Maximum accuracy of ±0.16% achieved with current sensors!

- Measure the primary and secondary sides of inverters
- Advanced motor analysis functions
- Measure inverter noise

Large Assortment of Wide-band, High-Precision Feed-Through Current Sensors

4 Models

- CT6862 50A
- CT6863 200A
- 9709 500A
- CT6865 1000A

Effect of conductor position
Effect of external electromagnetic field
Completely Minimized
Current Sensor Method
Surpasses the Accuracy of Direct Connection Method

Power Analyzer 3390

When combined with the feed-through current sensors

Maximum accuracy of ±0.16%

±0.1%

±0.06%

Feed-through current sensors

Clamp-on sensors

For Current Sensor specifications, please go to page 15

Power Analyzing Control Engine
Technology processes

Weight & Volume

1/3

A HIOKI proprietary engine that takes advantage of the latest semi-conductor technologies enables a much smaller footprint than ever before (in comparison with other HIOKI high performance power meters)

Measurement data at high speeds and with excellent accuracy

50ms

Current sensor design allows for safe and efficient testing

- Choice of sensors include easy-to-measure AC and AC/DC clamp-on sensors and feed-through current sensors for high-accuracy measurements
- Immune to in-phase noise effects when measuring inverters

Basic accuracy of Model 3390: ±0.1%

Basic measurement range: DC, 0.5 Hz to 5 kHz
(Frequency bandwidth: DC, 0.5 Hz to 150 kHz)

Effective input range: 1% to 110%

- High accuracy, wide band, and wide dynamic range
- Also measure the secondary side of DC inverters in conjunction with a variety of HIOKI current sensors

All data updated at 50ms*

- 50ms data refresh rate for all measurements unaffected by settings restraints
- Synchronize the measurements of multiple 3390s
Automatic update rate eliminates the need of switching for low-frequency measurements

* 50ms data refresh rate does not apply to waveform and noise analysis
Meet the Needs of Alternative Energy and Inverter or Motor Evaluations

4-channel isolated input

Measure the primary and secondary sides of inverters simultaneously

- Choose wiring from single-phase two-wire to three-phase four-wire
- Synchronize the measurements of multiple 3390s

Ideal for Motor Evaluation and Analysis

- Use of the MOTOR TESTING OPTION 9791 (or 9793) allows torque meter output and rotation input, and facilitates motor power measurement

For motor evaluation and analysis specifications, please go to pages 8 & 9

A Variety of Interfaces Standardly Equipped

Includes 100Mbps Ethernet and USB 2.0 High Speed communications interfaces.

CF card interface & USB memory interface

Automatically save interval measurement data to a CF card
(When saving manually, measured data and waveform data can be saved directly to the CF card and USB memory)

Even More!

- Connect up to four 3390s and synchronize their clocks and measurement timing for multiple-channel measurements (using the SYNC terminal and Connection Cable 9683)
- Use dedicated application software to conduct synchronized operations for up to 4 units and obtain all the measurement data

HTTP server function available with free dedicated PC software

- HTTP server function through web browser enables easy remote operation
- Free dedicated PC application can be downloaded from the HIOKI website
  Collect data and operate the 3390 remotely by connecting it to a PC via LAN or USB

Waveform Output and 16 Channel D/A output

- Use the D/A OUTPUT OPTION 9792 to update data every 50ms and output up to 16 items in analog format
- Also output the voltage and current waveforms for each channel (using 1 to 8 channels)
  (Waveforms are output at 500 kS/s and sinusoidal waveforms can be represented accurately at up to 20 kHz)
Extra-Large Screen Expands Possibilities

Capture measured data and waveforms at a glance utilizing a variety of display options

The 9” color LCD can display up to 32 data parameters

All measurements start with just a connection
Wiring check function prevents connection errors
Display connection and vector diagrams on the Wiring screen
Improve efficiency and reliability while saving time in wiring even for three-phase measurements

Display just the required data in an easy-to-read graphic interface on the Select screen
Screen displaying 32, 16, 8, or 4 items
Display items can be set individually for each selected screen
Read data quickly and easily by just switching between the screens

Check Vector Direction
Intuitive Interface
All data is processed in parallel simultaneously.
A wealth of data analysis functions all built-in and ready to use.

Channel display
RMS and MEAN values, and AC, DC, and fundamental waveform components can be measured and displayed simultaneously

V rms value
V mean value
V fundamental value

Vectors display
Measured voltage, current, and power on channels 1 to 4 as numerical values and as vectors

Efficiency display
Simultaneously display efficiency and power loss

Harmonic analysis display
Harmonics graph display
Harmonics list display

Feed-through Current Sensor Enable Extremely Accurate Measurements
HIoki's high-performance feed-through current sensors absolutely minimizes the effects of conductor position and external fields, making them exceptionally precise. Repeatability and stability are absolutely unmatched!

Feed-through current sensors meet a large variety of applications from electric or hybrid vehicle testing, inverter motor evaluations and solar power devices and fuel cell analysis to individual testing of electrical appliances and facilities equipment.

*For further information and specifications, please refer to page 15.
Measure the primary and secondary sides of inverters
(Performance evaluation of motors and inverters)

Accurately and easily measure the power of inverters and motors for a wide range of applications, from research and development to field tests.

**Advantages**

1. Isolated input of voltage and current lets you measure the power on the primary and secondary sides of inverters simultaneously.
2. Using a non-invasive current sensor makes the connection simple and easy. A vector diagram display ensures connections are checked.

**Proprietary HIOKI Technology**

3. Accurately measure the fundamental wave voltage and current values related to the motor axis output with confidence.
4. All data is measured simultaneously and updated every 50 ms.
5. In addition to the harmonic analysis required to evaluate the inverter control, noise components can also be measured at the same time - ideal for determining the leakage of inverter noise.
6. Use of a current sensor reduces the effect of in-phase noise from inverters when measuring the power.

