

HIOKI



Power Meter 1994

3165

CLAMP ON POWER HITESTER

New Clamp Sensor Yields Superior Frequency Response

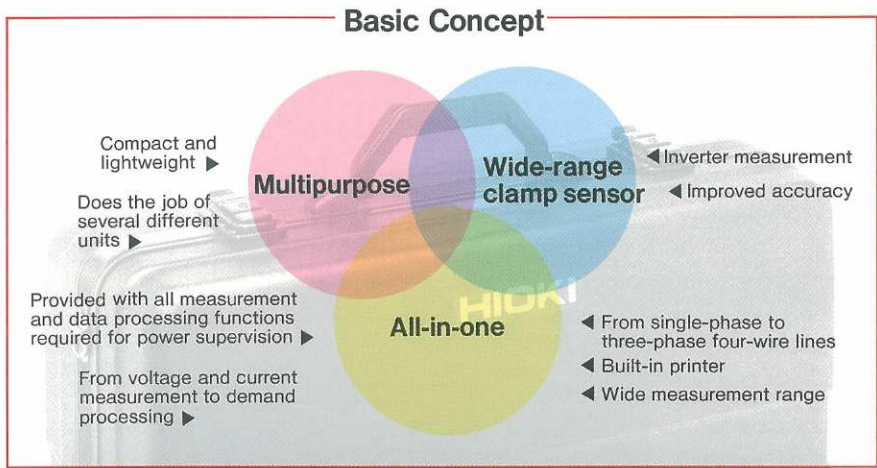
Multipurpose Power Meter Does Inverter Measurement Too!



A Multipurpose Power Tester You Can Carry With You Anywhere

The compact and lightweight 3165 Clamp OnPower Hi Tester is provided with all measurement functions and data processing capabilities required for electric power supervision. Its newly developed clamp sensor and voltage input section make possible the measurement of low frequencies, difficult with conventional power meters. Accurate power measurement can be performed over a wide frequency range from 10Hz to 20kHz. Inverter measurement is also supported. The complete array of data processing functions of this multipurpose power tester makes it suitable for a wide variety of applications, from power line maintenance and supervision to development tests.

- Single unit capable of measuring single or multi-phase power lines (up to 3-phase/4-wire line)
- Allows measurement over wide range of frequencies, from 10 Hz to 10 kHz
- Wide span of measurement ranges, from 2A to 200A/200W to 240 kW (when used with the 9272 Clamp On Sensor)
- Calculates and displays or records apparent and reactive power, watt-hours, power factor, and frequency
- Large LCD panel allows simultaneous display of a variety of measurements
- Choice of RMS or average rectification for effective voltage and current
- User-selectable scaling, comparator settings, and output (digital/analog or analog only)
- Printer provides data and graph printing and analog recording
- Allows realtime control of watt-hour meter and printer
- Direct reading made possible by the PT and CT ratio multiplication function
- Built-in RS-232C interface



Clamp-on sensor and voltage cord connector permitting the measurement of single-phase to three-phase four-wire lines.
 ■ The clamp sensors are sold separately.

