New

HIOKI

2002

3169-20,3169-21
CLAMP ON POWER HiTESTER

Power Measuring Instruments

- **Measure up to two 3-phase, 3-wire systems (displays voltage and current for three lines) Measure up to four single-phase, 2-wire systems**
- **5 A to 5000 A range**

- **Compact and light weight**
- **PC card data storage**
- **Power recording for individual waveforms**
- **Simultaneous recording of demand values and harmonics**

CE

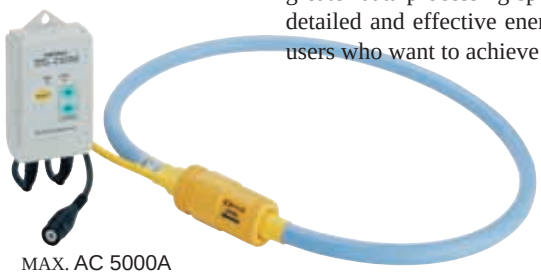
The photo shows **the 3169-21** combined with **the 9661 and 9669 clamp-on sensors** (optional) for measuring two systems. The 3169-20/21 can also be used in combination with **clamp-on sensors** (optional) rated up to 5000 A.

Offering a new approach to energy-related measurement

such as energy conservation, ISO14001 testing, equipment diagnosis, and harmonics measurement, to support programs !

Measures power lines of up to 254 mm in diameter

9667
FLEXIBLE CLAMP ON SENSOR



MAX. AC 5000A

The 3169-20 and 3169-21 are clamp-on power HiTESTERs that allow measurement of single-phase to three-phase 4-wire circuits with a single unit. In addition to measuring standard parameters such as voltage, current, power, power factor, and integrated values, these clamp-on power meters can simultaneously perform demand measurements required for carrying out power management and energy-saving measures, as well as harmonic measurements. The two new power meters also feature PC card support, and come equipped with an RS-232C interface for PC communications. Further, with greater data processing speeds, it is possible to measure the power of just a few cycles, enabling more detailed and effective energy-saving measures for equipment. The 3169-20 and 3169-21 are ideal for users who want to achieve close control over energy-saving management activities and measures.

ISO14001
JQA-E-90091

INTERNET HIOKI Website

http://www.hioki.co.jp/

HIOKI company overview, new products, environmental considerations and other information are available on our website.

Offering a new measurement method for energy savings activities

All in a compact A5-size unit

Example of use in combination with four **9661 clamp-on sensors** (optional)

3169-21 Clamp-on Power HiTESTER
(Shown with D/A output)

Simultaneous recording of a variety of signal and energy-saving data.

Simultaneous measurement of two 3-phase, 3-wire systems.
Further, you can select the clamp-on sensor type most suited to your measurement needs for each individual circuit.

Allows high-speed data transfer to a PC card for each waveform or at intervals of 0.1, 0.2, or 0.5 second.

9661 Clamp-on Sensor (500 A AC)
9669 Clamp-on Sensor (1000 A AC)
(optional)

9438-03 voltage cord (4 provided)

Features

■ Measurepower lines of up to four systems (with a common voltage)

One single unit can measure four circuits (single-phase 2-wire), two circuits (3-phase, 3-wire), or a one circuit (3-phase, 4-wire)system.

■ A wide range of measurement functions

The 3169-20/21 can simultaneously measure voltage, current, power (active, reactive, and apparent), integrated power, power factor, and frequency. Further, when using 3-phase, 3-wire (3P3W2M) mode, you can display the voltage and current for all three lines by measuring just two of them. When using the 3-phase, 4-wire (3P4W4I) mode, neutral line current can be displayed using 4 current measurement.

■ Equipped with ranges from 5 A to 5000 A

The power meters support four types of clamp-on current sensors to enable measurement for a variety of items, from CT terminals to large current and thick power lines.

■ Supports high-speed data storage from individual waveforms

When using the standard mode to perform integrated power measurement, you can store data in intervals starting from one second, and when simultaneously measuring integration and harmonics, in intervals starting from one minute. When in the fast mode, you can store RMS data for individual waveforms.

■ PC cards compatible plus internal hard drive for extra memory

The power meters support PC cards. The internal memory (1 MB) supports measurement over extended periods and detailed measurement parameters.

■ Housed in a compact A5 body size

The 3169-20 and 3169-21 feature a compact design that makes them portable and easy to use in tight spaces, and are approximately 30% more compact than the 3166 CLAMP ON POWER HiTESTER.

■ Multi-language Compatibility (Available soon)

Select from six languages, including Japanese and English.

■ Detect incorrect connection using vector diagrams

Use the vector display on the connection confirmation screen to check the phase, whether a connection is loose, or whether the clamp-on sensor connection has been reversed during VT/CT terminal measurement.

■ Polarity display and measurement using the reactive power measurement method

The units come equipped with a polarity display for checking LAG/LEAD when measuring power factor or reactive power. Further, you can select the reactive power measurement method, or display the phase factors for RMS values and power comparison.

■ High-speed D/A output

The 3169-21 comes equipped with 4-channel high-speed D/A output to enable analog output of RMS values for individual waveforms.

■ Ideal for power and harmonics management

The power meters come equipped with a harmonics measurement function that supports measurement of 3-phase power lines. They can also perform simultaneous measurement of harmonics and demand values, enabling both power and harmonics management.

The ultimate in clamp-on power meters!

Sleek Design and Engineering

The photo shows the 3169-21 with D/A output.

D/A output terminal pin placement

Use the 9441 connection cable to connect to external devices. (Output resistance: 100 Ω)

Pin	Signal name
1	D/A output ch1
2	D/A output ch2
3	D/A output ch3
4	D/A output ch4
5 to 8	GND

External I/O terminal pin placement

Pin	Signal name
1	Start/stop input
2	Free
3	Status output
4	Data storage input
5	GND

Use the 9440 connection cable to connect to external devices.

