Improve Power Conversion Efficiency

Industry-Leading Accuracy and Maximum 12 Channels* 
Hioki Power Analyzers Set Next Generation Standards for Power Efficiency Testing

* When synchronizing two 6-channel models connected via optical link
Basic accuracy for power  \( \pm 0.02\% \) *

Achieving true power analysis

High accuracy, wideband, and high stability. The Hioki PW6001 combines the 3 important elements of power measurement and basic performance backed by advanced technology to achieve unsurpassed power analysis.

Strengthened resistance to noise and temperature fluctuations in the absolute pursuit of measurement stability

The custom-shaped solid shield made completely of finely finished metal and optical isolation devices used to maintain sufficient creepage distance from the input terminals dramatically improve noise resistance, provide optimal stability, and achieve a CMRR performance of 80 dB/100 kHz. Add the superior temperature characteristics of \( \pm 0.01\%/\degree C \) and you now have access to a power analyzer that delivers top-of-the-line measurement stability.*

* Unit accuracy only
**TrueHD 18-bit converter** measures widely fluctuating loads with extreme accuracy

A built-in 18-bit A/D converter provides a broad dynamic range. Even loads with large fluctuations can be shown accurately down to tiny power levels without switching the range. Further, a digital LPF is used to remove unnecessary high-frequency noise, for accurate power analysis.

**Fast, simultaneous calculation functions achieved with Power Analysis Engine II**

All measurements, including period detection, wideband power analysis, harmonic analysis, and waveform analysis, are digitally processed independently and with no effect on each other. Fast calculation processing is used to achieve a data update speed of 10 ms while maintaining maximum accuracy.

**Conversion efficiency measurement during mode measurement without switching ranges**

- TrueHD 18-bit resolution
- Accuracy guaranteed @ 10ms data update
- Fast, simultaneous processing
- Zero-cross filter

**DC accuracy is indispensable for achieving correct efficiency measurements**

For example, when measuring the efficiency of a DC/AC converter, not only AC accuracy but also DC accuracy are equally important. With the PW6001, a DC measurement accuracy of ±0.02% rdg. ±0.05% f.s.* delivers correct and stable efficiency measurements.

**Get a combined accuracy of ±0.07% rdg. even with current sensor**

Add ±0.05% rdg. accuracy of the current sensor to the PW6001’s basic accuracy of ±0.02% rdg. to achieve top-of-the-line accuracy of ±0.07%. Choose from a diverse array of sensors to cover very small currents from 10mA up to large 1000A loads.

**Improvement of S/N ratio with digital LPF**

Conversion efficiency measurement during mode measurement without switching ranges

**Speed**

**Measurement current**

**Measurement of high current and minute current in a single range**

**Improvement of S/N ratio with digital LPF**

*True HD : True High Definition

**Input waveform**

**A/D conversion**

**Digital AAF**

**Zero-cross filter**

**Accurate period detection**

**Wideband power analysis**

**Harmonic analysis**

**Waveform analysis**

**Completely simultaneous digital processing in the PW6001**

**AAF: Antialiasing filter**

Filter for preventing aliasing distortion in harmonic calculations

**Battery Inverter Motor**

Accuracy of efficiency is determined by AC accuracy and DC accuracy.

*Unit accuracy only

**High-accuracy AC/DC current sensors**

50 A 200 A 500 A 1000 A

*Effective measurement range

**High-accuracy current sensors**

±0.02% rdg. DC accuracy
DC, 0.1 Hz to 2 MHz frequency bandwidth

Broad and flat frequency characteristics

Power measurements across wide bandwidths are required for supporting high-speed switching devices such as SiC. Compared even to the Hioki 3390 Power Analyzer, the PW6001 is engineered with 10x the frequency band and sampling performance.

High-speed sampling of 5 MS/s for true frequency analysis

Measurements based on sampling theorem are required to perform an accurate power analysis of PWM waveforms. The Hioki PW6001 features direct sampling of input signals at 5 MS/s, resulting in a measurement band of 2 MHz. This enables analysis without aliasing error.

Dual sampling

Achieve independent sampling of waveform recordings and power analysis. Sampling for waveform recordings can be set freely, while maintaining a power analysis of 5 MS/s.

Large capacity waveform storage

Enjoy 1 Mword x 6 channels of data storage for voltage and current, making it possible to record signals for up to 100 seconds (at 10 kS/s).
Use of the Δ-Y conversion function allows for the calculation of phase voltage and phase power of 3-phase motors whose neutral points cannot be accessed. Further, the Y-Δ conversion function lets you calculate 3-phase 4-wire line-to-line voltage.

Wideband current probes supported

When combined with the HIOKI CT6700, it is also possible to measure minute currents of 1 mA. This is perfect for observing leakage current waveforms in inverters.

Built-in current sensor phase shift function

For accurate power measurement, both amplitude accuracy and phase accuracy specifications are important. Use of the phase shift function allows improvements in measurement accuracy for both high-frequency and low power factor signals. Enter the calibration value for the current sensor to optimize accuracy.

Harmonic analysis up to 1.5 MHz

Wideband harmonic analysis is provided as a standard feature to a max. 100th order for fundamental frequencies 0.1 Hz to 300 kHz and an analysis band of 1.5 MHz. Analysis of fundamental waves in motors and measurement of distortion rate in the transmission waveforms for wireless power supplies are now possible.

Unrestricted conversion of phase voltage and line-to-line voltage

Use of the Δ-Y conversion function allows for the calculation of phase voltage and phase power of 3-phase motors whose neutral points cannot be accessed. Further, the Y-Δ conversion function lets you calculate 3-phase 4-wire line-to-line voltage.

Digital LPF for displaying the waveform you want to view

Select a cutoff frequency for the measurement target. Digital LPF greatly reduces noise to let you display the waveform you want to view.
Specially designed for current sensors to achieve highly precise measurement

With direct wire connection method

The wiring of the measurement target is routed for connecting to the current input terminal. However, this results in an increase in the effects of wiring resistance and capacitive coupling, and meter loss occurs due to shunt resistance, all of which lead to larger accuracy uncertainty.

Advantages of current sensor method

A current sensor is connected to the wiring on the measurement target. This reduces the effects of wiring and meter loss, allowing measurements with wiring conditions that are close to the actual operating environment for a highly efficient system.