LCD with two display modes, for measurement and setting respectively

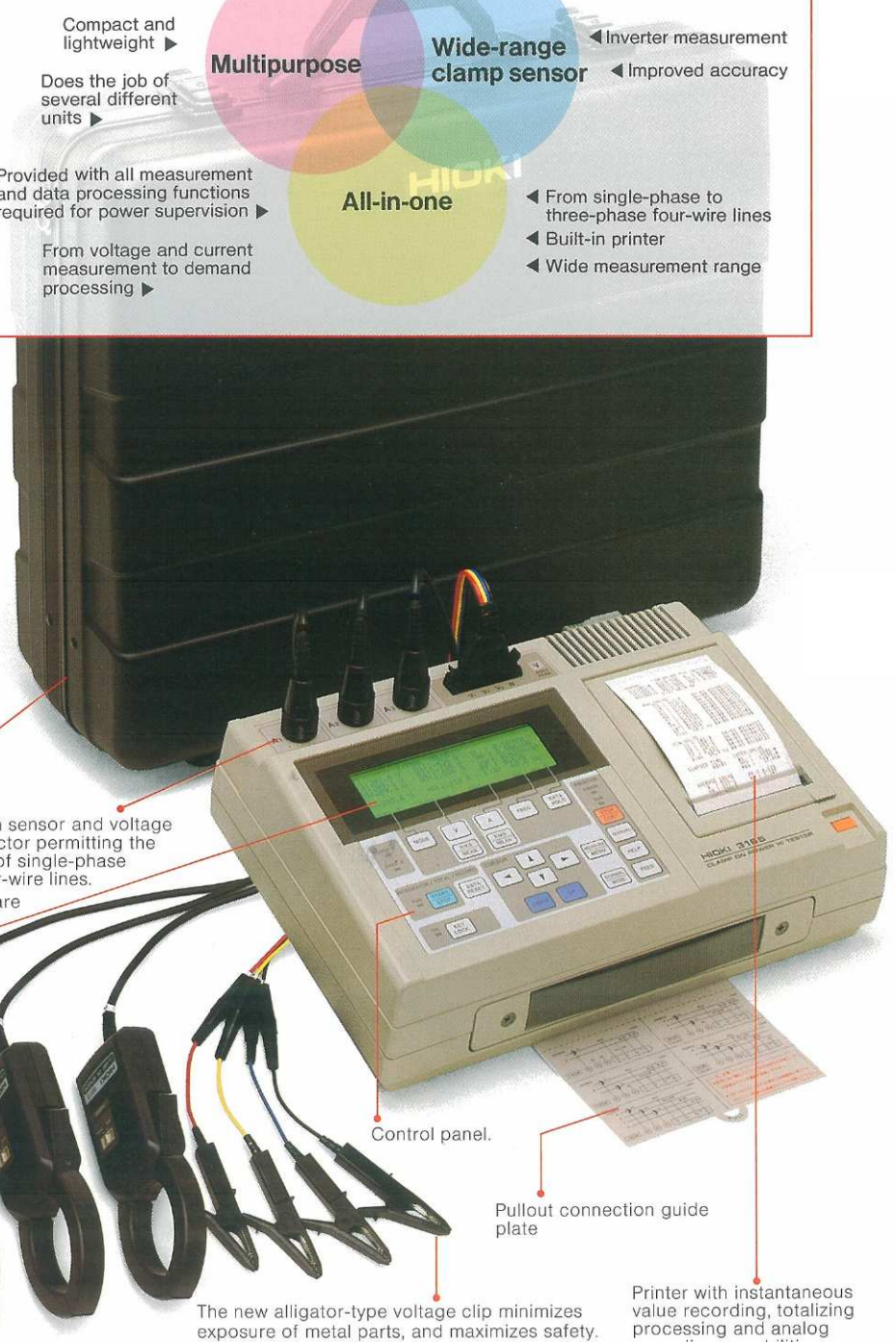
Control panel.

Pullout connection guide plate

9365 Carrying case, with space for the main unit and accessories
 ■ Sold separately.

The new alligator-type voltage clip minimizes exposure of metal parts, and maximizes safety. (Conforms with IEC 348)

Printer with instantaneous value recording, totaling processing and analog recording capabilities





Measures Voltage 1 to Power Factor, Watt-ho
All Measurements
 Letting you Grasp the

MEASURE MENU

Measurement Indications

Menus Indications

Normal Indication

P1	U1:207.4 U	A1:2.434 A	W : 0.504kW
	U2:209.1 U	A2:2.738 A	UA : 0.806kVA
	U3:209.3 U	A3:1.526 A	var: 0.629kvar
*U:	208.6 U	*A:2.232 A	F/A: 68.0 Hz
3P3W-3	200Urms	50Arms	#A

P1 Instantaneous value

The instantaneous value is displayed for all parameters, except integrated values. Line voltage and average current are also displayed for three-phase lines.

P2 Instantaneous maximum value

P2	U1:211.4 U	A1:2.834 A	W : 0.518kW
	U2:213.1 U	A2:2.853 A	UA : 0.824kVA
	U3:213.2 U	A3:1.552 A	var: 0.641kvar
			PF: 0.634
			F/A: 68.1 Hz
3P3W-3	200Urms	50Arms	#A

P2 Instantaneous maximum value

The instantaneous maximum value is displayed for all parameters, except integrated and average values.

P3 Instantaneous minimum/maximum values

P3	U1:203.9 U	U1:211.4 U	
	U2:205.5 U	U2:213.1 U	
	U3:205.7 U	U3:213.2 U	
	PF: 0.622	PF: 0.634	
	F/A: 59.9 Hz	F/A: 68.1 Hz	
3P3W-3	200Urms	50Arms	#A

P3 Instantaneous minimum/maximum values

Displays instantaneous maximum and minimum voltage, power factor and frequency values.

