POWER METER PW3335

Single-Phase AC/DC Power Meter

- Wide measurable range: 10 μA to 30 A, 60 mV to 1000 V
- Basic accuracy for voltage, current and power: ±0.1%*
- Frequency bandwidth: DC, 0.1Hz to 100kHz
- High-accuracy measurement even for equipment with low power factors: ±0.1% f.s. power factor effect
- Standby power consumption: Built-in harmonic measurement, IEC62301-compliant
- Measure up to 5000A AC: Built-in external sensor input terminals (PW3335-03, -04)

* For complete details, please refer to the specifications.
Single-Phase Power Meter with All-Round Capability

High accuracy of ±0.1%*1 and guaranteed accuracy range from 1 to 150% f.s.

DC, 0.1Hz to 100kHz frequency bandwidth
With built-in harmonic measurement for detailed analysis

Measure the standby power of AC adapters, both primary-side AC and secondary-side DC

Measure power supply conversion devices such as inverters and thyristors

Measures solar panels and power converters, max. 1000V range

<table>
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<th>Measured power parameters</th>
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<tr>
<td>Voltage</td>
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<td>Reactive power</td>
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<tr>
<td>Integral current</td>
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<tr>
<td>Maximum current ratio</td>
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<table>
<thead>
<tr>
<th>Harmonic measurement parameters</th>
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<tr>
<td>Harmonic effective value</td>
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<tr>
<td>Fundamental wave effective power</td>
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<tr>
<td>Fundamental wave power factor (displacement power factor)</td>
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<tr>
<td>Fundamental wave voltage/current phase difference</td>
</tr>
<tr>
<td>Harmonic voltage phase angle*</td>
</tr>
</tbody>
</table>

Use in the development and production of solar panels and AC adapters, secondary-side DC equipment and inverters, and power converters such as thyristors. Equipped with multiple functions for computing a wide variety of items, the PW3335 Power Meter can also be used alone for detailed analysis.

*1: For complete details, please refer to the specifications.

*2: Up to 1000 V with a voltage range of 1000 V.

*3: For detailed specifications of Model 3332, see the comparison chart on page 6.
from AC/DC Standby to Operating Power

PW3335

Highest basic accuracy and DC accuracy of any instrument in its class

Thanks to Hioki’s accumulated technology and track record, the PW3336/PW3337 delivers the highest basic accuracy and DC accuracy of any instrument in its class. Reliable measurement accuracy ensures robust performance in customers’ measurement applications.

* For complete details, please refer to the specifications.

Greater accuracy for standby power

The PW3335 Power Meter delivers a range configuration that lets you measure extremely low power levels with a margin to spare. Accuracy can be set from 10 μA and up for current, and 0 W and up for effective power. Perfect for measurements according to IEC62301 and other standards.

Peak value of up to 600% of the range, supporting crest factor of 6

Current waveforms in the switching power supply or at the primary-side of inverters become steep and often exceed the fundamental range, preventing them from being accurately measured. The PW3335 resolves these issues by offering a crest factor of 6, allowing it to measure accurately even when the waveform peaks are high relative to its range.

Power data and harmonic data — all measured simultaneously

All measurement data are internally processed in parallel simultaneously. Even when waveforms have mixed AC/DC components – half-wave rectification waveforms for example – the individual components can be measured simultaneously. The PC communication application further enables 180 or more measurement parameters to be acquired simultaneously.

Built-in harmonic measurement

The PW3335 measures harmonics up to the 50th order. Use it for evaluation and development of power sources for home appliances and other electrical equipment. Simultaneously display the effective voltage and total harmonic distortion (THD) on the screen. For THD computation, any maximum harmonic order can be specified.

Power consumption and regeneration (recharging) power integrated separately

Use for evaluating the input and output of secondary batteries in EVs, etc., and for measuring the sold power of solar panels. Power consumption and regeneration (recharging) power can each be measured separately.

MAX/MIN hold function for spotting current peaks at a glance

Capture maximum and minimum values such as inrush current waveform peak values and maximum consumed power.