Measurement example using the direct wire connection method

Compared to the direct wire connection method, measurement with conditions closer to the actual operation environment of a power converter is achieved.

Highly intuitive user interface

Seamless operability

Time spent on operations is reduced, to allow focused concentration on analysis.

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**Synchronization function for real-time connection of 2 units at a maximum distance of 500 m**

Build a 12-channel power meter using “numerical synchronization”

For multi-point measurements, use the numerical synchronization function to transfer power parameters from the slave device to aggregate at the master in real-time, essentially enabling you to build a 12-channel power analysis system.

Simply transfer waveforms with “waveform synchronization”

Achieve real-time* transfer of 5 MS/s 18-bit sampling data. Measurement waveforms on the slave instrument are displayed without modification on the master unit, paving the way for new applications for power analyzers, such as measurement of the voltage phase difference between two separate devices.

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**Models with motor analysis & D/A output**

(PW6001-11/-12/-13/-14/-15/-16)

Diverse motor analysis functions

Enter signals from torque meters and speed meters to measure motor power. In addition to motor parameters such as motor power and electrical angle, output signals from insolation meters and wind speed meters can also be measured.

D/A output supporting waveform output

Output analog measurement data at update rates of up to 10ms. Combine with a data logger to record long-term fluctuations, and use the built-in waveform output function to output voltage and current at 1 MS/s*.

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**Measurement parameters**

- Electric angle
- Rotation direction
- Motor power
- RPM
- Torque
- Slip

**Measurement targets**

- Motor x 1
- Motor x 2
- Pyranometer/ anemometer and other output signals

**I/O Configuration**

- Single Motor analysis
- Dual Motor analysis
- Independent input for motor analysis

<table>
<thead>
<tr>
<th>Channel</th>
<th>Measurement targets</th>
<th>Motor analysis</th>
<th>Analog output</th>
<th>D/A waveform output</th>
</tr>
</thead>
<tbody>
<tr>
<td>ch A</td>
<td>Torque A</td>
<td>Torque</td>
<td>Voltage/Pulse</td>
<td></td>
</tr>
<tr>
<td>ch B</td>
<td>Encoder A phase</td>
<td>Torque</td>
<td>Voltage/Pulse</td>
<td></td>
</tr>
<tr>
<td>ch C</td>
<td>Encoder B phase</td>
<td>RPM</td>
<td>Pulse</td>
<td></td>
</tr>
<tr>
<td>ch D</td>
<td>Encoder Z phase</td>
<td>RPM</td>
<td>Pulse</td>
<td></td>
</tr>
</tbody>
</table>

*Varies according to the number of channels installed in the PW6001.

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**During waveform output, accurate reproduction is possible at an output of 1 MS/s and with a sine wave up to 50 kHz.**

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**Models with motor analysis & D/A output**

(D/A analog output & D/A waveform output)

**Models with motor analysis & D/A output**

(D/A analog output & D/A waveform output)

**Models with motor analysis & D/A output**

(D/A analog output & D/A waveform output)
SiC measurement achieved with high resolution

High resolution is required for the high precision measurement of PWM waveforms for SiC semiconductors with low ON resistance. TrueHD 18-bit is achieved at a level of precision that has never been seen before.

Simultaneous harmonic analysis for input/output

Analyze harmonic data that is synchronized to the fundamental waveforms of both the input and output of an inverter. A maximum of 6 systems can be analyzed simultaneously.

Detailed analysis of PWM waveforms

A cursor readout function*, zoom function*, and trigger/pre-trigger function, which are not available on the Hioki 3390, are built-in on this unit. You can use the touch screen and dual knobs for unrestricted analysis of waveforms.

*Available soon.

Observe phase voltage waveforms

Use the Δ-Y conversion function to display the calculations for phase voltage at the waveform level from the line-to-line voltage of the motor, enabling you to analyze the harmonics of the phase voltage waveforms.

Line-to-line voltage waveform and line current waveform for 3-phase motor

Phase voltage waveform using Δ-Y calculation
Transmission efficiency of wireless power supplies

Harmonic analysis of transmission frequency
Measure the efficiency of wireless power supply devices such as those found in electric vehicles. Use of the wideband harmonic analysis function up to a fundamental wave of 300 kHz allows the analysis of waveform distortion rate and harmonic waves in the vicinity of 100 kHz used for wireless power transmission.

Accurate measurement of low power factor power
With wireless power supplies, the power factor drops due to the inductance component of the sending/receiving elements of energy. Use of the phase shift function in the PW6001 lets you accurately measure both high-frequency and lower power factor power.

Save data with a single touch
Use the [SAVE] key to save numerical data, and the [COPY] key to copy the screen. You can also enter comments on the saved data.

One-touch settings take you to measurement immediately
The built-in easy setup function allows you to simply select the type of measurement line and immediately start measurement using the automated optimum settings.
EV/HEV motor analysis

Advanced electrical angle measurement function
The PW6001 features a built-in electric angle measurement function required for the measurement of motor parameters in high-efficiency synchronized motors and the analysis of vector control via dq coordinate systems. Make real-time measurements of phases for voltage and current fundamental wave components based on encoder pulses. Further, zero-adjustment of the phase angle when induced voltage occurs allows phase measurement at the induction voltage standard. Finally, the PW6001 can detect the forward/reverse from A phase and B phase pulses to enable 4-quadrant analysis of torque and RPM.

Fast 10 ms calculation of power in transient state
Measure power transient states, including motor operations such as starting and accelerating, at 10ms update rates. Automatically measure and keep up with power with fluctuating frequencies, from a minimum of 0.1 Hz.

Simultaneous measurement of 2 motor powers
The PW6001 is engineered with the industry’s first built-in dual mode motor analysis function that delivers the simultaneous analysis of 2 motors. Simultaneous measurement of the motor power for HEV driving and power generation is now possible.

Rackmount support
Optimal full rack size for test benches and production inspection lines

Key features
-准确性保证 @ 10ms数据更新
-±0.02% rdg.
-DC accuracy
-灵活效率计算
Measuring the efficiency of PV power conditioners

Assess efficiency and loss at a glance

In addition to the measurement of power generated by solar cells, efficiency rate of conditioners, loss, and the measurement of power from purchased electricity when power systems are linked are also possible at the same time.