P4 Integrated/average values

P4	REAL TIME	INTEG	AVERAGE
	09:13:12	8986.mWh	W : 515.3 W
		13698.mVAh	UA : 821.8 UA
	ELAP TIME		var: 639.3 var
	0000:01		PF: 0.628
		37.46m*Ah	*A: 2.247 A
3P3W-3	200Urms	50Arms	#A

P4 Integrated/average values

Besides the integrated active and apparent power values, the integrated result and average within a certain period of a specified parameter are also displayed.

P5 Totalized values

P5	TOTAL	'90-04-09 08:30	
		'90-04-09 09:00	000000:30
	AVERAGE	MAX. AVERAGE	INTEG
	W : 527.5	W : 534.9	261791.mWh
	UA : 827.1	UA : 844.4	417569.mVAh
	var: 640.3	var: 653.3	1156.49m*Ah
	PF: 0.633	PF: 0.630	
	*A: 2.312	*A: 2.377	LF: 97.9%

P5 Totalized values

Displays totalizing start and end times, total integration time, total integrated amount, overall average value, maximum average value and load factor.

Enlarged Indication

P1	W	0.504k	UA	0.806k
var		0.629k	PF	0.626
3P3W-3	200Urms	50Arms	#A	

Four parameters (two for integrated value) can be selected for each item on the main menu and displayed in enlarged mode.

Parameter List

M0	0:SETTING MENU	6:REAL TIME
	1:HIDE DISPLAY	7:etc.
	2:PRINTER	8:RS-232C
	3:INTEG./TOTAL/RECORD	
	4:FREQ. SCALING, D/A OUT	
	5:COMPARATOR	

Enlarged display parameter selection

Printer

Integration-Summary-Recorder

Frequency-Scaling-D/A output

Comparator

Realtime

Number of display averaging operations-Power value offset etc.

RS-232C

Selection and setting of parameters for measurement and printing is performed, as well as scaling setting, D/A output selection, comparator setting, etc.

Help print

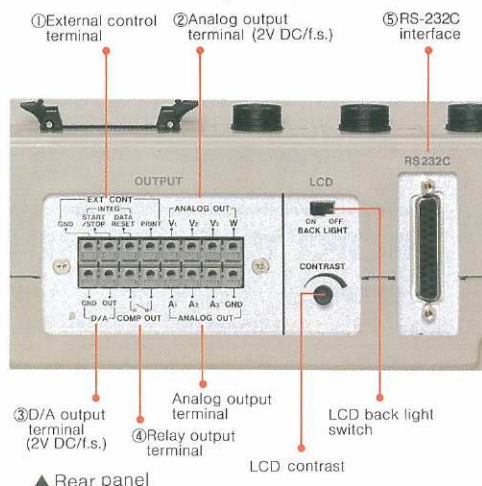
Prints each measured parameter settings.

Manual print

Prints the instantaneous, maximum, minimum, integrated and values of each parameter.

Rear Panel

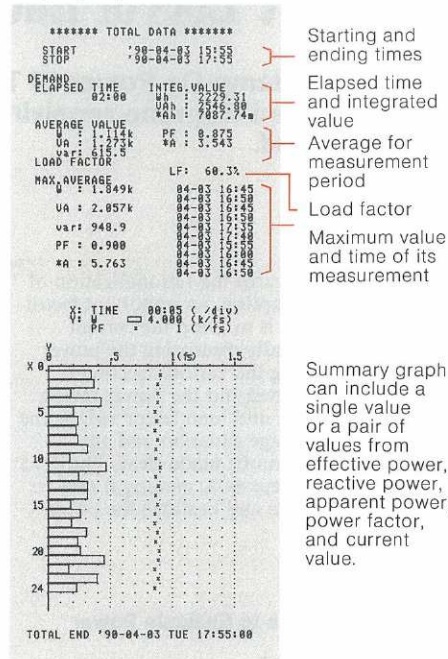
- ① Integration processing and printing can be externally controlled.
- ② An analog output can be simultaneously obtained for current (1 to 3), voltage (1 to 3) and active power.
- ③ One parameter among apparent/reactive power, power factor, average voltage/current, active power (offset), and frequency can be selected for D/A output.
- ④ If the reading goes beyond the set comparison value, relay output is performed.
- ⑤ When connected to a personal computer, the computer can control the 3165 remotely and obtain measurement data from it.



Current 1 to 3, Effective/Reactive/Apparent Power, and Frequency

Data are Simultaneously Displayed on the LCD, Power Line Condition at a Glance.

