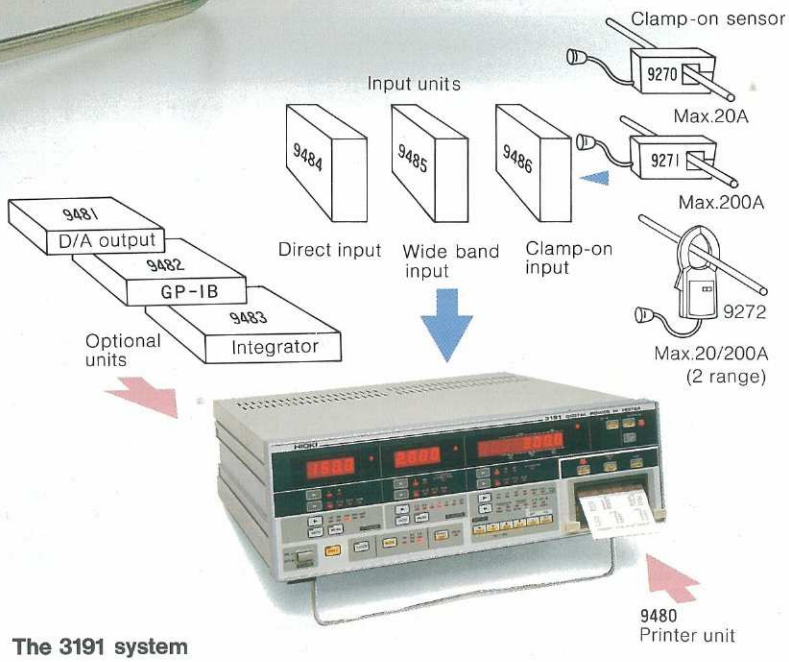
3191 DIGITAL POWER HITESTER

ched Potential

nce clamp power meter

The 3191 digital power hi-tester offers a wide selection of measurement functions which can be combined with various input units to cover single-phase lines up through triple-phase, four-line configurations. Here is the flexibility, precision and reliability needed in today's industry.
With three input units, it can be used in direct connection or clamp-on measurement modes. Optional accessories include a printer, a GP-IB interface, an integrator, and D/A output, making it possible to upgrade your system to handle everything from measurement to data collection and analysis.

Can measure all items at same point in time



The 3191 system

Features

- *Handles wide range of power lines*
- *Rich array of options to enhance system capabilities*
- *Scaling function for PT ratio and CT ratio*
- *Usable with a high-performance clamp-on sensor, allowing measurements to be taken from live circuits*
- *Recorder output standard for voltage, current and active power, and waveform monitor output for voltage and current.*
- *Voltage and current rectification selectable*
- *Averaging for voltage, current and power*
- *Realtime control*
- *Battery back-up*

Rich Selection of Functions with Simple Operation

Functions

1. Modular design for free expandability
Through the use of various input units, the 3191 is capable of handling arrays from single-phase through triple-phase, four-line configurations. And the user can select either direct connection of clamp-on measurement.

2. Measurement of all items at the same point in time
Holds measurements for voltage, current and active power for each channel at the same point in time, and A/D converts them. This means there is no time deviation for any parameter, including inactive power, phased power and power factor.

3. PT and CT scaling function
Even in measurement with an external PT or CT, the scaling function allows direct reading of voltage, current, active power and other items.

4. V-A-W analog output standard
Recording is possible because analog output is provided for voltage, current and active power for each channel. And voltage and current have a monitor output for observation and waveform recording.

5. Rectification selection
Rectification type can be selected for both voltage and current to suit specific measurement needs.
rms: displays true rms
averaging: displays average as converted from true rms