Harmonic analysis, important for linking systems

Conveniently evaluate according IEC61000-4-7 using the built-in IEC standard mode. You can also limit the number of THD calculations as required by the standard.

Power conditioner testing

Parameters required for power conditioners, such as fundamental wave reactive power Qfnd, DC ripple rate, and 3-phase unbalanced rate, can be measured and displayed simultaneously. The required measurement data can be viewed at a glance, improving test efficiency.

Measure output from environmental sensors

Using the independent input mode in the motor analysis function, you can measure the analog voltage signals from environmental testing devices such as insolation meters, thermometers, wind speed meters, and light meters, on a maximum of 2 channels. The signals can be recorded at the same time as power.
Simultaneous analysis of system and power generation

With the dual vector display, you can see the 3-phase balancing conditions for both the system and power generation at a glance.

Measure the efficiency of power conditioners

By using the numerical synchronization function, you can take measurements with complete synchronization of power conditioners for 2 systems. All power parameters can be aggregated on the master instrument, and the efficiency for each or the overall efficiency can be calculated and displayed.

Test and evaluate substations, plants and railroads

Measure phase difference between 2 separate points

Use the waveform synchronization function to measure the phase relationship between 2 points separated by a maximum distance of 500 m. Due to insulation with an optical connection cable, measurement can be performed safely even if the ground potential between the 2 points is not the same.

D/A output waveforms captured 500m away

Transfer voltage/current waveforms taken by the slave instrument located as far as 500m away and output the signals from the master device. When combined with a Hioki MEMORY HiCORDER, timing tests and simultaneous analysis of multiple channels for 3-phase power are possible.

* The waveform that is output has a delay of 7 μs to 12 μs, depending on the distance.
**Interface**

- View data in free dedicated application
- Command control*
- View data in free dedicated application
- Command control*
- START/STOP/DATA RESET control
- Terminals shared with RS-232C, ±5 V/200 mA power supply possible
- Fast Gbit LAN supported, command control*
- View data in free dedicated application
- Optical connection cable connector, Duplex-LC (2-core)
- Switching for 20 channels of analog output or maximum 12 channels of waveform + 8 channels of analog output

* Download the Communications Command Instruction Manual from the Hioki website.

**USB flash drive interface**

- Save waveform data/measurement data (csv) and screen captures (bmp)
- Real-time save of interval data (csv) at a maximum speed of 10ms

**Internal memory**

- Save interval data, for transfer later to USB flash drive

**PC Communication Software – PW Communicator** *(Available soon)*

PW Communicator is a dedicated application software for communicating between a PW6001 power meter and a PC. Free download is available from the Hioki website. The application contains convenient functions for setting the PW6001, monitoring the measurement values, acquiring data via communication, computing efficiency, and much more.

**Value monitoring**

Display the PW6001’s measurement values on the PC screen. You can freely select up to 64 values, such as voltage, current, power, and harmonics.

**Waveform monitoring**

Monitor the voltage, current, and waveforms measured by the meter right on the PC screen.

**Meter setting**

Configure the connected PW6001 from the PC screen.

**Synchronous measurement**

Compute the input/output efficiency of a power converter and similar operations when using multiple units of PW6001. In addition to the PW6001, you can also batch control other Hioki power meters, such as the PW3335, PW3336, and PW3337.

**Saving data as CSV file**

Record 180 or more measurement data to a CSV file at fixed intervals. The shortest interval between recordings is 200 ms.

**PW Communicator Specifications**

<table>
<thead>
<tr>
<th>Availability</th>
<th>Free download from the Hioki website</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating environment</td>
<td>PC/AT-compatible</td>
</tr>
<tr>
<td>OS</td>
<td>Windows 8, Windows 7 (32/64-bit)</td>
</tr>
<tr>
<td>Memory</td>
<td>2GB or more recommended</td>
</tr>
<tr>
<td>Interface</td>
<td>LAN, RS-232C, GP-IB</td>
</tr>
</tbody>
</table>

**LabVIEW Driver** *(Available soon)*

A LabVIEW driver compatible with the PW6001 will enable you to acquire data and build measurement systems. (LabVIEW is a registered trademark of National Instruments Corporation.)
Basic Specifications

**Power measurement**

<table>
<thead>
<tr>
<th>Frequency Band</th>
<th>Power measurement range</th>
</tr>
</thead>
<tbody>
<tr>
<td>500 Hz / 1 kHz / 5 kHz / 10 kHz / 50 kHz / 100 kHz / 500 kHz / OFF</td>
<td>0.01 Hz to 40 Hz</td>
</tr>
<tr>
<td>LPF</td>
<td>10 Hz to 100 kHz</td>
</tr>
<tr>
<td>Frequency Band</td>
<td>2.000 MHz (Input signal)</td>
</tr>
</tbody>
</table>

**Select from OFF / 0.1% f.s. / 0.5% f.s.**

**Measurement lines**

- Probe 2 power supply: +12 V ±0.5 V, -12 V ±0.5 V, max. 600 mA, up to a max. of 700 mA for up to 3 channels
- Voltage measurement unit: Input method
  - Voltage (U), current (I), active power (P), apparent power (S), reactive power (Q), power factor
- Polarity detection
- Current zero-cross timing comparison

**Input resistance**

- 2.40000 W to 4.50000 MW (depending on voltage and current combinations)
- (50 Hz / 60 Hz)

**Connection patterns that can be selected based on the number of channels:**

- Pattern 1
- Pattern 2
- Pattern 3
- Pattern 4
- Pattern 5
- Pattern 6
- Pattern 7

**Input terminal profile**

- Voltage: Plug in terminal (safety terminal)
- Device ID: Dedicated connector (ME155)
- Probe: 0% input (power supply normal)

**Probe 2 power supply**

- +12 V ±0.5 V, -12 V ±0.5 V: max. 600 mA up to a max. of 700 mA for up to 3 channels

**Input method**

- Voltage measurement unit: Probe 2 power supply
- Burst input: Probe 2 power supply
- Current measurement unit: Current measurement input (current sensor)
- Analog LPF + digital IIR filter (Butterworth characteristics equivalent)