---

**What's so special about inverter motors?**

Inverter motors are indispensable as the power source of industrial equipment. The rotation of an induction motor depends on the input frequency, so if this input frequency can be made variable, the rotation can be controlled freely. Development of a frequency conversion technology called an inverter has made it possible to freely control the rotation of motors.

In recent years, the mainstream inverter control method is the PWM (Pulse-width Modulation) method.

- **What is the PWM method?**
  
  A pseudo sinusoidal waveform (fundamental wave) resulting from the conversion of the fundamental wave frequency that determines the rotation of a motor to a pulse train called a carrier frequency (at about several kHz to 15 kHz) is effected, controlling the number of rotations.

- **Performance evaluation and electrical measurement of motor**
  
  The axis output of a motor is closely related to the fundamental wave frequency to be input, so an accurate measurement of this fundamental wave component is required to evaluate the input characteristics.

---

**PC measurements and synchronizing multiple devices**

- Dedicated application software allows you to perform PC measurements right out of the box.
- LAN and USB compatibility facilitates efficient data collection and remote operation. Bundled application software allows you to control up to 4 units.
- Acquire all data even when multi-unit measurements are performed. Two units can be connected using the CONNECTION CABLE 9683 (option) to synchronize the internal clocks and control signals.

Interval measurements with the two units allow the acquisition of perfectly synchronized data, making it easy to collect completely harmonized data with a CF card without using a PC.

---

**To ensure accurate measurements:**

- Understand the connections and input states while looking at the connection diagram screen.
- Checking unsure connections allows you to perform measurements without worry.

---

**What is the PWM method?**

A pseudo sinusoidal waveform (fundamental wave) resulting from the conversion of the fundamental wave frequency that determines the rotation of a motor to a pulse train called a carrier frequency (at about several kHz to 15 kHz) is effected, controlling the number of rotations.

- **Conventional measurement method**
  
  Traditional methods use the average rectified RMS indication (Mean) in order to obtain a component value close to the fundamental wave frequency from a pseudo sinusoidal waveform (fundamental wave + carrier wave) to be input. To measure an accurate fundamental component, frequency analysis was required; however, the conventional processing method was not practical because it could barely perform real-time measurements with FFT as a result of the limited computing power.

- **The 3390 is capable of measuring the fundamental wave component accurately.** The 3390 performs this frequency analysis using high-speed harmonic computation processing at an interval of 50 ms and displays the true fundamental wave component.
**3. To make the best of inverter motor measurements:**

- Parameters critical to the measurement of motor inputs (outputs on the secondary side of inverters) can be measured and displayed simultaneously.

<table>
<thead>
<tr>
<th>Display Item</th>
<th>Measurement Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>rms value</td>
<td>RMS value of fundamental wave + carrier wave components</td>
</tr>
<tr>
<td>mn value</td>
<td>RMS value (mean value) close to the fundamental wave component</td>
</tr>
<tr>
<td>fnd value</td>
<td>True fundamental wave component</td>
</tr>
<tr>
<td>thd value</td>
<td>Displays the distortion factor of measured waveform</td>
</tr>
<tr>
<td>unb value</td>
<td>Displays the balance between phases</td>
</tr>
<tr>
<td>±pk value</td>
<td>Maximum positive/negative values of waveform that is being measured</td>
</tr>
<tr>
<td>dc value</td>
<td>Displays a DC component harmful to the motor</td>
</tr>
<tr>
<td>ac value</td>
<td>RMS value obtained by removing the DC component from the RMS value</td>
</tr>
<tr>
<td>f value</td>
<td>Frequency of each phase</td>
</tr>
</tbody>
</table>

**4. Clearly display efficiency and loss of inverters**

- Efficiency and loss measurement function built-in

The operating efficiency and power loss of an inverter can be displayed when measuring the inputs and outputs of the inverter simultaneously.

**5. X-Y graph display lets you check the dynamic characteristics of inverters**

- X-Y graph display function built-in (X-axis: 1 item, Y-axis: 2 items)

By simply specifying the voltage for the X-axis and the power consumption and efficiency for the Y-axis, you can display the dynamic characteristics of a motor in real time.

**6. Harmonic measurement indispensable for inverter evaluation**

- 4-channel simultaneous harmonic analysis function built-in (Performed simultaneously with power measurement)

Harmonic analysis is essential for the development and evaluation of inverters. Synchronized to the fundamental wave frequency from 0.5 Hz to 5 kHz, harmonic analysis up to the 100th order can be performed simultaneously with power measurement.

**7. Evaluate of the troublesome noise of inverters**

- Noise measurement function built-in (1-channel measurement: Performed simultaneously with power measurement and harmonic analysis)

Noise components at up to 100 kHz can be read while looking at the measured waveforms. Simultaneously display the top 10 point frequency and voltage/current levels.

**8. Waveforms can be observed at 500 kS/s, and fundamental waves can also be checked**

- Waveform monitoring function fully supported

Display the voltage and current waveforms being measured. The carrier frequency components of an inverter are also displayed in real time.

- Filter function

A filter function is used to remove the carrier frequency components from the inverter, and fundamental wave frequency waveforms can be checked in the waveform display.

* The filter function is reflected in the measured values. Please be careful when you switch to the function during measurement.
**Advantages**
1. Use of the MOTOR TESTING OPTION 9791 (9793) lets you perform a total evaluation of inverter motors.
2. The voltage, torque, rotation, frequency, slip, and motor power required for motor analysis can be measured with one unit.
3. Current sensors make the connection simple. In addition, use of the AC/DC CURRENT SENSOR enables measurements with superior accuracy.