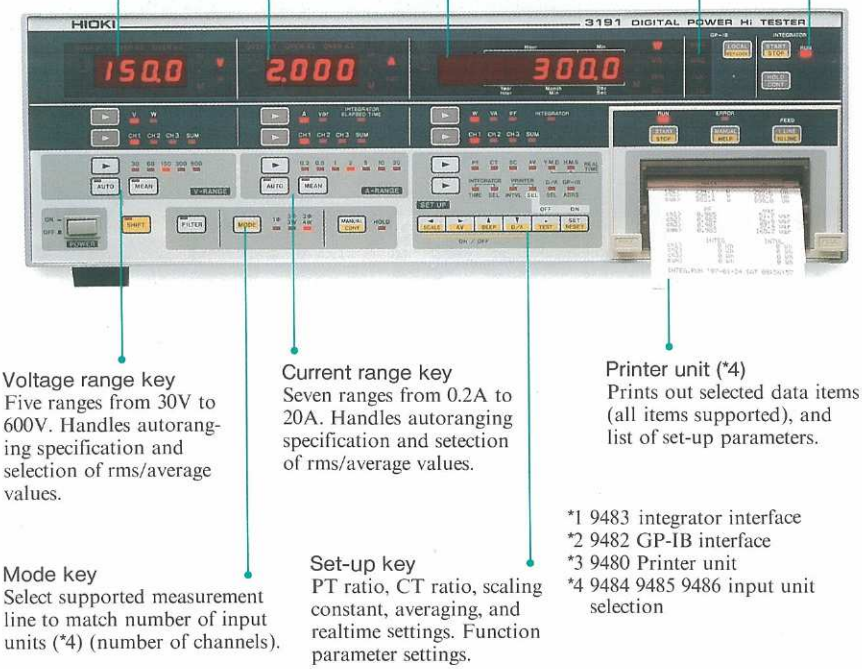
6. Averaging function
Measured values for voltage, current and power can be displayed as averages for a specific number of counts, or over a specified period of time. This is extremely effective for measurement processing on the macro level, such as measurement of fluctuating load or low-frequency signals.

7. Realtime control
Integrator, averaging and interval print can be started at specified times (integrator and printer are options).

8. Back-up function
The internal battery saves all set-up parameters and integrator values, even if there should be a power failure.

9. High-precision clamp-on sensor
An astonishing ±0.2% precision even for clamp-on measurement.

10. Load Factor (LF) calculation and printing
Load factor data provides an easy guide to operational status.



Measurement items and equations

		Voltage V	Current A	Power W	Phased power VA	Reactive power var	Power factor PF	* Integrator Wh	* Integrator Ah
CHi (i : 1~3)		Vi	Ai	Wi	ViAi	$si\sqrt{(ViAi)^2-Wi^2}$	$\frac{si\ \lvert Wi\rvert}{ViAi}$	Wih	Aih
SUM	1φ	$\frac{1}{N}\Sigma Vi$ (N: No.of unit)	$\frac{1}{N}\Sigma Ai$ (N: No.of unit)	ΣWi	ΣViAi	$\Sigma si\sqrt{(ViAi)^2-Wi^2}$	$\frac{su\ \lvert\Sigma Wi\rvert}{\Sigma ViAi}$	ΣWih	ΣAih
	3φ 3W	$\frac{1}{2}(V_1+V_2)$	$\frac{1}{2}(A_1+A_2)$	W_1+W_2	$\frac{\sqrt{3}}{2}(V_1A_1+V_2A_2)$	$s_1\sqrt{(V_1A_1)^2-W_1^2}+s_2\sqrt{(V_2A_2)^2-W_2^2}$; s_1 and s_2 are −1 for LEAD, +1 for LAG	$\frac{su\ \lvert W_1+W_2\rvert}{\frac{\sqrt{3}}{2}(V_1A_1+V_2A_2)}$	$(W_1+W_2)h$ or W_1h+W_2h	A_1h+A_2h
	3φ 3W (3V 3A)	$\frac{1}{3}(V_1+V_2+V_3)$	$\frac{1}{3}(A_1+A_2+A_3)$	W_1+W_2	$\frac{\sqrt{3}}{3}\Sigma ViAi = \frac{\sqrt{3}}{3}(V_1A_1+V_2A_2+V_3A_3)$	$s_1\sqrt{(V_1A_1)^2-W_1^2}+s_2\sqrt{(V_2A_2)^2-W_2^2}$; s_1 and s_2 are −1 for LEAD, +1 for LAG	$\frac{su\ \lvert W_1+W_2\rvert}{\frac{\sqrt{3}}{3}\Sigma ViAi}$	$(W_1+W_2)h$ or W_1h+W_2h	A_2h+A_2h
	3φ 4W	$\frac{1}{3}(V_1+V_2+V_3)$	$\frac{1}{3}(A_1+A_2+A_3)$	ΣWi	ΣViAi	$\Sigma si\sqrt{(ViAi)^2-Wi^2}$	$\frac{su\ \lvert\Sigma Wi\rvert}{\Sigma ViAi}$	$(W_1+W_2+W_3)h$ or $W_1h+W_2h+W_3h$	$A_1h+A_2h+A_3h$