**Voltage range**

- 6 V / 15 V / 30 V / 50 V / 100 V / 200 V / 400 V / 1500 V

**Current range**

- (Probe 1):
  - 400 mA / 800 mA / 2 A / 4 A / 20 A / 40 A / 200 A / 800 A
  - (with 20 A sensor)
- 2 A / 4 A / 20 A / 40 A / 200 A / 800 A
  - (with 20 A sensor)
- 10 A / 20 A / 30 A / 100 A / 200 A / 400 A / 1 A / 4 A
  - (with 500 A sensor)
- 10 A / 20 A / 30 A / 100 A / 200 A
  - (with 500 A sensor)
- 100 A / 200 A / 500 A / 1 A / 2 A / 4 A / 5 A
  - (with 10 kV/div sensor)
- 100 A / 200 A / 500 A / 10 A / 20 A / 50 A
  - (with 10 kV/div sensor)
- 100 A / 200 A / 500 A / 1 A / 2 A / 5 A
  - (with 1 kV/div sensor; CT6700 or CT6701)
- 1 V / 2.5 V / 5 V / 10 V / 20 V / 50 V / 100 V

**Power range**

- 2.40000 W to 4.50000 MW (depending on voltage and current combinations)

**Input resistance (50 Hz / 60 Hz)**

- 50 Ω ±50 kΩ
- 1 MΩ ±50 kΩ
- 4 MΩ ±40 kΩ

**Power factor**

- ±0.02% rdg. and ±0.02% f.s. ±0.02% rdg. ±0.02% f.s.

**Measurement accuracy**

- ±0.05% rdg. ±1 dgt. (with a sine wave that is at least 30% of the measurement source’s power frequency)
- 0.1 Hz to 2 MHz

**Measurement frequency range**

- ±30 Hz ≤ f ≤ 2 MHz (Display shows ±0.00001 Hz or ---- Hz if measurement is not possible.)

**Integration accuracy**

- ±1% f.s. or less (in a magnetic field of 400 A/m, DC or 50 Hz / 60 Hz)

**Effects of temperature and humidity**

- Voltage, current, and active power accuracy within the range of 5°C to 25°C ±0.01% rdg. / °C (add 0.01% f.s. / °C for DC measured values)

**Effects of common-mode voltage**

- 50 Hz / 60 Hz
  - 100 kHz or greater (when applied between the voltage input terminals and the enclosure)
  - 80 dB or greater (reference value)

**Effects of external magnetic fields**

- ±1% f.s. or less (in a magnetic field of 400 A/m, DC or 50 Hz / 60 Hz)

**Frequency measurement**

**Number of measurement channels**

- Max. 5 channels

**Measurement source**

- Different from OFF for each connection

**Measurement method**

- Reciprocal method × zero-crossing sampling value calculation

**Accuracy**

- ±0.01% rdg. /°C (add 0.01% f.s. /°C for DC measured values)

**Power factor**

- ±0.05% rdg. ±0.2° (a phase or at or above 10 kHz)

**Effects of storage temperature**

- -25°C to 70°C

**Display format**

- 0.00000 Hz to 9999.999 Hz

**Integration measurement**

**Measurement models**

- Select RMS or DC for each connection (DC mode can only be selected when using an AC/DC output interface)

**Measurement parameters**

- Current integration (I+, I-, I), active power integration (WP+, WP-, WP)
- f and f1: measured only in DC mode, only f is measured in RMS mode

**Input resistance**

- 0° to 40° to 100° to 150° to 200°

**Input current**

- DC mode

**Display resolution**

- 0.00011 (6 digits + decimal point), starting from the resolution at which 1% of each range is read.
Harmonics measurement

Number of measurement channels
Max. 6 channels, based on the number of built-in channels

Synchronization source
Based on the synchronization source setting for each connection.

Measurement mode
Select from IEC standard mode or wideband mode (setting applies to all channels).

Measurement parameters
- Harmonics measurement
  - Computing ratio
    - 1 Mword × ((voltage + current) × number of channels + motor waveforms *)
- Computation word
  - 1 kWord / 5 kWord / 10 kWord / 50 kWord / 100 kWord / 500 kWord / 1 Mword
- Number of bits
  - 16 bits (Voltage and current waveforms use the upper 16 bits of the 18-bit A/D.)

FFT processing word
Harmonic voltage RMS value, harmonic voltage content percentage, harmonic voltage phase angle, harmonic current RMS value, harmonic current content percentage, harmonic current phase angle, harmonic active power, harmonic power content percentage, harmonic voltage/current phase difference, total harmonic voltage distortion, total harmonic current distortion, voltage unbalance rate, current unbalance rate (16 internal harmonic parameters in IEC standard mode).

Harmonic measurement

Harmonic measurement
- Frequency
  - 45 Hz to 66 Hz
- Data update rate
  - Fixed at 50 ms.

Wideband mode

Wideband mode
- Frequency
  - 1 kHz to 3 kHz ±6% rdg. ±0.05% f.s. ±10% rdg. ±0.05% f.s. ±0.8°
- Harmonic voltage
  - 500 kHz < f ≤ 900 kHz ±4% f.s. ±5% f.s. ±(0.030×f)° ±2°
- DC
  - ±0.1% f.s. ±0.2% f.s.
- Grouping
  - OFF / Type 1 (harmonic sub-group) / Type 2 (harmonic group)
- Window function
  - Rectangular

Motor analysis (PW6001-11 to -16 only)

Motor analysis
- Signal source
  - Motor waveform and motor pulse

D/A output (PW6001-11 to -16 only)

D/A output
- Number of output channels
  - 4 channels
- Signal source
  - CH A: Analog DC input / Frequency input / Pulse input
  - CH B: Analog DC input / Frequency input / Pulse input
  - CH C: Pulse input
  - CH D: Pulse input
- Number of input channels
  - 4 channels
- Measurement type
  - Signal source: Analog DC input / Frequency input / Pulse input
- Measurement accuracy
  - ±0.5% f.s. (at ±2 V f.s.) or ±1.0% f.s. (at ±1 V f.s.)