Range Configuration Table

Current \ Voltage / Connection	9660 Clamp On Sensor / 9661 Clamp On Sensor 5.0000A	10.000A	50.000A	100.00A	500.00A
150.00V	Single-phase 2-wire	750.00 W	1.5000kW	7.5000kW	15.000kW	75.000kW
	Single-phase 3-wire Three-phase 3-wire	1.5000kW	3.0000kW	15.000kW	30.000kW	150.00kW
	Three-phase 4-wire	2.2500kW	4.5000kW	22.500kW	45.000kW	225.00kW
300.00V	Single-phase 2-wire	1.5000kW	3.0000kW	15.000kW	30.000kW	150.00kW
	Single-phase 3-wire Three-phase 3-wire	3.0000kW	6.0000kW	30.000kW	60.000kW	300.00kW
	Three-phase 4-wire	4.5000kW	9.0000kW	45.000kW	90.000kW	450.00kW
600.00V	Single-phase 2-wire	3.0000kW	6.0000kW	30.000kW	60.000kW	300.00kW
	Single-phase 3-wire Three-phase 3-wire	6.0000kW	12.000kW	60.000kW	120.00kW	600.00kW
	Three-phase 4-wire	9.0000kW	18.000kW	90.000kW	180.00kW	900.00kW

Indicates ranges that can be used with the 9660 sensor

Note 1: The range configuration table displays the full-scale display values for each measurement range.

Note 2: In the table, "unit W" has been replaced with "VA" or "var" for the apparent power and reactive power measurement ranges.

Note 3: Voltage and current input values 0.4% or less than the measurement range are displayed as "zero". When either the voltage or current for the power line is zero, the power value is displayed as zero.

Note 4: You can display measurement values up to 130% of each measurement range.

Note 5: The 9660 conforms to CAT III 300 V (voltage to ground) standards. Do not measure power lines with a voltage to ground that exceeds this level.

Current \ Voltage / Connection	9669 Clamp On Sensor 100.00 A	200.00 A	1.0000kA
150.00V	Single-phase 2-wire	15.000kW	30.000kW	150.00kW
	Single-phase 3-wire Three-phase 3-wire	30.000kW	60.000kW	300.00kW
	Three-phase 4-wire	45.000kW	90.000kW	450.00kW
300.00V	Single-phase 2-wire	30.000kW	60.000kW	300.00kW
	Single-phase 3-wire Three-phase 3-wire	60.000kW	120.00kW	600.00kW
	Three-phase 4-wire	90.000kW	180.00kW	900.00kW
600.00V	Single-phase 2-wire	60.000kW	120.00kW	600.00kW
	Single-phase 3-wire Three-phase 3-wire	120.00kW	240.00kW	1.2000MW
	Three-phase 4-wire	180.00kW	360.00kW	1.8000MW

Current \ Voltage / Connection	9667 Flexible Clamp On Sensor 500.00 A	5.0000kA
150.00V	Single-phase 2-wire	75.000kW	750.00kW
	Single-phase 3-wire Three-phase 3-wire	150.00kW	1.5000MW
	Three-phase 4-wire	225.00kW	2.2500MW
300.00V	Single-phase 2-wire	150.00kW	1.5000MW
	Single-phase 3-wire Three-phase 3-wire	300.00kW	3.0000MW
	Three-phase 4-wire	450.00kW	4.5000MW
600.00V	Single-phase 2-wire	300.00kW	3.0000MW
	Single-phase 3-wire Three-phase 3-wire	600.00kW	6.0000MW
	Three-phase 4-wire	900.00kW	9.0000MW

Measure hidden power waste through secure connections, simple measurement methods, and detailed data capture.

Promises reliable measurement for power demand requirements!

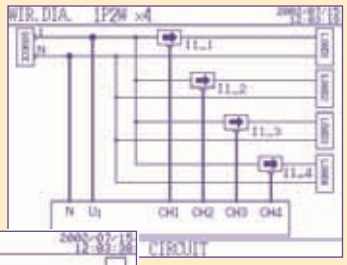
■ Select from a variety of data, including detailed and harmonics data for multiple circuits

★ To measure multiple systems simultaneously

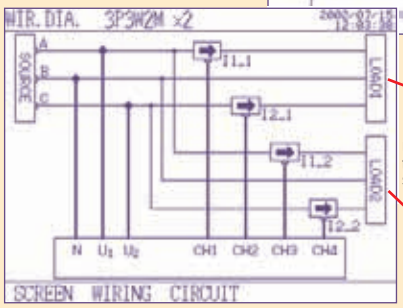
A single unit can measure two three-phase, 3-wire systems. Further, you can make individual clamp-on sensor and current range settings for each system.

Also, in addition to performing simultaneous measurement for up to four systems (single-phase, 2-wire) with a common voltage, you can set the current range individually for each system. Setting the most suitable current range for both large and small loads allows you to acquire more accurate measurements.

Measurement for up to four single-phase, 2-wire systems



Measurement for up to two three-phase, 3-wire systems



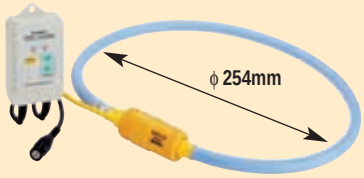
Use the 9661 sensor to measure a single system

Use the 9669 sensor to measure two systems

★ Having trouble clamping onto thick power lines?

Using the 9667 Flexible Clamp On Sensor, you can measure power lines that are up to 5000 A AC and up to 245 mm in diameter.

The 9667 Flexible Clamp-on Sensor's ability to measure power lines with good phase characteristics carrying up to 5000 A AC and measuring up to 254 mm in diameter allows you to measure the power for large current lines that were previously difficult to measure, such as trunk lines at factories.