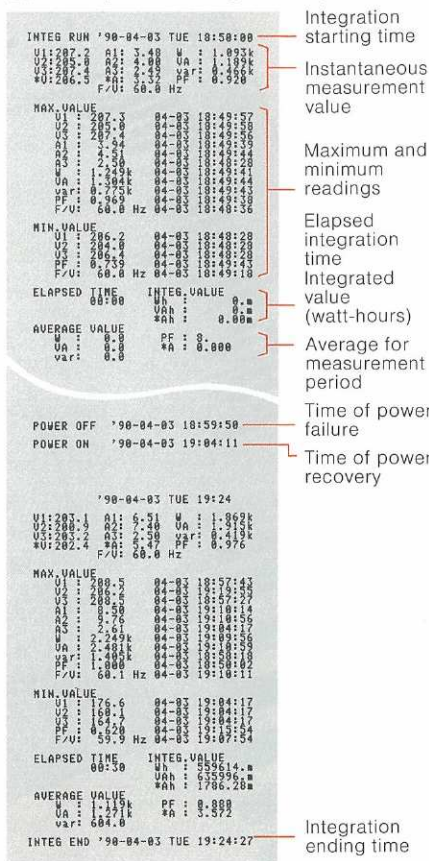
Example of summary and graph printout



Starting and ending times
Elapsed time and integrated value
Average for measurement period
Load factor
Maximum value and time of its measurement

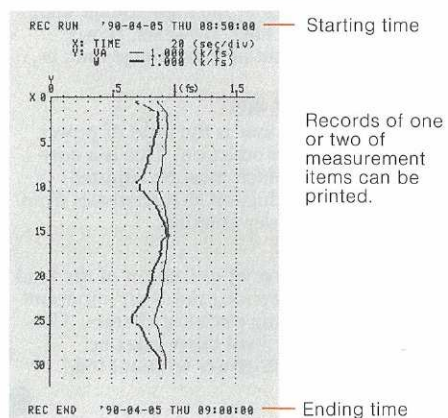
Summary graph can include a single value or a pair of values from effective power, reactive power, apparent power, power factor, and current value.

Example of integration printout



Integration starting time
Instantaneous measurement value
Maximum and minimum readings
Elapsed integration time
Integrated value (watt-hours)
Average for measurement period
Time of power failure
Time of power recovery
Integration ending time

Sample recorder printout



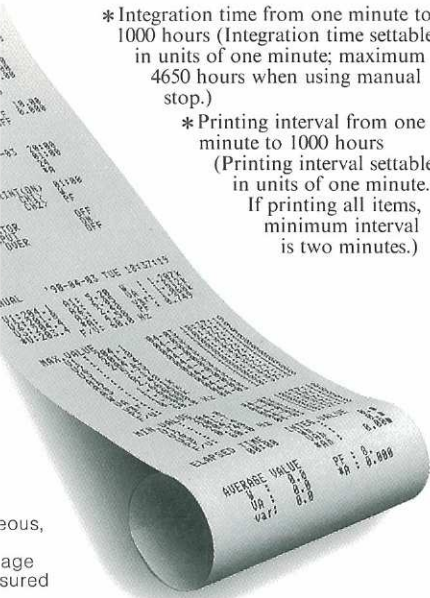
Starting time
Records of one or two of measurement items can be printed.
Ending time

Printer Function

One item among integrated values, totalizing and measurement record can be selected for printing. The help printing function prints settings for each parameter, and the manual printing function records instantaneous values. Since integration, totalizing and record printing can be controlled in real time, data collection can be carried out with no human supervision. In the event of a power failure, interruption and restoration times are printed, and measurement data are kept as well.

* Integration time from one minute to 1000 hours (Integration time settable in units of one minute; maximum 4650 hours when using manual stop.)

* Printing interval from one minute to 1000 hours (Printing interval settable in units of one minute. If printing all items, minimum interval is two minutes.)



Other Functions

PT and CT Ratio Multiplication Function

Voltage, current, active power and other parameters can be read directly when a measurement is performed by means of a PT or a CT.

Switching between Active and Average Voltage and Current Values

The rectification method can be switched for either active or average voltage and current measurement.

3-voltage, 3-current, 3-power Measurement Method

Besides the 2-power measurement method, the 3-voltage, 3-current, 3-power method, using the virtual neutral point as a reference, is also supported for measurement of three-phase four-wire lines. This is especially effective for unbalanced lines.