Notes
- Vi, Ai, and Wi are obtained by analog processing.
- Values other than Vi, Ai, and Wi are calculated from the measured values (Vi, Ai, and Wi), which are obtained by analog processing and thus do not have the ±1-digit rounding error that is incurred with digital processing.
  The accuracy is ±1 digit for values calculated directly from the measured values. and ±3 digits for summed values.
- si is −1 for LEAD, and +1 for LAG, indicating polarity
- su is −1 when var SUM is negative, and +1 when positive
- Refer to general specifications for precisions of Vi, Ai, and Wi

*Optional
- Only specified data is input to the integrator (up to three items can be input and integrated at once).

Expanded Measurement Range through Wide Array of Options

Options

All options are plug-in in design, making it possible for the user to directly upgrade the system quickly and easily.

Input units

9484 direct input unit (10Hz to 10kHz)
9485 wide-range input unit (10Hz to 30kHz)
9486 clamp-on input unit (10Hz to 30 kHz)
Select to match specific measurement needs. . . system will support up to three channels.

9482 GP-IB interface

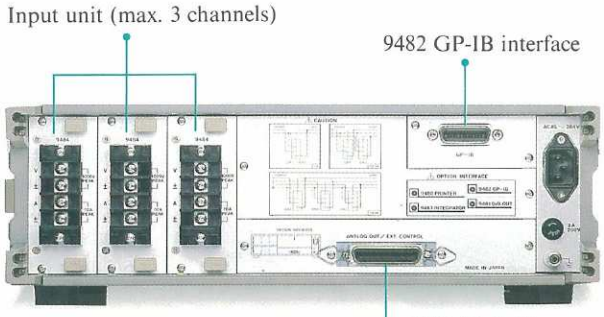
All function can be controlled through remote control with the exception of the power supply.

9483 integrator interface

Simultaneous integration of any three items from current and active power for all three channels.

9480 printer unit

Any or all measurement items can be selected and printed.



▲3191 Digital Power Hi Tester rear panel

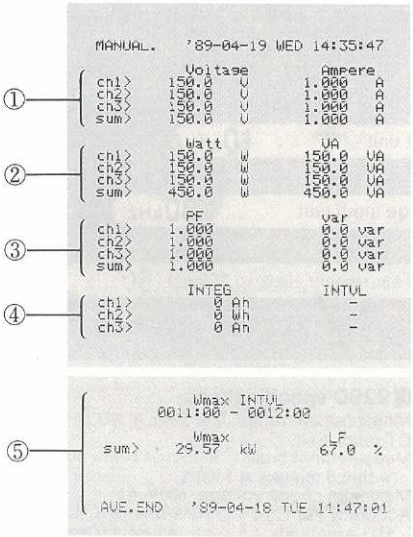

▲9486+9270

9481 D/A output interface

Analog output for any three calculated data items, for any of the three channels, including inactive power, phased power, power factor and integrated values (analog output of integrated values requires the 9483 unit).

Data print sample

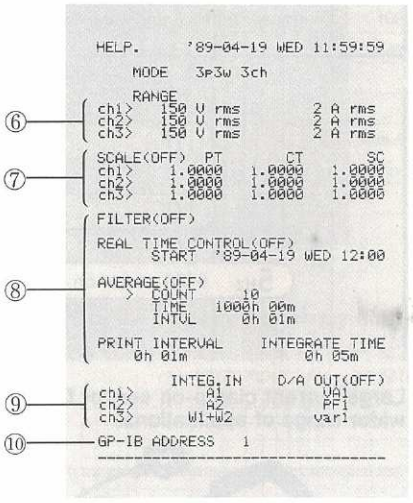
Prints the voltage, current, power, power factor and integrated value for each channel.