**Proprietary HIOKI Technology**
4. All data is measured simultaneously and updated every 50 ms. Data collection and characteristics tests can be performed at the industry’s fastest speed.
5. Evolution of electrical angle measurements critical to motor analysis has made it possible to perform more accurate measurements using an incremental encoder.
6. Harmonic analysis at 0.5 Hz to 5 kHz without the need for an external timing mechanism.
7. Built-in digital anti-aliasing filter (AAF) lets you measure the broadband power on the secondary side of inverters to make accurate harmonic analyses.

---

**Example of HEV and EV measurement systems**

- **Measure the primary side of inverters**
  - Voltage, current, power, power factor, n/electrical energy, frequency, harmonic analysis *1, noise measurement
  - *2: Harmonic components superimposed on the DC
- **Measure the secondary side of inverters and of motor outputs**
  - Using channels 1, 2, and 3, and the Motor Testing Option

---

**The importance of measuring the electrical angle of synchronous motors**

The key to the performance of high-performance low-fuel consumption vehicles represented by HEV and EV is the synchronous motor that is used as the power source. The synchronous motor is finely controlled by alternating signals generated by an inverter device (DC to AC conversion) using the electricity from batteries.

---

**What is a synchronous motor?**

A synchronous motor rotates in synchronization with the AC frequency. Structurally, the motor is turned by the rotating force at the magnetic pole of the rotor (rotor magnetic pole), which is generated by the rotating magnetic field generated by applying an alternating current to the magnetic field (stator magnetic pole). The rotation speed is synchronized to the speed of the rotating magnetic field, so the speed can be controlled by changing the speed of the rotating magnetic field (power supply frequency). In addition, high operating efficiency is one of the advantages of the synchronous motor.

---

**Why is electrical angle measurement necessary?**

In the case of a synchronous motor, a phase shifting occurs between the stator magnetic pole and the rotor magnetic pole due to a change in the load torque. This shifted angle and the torque force that can be generated by a motor have a close relationship, so it is important to understand this shifted angle (electrical angle) in order to achieve high-efficiency motor control.

---

**The 3390 provides a more accurate measurement method**

The 3390 supports the incremental encoder output in addition to the measurement methods of the HIOKI 3194 Power HiTESTER – enabling you to measure this electrical angle more easily and accurately.
2 Analyze harmonic signals from the low-speed rotation range of motors.
- Harmonic analysis from a synchronization frequency of 0.5 Hz
  Accurate measurements can be performed in the low-speed rotation
  range of motors without the need of an external clock.
If the synchronization frequency is 45 Hz or more, analysis results are
updated every 50 ms, so data analysis can be performed in real time.

<table>
<thead>
<tr>
<th>Synchronization frequency range</th>
<th>Window wave number</th>
<th>Analysis order</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5Hz to 40Hz</td>
<td>1</td>
<td>100th order</td>
</tr>
<tr>
<td>40Hz to 80Hz</td>
<td>1</td>
<td>100th order</td>
</tr>
<tr>
<td>80Hz to 160Hz</td>
<td>2</td>
<td>80th order</td>
</tr>
<tr>
<td>160Hz to 320Hz</td>
<td>4</td>
<td>40th order</td>
</tr>
<tr>
<td>320Hz to 640Hz</td>
<td>8</td>
<td>20th order</td>
</tr>
<tr>
<td>640Hz to 1.2kHz</td>
<td>16</td>
<td>10th order</td>
</tr>
<tr>
<td>1.2kHz to 2.5kHz</td>
<td>32</td>
<td>5th order</td>
</tr>
<tr>
<td>2.5kHz to 5kHz</td>
<td>64</td>
<td>3rd order</td>
</tr>
</tbody>
</table>

3 Vector display of electrical angles of motors.
- Display vectors including that of the phase angle and electrical angle
  ($\theta$) of fundamental wave voltage and current. The measured data can
  be used as parameters to calculate the $L_d$ and $L_q$ values.

4 Clearly view the inverter efficiency/loss and motor power.
- Output, efficiency, and loss of inverter motors can be measured with
  one single unit
Operating efficiency and power loss of the inverter and motor can be displayed
when the inputs and outputs of the inverter are measured simultaneously.

5 X-Y graph display lets you check the dynamic characteristics of inverters.
- X-Y graph display function built-in (X-axis: 1 item, Y-axis: 2 items)
  By simply setting 2 items to the Y-axis as with a 6-axis graph used to evaluate motors,
you can display the characteristics of a motor and similar devices in real time.

Application 2: Electrical angle measurement using induced voltage of motors (The same measurements conducted with the HIOKI 3194 can also be performed)
Correct the rotation synchronization signal and induced voltage phase of motors as well as measure the phase of voltage and current for the induced voltage of a running motor as
an electrical angle.

Step 1: Turn the motor from the load side, and measure the induced voltage of the motor

- Measure the fundamental wave’s RMS value
- Measure the total RMS value of the induced voltage.
- Perform zero compensation for the phase between the rotation synchronization signal and
  the fundamental wave voltage of the induced voltage.

Step 2: Measurement of a running motor

- Measure the fundamental wave component, harmonic component, and electrical angle of line voltage
  and current of a line to the motor. (The measured data can also be used as parameters for calculation of $L_d$/$L_q$)
- Simultaneously measure motor efficiency, inverter efficiency, total efficiency, and inverter loss while
  observing the motor control.