Example of half-wave rectification waveform

Example of distorted waveform containing harmonic component

Example of power fluctuation

Example of power consumption Wh(+) Regeneration power Wh(-)

Example of off mode

Example of standby mode

Power consumption Wh(+) Regeneration power Wh(-)
Diverse and Powerful Functionality

Measure power in accordance with international standards

The PW3335 is engineered to comply with important international standards, including IEC62301 for electrical power consumption in standby mode and the ErP Directive or Energy Star standard. It can also be used to find the special parameters required by the standards – such as THD, CF, and MCR.

THD (total harmonic distortion)
Indicates the total harmonic components in an AC waveform.

CF (crest factor)
Also known as the peak-to-rms ratio, the ratio of the waveform’s peak value to its effective value.

MCR (maximum current ratio)
Evaluation index of the current, calculated from the crest factor and the power factor.

Measure integral power of equipment that operates intermittently or has a large power variation

Time-averaged effective integral power
Use this feature to measure the power of equipment that operates intermittently or is under cycle control. Average power is calculated from the integral value of the fluctuating power.

Auto-range integration
A function whereby the device jumps automatically to the optimal current range for the consumed current as it measures and integrates the values. Power integration can be carried out on separate ranges, enabling measurements for individual modes in equipment that has fluctuations in power levels.

Download free software for creating IEC62301-compliant reports from the Hioki website.
Rich interfaces and extensibility

3 D/A output types
(PW3335-02, PW3335-04)

The PW3335 can output measurement values to a data logger, Hioki Memory HiCorder or similar, via voltage signals. The power meter is also built in with functions for outputting the high-speed level of each successive fundamental wave cycle*, in addition to instantaneous waveform output and level output, and provides in-depth analysis of power-consuming equipment such as cutting/grinding tool monitoring equipment.

* For voltage and current, cycle-by-cycle updating is possible only with an input of 45 to 66 Hz.

PC communication software

By using the bundled PC application, you can control the power meter from a PC without needing to code your own communication program. The software enables you to save data to the PC, display waveforms, and perform efficiency calculations*, etc.

Compatible with LAN, RS-232C, GP-IB

*Two or more PW3335s are necessary in order to carry out efficiency computation.

Up to 8 units of simultaneous control

Use the simultaneous control feature for measuring input/output efficiency of the power source equipment, for making comparisons between multiple equipment, or for simultaneous parallel testing of production lines and achieve measurement with guaranteed synchronization. Efficiency computation is also possible in conjunction with PC software. Synchronization with both the Hioki PW3336 and PW3337 Power Meters is also supported.

Pair with current sensors delivering a maximum accuracy of ±0.26% to measure 30 A and up
(PW3335-03, PW3335-04)

You can input up to 5000A AC with the use of an optional current sensor. Using Hioki AC/DC high-accuracy pull-through sensors will enable precise measurement with maximum accuracy of ±0.26%.
PC Communication Software – PW Communicator

PW Communicator is an application software for communicating between a PW3335 series power meter and a PC. Free download is available from the Hioki website. The application contains convenient functions for setting the PW3335, monitoring the measurement values, acquiring data via communication, computing efficiency, and many more.

- **Value monitoring**
  The Value monitoring function displays the PW3335’s measurement values on the PC screen. You can freely select up to 64 values, such as voltage, current, power, and harmonics.

- **Waveform monitoring**
  This function enables you to monitor the voltage, current, and waveforms measured by the meter right on the PC screen.

- **Meter setting**
  The application also enables you to configure the connected PW3335 from the PC screen.

- **Synchronous measurement**
  When using multiple PW3335s, computation of the input/output efficiency of a power converter and similar operations are supported. This feature can be used to synchronously control up to 8 meters – including Hioki PW3336 and PW3337 series units – connected together with synchronous control cables.

**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>

**IEC62301-compliant reporting software**
Download free software for creating IEC62301-compliant reports from the Hioki website.

**LabVIEW Driver**
A LabVIEW driver compatible with the PW3335 will enable you to acquire data and build measurement systems.
( LabVIEW is a registered trademark of National Instruments Corporation.)