①Voltage, current and averages for all three channels.
②Active power and phased power values for all three channels, and sum.
③Inactive power and power factor for all three channels, and sum.
④Integrated power and integrated power per interval for all three channels, and sum.

HELP function print sample

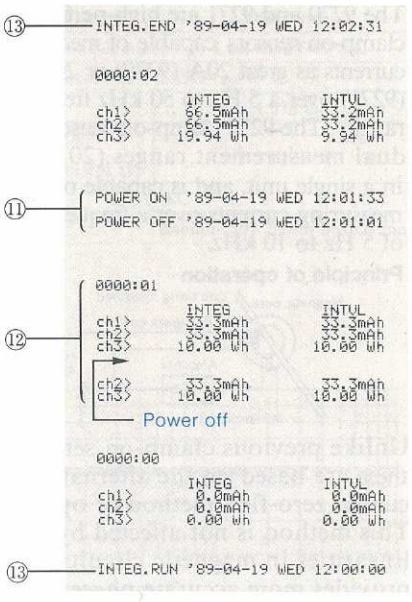
Handy for keeping track of the range, scaling, date and time, and interval for a measurement.



⑤Load factor, and intervals showing max. power and min. power readings.
⑥Voltage and current ranges for all three channels.
⑦Scaling constants for all three channels.
⑧Filter, realtime control, averaging, print interval and integration time settings.
⑨Integrator input and D/A output for all three channels.

Power off print sample

After integrator start, data is backed up even if a power failure occurs, and the times are printed out for power failure and power restoration.



⑩GP-IB interface address.
⑪Power failure time and restoration time.
⑫If power fails during printout, printing starts again by printing the same item.
⑬Integration start and stop date and time.

9486 clamp unit to covers from 5Hz to 50kHz

Measures Inverter-controlled Power !!

Input unit

The 3191 power hi-tester input units can be freely selected and combined to handle a range of measurement applications and methods. Their plug-in design means that a single 3191 can handle measurement from single-phase lines to triple-phase, four-line configurations, or use input units independently to measure three single-phase lines.

For unbalanced triple-phase three-line configurations, the 3V3A mode provides accurate phased power and power factor measurements.
The frequency range stretches from 5Hz to 50kHz, and the 3191 can handle inverter measurement as well. . . a surprisingly wide range of applications.

Three types of input units

9484 input unit

High-precision input unit that covers frequencies from 10Hz to 20kHz.

9485 wide-range input unit

An even wider range than the 9484, with enhanced precision that makes measurement of even traditionally hard-to-measure inverter power accurate.

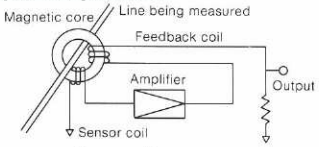
9486 clamp unit

By using the 9270 • 9271 or 9272 clamp-on sensor and the 9486 clamp unit together, the 3191 can be used as a clamp-on power meter. The 9270 • 9271 clamp-on sensors cover a wide range of frequencies from 5Hz to 50kHz. (9272 = 5Hz ~ 10kHz)

9270•9271•9272 clamp on sensors

The 9270 and 9271 are high-performance clamp-on sensors capable of measuring currents as great 20A (9270) or 200A (9271) over a 5 Hz to 50 kHz frequency range. The 9272 clamp-on sensor provides dual measurement ranges (20A/200A) in a single unit, and is capable of measuring currents over a frequency range of 5 Hz to 10 kHz.