Other Advance Functions
- Motor
- Inverter
- Load/motor
- DC power supply
- Motor sensor
- Load motor
- Induced voltage
- Rotation synchronization signal

- Frequency divider circuit (up to 1/100000 frequency dividing) – helpful when the rotation synchronization
  signal consists of multiple pulses for one cycle of induced voltage.
- $\Delta$-to-Y conversion function – convert the line voltage to a phase voltage (virtual neutral reference) when
  three-phase three-wire (3P3W3M connection) measurements are performed.
Evaluate new energies such as solar power, wind power, and fuel cells
Assess power conditioners that are indispensable for converting new energies to electrical power

**Advantages**
1. The input and output characteristics of a power conditioner can be measured simultaneously in combination with an AC/DC current sensor
2. Use of a current sensor makes the connection simple. Make accurate measurements in combination with the AC/DC CURRENT SENSOR
3. The sale and purchase of electrical energy of a power line connected to a power conditioner can also be measured with one unit

**Proprietary HIOKI Technology**
4. Measure DC mode integration, which responds quickly to changes in the input of sunlight and the like, and RMS mode integration, which handles the separate integration of the sale and purchase of electric energy, all at the same time
5. Ripple factor, efficiency and loss, which are required to evaluate power conditioners for solar power generation, can be measured with one single unit.

---

1. **Conditioner-specific measurement items all measurable**

   - Power conditioner measurement-specific ripple factor and disequilibrium factor can also be measured and displayed simultaneously (up to 32 items can be displayed simultaneously), resulting in enhanced test efficiency

<table>
<thead>
<tr>
<th>Display item</th>
<th>Measurement item</th>
</tr>
</thead>
<tbody>
<tr>
<td>rms value</td>
<td>RMS (DC/AC voltage/current of input and output)</td>
</tr>
<tr>
<td>P, Q, S, λ values</td>
<td>Active power, reactive power, apparent power, power factor</td>
</tr>
<tr>
<td>Loss value</td>
<td>Input and output loss</td>
</tr>
<tr>
<td>η value</td>
<td>Efficiency</td>
</tr>
<tr>
<td>thd value</td>
<td>Distortion factor (voltage/current)</td>
</tr>
<tr>
<td>rf value</td>
<td>Ripple factor (for DC)</td>
</tr>
<tr>
<td>unb value</td>
<td>Disequilibrium</td>
</tr>
<tr>
<td>f value</td>
<td>Output frequency</td>
</tr>
</tbody>
</table>

---

**Current trends in solar power generation**
- Interconnected system of solar power generation and power conditioner
  - Electrical energy generated from the solar power generation is DC electrical energy, so it needs to be converted to AC electrical energy to be used by connecting to the utility grid. The device to convert direct current to alternating current is the power conditioner. In particular, to sell electrical energy by connecting to the utility grid, the performance of the power conditioner is important, so the method to evaluate the performance is specified by the national standards.

- **IEC standard**
  - IEC 61683:1999, Photovoltaic systems - Power conditioners - Procedure for measuring efficiency

- **Evaluation and measurement of power conditioners**
  - The IEC standard stipulates detailed measurement items to evaluate the input and output characteristics of power conditioners such as harmonic level, ripple factor, voltage disequilibrium factor, and voltage/current waveform.

- The 3390 supports a long list of measurement items including the specific ones required.

  - The 3390 can measure ripple factor and evaluate and analyze through simultaneous measurements.
The efficiency (loss) and the amount of electrical energy sold and purchased can be displayed clearly

- Not only the amount of electricity generated with solar cells and the efficiency (loss) of a conditioner but also the amount of electrical energy sold and purchased by connecting to the utility grid can be measured simultaneously with one single unit.

Check the input and output waveforms of a conditioner

- Simultaneously check the input and output waveforms of a conditioner at 500 kS/s. The input and output waveforms required to evaluate power conditioners can be checked simultaneously with one unit.

Accurately measure harmonics that are important for connecting to the utility grid

- The harmonic component and distortion factor important for connecting a power conditioner to the utility grid can be measured simultaneously. Synchronized to the fundamental frequency of 0.5 Hz to 5 kHz. Analyze up to the 100th order of voltage, current, and voltage harmonic, and display the current direction.

Also measure the noise flow of a connected utility grid

- Noise measurement function (1-channel measurement: Performed simultaneously with power measurement and harmonic analysis).
  - Noise components at up to 100 kHz can be read while looking at the measured waveforms.
  - Frequency and voltage/current levels for the top 10 points can be displayed simultaneously.

Bundled software dedicated to the 3390 (free download from the HIOKI website)

- Features
  - Connect the 3390 to a PC via LAN or USB for completely remote operation
  - Save measured data to the PC in real time (interval saving is also available)
  - Download data stored in the USB memory or CF card
  - Connect up to four 3390 Power Analyzers using the free software for remote operation and simultaneous data collection

General specifications

- Delivery media: Download from the HIOKI website
- Operating environment: Windows 2000, XP, Vista, 7 PC
  - Pentium III 500 MHz or higher CPU, 128 MB or more RAM, and LAN or USB interface
  - Java Runtime Environment (JRE) 1.5.0 or later required
- Communication method: Ethernet (TCP/IP), USB 1.1/2.0
  - For a USB connection, use the supplied dedicated driver (included with the software)
- Number of simultaneously connected units: 4

Functions

- Remote operation function: Key operation and screen display on a PC
- Download function: Downloads data stored on the media (Files in the USB memory or CF card)
- Display function: Displays instantaneously measured values of the 3390 on the PC monitor
  - Numerical display: Basic measurement items
  - Waveform display: Instantaneous waveform data
  - Bar graph: Harmonic Vector: Fundamental wave vector
- Measured value save function: Saves the specified instantaneous value data to the PC
- Interval save function: Saves instantaneous value data to the PC at the specified interval
- CSV conversion function: Saves the displayed waveform data as CSV format to the PC
- BMP save function: Saves the displayed waveform and graph data in image format to the PC or copy images to the clipboard
- Setting function: Sends the settings of the 3390 made on a PC to the 3390
  - Setting contents can be saved and loaded to and from a file.
### 3390 Specifications