**Comparison with Hioki legacy Model 3332**

<table>
<thead>
<tr>
<th></th>
<th>PW3335 series</th>
<th>3332</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency bandwidth</td>
<td>DC, 0.1 Hz to 100 kHz</td>
<td>1 Hz to 100 kHz</td>
</tr>
<tr>
<td>Sampling</td>
<td>700 kHz digital sampling</td>
<td>Analog computation</td>
</tr>
<tr>
<td>Voltage measurement range</td>
<td>6 V to 1000 V</td>
<td>15 V to 600 V</td>
</tr>
<tr>
<td>Current measurement range</td>
<td>1 mA to 20 A</td>
<td>1 mA to 50 A</td>
</tr>
<tr>
<td>Power measurement range</td>
<td>Determined by combination of voltage and current ranges. 6.0000 mW and up</td>
<td>Determined by combination of voltage and current ranges. 15.000 mW and up</td>
</tr>
<tr>
<td>Basic accuracy (DC)</td>
<td>Voltage/current/power: ±0.1% rdg, ±0.1% f.s.</td>
<td>-</td>
</tr>
<tr>
<td>Basic accuracy (45 Hz to 66 Hz)</td>
<td>Voltage/current/power: ±0.1% rdg, ±0.05% f.s.</td>
<td>Voltage/current/power: ±0.1% rdg, ±0.1% f.s.</td>
</tr>
<tr>
<td>Effect of power factor</td>
<td>±0.1% f.s. with 45 Hz to 66 Hz, PF = 0</td>
<td>±0.23% f.s. with 45 Hz to 66 Hz, PF = 0</td>
</tr>
<tr>
<td>Communication interface</td>
<td>LAN, RS-232C, PW3335-02, PW3335-03, PW3335-04, PW3335-01, PW3335-04</td>
<td>RS-232C GP-IB</td>
</tr>
<tr>
<td>Synchronous control</td>
<td>Up to 8 meters</td>
<td>-</td>
</tr>
<tr>
<td>Harmonics measurement</td>
<td>Available on all models Compliant with IEC61000-4-7-2002</td>
<td>-</td>
</tr>
<tr>
<td>Current sensor support</td>
<td>PW3335-03, PW3335-04</td>
<td>-</td>
</tr>
<tr>
<td>Auto-range integration function</td>
<td>Available</td>
<td>-</td>
</tr>
<tr>
<td>D/A output</td>
<td>7 channels (level output, high-speed level output and waveform output selectable)</td>
<td>Level output (fixed voltage, current and effective power) Waveform output (fixed voltage and current) 1-channel D/A level output</td>
</tr>
<tr>
<td>Time-averaged effective integral power</td>
<td>Computable</td>
<td>Computable</td>
</tr>
<tr>
<td>Maximum current ratio (MCR)</td>
<td>Computable</td>
<td>-</td>
</tr>
</tbody>
</table>
Specifications

Input Specifications

<table>
<thead>
<tr>
<th>Measurement type</th>
<th>Single-phase 2 wire(12P)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input methods</td>
<td>Voltage Isolated input, resistive voltage divider method</td>
</tr>
<tr>
<td>Voltage</td>
<td>Current Isolated input, shunt input method</td>
</tr>
<tr>
<td>Voltage measurement ranges</td>
<td>60.000 V</td>
</tr>
<tr>
<td>Current measurement ranges</td>
<td>1.0000 A</td>
</tr>
<tr>
<td>Power ranges</td>
<td>Depends on the combination of voltage and current; From 6.0000 mW to 20.0000 kW (also applies to VA, var)</td>
</tr>
<tr>
<td>Input resistance</td>
<td>Voltage input terminal: Approx. 2 MΩ</td>
</tr>
<tr>
<td></td>
<td>Current input terminal: 1 mA to 100 mA range: 520 mΩ or less</td>
</tr>
<tr>
<td></td>
<td>≥ 200 mA to 20 A range: 15 mΩ or less</td>
</tr>
</tbody>
</table>