Waveform recording

Waveform recording
- Number of measurement channels
  - Max. 6 channels, based on the number of installed channels
- Sampling speed
  - Voltage and current waveforms
    - Always 5 Ms/s

Display section

Display section
- Display characters
  - English / Japanese / Chinese (simplified, available soon)
- Resolution
  - 101 kHz ≤ f < 201 kHz
  - 80 Hz ≤ f < 160 Hz
  - 6 kHz ≤ f < 12 kHz
  - 500 kHz ≤ f ≤ 100 kHz

Temperature correction

Temperature correction
- Temperature
  - ±0.05% rdg. ±0.05% f.s.

Accuracy

Accuracy
- Power factor
  - Power factor is defined for a power factor of 1.
- Power measurement accuracy
  - For voltage and active power at 100 Hz, ±0.5% f.s. or less (however, figures are reference values).

Motor analysis

Motor analysis
- Measurement accuracy
  - ±0.5% f.s. ±0.05% f.s.

Trigger mode

Trigger mode
- Trigger
  - SINGLE or NORMAL (with trigger setting)
(1) USB flash drive interface

Connector: USB Type A connector × 1
Electrical specifications: USB 2.0 (high-speed)
Power supplied: Max. 500 mA
Supported USB flash drives: USB Mass Storage Class compatible
Recorded data: - Saved booting files
- Saved measured values/automatic recorded data (CSV format)
- Copy measured values/automatic recorded data from internal memory
- Saved waveform data, save screenshots (compressed BMP format)

(2) LAN interface

Connector: RJ-45 connector × 1
Electrical specifications: IEEE 802.3-compliant
Transmission method: 10Base-T / 100Base-TX / 1000Base-T (automatic detection)
Protocol: TCP/IP (with DHCP function)
Functions: Dedicated port (data transfers, command control)

(3) GPIB interface

Communication method: EIEEE 488.1-1987 compliant developed with reference to IEEE 488.2-1987
Interface functions: SH1, AH1, TL, LA, SH2, RL1, PYN, OCL, CTL, C0
Addresses: 00 to 39
Functions: Command control

(4) RS-232C interface

Connector: Di-sub 9-pin connector × 1
Full duplex, start/stop synchronization, data length of 8 bit, no parity, 1 stop bit
Flow control: Hardware control/DSR/CTS
Communications speed: 9,600 bps, 19,200 bps, 38,400 bps, 57,600 bps, 115,200 bps, 230,400 bps
Functions: Command control

(5) External control interface

Connector: Di-sub 9-pin connector × 1
Power supplied: OFF/ON (voltage of +5 V, max. 200 mA)
Electrical specifications: 0 V to 5 V (2.5 V to 5 V) logic signals or contact signal with terminal shorted or open
Functions: Sends data from the connected slave instrument to the master instrument, which performs calculations and displays the results

(6) Two-instrument synchronization interface

Connector: OFF/ON (voltage of 0 V to 5 V, max. 200 mA)
Electrical specifications: OFF/ON (voltage of 0 V to 5 V, max. 200 mA)
Functions: Data format: CSV file format

(7) Current sensor phase shift calculation

Functions: Selects the reactive power, power factor, and power phase angle formulas.

(8) Voltage RMS

Function list: <br> Y-<br> X-<br> Z-<br> Δ<br> Y+Z<br> Δ+Y<br> Δ+Z<br> Δ+Y+Z<br> Z+Δ+Y</br>

(9) Power formula selection

Function list: TYPE1, TYPE2, TYPE3
- TYPE1: Compatible with standard as used by the Hioki 3192 and 3200.
- TYPE2: Compatible with standard as used by the Hioki 3192 and 3193.
- TYPE3: The sign of the TYPE1 power factor and power phase angle are used as the active power signs.

(10) Delta conversion

Function list: When using a 3P4W connection, converts the line voltage waveform to a phase voltage waveform using a virtual neutral point. When using a SPW connection, converts the phase voltage waveform to a line voltage waveform.

(11) Current sensor phase shift conversion

Function list: Corrects the phase of the current sensor using harmonic phase characteristics using calculations.

(12) Display functionality

Function list: Displays a connection diagram and voltage and current vectors based on the selected measurement lines. The ranges for a correct connection are displayed on the vector display so that the connection can be checked.

(13) Numerical display screen

Function list: Displays power measured values and motor measured values for up to six instrument channels.

(14) Harmonic display screen

Function list: Displays harmonic measured values on the instrument's screen.

(15) Waveform display screen

Function list: Displays waveforms for up to 20 instrument channels.

(16) Automatic save function

Function list: Saves the specified measured values in files for each interval.

(17) Save destination

Function list: Internal memory / USB flash drive

(18) Date format

Function list: Date format: YYYY/MM/DD, YYYY-MM-DD, YYYY/MM/DD
Manual save function

(1) Measurement data

| Functions | The [SAVE] key saves specified measured values at the time it is pressed. The specified data can be entered for each saved data point, up to a maximum of 20 alphanumeric characters. The manual save function for measurement data cannot be used while automatic save is in progress.
| Save destination | USB flash drive
| Saved parameters | User-selected from all measured values, including harmonic measured values
| Data format | CSV file format

(2) Waveform data

| Functions | A button on the touch screen saves waveform data at the time it is pressed. The specified data can be entered for each saved data point, up to a maximum of 40 alphanumeric characters. The manual save function for measurement data cannot be used while automatic save is in progress.
| Save destination | USB flash drive
| Data format | CSV file format

(3) Screenshots

| Functions | The [DUMP] key saves a screenshot to the save destination. This function can be used at an interval of 1 sec or more while automatic saving is in progress.
| Save destination | USB flash drive
| Comment entry | OFF / Touch function
| Data format | Compressed BMP

(4) Settings data

| Functions | Saves settings information to the save destination as a settings file via functionally provided on the File screen. In addition, previously saved settings files can be loaded and their settings restored on the File screen. However, language and communications settings are not saved.
| Save destination | USB flash drive

Two-instrument synchronization function

| Functions | Sends data from the connected slave instrument to the master instrument, which performs calculations and displays the result. In numerical synchronization mode, the master instrument operates as a power meter with up to 12 channels. In waveform synchronization mode, the master instrument operates while synchronizing up to three channels from the slave instrument at the waveform level.
| Operating mode | OFF / Numerical synchronization / Waveform synchronization
| Numerical synchronization mode | Numerical synchronization cannot be selected when the data update rate is 10 ms.
| Waveform synchronization mode | For both master instruments and slave instruments, waveform synchronization operates only when there are 3 or more channels.
| Synchronized items | Numerical synchronization mode: Waveform synchronization mode: Data update timing, startstop timer reset
| Synchronization delay | Numerical synchronization mode: Waveform synchronization mode: Basic measurement parameters for up to six channels (including motor data)
| Transfer items | Numerical synchronization mode: Waveform synchronization mode: Voltage/current sampling waveform for up to three channels (not including motor data). However, the maximum number of channels is limited to a total of six, including the master instrument's channels.