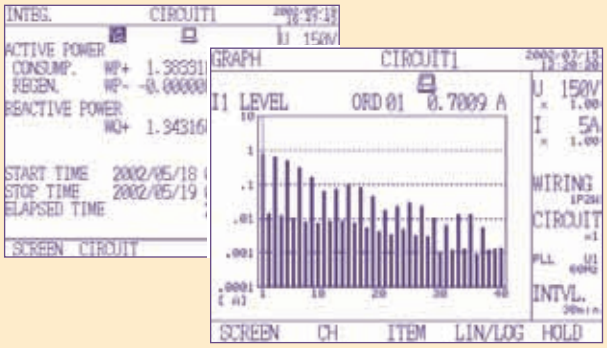
Range: AC 500A/5000A
Power supply:
4 × AAA alkaline batteries (LR03)
(continuous use:one week or longer)
or the 9445-02/03 AC adapter

★ Simultaneous power and harmonics management

You can use a single unit to simultaneously measure data for power and harmonics.

All acquired data can be saved onto a PC card.

Also, power data (including demand data) and harmonics data can be simultaneously saved onto a PC card or in the units internal memory. Further, data for all of the systems being measured can be saved when measuring multiple circuits. Each of these two new units offers a management system for power and harmonic quality.



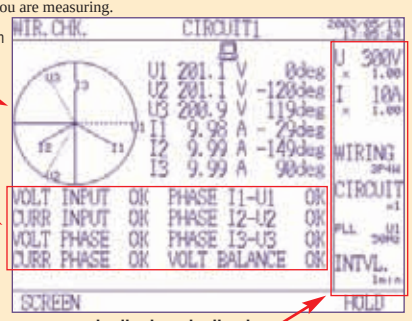
★ When measurement accuracy is crucial

The addition of a vector display for viewing the connection status completes the preparation required for measurement.

Have you ever experienced incorrect measurement results?
The most common cause of incorrect data is a faulty connection. With the 3169-20/21 you can use the vector display to check the phase, whether a connection is loose, or whether the clamp-on sensor connection has been reversed.
Also, you are assured of proper connection when measuring the VT (PT)/CT terminals even if you cannot see the line you are measuring.

Checking the connection on the vector display

Accurate and reliable results



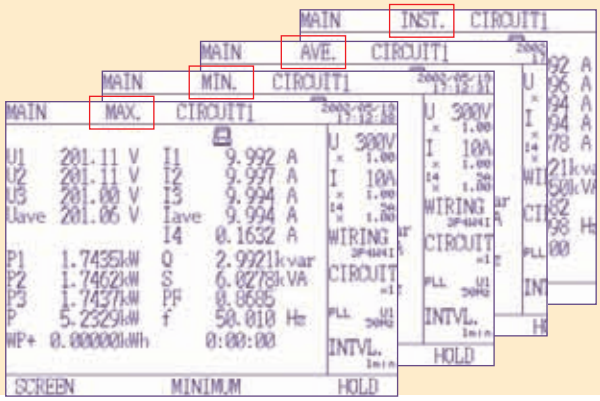
The basic settings are constantly displayed, allowing you to measure with confidence.

During measurement, in addition to displaying the voltage and current ranges, and VT (PT) and CT ratios for each system, the unit can also display items such as the measurement interval. Because the basic settings are constantly visible, you can be confident of obtaining the correct measurement results.

★ Capture facility data quickly

By using continuous processing to measure individual waveforms, you can accurately measure data in a relatively short amount of time.

Use the desired measurement method to continuously measure the voltage, current, and power for individual waveforms, enabling you to obtain accurate data in one second or less. Further, you can record the maximum, minimum and average values.



★ Measure another device simultaneously

Using the external I/O function, you can obtain even more detailed measurements for energy conservation.

In addition to measurement start/stop control through external input, you can use this function to output the measurement start/stop signal for the 3169-20/21. Simultaneous recording of a variety of signals is also possible for equipment when using multiple devices to perform start control and multi-channel recording.

Simultaneous control for signals from equipment

Large storage capacity to accommodate power and harmonics data for individual waveforms. Supports energy saving measures that can be carried out from your PC.

Greater flexiblity for energy saving measures through detailed measurement!

Reduce energy consumption by "1%"! Why not try analyzing your energy saving measures?

★ Save measurement details to PC card for extended measurements!

Why not try a shorter data management interval?
With the 3169-20/21, you can set the data recording interval to 1 minute. If you are unsure how to proceed with energy conservation, you can use a large capacity PC card to save measurement details, then use the data to create a load fluctuation graph and analyze this to help reduce wasted power consumption.
Further, because you can save a variety of data, including simultaneous recording of power and harmonics data, waveform data storage, and print-outs of the screen, these two new units help by storing measurement details.

Measurement conditions: 1-minute recording interval, when using a PC card (64 MB)

Data storage	1P2W × 4	1P3W × 2	3P3W2M × 2	3P3W3M,3P4W
Normal measurement (only saves average, integrated, and demand values)	42 days	53 days	50 days	85 days
Normal measurement (saves all items)	22 days	20 days	18 days	31 days
Normal measurement + harmonics measurement (saves all items)	18 hours	20 hours	15 hours	23 hours

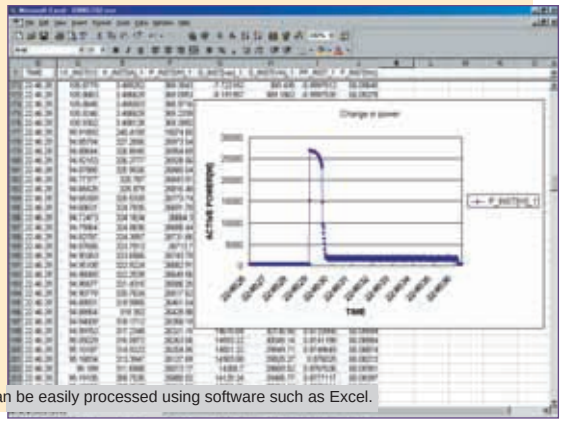
When using a 64 MB PC card

Interval	1P2W × 4	1P3W × 2	3P3W2M × 2	3P3W3M,3P4W
1 minute	22 days (18 hours)	20 days (20 hours)	18 days (15 hours)	31 days (23 hours)
2 minutes	45 days (37 hours)	40 days (40 hours)	37 days (30 hours)	62 days (47 hours)
5 minutes	114 days (93 days)	102 days (101 days)	94 days (76 days)	156 days (119 days)
10 minutes	229 days (7 days)	204 days (8 days)	188 days (6 days)	313 days (9 days)
15 minutes	344 days (11 days)	307 days (12 days)	282 days (9 days)	365 days (14 days)
30 minutes	365 days (23 days)	365 days (25 days)	365 days (19 days)	365 days (29 days)