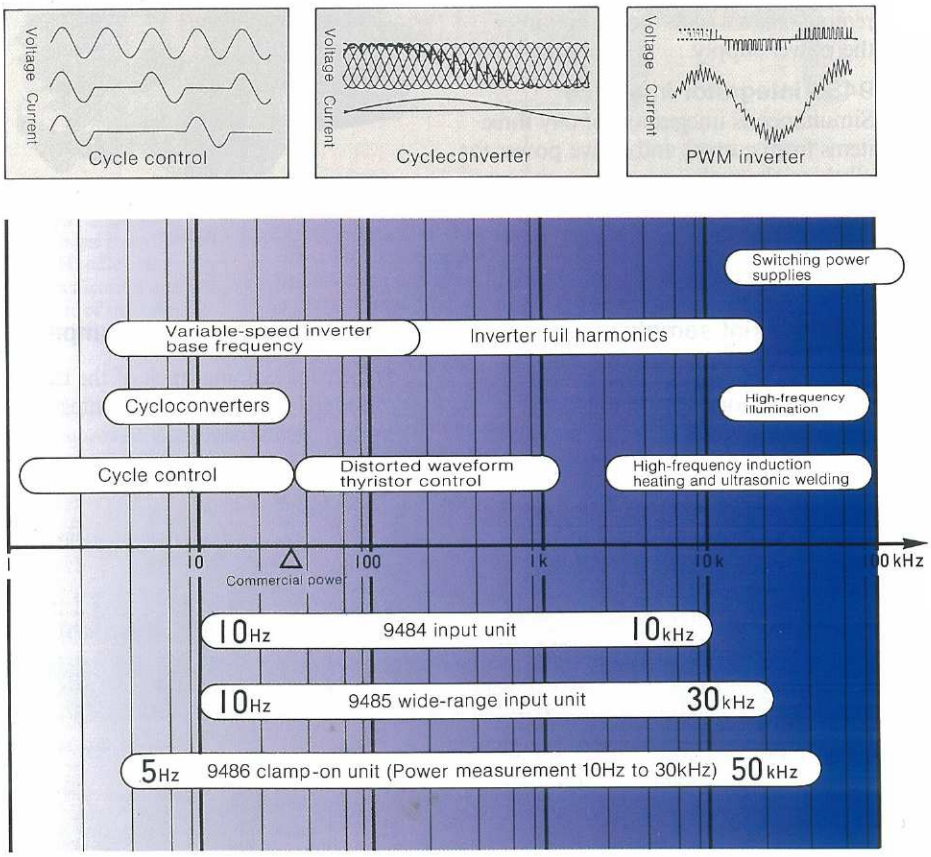
Principle of operation



Unlike previous clamp-on sensors, these are based on the alternating current zero-flux method of operation. This method is not affected by non-linearities in magnetic circuits, provides more accurate phase characteristics, and has a wider frequency response. All of these advantages are achieved in the new 9270•9271 and 9272 clamp-on sensors.

The 9555 sensor unit permits current monitoring with the 9270 series clamp-on sensors and no additional units.
Note: Refer to the section on clamp sensor related products.

Wide frequency coverage



Large-current clamp-on sensor for a wider range of applications.

Cord length: 3m

The 9290 is a 10:1 clamp adapter for high-precision measurement of currents up to 1500A AC. Compared with former types, it offers wider frequency characteristics and better phase characteristics that reduce the influence of the power factor, making it suitable for power measurement with a poor power factor.

■9290 specifications

Measurement range: 0 to 1500 A AC
CT ratio: 10:1
Measurement time: Continuous below 1000A, within 5 minutes at 1500A
Maximum circuit voltage: 600V AC
Accuracy (23°C±3°C): (10A to 1500A, 45Hz to 66 Hz) Amplitude: 1.5% rdg. Phase: 1.0°max.
Frequency characteristic (deviation from accuracy):
Amplitude; 1% rdg. (40 Hz to 1 kHz)
2.5% rdg. (20 Hz to 4 kHz)
Phase; 1.0° max. (40 Hz to 1 kHz)
3.0° max. (20 Hz to 4 kHz)
Effect of external magnetic fields: 0.8 A equivalent (at 400 A/m)
Dielectric resistance: 2200 V AC (between the core and the case)
Core opening: φ55mm; accepts up to 80mm-wide busbar
Dimensions, weight: 194H×99W×33D mm, approx. 500g
Accessories: 9148 carrying case 1, Marking bands 6