Other functions

| Check function | Auto-evaluate, automatic leap year detection, 24-hour clock
| Actual time accuracy | When the instrument is on, ±10 mins; when the instrument is off, within ±3 sec/day (25°C)
| Sensor identification | Current sensors connected to Probes are automatically detected.
| Zero-adjustment function | After the AC/DC current sensor's DEMAG signal is sent, zero-correction of the voltage and current output offset is performed.
| Touch screen control | Position calibration is performed for the touch screen.
| Key lock | When the key lock is engaged, the key lock icon is displayed on the screen.

General Specifications

| Operating environment | Indoors at an elevation of up to 2000 m in a Pollution Level 2 environment
| Storage temperature and humidity | -10°C to 50°C, 80% RH or less (no condensation)
| Operating temperature and humidity | 0°C to 40°C, 80% RH or less (no condensation)
| Diaphragm strength | 54 kPa±1 kPa, 1500 kPa±1 kPa (calibrated at 25°C ±2°C, ±2% F.S.)
| Standards | EN50160, IEC 61000-4-30, IEC 61000-4-40, IEC 61000-4-30 (IEC 61000-4-30), IEC 61000-4-30, IEC 61000-4-30, IEC 61000-4-30
| Rated supply voltage | 100 V AC to 240 V AC, 50 Hz/60 Hz
| Maximum rated current | 0.1 A
| External dimensions | 165 (H) × 275 (W) × 280 (D) mm (excluding protruding parts)
| Mass | Approx. 14 kg ±1 kg (PW6001/26)
| Backup battery life | Approx. 10 years (reference value at 23°C [Humidity: battery that stores time and setting functions])
| Product warranty period | 1 year
| Guaranteed accuracy period | 6 months (1-year accuracy ±6-month accuracy ±1.5%)
| Accuracy guarantted conditions | Accuracy guarantted temperature and humidity range
| Accessories | Instruction manual x 1, power cord x 1, DC plug 25-pin connector x 1 (PW6001/26)

Motor analysis formule

| Parameter | Formula
| Voltage | \[ V = \frac{X_{ac(i)}}{X_{rms(i)}} \] \[ V = \frac{X_{ac(i)}}{X_{rms(i)}} \]
| Current | \[ I = \frac{X_{ac(i)}}{X_{rms(i)}} \] \[ I = \frac{X_{ac(i)}}{X_{rms(i)}} \]
| Apparent power | \[ S = \sqrt{P^2 + Q^2} \] \[ S = \sqrt{P^2 + Q^2} \]
| Power factor | \[ \delta = \frac{Q}{P} \] \[ \delta = \frac{Q}{P} \]
| Active power | \[ P = \frac{S_i^2}{X_{ac(i)}} \] \[ P = \frac{S_i^2}{X_{ac(i)}} \]
| Reactive power | \[ Q = \frac{S_i^2}{X_{ac(i)}} \] \[ Q = \frac{S_i^2}{X_{ac(i)}} \]
| AC component | \[ X_{rms} = \sqrt{X_{rms}^2 + X_{dc}^2} \] \[ X_{rms} = \sqrt{X_{rms}^2 + X_{dc}^2} \]
| Fundamental wave component | \[ X_{pk} = \frac{X_{ac(i)}}{X_{rms(i)}} \] \[ X_{pk} = \frac{X_{ac(i)}}{X_{rms(i)}} \]

Formule

**Formulae**

**Basic formulae**

| Parameter | Formula
| Voltage, current | \[ X_{rms} = \frac{1}{N} \sum_{i=1}^{N} X_{ac(i)} \] \[ X_{rms} = \frac{1}{N} \sum_{i=1}^{N} X_{ac(i)} \]
| RMS value | \[ X_{pk} = \frac{X_{ac(i)}}{X_{dc}} \] \[ X_{pk} = \frac{X_{ac(i)}}{X_{dc}} \]
| Average value | \[ X_{av} = \frac{1}{N} \sum_{i=1}^{N} X_{av(i)} \] \[ X_{av} = \frac{1}{N} \sum_{i=1}^{N} X_{av(i)} \]

**Waveform data**

| Function | Formula
| Voltage, current | \[ V = \frac{X_{ac(i)}}{X_{rms(i)}} \] \[ V = \frac{X_{ac(i)}}{X_{rms(i)}} \]
| Mean value | \[ M = \frac{1}{N} \sum_{i=1}^{N} X_{av(i)} \] \[ M = \frac{1}{N} \sum_{i=1}^{N} X_{av(i)} \]
| AC component | \[ X_{rms} = \sqrt{X_{rms}^2 + X_{dc}^2} \] \[ X_{rms} = \sqrt{X_{rms}^2 + X_{dc}^2} \]
| Fundamental wave component | \[ X_{pk} = \frac{X_{ac(i)}}{X_{dc}} \] \[ X_{pk} = \frac{X_{ac(i)}}{X_{dc}} \]

**Tables**

- **Data format**: CSV file format
- **Save destination**: USB flash drive
- **Synchronization mode**: numerical synchronization mode
- **Synchronization delay**: basic measurement parameters for up to six channels (including motor data)
- **Transfer items**: basic measurement parameters for up to six channels (including motor data)
High accuracy sensor (connected to input terminal Probe 1)