(Accuracy guarantee conditions: 23°C ±3°C, 80%RH or less, warm-up time 30 minutes or more, sinusoidal wave input, power factor 1, voltage to ground 0 V, in the range where the fundamental wave meets the conditions of the synchronization source after zero adjustment)

#### Input

<table>
<thead>
<tr>
<th>Measurement setting</th>
<th>CH1</th>
<th>CH2</th>
<th>CH3</th>
<th>CH4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connection setting</td>
<td>1P2W</td>
<td>1P2W</td>
<td>1P2W</td>
<td>1P2W</td>
</tr>
</tbody>
</table>

#### Number of input channels

- Voltage: 4 channels U1 to U4
- Current: 4 channels I1 to I4

#### Input terminals

- Voltage: Plug-in terminal (safety terminal)
- Current: Dedicated connector

#### Input method

- Voltage: Isolated input, resistance voltage dividing method
- Current: Dedicated connector

#### Measurement range

- Voltage: 15000 / 30000 / 60000 / 150000 V
- Current: 15.000A / 30.000A / 60.000A / 150.00A / 300.00A / 600.00A (When power factor = 0.0 at 45 kHz to 66 Hz, add ±0.45% fs. when LPF is 500 Hz)

#### Crest factor

- Voltage: 3 (voltage/current), 1.33 for 1500 V
- Current: Selectable for each connection, auto range available (0.02% to 500 A)

#### Number of input range

- Voltage: 3P4W 1P2W
- Current: 3P3W 1P2W

#### Power range

Depends on combination of voltage and current range (2000 W to 2.2500 MW)

#### Frequency measurement

- 0.5Hz to 5kHz
- 999999 (6 digits + decimal point)

#### Integration measurement

- RMS/DC: Selectable for each connection, DC is only available when AC/DC sensor is used for I1 and I4
- Integration of RMS voltage, RMS current, and RMS power
- Integration accuracy: ±0.05% rdg. ±1dgt.

#### Harmonic measurement

- 4 channels (Harmonic measurement for another line at a different frequency cannot be performed)
- Harmonic voltage RMS value, harmonic voltage percentage, harmonic voltage phase angle, harmonic current RMS value, harmonic current percentage, harmonic current phase angle, harmonic active power, harmonic power percentage, harmonic voltage current phase difference, total harmonic voltage distortion factor, total harmonic current distortion factor, voltage disqualifying factor, current disqualifying factor

#### Accuracy

- Voltage, Current, and active power measurements
- Digital calculation from each current and active power
- Average of 5 measurement points
- ±(Accuracy of current and active power) ± integration time accuracy
- Power factor ±0.15% fs. or less (When power factor = 0.0 at 45 kHz to 66 Hz, add ±0.45% fs. when LPF is 500 Hz)

#### Frequency measurement

- Measurement range
- 0.5 Hz to 5 kHz
- Integration time accuracy
- ±0.05% fs. ±1dgt.

#### Harmonic measurement

- Measurement item
- Harmonic voltage RMS value, harmonic voltage percentage, harmonic voltage phase angle, harmonic current RMS value, harmonic current percentage, harmonic current phase angle, harmonic active power, harmonic power percentage, harmonic voltage current phase difference, total harmonic voltage distortion factor, total harmonic current distortion factor, voltage disqualifying factor, current disqualifying factor

#### Datasheet

- Selected from U1 for each input channel
- DC (50 ms/10 ms)
- 32-bit

---

### Table

<table>
<thead>
<tr>
<th>Measurement item</th>
<th>CH1</th>
<th>CH2</th>
<th>CH3</th>
<th>CH4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage (U)</td>
<td>±0.05% rdg. ±1dgt.</td>
<td>±0.05% rdg. ±1dgt.</td>
<td>±0.05% rdg. ±1dgt.</td>
<td>±0.05% rdg. ±1dgt.</td>
</tr>
<tr>
<td>Current (I)</td>
<td>±0.05% rdg. ±1dgt.</td>
<td>±0.05% rdg. ±1dgt.</td>
<td>±0.05% rdg. ±1dgt.</td>
<td>±0.05% rdg. ±1dgt.</td>
</tr>
</tbody>
</table>

- Voltage and current ripple (U/I): (0% to ±9999.99 TAh / TWh (Integration time is within 9999 h 59 m)) / 10.000A / 20.000A / 50.000A / 100.000A / 200.000A / 500.000A (500 A rating)

#### Display resolution

- ±0.01%.f.s / °C (When DC: Add ±0.01%f.s./°C)

#### Maximum order

- Maximum order accuracy
- Phase zero adjustment is possible by key / communication command (only when the synchronization source is DC)
**Noise measurement (FFT processing)**

- **Number of channels**: 1 channel (Selects one channel from CH1 to CH4)
- **Measurement item**: Voltage/current
- **Calculation type**: RMS spectrum
- **FFT processing word length**: 32-bit
- **Number of FFT points**: 1,000 points / 5,000 points / 10,000 points / 50,000 points (Linked to the waveform display record length)
- **Anti-aliasing filter**: Digital filter (variable by the maximum analysis frequency)
- **Window function**: Rectangular / Hanning / flat top
- **Data update rate**: Within about 400 ms to 15 s depending on the number of FFT points, with gap
- **Maximum analysis frequency**: 10kHz / 50kHz / 10kHz / 5kHz / 2kHz
- **Frequency resolution**: 0.2 Hz to 500 Hz (Determined by the number of FFT points and the maximum analysis frequency)
- **Noise measurement**: Calculates the levels and frequencies of voltage and current peaks (maximum values) for the top 10 points