Measurement conditions: When saving all items using normal measurement, the number of days in parentheses indicate normal measurement + harmonics measurement, maximum measurement period of one year

★ Identify even small amounts of power waste using individual waveform measurements

The 3169-20/21 can help turn you into a keen energy saving specialist.
These two new units allow you to measure power data by recording the RMS values for individual waveforms.
By measuring just a few seconds of machine cycles or changes in operating patterns of facilities such as manufacturing equipment, you can grasp power fluctuations over a relatively short amount of time and view improvements in the form of numerical data. Gain unsurpassed energy savings by achieving simple improvements around the work environment.



Results can be easily processed using software such as Excel.

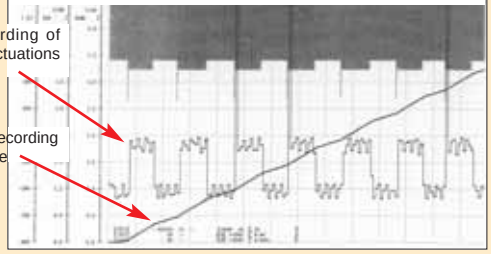
★ Improve energy-saving operations and create an energy-efficient facility

Why not try to improve your energy-saving measures using the 3169-21?
Using the D/A output (4 ch) function on the 3169-21, you can simultaneously record a variety of measurement and control signals for equipment, such as the power fluctuation and temperature/flow for individual waveforms, onto a HIOKI MEMORY HiCORDER or logger.
A slight reduction in power consumption due to changes in the inverter motor operating patterns or temperature settings equals to an energy-saving effect.

The 3169-20/21 allows you to view changes that are hard to determine from numerical data alone.

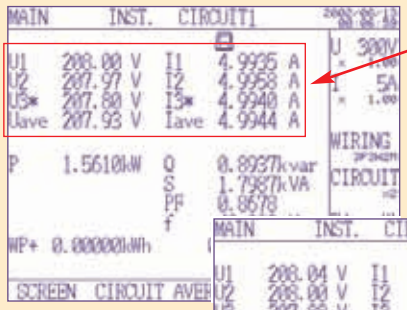
Accurate recording of momentary fluctuations in power, etc.

Simultaneous recording of power volume

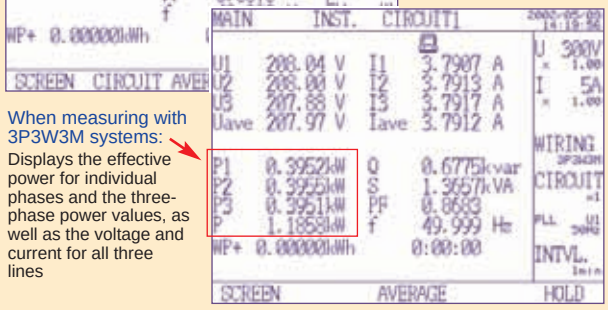


★ Unbalanced loads are an enemy to energy saving activities. Solve your problems with careful management of power lines.

Unbalanced 3-phase loads can result in a damaged power line.
To provide detailed management of measurements, the 3169-20/21 displays voltage and current for all three lines even when measuring just two circuits (3P3W2M). Further, because the effective power for each phase is displayed based on a virtual center point when measuring the voltage and current for all three lines (3P3W3M), the units can also be used to implement energy saving measures and power management systems.



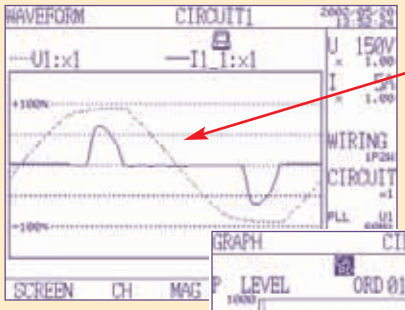
When measuring 3P3W2M systems:
Displays the voltage/current difference between each pair of lines and average values



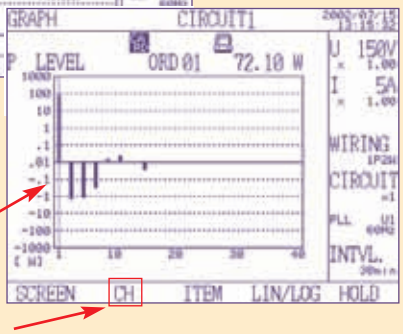
When measuring with 3P3W3M systems:
Displays the effective power for individual phases and the three-phase power values, as well as the voltage and current for all three lines

★ Harmonics cause wasted power

Did you think that harmonics and energy saving activities were unrelated?
Due to a spread in equipment that uses semiconductor control devices, such as inverters, power quality has decreased. Also, power consumed in harmonic components is all wasted power.
Harmonic control and management are essential for energy conservation.



The degree of distortion is obvious in the voltage/current display



The current direction of harmonic waves is obvious

You can switch channels to easily check the harmonics for each circuit

★ To identify causal factors with harmonic measurements of multiple systems circuits

If production equipment malfunctions, power is wasted if repeated manufacture results in defective products again.
If you think harmonics are causing malfunctions, you can simultaneously measure the harmonics of individual circuits using multi-circuit measurement to obtain detailed information about the occurrence of harmonics along with the current direction for each phase. Using the 3169-20/21 you can accurately determine the relationship for harmonic inflow and outflow between power lines by analyzing the data acquired simultaneously, and then devising energy-saving measures based on the cause of the occurrence.