Basic Measurement Specifications

<table>
<thead>
<tr>
<th>Measurement method</th>
<th>Simultaneous voltage and current digital sampling, zero-cross simultaneous calculation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sampling frequency</td>
<td>Approx. 700 Hz</td>
</tr>
<tr>
<td>A/D converter resolution</td>
<td>16-bit</td>
</tr>
<tr>
<td>Frequency bandwidth</td>
<td>DC: 0.1 Hz to 100 kHz</td>
</tr>
<tr>
<td></td>
<td>(Values within 0.1 Hz ≤ f &lt; 10 Hz are for reference only)</td>
</tr>
<tr>
<td>Synchronization sources</td>
<td>U, I, DC (fixed to 200 ms)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Measurement items</th>
<th>Voltage</th>
<th>Current</th>
<th>Active power</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Apparent power</td>
<td>Reactive power</td>
<td>Power factor</td>
</tr>
<tr>
<td></td>
<td>Frequency</td>
<td>Integration time</td>
<td>Current waveform peak value</td>
</tr>
<tr>
<td></td>
<td>Voltage crest factor</td>
<td>Current crest factor</td>
<td>Maximum current ratio</td>
</tr>
<tr>
<td></td>
<td>Time active current</td>
<td>Voltage ripple rate</td>
<td></td>
</tr>
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</table>

Harmonic parameters

<table>
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<tr>
<th>Harmonic RMS value</th>
<th>Harmonic current RMS value</th>
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<tr>
<td>Harmonic active power</td>
<td>Total harmonic voltage distortion</td>
</tr>
<tr>
<td>Total harmonic current distortion</td>
<td>Fundamental wave voltage</td>
</tr>
<tr>
<td>Fundamental wave current</td>
<td>Fundamental wave active power</td>
</tr>
<tr>
<td>Fundamental wave apparent power</td>
<td>Fundamental wave reactive power</td>
</tr>
<tr>
<td>Fundamental wave power factor</td>
<td>(Displacement power factor)</td>
</tr>
<tr>
<td>Fundamental wave voltage current phase difference</td>
<td>Harmonic voltage content percentage</td>
</tr>
<tr>
<td>Harmonic current content percentage</td>
<td>Harmonic current phase percentage</td>
</tr>
<tr>
<td>(The following parameters can be downloaded as data via PC communication)</td>
<td>Harmonic voltage phase angle</td>
</tr>
<tr>
<td>Harmonic current phase angle</td>
<td>Harmonic voltage current phase difference</td>
</tr>
</tbody>
</table>

AC+DC: AC+DC measurement

Display of true RMS values for both voltage and current

AC+DC Umm: AC+DC measurement

Display of average value rectified RMS converted values for voltage and true RMS values for current

DC: DC measurement

Display of simple averages for both voltage and current

Rectifiers

AC: AC measurement

Display of values calculated by √(AC+DC value^2 - DC value^2) for both voltage and current

Display of values calculated by (AC+DC value) × (DC value) for active power

FND - Extraction and display of the fundamental wave component from harmonic measurement

Zero-cross Filter

100 Hz: 0.1 Hz to 100 Hz
500 Hz: 0.1 Hz to 500 Hz
5 kHz: 0.1 Hz to 5 kHz
10 kHz: 0.1 Hz to 10 kHz
100 kHz: 0.1 Hz to 100 kHz

Range table (Power ranges)