---

**MOTOR TESTING OPTION (Applicable to the 9791 and 9793)**

- **Number of input channels**: 3 channels
  - CH A: Analog DC input / frequency input (torque signal input)
  - CH B: Analog DC input / pulse input (rotation signal input)
  - CH Z: Pulse input (Z-phase signal input)
- **Input terminal form**: Isolation type BNC connector
- **Input resistance (DC)**
  - CH A / CH B: ±20V allowable input
  - CH Z: ±20V / ±10V (When analog DC input)
- **Maximum input voltage**: ±20 V (When analog / frequency / pulse)
- **Maximum rated voltage to ground**: 50 (±20 V) Hz
- **Accuracy**: ±0.01%rdg. ±0.1%f.s. (6 months (One-year accuracy is the accuracy below x 1.5) (Post-adjustment accuracy guaranteed for 6 months)

---

**4. CF card interface**

- **Slot**: TYPE I x 1
- **Recordable items**: Setting file: Save/Load, Measured value/recorded data: Copy (from the CF card data)

---

**5. RS-232C interface**

- **Method**: RS-232C, EIA RS-232D, CCITT V.24, JIS X5101 compliant
- **Connector**: D-sub-9 pin connector x 1
- **Data format**: MS-DOS format (FAT16 / FAT32)
- **Transmission method**: Full duplex asynchronous method
- **Protocol**: RS-232C, TCP/IP
- **Function**: HTTP server (remote operation), dedicated port (port transfer, command control)

---

**Functions**

- **Setting**: rms / mean (Selectable for the voltage/current of each connection)
- **Rectification switching**: rms: Displays the true RMS value (True RMS) mean: Displays the average-value rectified RMS value
- **Auto range**: OFF/ON (Voltage and current range is selectable for each connection)
### 1. Data save

<table>
<thead>
<tr>
<th>Data save interval</th>
<th>Interval</th>
<th>Number of Items</th>
<th>Auto-save (When using a 512 MB card)</th>
<th>Maximum period</th>
</tr>
</thead>
<tbody>
<tr>
<td>50ms</td>
<td>130</td>
<td>10</td>
<td>About 2 days</td>
<td>About 4 hours</td>
</tr>
<tr>
<td>(When 200 ms: 520)</td>
<td>1s</td>
<td>10</td>
<td>About 11 hours</td>
<td></td>
</tr>
<tr>
<td>5s or more: 5000</td>
<td>1min</td>
<td>500</td>
<td>About 416 days</td>
<td>About 7 days</td>
</tr>
</tbody>
</table>

### 2. Display

#### 2.1. Connection check screen

- Displays the connection diagram and the voltage/current vector diagram.
- The right connection range is displayed in the vector diagram, so the connection can be checked.

#### 2.2. DMM screen

- Basic Measurement screen, Voltage Measurement screen, Current Measurement screen, Power Measurement screen

#### 2.3. Harmonic screen

- Basic Measurement screen
- Select/Deselect screen
- Selects and displays any 4, 8, 16, or 32 measurement items from all basic measurement items
- Display pattern: 4 items, 8 items, 16 items, or 32 items (4 pattern switching)

#### 2.4. Efficiency/Loss screen

- Calculates and updates at a data update rate of 50 ms
- The right connection range is displayed in the vector diagram, so the connection can be checked.

#### 2.5. Recording time

<table>
<thead>
<tr>
<th>Recording time</th>
<th>Recording speed</th>
<th>Recording length</th>
<th>Number of points</th>
<th>Number of 5000 points</th>
<th>Number of 10000 points</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2/1, 12/13/10/12/1, 1/50-Peak Recording compression</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### 2.6. X-Y Plot screen

- Selects items on the vertical and horizontal axes from the basic measurement items and displays them in the X-Y graph
- The graph is drawn at the data update rate, data is not recorded, and drawing data is cleared

### 3. Auto save data

- Auto save data destination

<table>
<thead>
<tr>
<th>Auto save data destination</th>
<th>OFF / CF card (cannot be saved to the USB memory), the save destination folder can be specified</th>
<th>Data format</th>
<th>CSV file format</th>
</tr>
</thead>
<tbody>
<tr>
<td>Save item/Save</td>
<td>Any item can be selected from all measured data, including harmonic value, and peak value of the noise measurement function</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Save data format</td>
<td>Any item can be selected from all measured data, including harmonic value, and peak value of the noise measurement function</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 4. Manual data save

- Manual data save destination

<table>
<thead>
<tr>
<th>Manual data save destination</th>
<th>Save USB memory / CF card, the save destination folder can be specified</th>
</tr>
</thead>
<tbody>
<tr>
<td>Save data format</td>
<td>USB memory / CF card, the save destination folder can be specified</td>
</tr>
</tbody>
</table>

### 5. Setting data save

- Setting data save

<table>
<thead>
<tr>
<th>Setting data save</th>
<th>Setting information can be saved and loaded to and from the save destination as a setting file</th>
</tr>
</thead>
<tbody>
<tr>
<td>Save data format</td>
<td>(With the exception of language setting and communication settings)</td>
</tr>
</tbody>
</table>

### 6. External connected equipment

- Synchronized measurement

<table>
<thead>
<tr>
<th>Synchronized measurement</th>
<th>The 3390 master and 3390 slaves can be connected with synchronization cables to perform synchronized measurements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Synchronized item</td>
<td>Clock, data update rate (excl. noise measurement), integration start/stop, data reset, event</td>
</tr>
<tr>
<td>Synchronized timing</td>
<td>Hold, manual save, screen copy</td>
</tr>
<tr>
<td>Synchronized data</td>
<td>Clock, data update rate, start/stop, data reset, event (During operation of the master by the key or via communication)</td>
</tr>
</tbody>
</table>