Input unit specifications

	Voltage			Current			Power		
Measurement range	30.00/60.00/150.0 300.0/600.0V			200.0/500.0mA/1.000 2.000/5.000/10.00/20.00A			Depending on combination of voltage and current		
Max. non-destructive input (continuous)	1000V peak			70A peak			———		
Crest facter	2.5 max.			2.5 max.			Same as voltage and current		
Input resistance (55Hz)	1MΩmin.			Approx. 3mΩ			———		
Effect of power factor (55Hz)	———			———			±0.6% rdg. where power factor=0.5 (9486 : ±0.4%rdg.)		
Temperature coefficient	Less than ±0.04%f.s./°C			←			←		
Accuracy (23°C±3°C, Power factor 1)	9484	9485	9486	9484	9485	9486	9484	9485	9486
5Hz			±2.0%			±2.0%			
10Hz	±1.5%f.s. (300V max.)	±0.4%rdg. ±0.4%f.s.	±1.0%	±1.5%f.s. (10A max.)	±0.4%rdg. ±0.4%f.s. (10A max. at 20Hz or less)	±1.0%	±1.5%f.s. (300V,10A max.)	±1.0%f.s. (10A max.)	±1.0%
20Hz	±0.4%rdg. ±0.2%f.s.			±0.4%rdg. ±0.2%f.s.			±0.4%rdg. ±0.2%f.s.	±0.4%rdg. ±0.4%f.s.	
45Hz	±0.2%rdg. ±0.2%f.s.	←	←	←	←	±0.2%rdg. ±0.1%f.s.	±0.2%rdg. ±0.2%f.s.	←	←
66Hz	±0.4%rdg. ±0.2%f.s.	±0.4%rdg. ±0.4%f.s.	±1.0%	±0.4%rdg. ±0.2%f.s.	±0.4%rdg. ±0.4%f.s.	±1.0%	±0.4%rdg. ±0.2%f.s.	±0.4%rdg. ±0.4%f.s.	±1.0%
2kHz	±2.0%f.s.			±1.5%f.s.			±2.0%f.s.	±1.0%f.s.	
5kHz	±4.0%f.s.		±1.0%				±4.0%f.s.		
10kHz		±1.0%f.s.		±2.0%f.s.	±1.5%f.s.			±3.0%f.s.	±3.0%
20kHz								±6.0%f.s.	
30kHz			±2.0%			±2.0%			
50kHz									

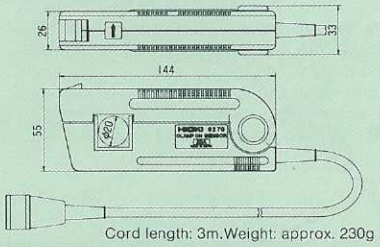
1. Accuracy shown represents deviation from the basic accuracy (at 45 to 66 Hz).
2. The accuracy indicated above applied when an ac signal is input to the unit's current terminal.
3. When used together with the 9270(or 9271, 9272), resulting accuracy is the sum of that indicated above and the accuarcy of the 9270 (or 9271, 9272).

9270, 9271, 9272 clamp on sensor specifications

	9270	9271	9272	
Rated current f.s. (output/range)	20A AC(2V/20A)	200A AC(2V/200A)	20A AC(2V/20A)	200A AC(2V/200A)
Accuracy (23±3°C, 45 to 65Hz)	±0.5%rdg. ±0.05%f.s. (vibration amplitude) ±0.2° max (phase)			
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.	
Operating input range	0 to 50 Arms	0 to 300 Arms	0 to 60 Arms	0 to 300 Arms
Max. permissible input (continuous)	100 Arms	500 Arms	400 Arms	
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.	
Effect of external magnetic fields	20mA equivalent typ	200mA equivalent typ	2.5A equivalent typ	
Max. circuit voltage	600V AC			
Measurable conductor diameter	φ20mm max.		φ46mm, 50×20mm busbar max.	