3169-20/21 Basic Specifications

Measurement line type	:	Single-phase 2-wire, single-phase 3-wire, three-phase 3-wire, and three-phase 4-wire systems (50/60 Hz)
Number of systems that can be measured (for systems that share the same voltage)	:	Single-phase: 1P2W . . . . . 4 systems 1P3W . . . . . 2 systems Three-phase: 3P3W2M (measures the voltage and current for two lines) . . . . . 2 systems 3P3W3M (measures the voltage and current for all three lines) . . . 1 system 3P4W (measures the voltage and current for three lines) . . . . . 1 system 3P4W4I . . . . . 1 system (measures the voltage for three lines and the current for four lines)
Item	:	Voltage, current, active power, reactive power, apparent power, power factor, integrated value, frequency, harmonics
Measurement range	:	For the voltage, current, and effective power ranges, see the range configuration tables on page 2.
Measurement method	:	Simultaneous digital sampling of voltage and current, PLL synchronization or a fixed clock (50/60 Hz)
Input methods	:	Voltage: Isolated input Current: Isolated input using a clamp-on sensor
Effective measurement area	:	Within 5 to 110% of the range
Total display area	:	Voltage and current: Within 0.4 to 130% of the range (zero is suppressed for less than 0.4%) Power: Within 0 to 130% of the range (zero is suppressed when the voltage or current is zero) Harmonic level: Within 0 to 130% of the range
Display	:	5.7-inch LCD (320 × 240 dots), with backlight
Range switching method	:	Manual (the current range can be set for each system)
Display update rate	:	Approx. every 0.5 seconds (except when using a PC card while accessing the internal memory, or when performing RS-232C communications)
Input resistance (50/60 Hz)	:	Voltage: 2.0 MΩ ± 10% (differential input) Current: 200 kΩ ± 10%
Maximum measurement terminal voltage	:	Voltage input: 780 Vrms AC, peak value: 1103 V Current input: 1.7 Vrms AC, peak value: 2.4 V
Maximum in-phase voltage	:	Voltage input terminals: 600 Vrms AC (50/60 Hz)
Crest factor	:	Voltage: Less than 2 (for full-scale input) Current: Less than 4 (for full-scale input. However, less than 2 for the 500 A, 1 kA, and 5 kA ranges)
Internal memory capacity	:	1MB

[Voltage/current measurement]

Measurement method	:	True RMS method
Measurement display	:	Measurement of three voltage lines and 3 or 4 current lines is possible when using three-phase 3-wire and three-phase 4-wire systems

[Active power measurement]

Measurement display	:	For three-phase 3-wire (the 3P3W3M setting), refer to the display for phase power values.
Polarity display	:	For consumption: no symbol, for regeneration: "-"

[Reactive power measurement]

Using the reactive power measurement method	:	ON: Measures the reactive power directly using the reactive power measurement method OFF: Calculates the reactive power from the measurement values for voltage, current, and active power
Polarity display	:	For lag phase (LAG : current is slower than voltage): no symbol For lead phase (LEAD: current is faster than voltage) : "-" (Reactive power measurement method "ON")

[Apparent power measurement]

Polarity display	:	No polarity

[Power factor measurement]

Measurement range	:	-1.0000 (lead) to 0.0000 to +1.0000 (lag)
Polarity display	:	For lag phase (LAG: current is slower than voltage) :no symbol For lead phase (LEAD: current is faster than voltage) : "-"

[Frequency measurement]

Measurement range	:	40.000 to 70.000 Hz
Input area for guaranteed accuracy	:	Within 10 to 110% of the range (for sine wave input)
Measurement source	:	Voltage U1

[Integrated measurement]

Measurement range	:	Active power : 0.00000 mWh to 99999.9 GWh consumption -0.00000 mWh to -99999.9 GWh regeneration Reactive power : 0.00000 mvarh to 99999.9 Gvarh lag -0.00000 mvarh to -99999.9 Gvarh lead
Measurement display	:	Active power : Displays consumption and regeneration separately Reactive power : Displays lag and lead separately

[Harmonic measurement]

Measurement range	:	Basic wave frequency: 45 to 66 Hz	
Measurement method		PLL synchronization	
Order for analysis	:	Up to the 40th order	
Window width	:	A single cycle (number of data points analyzed: 128 points)	
Window type	:	Rectangular	
Analysis rate	:	1/16 cycles	
Item for analysis	:	Harmonic level:	The voltage, current, or power level for each harmonic order
	:	Harmonic content percentage:	The voltage, current, or power content percentage for each harmonic order
	:	Harmonic phase angle:	The voltage, current, or power phase angle for each harmonic order
	:	Total value:	The total value for voltage, current, or power up to the 40th harmonic order
	:	Total harmonic distortion factor:	For voltage or current (THD-F or THD-R)

[Measurement display]

Instantaneous value display	:	Voltage, current, active power, reactive power, apparent power, power factor, frequency, average voltage, average current, (average values are for each system)
Average value display	:	Voltage, current, active power, reactive power, apparent power, power factor, frequency, average voltage, average current * The average value from the beginning of time series measurement until the present.
Maximum/minimum value display	:	Voltage, current, active power, reactive power, apparent power, power factor, frequency * The maximum/minimum value from the beginning of time series measurement until the present.
Integrate display	:	Integrated value Active power (consumption/regeneration) Reactive power (lag/lead) * The total integrated value from the beginning of time series measurement.
Demand volume display (Integrated value within the specified interval)	:	Integrated value Active power volume (consumption/regeneration) Reactive power volume (lag/lead) * The integrated value within each specified interval (latest value).
Demand value display (average value within the specified interval)	:	Active power (consumption), reactive power (lag), power factor * The demand value within each specified interval (previous value).
Maximum demand value display (average value within the maximum specified interval)	:	The maximum demand value since the beginning of time series measurement and the time and date it occurred.
Harmonics list	:	List of the items measured for the specified harmonic (numerical value). (including the total value and total harmonic distortion factor (THD-F/THD-R))
Harmonics graph	:	Bar graph or vector diagram of the items measured for the specified harmonic. (cursor measurement, magnification update, with a linear/LOG axis selection function)
Waveform display	:	Voltage and current waveforms (with a magnification update function)
Measurement value enlargement display	:	Select and enlarge up to 5 items from the instantaneous value display.