### 5. System

- Display language

<table>
<thead>
<tr>
<th>Display language</th>
<th>English / Japanese / Chinese</th>
</tr>
</thead>
</table>

- Clock function

<table>
<thead>
<tr>
<th>Clock function</th>
<th>Auto Calendar, Auto Leap Year Adjustment, 24 Hour Meter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clock setting</td>
<td>Year, Month, Day, Hour, Minute Setting, Zero Second Adjustment</td>
</tr>
<tr>
<td>Real time accuracy</td>
<td>Within ±0.1 s / day (25°C)</td>
</tr>
</tbody>
</table>

- Deep tone

<table>
<thead>
<tr>
<th>Deep tone</th>
<th>OFF / ON</th>
</tr>
</thead>
</table>

- Screen color

<table>
<thead>
<tr>
<th>Screen color</th>
<th>COLOR1 / COLOR2 / COLOR3 / COLOR4 / MONO</th>
</tr>
</thead>
</table>

- Start screen select

<table>
<thead>
<tr>
<th>Start screen select</th>
<th>Connection screen / screen closed in the previous session (Measurement screen only)</th>
</tr>
</thead>
</table>

- LCD backlight

<table>
<thead>
<tr>
<th>LCD backlight</th>
<th>ON / Off / ON / 5min / 10min / 30min / 60min</th>
</tr>
</thead>
</table>

- Sensor recognition

<table>
<thead>
<tr>
<th>Sensor recognition</th>
<th>Automatically recognizes the current sensor connected</th>
</tr>
</thead>
</table>

- Alarm display

<table>
<thead>
<tr>
<th>Alarm display</th>
<th>Voltage/current peak over threshold detection, synchronization source non-detection (Alarm mark on)</th>
</tr>
</thead>
</table>

- Key lock

<table>
<thead>
<tr>
<th>Key lock</th>
<th>electromag Key, OFF by holding down the key for 3 seconds (Key lock mark on)</th>
</tr>
</thead>
</table>

- System reset

| System reset | Sets the equipment to the default (factory) settings (Communication settings are not changed) |

- File manipulation

| File manipulation | Media data list display, media formatting, new folder creation, folder file deletion, file copy between media |

### 7. General specifications

- Operating voltage

<table>
<thead>
<tr>
<th>Operating voltage</th>
<th>Intensity, altitude up to 2000 m, contamination class 2</th>
</tr>
</thead>
</table>

- Storage temperature and humidity ranges

<table>
<thead>
<tr>
<th>Storage temperature and humidity ranges</th>
<th>-10°C to 50°C, 80%RH or less (No dew condensation)</th>
</tr>
</thead>
</table>

- Operating temperature and humidity ranges

<table>
<thead>
<tr>
<th>Operating temperature and humidity ranges</th>
<th>0°C to 40°C, 80%RH or less (No dew condensation)</th>
</tr>
</thead>
</table>

- Withstand voltage

<table>
<thead>
<tr>
<th>Withstand voltage</th>
<th>AC5.312 kVrms: Between the voltage input terminal and the unit case</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AC3.3 kVrms: Between the 9791 and 9793 input terminals (CH A, CH B, CH Z) and the unit case</td>
</tr>
</tbody>
</table>

- Applicable standard

<table>
<thead>
<tr>
<th>Applicable standard</th>
<th>Safety: EN50101</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good performance</td>
<td>EN61326, EN61000-3-2, EN61000-3-3</td>
</tr>
<tr>
<td>High purity</td>
<td>1400VA</td>
</tr>
<tr>
<td>Electronic card</td>
<td>EN61600-3</td>
</tr>
</tbody>
</table>

- Rated power supply voltage

<table>
<thead>
<tr>
<th>Rated power supply voltage</th>
<th>1400VA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum voltage</td>
<td>100 to 240 VAC (expected transient overvoltage of 2500 V), 50/60 Hz</td>
</tr>
</tbody>
</table>

- Dimensions

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>340 W x 170 H x 157 D mm (13.99” W x 6.69” H x 6.18” D) (excluding protrusions)</th>
</tr>
</thead>
</table>

- Weight

<table>
<thead>
<tr>
<th>Weight</th>
<th>4.8 kg (10.6 lbs) (excluding the 9793)</th>
</tr>
</thead>
</table>

- Backup battery life

<table>
<thead>
<tr>
<th>Backup battery life</th>
<th>About 10 years (a reference value of a lithium ion battery used at 23°C)</th>
</tr>
</thead>
</table>

- Product warranty period

<table>
<thead>
<tr>
<th>Product warranty period</th>
<th>1 year</th>
</tr>
</thead>
</table>
Basic calculation algorithms

<table>
<thead>
<tr>
<th>Connection</th>
<th>1P2W</th>
<th>1P3W</th>
<th>3P3W/2M</th>
<th>3P3W/3M</th>
<th>3P4W</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage and current</td>
<td>X(i)s</td>
<td>X(i)s</td>
<td>X(i)s</td>
<td>X(i)s</td>
<td>X(i)s</td>
</tr>
<tr>
<td>RMS value (True RMS value)</td>
<td>Xrms(i) = 1/2 \sqrt{\sum_{n=1}^{N} X_{(n)i}^2}</td>
<td>Xrms(i) = 1/2 \sqrt{\sum_{n=1}^{N} X_{(n)i}^2}</td>
<td>Xrms(i) = 1/2 \sqrt{\sum_{n=1}^{N} X_{(n)i}^2}</td>
<td>Xrms(i) = 1/2 \sqrt{\sum_{n=1}^{N} X_{(n)i}^2}</td>
<td>Xrms(i) = 1/2 \sqrt{\sum_{n=1}^{N} X_{(n)i}^2}</td>
</tr>
<tr>
<td>Voltage and current average value</td>
<td>Xmn(i) = \frac{1}{N} \sum_{n=1}^{N} X_{(n)i}</td>
<td>Xmn(i) = \frac{1}{N} \sum_{n=1}^{N} X_{(n)i}</td>
<td>Xmn(i) = \frac{1}{N} \sum_{n=1}^{N} X_{(n)i}</td>
<td>Xmn(i) = \frac{1}{N} \sum_{n=1}^{N} X_{(n)i}</td>
<td>Xmn(i) = \frac{1}{N} \sum_{n=1}^{N} X_{(n)i}</td>
</tr>
<tr>
<td>Voltage and current alternating component</td>
<td>X(i)s</td>
<td>X(i)s</td>
<td>X(i)s</td>
<td>X(i)s</td>
<td>X(i)s</td>
</tr>
</tbody>
</table>