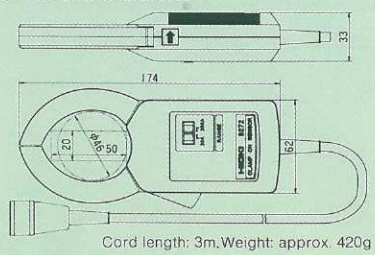
●9270, 9271 dimension

Unit: mm



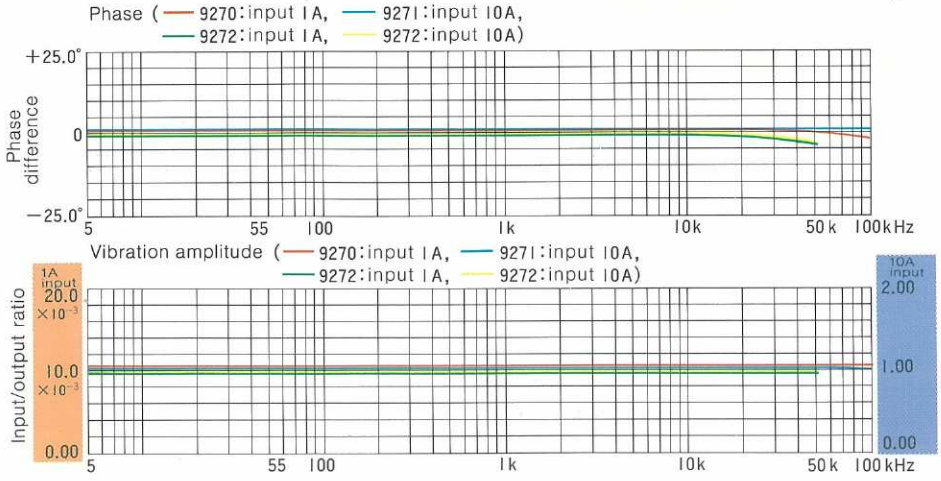
Cord length: 3m,Weight: approx. 230g

●9272 dimension



Cord length: 3m,Weight: approx. 420g

●9270, 9271, 9272 frequency characteristics



General specifications

Display: LED (Light Emitting Diode)
Display digits:
Display a, ±9999 (V, W)
Display b, ±9999 (A, Var)
Display c, (±9999(W, VA, PF) / 99999999(Wh, Ah)
Display units: m, k, M, V, A, W, VA, var, Wh, Ah
Sampling rate: Approx. 2.5 times
A/D conversion resolution: 0.05% of range (polarity +11 bits)
Effective input range: 10 to 102% of range
Response time: Approx. 0.8s (analog output for V, A and W)
Analog output: V, A, W, W_1+W_2, $W_1+W_2+W_3$ for each channel, 2V DC/f.s. accuracy ±0.2% f.s.
Monitor output: V, A for each channel 2Vrms/f.s.
External control: A/D trigger (sampling start in hold). Integration start/stop and printer printout commands supported with options
Realtime clock: accuracy ±100 ppm (25°C)
Operating environment: 0 to 40°C (RH80% max. no condensation)
Common mode voltage effects: Voltage 0.05% f.s. max (input terminals shorted, 1000V between input and case).
Current 0.05% f.s. max (input terminals open, 1000V between input and case).
Insulation resistance: (100MΩ min. at 500V DC, Between V/A input and case, between V/A input and output, between V and A inputs, between case and power supply, between output and power supply).
Dielectric strength: 2.2kV AC one minute (Between V/A input and case, between V/A input and output, between V and A inputs)
1.5kV AC one minute (between case and power supply, between output and power supply)
Power supply: 85 to 250V AC (45 to 66Hz)
Consumed power: 80VA max. (100V/60Hz with all options, about 42VA at initial state)
Dimensions and weight: 133H×430W×435Dmm. approx. 13kg (with all input units and options)
Accessories: Power cord (1), midget fuse 3A (1), connector(1)
Note: Consumed power and weight are for configuration with 9484 input units.

Other functions

○ Scaling: Displays (PT ratio/CT ratio/scaling constant)×(measured value). Constant from 0.0001 to 10000.
○ Averaging: Counter mode: Set sample count (1 to 100) and display averages. Timer mode: Set time to be averaged (1 min. to 1 h), and display average from start time.
○ Load factor: Prints the maximum average power value for each interval, the resultant load factor, and the interval number that the maximum was measured in.
LF = War/ Wmax.
Wav = (total average power)
○ Filter: Harmonics over 500Hz are cut out for stable phase detection.
○ Range selection either automatic or manual.
○ Detects over input (peak of 2.5 times range), lights warning LED
○ Sampling is selectable between continuous (2.5 times/s) or manual