Measurement items and equations

Mode	1 φ 2 W	1 φ 3 W	3 φ 3W-2	3 φ 3W-3	3 φ 4 W
Voltage	V1	V1 V2	V1 V2	V1 V2 V3 * V $\left[\frac{V1+V2+V3}{3} \right]$	v1 v2 v3 * v $\left[\frac{v1+v2+v3}{3} \right]$
Current	A1	A1 A2	A1 A2	A1 A2 A3 * A $\left[\frac{A1+A2+A3}{3} \right]$	A1 A2 A3 * A $\left[\frac{A1+A2+A3}{3} \right]$
Effective power	$\dot{V}1 \cdot \dot{A}1$	$\dot{V}1 \cdot \dot{A}1 + \dot{V}2 \cdot \dot{A}2$	$\dot{V}1 \cdot \dot{A}1 + \dot{V}2 \cdot \dot{A}2$	$\dot{v}1 \cdot \dot{a}1 + \dot{v}2 \cdot \dot{a}2 + \dot{v}3 \cdot \dot{a}3$	$\dot{v}1 \cdot \dot{a}1 + \dot{v}2 \cdot \dot{a}2 + \dot{v}3 \cdot \dot{a}3$
Apparent power	V1 · A1	V1 · A1 + V2 · A2	$\frac{\sqrt{3}}{2} (V1 \cdot A1 + V2 \cdot A2)$	$\frac{\sqrt{3}}{3} (V1 \cdot A1 + V2 \cdot A2 + V3 \cdot A3)$	$v1 \cdot a1 + v2 \cdot a2 + v3 \cdot a3$
Reactive power			$\sqrt{VA^2 - W^2}$		
Power factor			$\frac{W}{VA}$		
Load factor			Overall average power / Demand maximum power		

Note) V: line voltage, v: phase voltage, A: line current, $\dot{V} \cdot \dot{v} \cdot \dot{A}$: vector values, * V · * v · * A: average values

Using a Clamp-on Power Meter to Reduce Power Consumption

Aren't You Wasting Electricity? Review Your Electrical Installation and Save Lots of Energy

The 3165 Clamp On Power Hi Tester permits easy measurement from the receiving end to the terminal load.



The first step towards the rationalization of electricity consumption, an important factor in energy saving, is to grasp the current situation by actually measuring the power line. By analyzing the various electrical parameters obtained and the power factor, basic power unit, and load factor values, the current power usage situation and any problem points can be made clear. The 3165 can supply all these data, making it easy to accurately analyze and evaluate the power line.

Three Indexes to Evaluate Power Usage

1. Power factor

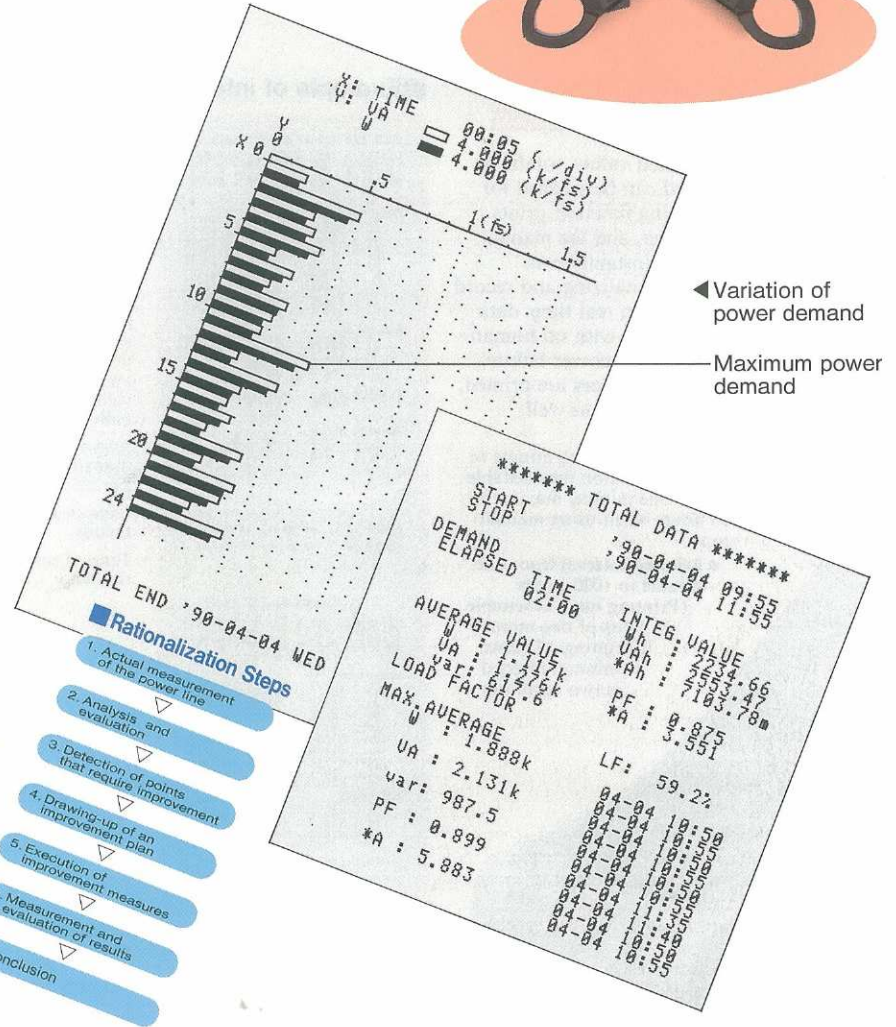
At most factories, power factor improvement measures are taken at the high-voltage end, that is the power inlet. However, power factor improvement at low-voltage lines is also important.