\[
X(i) = X_{mn(i)} + X_{rms(i)}
\]

Motor analysis calculation algorithm

<table>
<thead>
<tr>
<th>Item</th>
<th>Setting unit</th>
<th>Calculation algorithm</th>
</tr>
</thead>
<tbody>
<tr>
<td>V(i)</td>
<td>(V)</td>
<td>V = \sqrt{\sum_{n=1}^{M} V_{(n)i}^2}</td>
</tr>
<tr>
<td>N*</td>
<td>(mA/m)</td>
<td>N* = (mA/m)</td>
</tr>
<tr>
<td>f</td>
<td>(Hz)</td>
<td>f = f_{setpoint}</td>
</tr>
<tr>
<td>(unit of chA)</td>
<td>(Indicated value of chA) = 2\pi \times \frac{500}{n_{chA}}</td>
<td></td>
</tr>
<tr>
<td>(unit of chB)</td>
<td>(Indicated value of chB) = 2\pi \times \frac{500}{n_{chB}}</td>
<td></td>
</tr>
<tr>
<td>t/min</td>
<td>(rotation)</td>
<td>t = t_{setpoint}</td>
</tr>
<tr>
<td>(Hz)</td>
<td>(Hz)</td>
<td>f = f_{setpoint}</td>
</tr>
<tr>
<td>Hz (unit of chB)</td>
<td>100 \times f_{setpoint}</td>
<td></td>
</tr>
<tr>
<td>Hz</td>
<td>(unit of chA)</td>
<td>100 \times f_{setpoint}</td>
</tr>
<tr>
<td>Hz</td>
<td>(unit of chA)</td>
<td>100 \times f_{setpoint}</td>
</tr>
<tr>
<td>Hz</td>
<td>(unit of chA)</td>
<td>100 \times f_{setpoint}</td>
</tr>
</tbody>
</table>

Current sensors specifications

<table>
<thead>
<tr>
<th>Model</th>
<th>CT6862</th>
<th>CT6863</th>
<th>CT6865</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated current</td>
<td>AC/DC 20A</td>
<td>AC/DC 20A</td>
<td>AC/DC 50A</td>
</tr>
<tr>
<td>Maximum continuous input range</td>
<td>50A/300A rms</td>
<td>40A rms</td>
<td>40A rms</td>
</tr>
<tr>
<td>Accuracy (45 to 60 Hz, DC, compatible sensor)</td>
<td>±0.3%rdg. ±0.01%fs, ±0.2°</td>
<td>±0.3%rdg. ±0.01%fs, ±0.1°</td>
<td>±0.5%rdg. ±0.05%fs, ±0.2°</td>
</tr>
<tr>
<td>Frequency characteristics</td>
<td>1kHz to 5kHz: ±0.02%</td>
<td>1kHz to 5kHz: ±0.02%</td>
<td>1kHz to 5kHz: ±0.02%</td>
</tr>
<tr>
<td>Effect of conductor position (at 100A/55Hz input, using with the wire 10mm diameter)</td>
<td>Without ±0.1%rdg. (deviation from center)</td>
<td>±0.5%rdg. or less (DC,55Hz)</td>
<td>Max. 2A</td>
</tr>
<tr>
<td>Effect of external electromagnetic field</td>
<td>100mA or less (in an AC electromagnetic field of 400mA/60Hz)</td>
<td>50mA or less (400mA/m, 55Hz)</td>
<td>Max. 2A</td>
</tr>
<tr>
<td>Operating temperature and humidity</td>
<td>0°C to 50°C (-14°F to 122°F)</td>
<td>0°C to 50°C (-14°F to 122°F)</td>
<td>0°C to 50°C (-14°F to 122°F)</td>
</tr>
<tr>
<td>Measurable conductor diameter</td>
<td>φ 40mm (1.97&quot;)</td>
<td>φ 15mm (0.59&quot;)</td>
<td>φ 20mm (0.79&quot;)</td>
</tr>
<tr>
<td>Dimensions, mass</td>
<td>40kHz to 100kHz: ±0.05° or less (1000A input)</td>
<td>20kHz to 100kHz: ±0.05° or less (1000A input)</td>
<td>20kHz to 100kHz: ±0.05° or less (1000A input)</td>
</tr>
<tr>
<td>Measurable conductor diameter</td>
<td>50mm or less</td>
<td>50mm or less</td>
<td>50mm or less</td>
</tr>
<tr>
<td>Dimensions, mass</td>
<td>220W to 1010W-43.5kW (60/40/5/1.71), 470/16.6 oz)</td>
<td>220W to 1010W-43.5kW (60/40/5/1.71), 470/16.6 oz)</td>
<td>220W to 1010W-43.5kW (60/40/5/1.71), 470/16.6 oz)</td>
</tr>
</tbody>
</table>

Note: Includes derating characteristics
Note: No phase precision regulations
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