<table>
<thead>
<tr>
<th>Model</th>
<th>AC/DC CURRENT SENSOR CT6862-05</th>
<th>AC/DC CURRENT SENSOR CT6863-05</th>
<th>AC/DC CURRENT SENSOR 9709-05</th>
<th>AC/DC CURRENT SENSOR CT6865-05</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appearance</td>
<td>![Image](334x39 to 416x199)</td>
<td>![Image](457x719 to 510x756)</td>
<td>![Image](563x648 to 624x756)</td>
<td>![Image](738x719 to 800x756)</td>
</tr>
<tr>
<td>Rated primary current</td>
<td>50A AC/DC</td>
<td>200A AC/DC</td>
<td>500A AC/DC</td>
<td>1000A AC/DC</td>
</tr>
<tr>
<td>Diameter of measurable conductors</td>
<td>Max. φ 24mm (0.94&quot;)</td>
<td>Max. φ 24mm (0.94&quot;)</td>
<td>Max. φ 36mm (1.42&quot;)</td>
<td>Max. φ 36mm (1.42&quot;)</td>
</tr>
<tr>
<td>Basic accuracy</td>
<td>±0.05 %rdg. ±0.01 % f.s. , ±0.2° (DC and 16Hz to 400Hz)</td>
<td>±0.05 %rdg. ±0.01 % f.s. , ±0.2° (DC and 45Hz to 66Hz)</td>
<td>±0.05 %rdg. ±0.01 % f.s. , ±0.2° (DC and 45Hz to 66Hz)</td>
<td>±0.05 %rdg. ±0.01 % f.s. , ±0.2° (DC and 45Hz to 66Hz)</td>
</tr>
<tr>
<td>Frequency characteristics (Amplitude/typical)</td>
<td>DC to 16Hz : ±0.1%rdg. ±0.02% f.s.</td>
<td>DC to 50Hz : ±0.2%rdg. ±0.02% f.s.</td>
<td>DC to 50Hz : ±0.2%rdg. ±0.02% f.s.</td>
<td>DC to 50Hz : ±0.2%rdg. ±0.02% f.s.</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>-30°C to 85°C (-22°F to 185°F)</td>
<td>-30°C to 85°C (-22°F to 185°F)</td>
<td>0°C to 50°C (-32°F to 122°F)</td>
<td>-30°C to 85°C (-22°F to 185°F)</td>
</tr>
<tr>
<td>Effects of external magnetic fields</td>
<td>10mA equivalent or lower (400A/m, 60Hz and DC)</td>
<td>50mA equivalent or lower (400A/m, 60Hz and DC)</td>
<td>50mA equivalent or lower (400A/m, 60Hz and DC)</td>
<td>200mA equivalent or lower (400A/m, 60Hz and DC)</td>
</tr>
<tr>
<td>Maximum rated voltage to earth</td>
<td>CAT III 1000Vrms</td>
<td>CAT III 1000Vrms</td>
<td>CAT III 1000Vrms</td>
<td>CAT III 1000Vrms</td>
</tr>
<tr>
<td>Dimensions</td>
<td>70W(2.76&quot;)×100H(3.94&quot;)×53D(2.09&quot;)mm</td>
<td>160W6.30&quot;)×112H(4.41&quot;)×50D(1.97&quot;)mm</td>
<td>160W6.30&quot;)×112H(4.41&quot;)×50D(1.97&quot;)mm</td>
<td>160W6.30&quot;)×112H(4.41&quot;)×50D(1.97&quot;)mm</td>
</tr>
<tr>
<td>Mass</td>
<td>Approx. 340g (12.0 oz.)</td>
<td>Approx. 350g (12.3 oz.)</td>
<td>Approx. 850g (30.0 oz.)</td>
<td>Approx. 980g (35.3 oz.)</td>
</tr>
</tbody>
</table>

Derating properties

Conversion cables

CONVERSION CABLE CT9900 is required to connect the following current sensors to the high accuracy sensor terminal.

For use with CT6862, CT6863, 9709, CT6865, CT6841, CT6843 When using a sensor without “-05” in the model name, Conversion Cable CT9900 must be used to make the connection.
### Broadband probe (connected to input terminal Probe 2)

<table>
<thead>
<tr>
<th>Model</th>
<th>CLAMP ON PROBE 3273-50</th>
<th>CLAMP ON PROBE 3274</th>
<th>CLAMP ON PROBE 3275</th>
<th>CLAMP ON PROBE 3276</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appearance</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequency band</td>
<td>DC to 50 MHz (-3dB)</td>
<td>DC to 10 MHz (-3dB)</td>
<td>DC to 2 MHz (-3dB)</td>
<td>DC to 100 MHz (-3dB)</td>
</tr>
<tr>
<td>Rated primary current</td>
<td>30A AC/DC</td>
<td>150A AC/DC</td>
<td>500A AC/DC</td>
<td>30A AC/DC</td>
</tr>
<tr>
<td>Diameter of measurable conductors</td>
<td>5 mm dia. or less (insulated conductors)</td>
<td>20 mm dia. or less (insulated conductors)</td>
<td>20 mm dia. or less (insulated conductors)</td>
<td>5 mm dia. or less (insulated conductors)</td>
</tr>
<tr>
<td>Basic accuracy</td>
<td>0 to 30 A rms ±1.0% rdg. ±1 mV, 30 A rms to 50 A peak ±2.0% rdg. (At 45 to 66 Hz, DC)</td>
<td>0 to 150 A rms ±1.0% rdg. ±1 mV, 150 A rms to 300 A peak ±2.0% rdg. (At 45 to 66 Hz, DC)</td>
<td>0 to 500 A rms ±1.0% rdg. ±5 mV, 500 A rms to 700 A peak ±2.0% rdg. (At 45 to 66 Hz, DC)</td>
<td>0 to 30 A rms ±1.0% rdg. ±1 mV, 30 A rms to 50 A peak ±2.0% rdg. (At 45 to 66 Hz, DC)</td>
</tr>
<tr>
<td>Operating temperature and humidity</td>
<td>0°C to 40°C (32°F to 104°F), 80% rh or less (no condensation)</td>
<td>0°C to 40°C (32°F to 104°F), 80% rh or less (no condensation)</td>
<td>0°C to 40°C (32°F to 104°F), 80% rh or less (no condensation)</td>
<td>0°C to 40°C (32°F to 104°F), 80% rh or less (no condensation)</td>
</tr>
<tr>
<td>Effects of external magnetic fields</td>
<td>Max. 20 mA or equivalent (400A/m, 60Hz and DC)</td>
<td>Max. 150 mA or equivalent (400A/m, 60Hz and DC)</td>
<td>Max. 800 mA or equivalent (400A/m, 60Hz and DC)</td>
<td>Max. 5 mA or equivalent (400A/m, 60Hz and DC)</td>
</tr>
<tr>
<td>Dimensions</td>
<td>175W (6.89&quot;) x 18H (0.71&quot;) x 40D (1.57&quot;) mm, Cable length: 1.5 m</td>
<td>176W (6.93&quot;) x 18H (0.71&quot;) x 27D (1.06&quot;) mm, Cable length: 2 m</td>
<td>176W (6.93&quot;) x 18H (0.71&quot;) x 27D (1.06&quot;) mm, Cable length: 2 m</td>
<td>175W (6.89&quot;) x 18H (0.71&quot;) x 40D (1.57&quot;) mm, Cable length: 1.5 m</td>
</tr>
<tr>
<td>Mass</td>
<td>Approx. 230 g (8.1oz)</td>
<td>Approx. 500 g (17.6oz)</td>
<td>Approx. 520 g (18.3oz)</td>
<td>Approx. 240 g (8.5oz)</td>
</tr>
</tbody>
</table>