2. Basic power unit

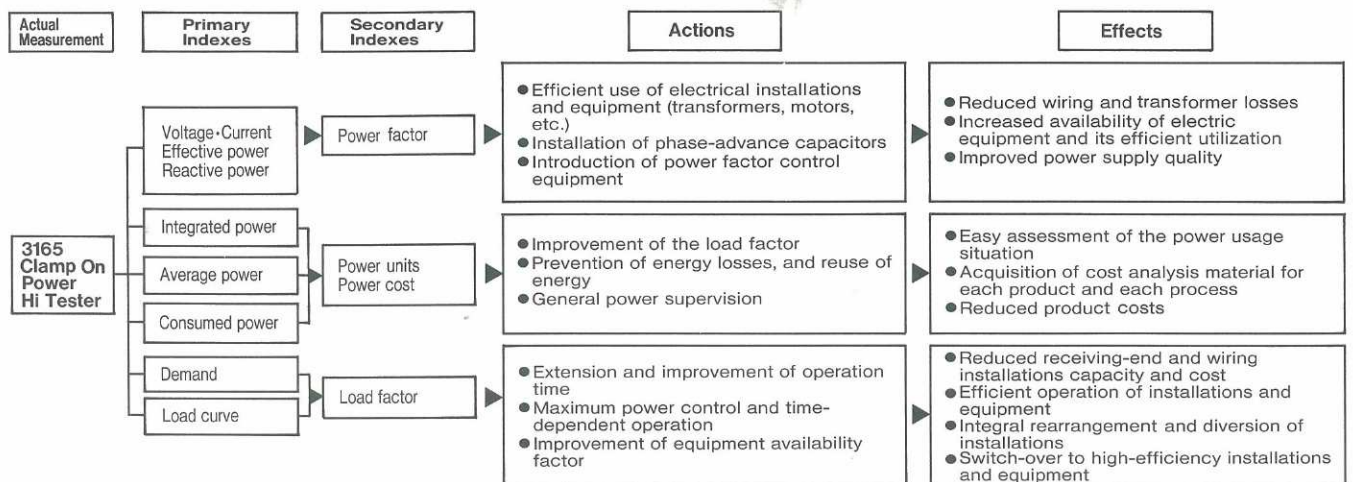
The basic power unit is the ratio of power consumption to production. This is a cost-oriented index, which must be adjusted according to production characteristics from the integrated power amount.

3. Load factor

Indicates the degree of utilization of the load during a certain period, and is an important index for estimating electrical charges. The load factor or the load curve must be calculated for each power terminal load.