[Setting contents]

Measurement line settings	:	1P2W, 1P3W, 3P3W2M, 3P3W3M, 3P4W, 3P4W4I
Clamp-on sensor settings	:	9660, 9661, 9667, and 9669 (* A different sensor can be set for each system.)
VT (PT) and CT ratio settings	:	0.01 to 9999.99 (* A different CT ratio can be set for each system.)
Measurement start method	:	Manual or time (year, month, day, hour, minute)
Measurement stop method	:	Manual, time, or timer (10 seconds to 1000 hours)
Output Interval	:	Standard or fast (*Maximum measurement period: 1 year) Standard interval: 1, 2, 5, 10, 15, or 30 seconds, or 1, 2, 5, 10, 15, 30, or 60 minutes Fast interval: A single waveform, or 0.1, 0.2, or 0.5 seconds
Data output destination	:	PC card, internal memory, or printer
File name	:	Automatically attached, or set the desired name (up to 8 alphanumeric characters)
Display averaging circuit	:	OFF, 2, 5, 10, 20 times (for movement averaging)
Screen copy destination	:	PC card, internal memory, or printer
Display language settings	:	Japanese, English, German, French, Italian, Spanish (* All languages other than Japanese and English soon to be supported.)
Other settings	:	Reactive power measurement method selection, harmonic distortion selection, order display selection, backlight settings, ID settings, clock settings, etc.

[File operations]

Copy file	:	Copies files from the internal memory to the PC card.
Load/Save selected file	:	Loads/Saves the file(s) selected from the internal memory or PC card.
Delete file	:	Deletes the file(s) from the PC card.
Format	:	Initializes the PC card or internal memory.
Storage format	:	Measurement data: CSV format (binary format when using the fast interval setting) Waveform data: Binary format Screen data: BMP format Settings data: CSV format

[Data output item]

Instantaneous values	:	Voltage, current, active power, reactive power, apparent power, power factor, frequency, average voltage, average current, (average values are for each system) * The instantaneous value for interval output.
Average value	:	Voltage, current, active power, reactive power, apparent power, power factor, frequency, average voltage, average current, (average values are for each system) * The average value for each interval.
Maximum/minimum value	:	Voltage, current, active power, reactive power, apparent power, power factor, frequency * The maximum/minimum value for each interval (no event details provided).
Integrated value	:	Active power (consumption/regeneration) Reactive power (lag/lead) * The total value since the beginning of time series measurement, and the power volume for each interval.
Demand value	:	Active power (consumption), reactive power (lag), power factor * The value for each interval.
Maximum demand value	:	The maximum demand value since the beginning of time series measurement and the time and date it occurred.
Harmonic	:	Each harmonic order (level, content percentage, and phase angle), total value, instantaneous value for THD-F/THD-R
	:	Each harmonic order (level, content percentage, and phase angle), total value, average value for THD-F/THD-R for each interval
	:	Each harmonic order (level, content percentage, and phase angle), total value, maximum/minimum value for THD-F/THD-R within each interval (no event data provided)
Waveform	:	Waveform (Voltage or current)
Status information	:	Exceeds the voltage/current crest factor, PLL unlock, power failure, exceeds the display limit

[Print items]

Numerical values	:	Prints the data selected as the data output item (during time series measurement).
Waveform	:	Hard copy of the screen (printing of each interval not available)

[External interface]

D/A output		(3169-21 only)
Number of output channels	:	4 channels
Output items	:	For instantaneous values: Voltage, current, average voltage, average current, Active power, reactive power, apparent power, power factor, frequency
		For Integrated value: Active power (consumption/regeneration) or reactive power (lag/lead)
		For harmonics: Each harmonic order (level, content percentage, and phase angle), total value, THD-F/THD-R
	:	±5V DC/f.s.
	:	Polarity + 11 bits
Output level	:	Measurement accuracy ±0.2% f.s.
Resolution	:	Less than ±0.02% f.s./°C
Output accuracy	:	100Ω ±5%
Temperature characteristic	:	For each cycle of measurement input (when a measurement item other than harmonics is set)
Output resistance		For every 16 cycles of measurement input (when harmonics is set as the measurement item)
Output update rate		

PC card	:	Slot: 1 × PC Card Standard-compliant Type II
		Card type: Flash ATA card
		Compatible memory capacity: Up to 528 MB
		Storage content: Settings data, measurement data, screen data
RS-232C	:	Printer or PC connected to an RS-232C interface
		Compliance: EIA RS-232C-compliant
		Transfer method: Asynchronous communication method, full duplex
		Baud rate: 2400, 9600, 19200, 38400 bps
		Flow control and delimiter settings possible

[External I/O]

Control input	:	Start/stop control for time series measurement, data storage
Control output	:	LOW level is output during time series measurement.
Control signal level	:	A 0/5 V logic signal or a short-circuit/release contact signal

Measurement accuracy

Voltage	Current/active power
±0.2%rdg.±0.1%f.s.	±0.2% rdg. ±0.1% f.s. + clamp-on sensor accuracy

Conditions of guaranteed accuracy	:	After 30 minutes of warm-up, sine-wave input, PF=1
Temperature and humidity for guaranteed accuracy	:	23°C ±5°C, less than 80% relative humidity
Fundamental waveform range for guaranteed accuracy	:	45 to 66 Hz
Display area for guaranteed accuracy	:	Effective measurement area

● Table of current and active power accuracy with clamp-on sensor combinations

Current rang	9660	9661	9669	9667
5 A	±0.5%rdg.±0.5%f.s.	±0.5%rdg.±1.1%f.s.	-	-
10 A	±0.5%rdg.±0.3%f.s.	±0.5%rdg.±0.6%f.s.	-	-
50 A	±0.5%rdg.±0.14%f.s.	±0.5%rdg.±0.2%f.s.	-	-
100 A	±0.5%rdg.±0.12%f.s.	±0.5%rdg.±0.15%f.s.	±1.2%rdg.±0.2%f.s.	-
200 A	-	-	±1.2%rdg.±0.15%f.s.	-
500 A	-	±0.5%rdg.±0.11%f.s.	-	±2.2%rdg.±0.4%f.s.
1000 A	-	-	±1.2%rdg.±0.11%f.s.	-
5000 A	-	-	-	±2.2%rdg.±0.4%f.s.