Resolution

V	A	200.0mA	500.0mA	1.000A	2.000A	5.000A	10.00A	20.00A
30.00V	1φ	6.000W	15.00W	30.00W	60.00W	150.0W	300.0W	600.0W
	3φ3W	12.00/9.999	30.00	60.00	120.0/99.99	300.0	600.0	1.200k/999.9W
	3φ4W	18.00/9.999	45.00	90.00	180.0/99.99	450.0	900.0	1.800k/999.9
60.00V	1φ	12.00W	30.00W	60.00W	120.0W	300.0W	600.0W	1.200kW
	3φ3W	24.00	60.00	120.0/99.99	240.0	600.0	1.200k/999.9W	2.400
	3φ4W	36.00	90.00	180.0/99.99	360.0	900.0	1.800k/999.9	3.600
150.0V	1φ	30.00W	75.00W	150.0W	300.0W	750.0W	1.500W	3.000kW
	3φ3W	60.00	150.0/99.99	300.0	600.0	1.500k/999.9W	3.000	6.000
	3φ4W	90.00	225.0/99.99	450.0	900.0	2.250k/999.9	4.500	9.000
300.0V	1φ	60.00W	150.0W	300.0W	600.0W	1.500kW	3.000W	6.000kW
	3φ3W	120.0/99.99	300.0	600.0	1.200k/999.9W	3.000	6.000	12.00/9.999
	3φ4W	180.0/99.99	450.0	900.0	1.800k/999.9	4.500	9.000	18.00/9.999
600.0V	1φ	120.0W	300.0W	600.0W	1.200kW	3.000kW	6.000kW	12.00kW
	3φ3W	240.0	600.0	1.200k/999.9W	2.400	6.000	12.00/9.999	24.00
	3φ4W	360.0	900.0	1.800k/999.9	3.600	9.000	18.00/9.999	36.00

Option specifications

●9480 printer unit
- Thermal printer
- Paper width: 80mm
- Print interval: 1 minute to 1000 hours
- Panel settings/data printout
- Externally-controlled printout or manual printout
- Simultaneous start with (optional) integrator

●9481 D/A output interface
- 3-channel 12-bit D/A converter
- Output: 2VDC/f.s.
- Precision: ±0.1% of main unit precision at full scale
- Temperature coefficient: Max ±0.02% of f.s./°C
- Sampling rate: 2.5 samples/s
- Analog output: VA, var, PF, Wh* or Ah* (any three).
*Requires optional 9483 integrator interface.

●9482 GP-IB interface
- IEEE488-1978 compatible
- SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C0
- All panel setting can be set remotely

●9483 integrator interface
- 3-channel integrator: Displays up to 8 digits
- Integration interval: 1 minute to 1000 hours (10000 hours for 0 setting)
- Integration time precision: ±0.02% ±1 s (0~40°C)
- Integration value precision ±0.2% of main unit precision, ±1 dgt.
- Temperature characteristics: ±1% of reading (0°C to 40°C, 23°C optimum)
- Integration of any three of A, W, W_1+W_2 (3-phase, 3-wire) or $W_1+W_2+W_3$ (3-phase, 4-wire) for any channle
- External control allows simultaneous start/stop for all channels

●9484 direct input unit
●9485 wide band input unit
●9486 clamp unit
●9270 clamp on senser
●9271 clamp on senser
●9272 clamp on senser

Refer to P.6

Note
The 3191 digital power meter cannot be used alone.
Power measurement requires one or more input units.

●Optional units

9484 Direct input unit
9485 Wide band input unit
9486 Clamp unit
9270 Clamp on sensor
9271 Clamp on sensor
9272 Clamp on sensor

Note
Each clamp on sensor (9270, 9271, 9272) requrires a 9486 clamp unit.

Old-style 3191 requires modification to mount the 9486 input unit. Please contact your vendor for details.

9480 Printer unit
9481 D/A output interface
9482 GP-IB interface
9483 Integrator interface

●Optional accessories

9223 Recording paper (30m, 5 rolls)
9290 Clamp on adapter (1500A AC Max.)
9405 Rack-mounting kit (JIS)
9405-01 Rack-mounting kit (EIA)
9545 Alumi carrying case

((((Clamp Sensor Related Products))))

This power unit makes current monitoring possible with the 9270 series clamp-on sensors and no additional units.

Applicable sensors: 9270, 9271, 9272
Output: 2V AC/f.s.
Power requirements: 85V to 265V AC (47 Hz to 440 Hz)
Dimensions, weight: 100H×48W×180D mm, approx. 700g
■ Clamp-on sensors are sold separately

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