Energy Saving and Power Supervision



Specifications

Measurement lines: 1 ϕ 2W, 1 ϕ 3W, 3 ϕ 3W, 3 ϕ 4W
 Measurements: • Voltage, current, effective power, reactive power, apparent power, power factor, watt-hours, frequency
 • Instantaneous maximum value of each item
 • Instantaneous minimum value of voltage, power factor, and frequency
 Measurement ranges: Voltage-100/200/400V (manual)
 Current-2/5/10/20A, 20/50/100/200 A (manual/auto)
 (20/200A switched manually when using the 9272 clamp-on sensor)
 Power-Depends on measurement mode and voltage/current range
 Frequency 100Hz/1kHz/10kHz (manual/auto)
 Accuracy: Voltage $\pm 0.5\%$ rdg. $\pm 0.2\%$ f.s.
 (23°C $\pm 3^\circ\text{C}$) Current $\pm 0.5\%$ rdg. $\pm 0.2\%$ f.s.
 (45 to 66Hz) Power $\pm 0.5\%$ rdg. $\pm 0.3\%$ f.s.
 Realtime clock ± 100 ppm (25°C)
 Frequency $\pm 0.5\%$ rdg. ± 1 dgt.
 Integrator $\pm 0.5\%$ rdg. ± 1 dgt.
 Integration interval $\pm 0.02\%$ ± 1 s
 Note) When used together with the 9272 (or 9270, 9271) resulting accuracy is the sum of the accuracy of the 9272 (or 9270, 9271).
 Frequency characteristics: (deviation from accuracy)

Frequency	Voltage	Current	Power
10 Hz to 20 Hz	$\pm 1.5\%$	$\pm 1.5\%$	$\pm 1.0\%$
20 Hz to 45 Hz	$\pm 0.5\%$	$\pm 0.5\%$	$\pm 0.5\%$
66 Hz to 1kHz	$\pm 0.5\%$	$\pm 0.5\%$	$\pm 0.5\%$
1kHz to 10kHz	$\pm 2.5\%$	$\pm 1.0\%$	$\pm 1.0\%$
10kHz to 20kHz	$\pm 3.5\%$	$\pm 2.0\%$	$\pm 1.5\%$

Temperature coefficient: $\pm 0.05\%$ f.s./°C or less
 Effect of power factor: $\pm 1.0\%$ rdg. (at 55 Hz, power factor=0.5)
 Crest factor: Voltage 2 or less
 Current 3 or less
 Power Same as voltage and current
 Valid measurement ranges: Voltage 10% to 150% of range setting
 Current 10% to 150% of range setting
 Power 10% to 125% of range setting
 Frequency 10% to 100% of range setting
 Input impedance: Voltage approx. 1 M Ω
 Current approx. 270 k Ω
 Maximum nondestructive input: Voltage peak of approx. 850 V (continuous)
 Current peak of approx. 12 V (continuous)
 Operation temperature/humidity ranges: 0 to 40°C, RH 80% max. (no condensation)
 Response time: Approx. 2.2s (analog output response)
 Data output: Approx. 1s (indication sampling)
 Analog output 2 V DC/f.s. (selectable among VA, var, PF, FRQ, Vave, Aave and Wos)
 External control: Integration and recording start/stop, data reset, printing command
 Printer: Thermal graphic printer
 Interface: RS-232C
 (Asynchronous Communication)
 Insulation resistance: 100 M Ω min. at 500 V DC (between the voltage input terminal and the case, between the voltage input terminal and the current input terminal, between the voltage input terminal and the output terminal, between the case and the power source, and between the output terminal and the power source)
 Dielectric resistance: 2.2 kV AC/one minute (between the voltage input terminal and the case, between the voltage input terminal and the current input terminal, and between the voltage input terminal and the output terminal)

Power requirements: 85 to 250 V AC (45 to 66 Hz)
 Power consumption 30 VA max.
 Dimensions and weight: 250H \times 360W \times 120D mm, approx. 4 kg
 Accessories: 9178 voltage cord (3 m) 1, 0.3-A midjet fuse (with arc-extinguishing material) 2, 9223 recording paper 1 box (30m, 5 rolls), Power cord 1

Note

Measurement is not possible with only the 3165. It requires one or more optional (9270, 9271, 9272) clamp-on sensors.