Note: The table of accuracy for different clamp-on sensor combinations indicates the measurement accuracy for each current range of the 3169-20/21. (The accuracy for each clamp-on sensor is converted and displayed according to the 3169 current measurement range.)

Reference: Accuracy of the 9660, 9661, 9667, and 9669 clamp-on sensors

- 9660 (rated for 100 A) : ±0.3%rdg.±0.02%f.s.
- 9661(rated for 500 A) : ±0.3%rdg.±0.01%f.s.
- 9669 (rated for 1000 A): ±1.0%rdg.±0.01%f.s.
- 9667(rated for 5000 A) : ±2.0%rdg.±1.5mV
  (500 A range: For 50 to 500 A input)
  (5000 A range: For 500 to 5000 A input)

* f.s. is the sensor's rated primary current value.

Apparent power accuracy	:	±1 dgt. for the calculation obtained from each measurement value
Reactive power accuracy	:	When using the reactive power measurement method ±0.2% rdg. ±0.1% f.s. + clamp-on sensor accuracy When not using the reactive power measurement method ±1 dgt. for the calculation obtained from each measurement value
Integration accuracy	:	±1 dgt. for the measurement accuracy of effective power, reactive power, and apparent power
Power factor accuracy	:	±1 dgt. for the calculation obtained from each measurement value
Frequency accuracy	:	±0.5% rdg. ±1dgt.

Frequency characteristic	:	Fundamental waveforms up to the 50th order ±3% f.s. + measurement accuracy (of a 45- to 66-Hz fundamental waveform)
Temperature characteristic	:	Within ±0.03% f.s./°C
Effect of in-phase voltage	:	Within ±0.2% f.s. (600 Vrms AC, 50/60 Hz, between voltage input terminal and case)
Effect of external magnetic field	:	Within ±1.5% f.s. (in a magnetic field of 400 A/m rms AC, 50/60 Hz)
Power factor influence	:	±1.0% rdg. (45 to 66 Hz, power factor = 0.5, for effective power measurement)
Effect of reactive factor	:	±1.0% rdg. (45 to 66 Hz, reactive factor = 0.5, when using the reactive power measurement method)
Real-time clock accuracy	:	±10 ppm ±1 second (23°C) (within ±1.9 sec/day (23°C))

Formulae
(for single-phase 2-wire systems)

Voltage $U = \sqrt{\frac{1}{M}\sum_{s=0}^{M-1}(Us)^2}$

Current $I = \sqrt{\frac{1}{M}\sum_{s=0}^{M-1}(Is)^2}$

Active Power $P = \frac{1}{M}\sum_{s=0}^{M-1}(Us \times Is)$

U : Inter-line voltage
I : Line current
M: Number of samples
s : Sample count
m : 128 samples per cycle

● Also measure is also possible using the reactive power measurement method

In addition to conventional calculation methods that search for reactive power using voltage, current, and active power, you can select the reactive power measurement method, which derives reactive power directly from voltage and current values, just as with the reactive power volume measurement method used in large-volume power consumers.

When using the reactive power measurement method:

Reactive power $Q = \frac{1}{M}\sum_{s=0}^{M-1}\{Us \times I(s+\frac{m}{4})\}$

Apparent power $S = \sqrt{P^2+Q^2}$

Power factor $PF = \frac{P}{\sqrt{P^2+Q^2}}$

Derives reactive power directly from voltage and current values, just as with the measurement of active power. (The same measurement principle is the same as that used to determine reactive power by large-volume power consumers.)

When not using the reactive power measurement method:

Reactive power $Q = \sqrt{S^2-P^2}$

Apparent power $S = U \times I$

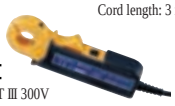
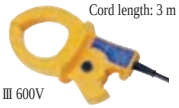
Power factor $PF = \frac{P}{S}$

Calculates reactive power after calculating the apparent power using the voltage, current, and RMS values.

General Specifications

Operating environment	:	Indoors, up to 2000m ASL
Operating temperature and humidity	:	0 to 40°C, 80% RH or less (non-condensating)
Storage temperature and humidity	:	-10 to 50°C, 80% RH or less (non-condensating)
Withstand voltage (50/60 Hz, 1-minute intervals)	:	5.55 kVrms AC: Between the voltage input terminal and the 3169 casing 3.25 kVrms AC: Between the voltage input terminal and the current input terminal/external interface terminal 2.3 kVrms AC: Between the power supply and the 3169 casing 1.35 kVrms AC: Between the power supply and the current input terminal/external interface terminal
Conforming standards	:	Safety EN61010-1:1993 + A2:1995 Voltage input: Pollution degree 2, overvoltage category (anticipated transient overvoltage 6000V) Power supply connector: Pollution degree 2, overvoltage category (anticipated transient overvoltage 2500 V)
	:	EMC EN61326 - 1:1997+A1:1998 class A EN61000 - 3 - 2:1995+A14:2000, EN61000 - 3 - 3:1995
Power supply voltage rating	:	100 to 240 V AC, 50/60 Hz
Maximum rated power	:	30 VA
Dimensions and weight	:	210W × 160H × 60D mm ±5 mm (excluding protrusions), 1.2 kg ±100 g (3196-20, 3169-21)
Accessories	:	9438-03 voltage cord set (1) (1 cord each of black, red, yellow, and blue), voltage cord (1), ground adapter (3P to 2P) (1), input cord label (1), operating manuals (2) (Advanced edition and Quick Start Guide), CD-R (1) (Advanced edition and RS-232C interface operating manuals), 9441 connection cable (1) (for the 3169-21 only)