### Sensor switching method

**High accuracy sensor terminal:** Slide the cover to the left.

When connecting CT6862-05, CT6863-05, CT6865-05, CT6841-05 or CT6843-05

**Wideband probe terminal:** Slide the cover to the right.

When connecting 3273-50, 3274, 3275, 3276, CT6700 or CT6701
**Configurations**

<table>
<thead>
<tr>
<th>Model</th>
<th>Number of built-in channels</th>
<th>Motor analysis &amp; D/A output</th>
</tr>
</thead>
<tbody>
<tr>
<td>PW6001-01</td>
<td>1ch</td>
<td>—</td>
</tr>
<tr>
<td>PW6001-02</td>
<td>2ch</td>
<td>—</td>
</tr>
<tr>
<td>PW6001-03</td>
<td>3ch</td>
<td>—</td>
</tr>
<tr>
<td>PW6001-04</td>
<td>4ch</td>
<td>—</td>
</tr>
<tr>
<td>PW6001-05</td>
<td>5ch</td>
<td>—</td>
</tr>
<tr>
<td>PW6001-06</td>
<td>6ch</td>
<td>—</td>
</tr>
<tr>
<td>PW6001-11</td>
<td>1ch</td>
<td>✔</td>
</tr>
<tr>
<td>PW6001-12</td>
<td>2ch</td>
<td>✔</td>
</tr>
<tr>
<td>PW6001-13</td>
<td>3ch</td>
<td>✔</td>
</tr>
<tr>
<td>PW6001-14</td>
<td>4ch</td>
<td>✔</td>
</tr>
<tr>
<td>PW6001-15</td>
<td>5ch</td>
<td>✔</td>
</tr>
<tr>
<td>PW6001-16</td>
<td>6ch</td>
<td>✔</td>
</tr>
</tbody>
</table>

Accessories: Instruction manual x 1, power cord x 1, D-sub 25-pin connector (PW6001-11 to -16 only) x 1

- The optional voltage cord and current sensor are required for taking measurements.
- Specify the number of built-in channels and inclusion of Motor analysis & D/A output upon order for factory installation. These options cannot be changed or added at a later date.

**Current measurement options**

<table>
<thead>
<tr>
<th>Model</th>
<th>Rated primary current</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC/DC CURRENT SENSOR CT6862-05</td>
<td>50A</td>
</tr>
<tr>
<td>AC/DC CURRENT SENSOR CT6863-05</td>
<td>200A</td>
</tr>
<tr>
<td>AC/DC CURRENT SENSOR CT6865-05</td>
<td>500A</td>
</tr>
<tr>
<td>AC/DC CURRENT SENSOR CT6866-05</td>
<td>1000A</td>
</tr>
<tr>
<td>AC/DC CURRENT PROBE CT6841-05</td>
<td>20A</td>
</tr>
<tr>
<td>AC/DC CURRENT PROBE CT6843-05</td>
<td>200A</td>
</tr>
<tr>
<td>CLAMP ON PROBE 3273-50</td>
<td>30A</td>
</tr>
<tr>
<td>CLAMP ON PROBE 3274</td>
<td>150A</td>
</tr>
<tr>
<td>CLAMP ON PROBE 3275</td>
<td>500A</td>
</tr>
<tr>
<td>CLAMP ON PROBE 3276</td>
<td>30A</td>
</tr>
<tr>
<td>CURRENT PROBE CT6700</td>
<td>5A</td>
</tr>
<tr>
<td>CURRENT PROBE CT6701</td>
<td>5A</td>
</tr>
</tbody>
</table>

**Voltage measurement options**

**VOLTAGE CORD L9438-50**

Red, black: 1 each
1000 V specifications
Cable length: 3 m (9.84 ft)

**VOLTAGE CORD L1000**

Red, yellow, blue, gray: 1 each; Black: 4
1000 V specifications
Cable length: 3 m (9.84 ft)

**GRABBER CLIP 9243**

Red, black: 1 each
Change the tip of the VOLTAGE CORD to use

**Connection options**

**CONNECTION CORD L9217**

Length: 1.7m (5.58ft)
For motor signal input

**LAN CABLE 9642**

Length: 5m (16.41ft)
supplied with straight to cross conversion cable

**RS-232C CABLE 9637**

Length: 1.8m (5.91ft)
9pin to 9pin

**GP-IB CONNECTOR CABLE 9151-02**

Length: 2m (6.56ft)

**CONNECTION CABLE 9444**

Length: 1.5m (4.92ft)
For external control interface straight 9pin to 9pin

**OPTICAL CONNECTION CABLE L6000**

Length: 10m (32.8ft)
For synchronized control

**Conversions Cable CT9900**

For use with CT6862, CT6863, 9709, CT6865, CT6841, CT6843
When using a sensor without “-05” in the model name, Conversion Cable CT9900 must be used to make the connection.

**Other**

The following made-to-order items are also available.
Please contact your Hioki distributor or subsidiary for more information.

- Optical connection cable, Max. 500 m
- Rackmount fittings (EIA, JIS)
- Carrying case (hard trunk, with casters)

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