Range Table

Voltage	Current	When using the 9272 (20A range) or 9270				When using 9272 (200A range) or 9271			
		2.000 A	5.000 A	10.00 A	20.00 A	50.00 A	100.0 A	200.0 A	200.0 A
100.0 V	1 ϕ 2W	200.0 W	500.0 W	1.000 kW	2.000 kW	5.000 kW	10.00 kW	20.00 kW	20.00 kW
	1 ϕ 3W	400.0 W	1.000 kW	2.000 kW	4.000 kW	10.00 kW	20.00 kW	40.00 kW	40.00 kW
	3 ϕ 3W	400.0 W	1.000 kW	2.000 kW	4.000 kW	10.00 kW	20.00 kW	40.00 kW	40.00 kW
	3 ϕ 4W	600.0 W	1.500 kW	3.000 kW	6.000 kW	15.00 kW	30.00 kW	60.00 kW	60.00 kW
200.0 V	1 ϕ 2W	400.0 W	1.000 kW	2.000 kW	4.000 kW	10.00 kW	20.00 kW	40.00 kW	40.00 kW
	1 ϕ 3W	800.0 W	2.000 kW	4.000 kW	8.000 kW	20.00 kW	40.00 kW	80.00 kW	80.00 kW
	3 ϕ 3W	800.0 W	2.000 kW	4.000 kW	8.000 kW	20.00 kW	40.00 kW	80.00 kW	80.00 kW
	3 ϕ 4W	1.200 kW	3.000 kW	6.000 kW	12.00 kW	30.00 kW	60.00 kW	120.0 kW	120.0 kW
400.0 V	1 ϕ 2W	800.0 W	2.000 kW	4.000 kW	8.000 kW	20.00 kW	40.00 kW	80.00 kW	80.00 kW
	1 ϕ 3W	1.600 kW	4.000 kW	8.000 kW	16.00 kW	40.00 kW	80.00 kW	160.0 kW	160.0 kW
	3 ϕ 3W	1.600 kW	4.000 kW	8.000 kW	16.00 kW	40.00 kW	80.00 kW	160.0 kW	160.0 kW
	3 ϕ 4W	2.400 kW	6.000 kW	12.00 kW	24.00 kW	60.00 kW	120.0 kW	240.0 kW	240.0 kW

Note • Inputs up to 150% (for voltage and current) or 125% (for power) are possible in all ranges.
 • Analog output voltage is 2V DC/f.s. for each range.

Option

9270 Clamp on sensor (with case)
 9271 Clamp on sensor (with case)
 9272 Clamp on sensor (with case)

Optional accessories

9223 Recording paper (30m, 5 rolls)
 9365 Carrying case
 9360 Carrying case (for clamp sensor \times 3)
 9290 Clamp on adapter
 (for large currents over a wide frequency range)

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 \pm 3°C, 45 to 66Hz)	$\pm 0.5\%$ rdg. $\pm 0.05\%$ f.s. (vibration amplitude) $\pm 0.2^\circ$ max (phase)		
Frequency characteristics (vibration amplitude, phase) (deviation from the basic accuracy)	at 10Hz to 20kHz $\pm 1.0\%$, $\pm 0.5^\circ$ max. at 5Hz to 50kHz $\pm 2.5\%$, $\pm 1.0^\circ$ max.		at 10Hz to 1kHz $\pm 1.0\%$, $\pm 0.5^\circ$ max. at 5Hz to 10kHz $\pm 2.5\%$, $\pm 2.0^\circ$ 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 (for 10s)
Input resistance	Less than 0.2 m Ω	Less than 0.02 m Ω	Less than 0.02 m Ω
Temperature coefficient	Less than $\pm 0.05\%$ f.s./°C		
Effect of conductor position	$\pm 0.3\%$ max.		$\pm 1.5\%$ max.
Effect of external magnetic fields	20mA equivalent typ.	200mA equivalent typ.	2.5A equivalent typ.
Max. circuit voltage	600V AC		
Measurable conductor diameter	ϕ 20mm max.		ϕ 46mm, ϕ 20mm busbar max.
Dimensions-weight	60H \times 145W \times 33Dmm \approx approx. 230g		174H \times 62W \times 33Dmm \approx approx. 420g

9290 Clamp on adapter specification



Cord length: 3m

The 9290 is a 10:1 clamp adapter for high-precision measurement of currents up to 1500A AC.

Measurement range: 0 to 1500 A AC
 CT ratio: 10:1
 Measurement time: Continuous below 1000A, within 5 minutes at 1500 A
 Maximum circuit voltage: 600 V AC
 Accuracy (23°C \pm 3°C): Amplitude: 1.5% rdg. (10 A to 1500 A) Phase: 1.0° max. (45 Hz to 66 Hz)
 Frequency characteristic: (deviation from accuracy)
 Amplitude: 1% rdg. (40 Hz to 1kHz) 2.5% rdg. (20 Hz to 4kHz) Phase: 1.0° max. (40 Hz to 1kHz) 3.0° max. (20 Hz to 4kHz)
 Effect of conductor position Within: 1% max.
 Effect of external magnetic fields: 0.8 A equivalent (at 400 A/m)
 Dielectric resistance: 2.2kV AC (between the core and the case)
 Core opening: ϕ 55mm, accepts up to 80 mm-wide busbar
 Dimensions, weight: 194H \times 99W \times 33D mm, approx. 500g
 Accessories: 9148 carrying case 1, Marking bands 6

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