■Option Specifications

Clamp On Sensor	9660	9661	9669	9667
Appearance	Cord length: 3 m  CE CAT Ⅲ 300V	Cord length: 3 m  CE CAT Ⅲ 600V	Cord length: 3 m  CE CAT Ⅲ 600V	Cord length: Sensor - circuit: 2 m Circuit - connector: 1 m CE CAT Ⅲ 1000V 
Primary current rating	AC 100 A	AC 500 A	AC 1000 A	500 A AC and 5000 A AC ranges
Output voltage	AC 1mV/A	AC 1mV/A	AC 0.5mV/A	AC 500 mV f.s.
Accuracy (45 to 66 Hz) Amplitude	±0.3%rdg.±0.02%f.s.	±0.3%rdg.±0.01%f.s.	±0.1%rdg.±0.01%f.s.	±2.0%rdg.±1.5mV (for input 10% or more of range)
Accuracy (45 to 66 Hz) Phase	Within ±1° (within ±1.3° for 90 A or more)	Within ±0.5°	Within ±1°	Within ±1°
Frequency characteristic	Within ±1.0% at 66 Hz to 5 kHz (deviation from accuracy)		Within ±2.0% at 66 Hz to 5 kHz (deviation from accuracy)	Within ±3 dB at 10 Hz to 20 kHz (deviation from accuracy)
Effect of external magnetic field	Equivalent to 0.1 A or less (with a magnetic field of 400 A/m AC)		Equivalent to 1 A or less (with a magnetic field of 400 A/m AC)	Equivalent to 5 A, 7.5 A max (with a magnetic field of 400 A/m AC)
Effect of conductor position	Within ±0.5%		Within ±1.5%	Within ±3.0%
Maximum test circuit voltage	300 V rms (insulated conductor)	600 V rms (insulated conductor)	600 V rms (insulated conductor)	1000 V rms (insulated conductor)
Maximum input (45 to 66 Hz)	130 A continuous	550 A continuous	1000 A continuous	10000 A continuous
Measurable conductor diameter	Less than ϕ 15 mm	Less than ϕ 46 mm	Less than ϕ 55 mm, 80 × 20 mm bus bar	Less than ϕ 254 mm
Dimensions and weight	46W × 135H × 21D mm, 230g	77W × 151H × 42Dmm, 360g	99.5W × 188H × 42D mm, 590g	Sensor: 910 mm long, 240g, Circuit: 57W × 86H × 30D mm, 140g

9442 PRINTER

Print method : Thermal serial dot printing
Paper width : 112 mm
Print speed : 52.5cps
Power supply : 9443-02/03 AC adapter, or supplied nickel-metal hydride battery (approx. 3000 lines of printing when fully charged and used with the 9443-02/03)
Dimensions and weight : Approx.160W × 66.5H × 17D mm, approx.580g

When purchasing the 9442 printer, make sure you also purchase the 9721 RS-232C cable and 9443-02/03 AC adapter so that you can connect it to the 3169-20/21.

9720 CARRYING CASE

A soft type case for storing the 3169 and its accessories, such as the clamp-on sensors.

Dimensions and weight : Approx. 445W × 340H × 150D mm, approx. 2.2 kg

9721 RS-232C CABLE

Cord length for connecting to the 9442: 1.5 m

9443-02/03 AC ADAPTER

For the 9442
Photo: 9443-03

9440 CONNECTION CABLE

For external I/O
Cord length: 2m

9441 CONNECTION CABLE

For D/A output (supplied with the 3169-01)
Cord length: 2 m

9290 CLAMP ON ADAPTER

Cord length: 3 m
Max. 1500 A AC (continuous: 1000 A)
Measurable conductor diameter:
Bus bar: ϕ55 mm, width 80 mm
CT ratio: 10:1
*Used for expanding the measurement ranges of the 9660 and 9661 sensors

3169-20 CLAMP ON POWER HiTESTER

(supplied with the 9438-03 voltage cord, power cord (1), and ground adapter (3P to 2P) (1))

3169-21 (with D/A output) CLAMP ON POWER HiTESTER

(supplied with the 9438-03 voltage cord, 9441 connection cable, power cord (1), and ground adapter (3P to 2P) (1))

Accessory Specifications

9438-03 VOLTAGE CORD (1 cord each of black, red, yellow, and blue, cord length: 3 m)
9441 CONNECTION CABLE (D/A output cable, supplied with the 3169-21)

Current and power cannot be measured using the 3169-20/21 CLAMP ON POWER HiTESTER on its own. To perform current and power measurement, make sure you also purchase a clamp-on sensor (9660, 9661, 9667, or 9669) (sold separately).

● Combination examples

For single-phase 2-wire systems (one system): 3169-20 + 9660(100A) × 1
For single-phase 3-wire systems (one system/two single-phase 2-wire systems): 3169-20 + 9660(100A) × 2
For three-phase 3-wire systems (one system): 3169-20 + 9661(500A) × 2
For three-phase 3-wire systems (two systems/four single-phase 2-wire systems): 3169-20 + 9661(500A) × 4
For three-phase 4-wire systems (one system): 3169-20 + 9661(500A) × 3

■ Options

9660	CLAMP ON SENSOR (AC 100A)
9661	CLAMP ON SENSOR (AC 500A)
9667	FLEXIBLE CLAMP ON SENSOR (AC 5000A)
9669	CLAMP ON SENSOR (AC 1000A)
9290	CLAMP ON ADAPTER (AC 1500A)
9440	CONNECTION CABLE (for external I/O)
9612	RS-232C CABLE (for connection to a PC)
9442	PRINTER
9443-02	AC ADAPTER (for the 9442, for Europe)
9443-03	AC ADAPTER (for the 9442, for USA)
9721	RS-232C CABLE (for connection to the 9442)
1196	RECORDING PAPER (25 m/10 rolls, for the 9442)
9720	CARRYING CASE
9626	PC CARD 32M
9627	PC CARD 64M

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