<table>
<thead>
<tr>
<th>Current/ Voltage</th>
<th>6.000 V</th>
<th>15.000 V</th>
<th>30.000 V</th>
<th>60.000 V</th>
<th>150.00 V</th>
<th>300.00 V</th>
<th>600.00 V</th>
<th>1.0000 kV</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0000 mA</td>
<td>±0.1%rdg</td>
<td>±0.1%rdg</td>
<td>±0.1%rdg</td>
<td>±0.1%rdg</td>
<td>±0.2%f.s.</td>
<td>±0.3%rdg</td>
<td>±0.3%rdg</td>
<td>±1.0%rdg</td>
</tr>
<tr>
<td>2.0000 mA</td>
<td>±0.1%rdg</td>
<td>±0.1%rdg</td>
<td>±0.1%rdg</td>
<td>±0.1%rdg</td>
<td>±0.2%f.s.</td>
<td>±0.3%rdg</td>
<td>±0.3%rdg</td>
<td>±1.0%rdg</td>
</tr>
<tr>
<td>5.0000 mA</td>
<td>±0.1%rdg</td>
<td>±0.1%rdg</td>
<td>±0.1%rdg</td>
<td>±0.1%rdg</td>
<td>±0.2%f.s.</td>
<td>±0.3%rdg</td>
<td>±0.3%rdg</td>
<td>±1.0%rdg</td>
</tr>
<tr>
<td>10.000 mA</td>
<td>±0.1%rdg</td>
<td>±0.1%rdg</td>
<td>±0.1%rdg</td>
<td>±0.1%rdg</td>
<td>±0.2%f.s.</td>
<td>±0.3%rdg</td>
<td>±0.3%rdg</td>
<td>±1.0%rdg</td>
</tr>
<tr>
<td>20.000 mA</td>
<td>±0.1%rdg</td>
<td>±0.1%rdg</td>
<td>±0.1%rdg</td>
<td>±0.1%rdg</td>
<td>±0.2%f.s.</td>
<td>±0.3%rdg</td>
<td>±0.3%rdg</td>
<td>±1.0%rdg</td>
</tr>
</tbody>
</table>

Measurement accuracy

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Input ≤ 500 mV</th>
<th>0.0% ≤ Input ≤ 1000 mV</th>
<th>1000 mV ≤ Input</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC</td>
<td>±0.1%rdg</td>
<td>±0.1%rdg</td>
<td>±0.1%rdg</td>
</tr>
<tr>
<td>AC</td>
<td>±0.1%rdg</td>
<td>±0.1%rdg</td>
<td>±0.1%rdg</td>
</tr>
</tbody>
</table>

Effective measuring range

<table>
<thead>
<tr>
<th>Voltage</th>
<th>1% to 150% of the range (1000 V range, up to 1000 V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current</td>
<td>1% to 150% of the range (6% to 125% of the range (when using 1000 V range, up to 150%)</td>
</tr>
</tbody>
</table>

Maximum effective peak voltage

For all 30 V, 60 V, and 1000 V ranges, ±1500 V peak

Maximum effective peak current

For all 20 A range, ±60 A peak

Guaranteed accuracy period

1 year

Post-adjustment accuracy guaranteed

6 months

Conditions of guaranteed accuracy

Temperature and humidity range: 23°C±5°C (73°F±9°F), 80% RH or less

Warm-up time: 30 minutes

Input: Sine wave input, power factor of 1, voltage to earth of 0 V, after zero-adjustment; within range in which the fundamental wave satisfies synchronization source conditions

Temperature coefficient

±0.03%/°C or less

However, for 1 mA range, ±0.06%/°C, per °C or less.
Effect of power factor: ±0.1% fs. or less (45 to 66 Hz, at power factor = 0)
Internal circuitry voltage/current phase difference: ±0.05°*E
Effect of common mode voltage: ±0.01% fs. or less (600 V, 50/60 Hz, applied between input terminals and enclosure)

Effect of magnetic field:
- 400 A/m, DC and 50 Hz/60 Hz magnetic field
- Voltage: ±1.5% fs. or less
- Current: ±1.5% fs. or less than or equal to the following value, whichever is greater:
  - 200 mA/500 mA: 1 A/2 A/5 A/10 A/20 A range: ±20 mA
  - 1 mA/2 mA/5 mA/10 mA/20 mA/50 mA/100 mA range: ±200 μA

Active power:
- ±0% to ±225% of the range, however, up to ±150% of the range.
- Voltage effective measurement range.

Effect of self-heating:
- With input of at least 15 A to current input terminals
- AC input signal: ±0.025 ± 0.005 × (I - 15)% fs. or less
- DC input signal: ±0.025 ± 0.005 × (I - 15)% fs. or less

Effective measuring range:
- Voltage: +1% to ±150% of the range.
- Current: +1% to ±150% of the range

Display range:
- Voltage: ±2.0% f.s. at DC, ±2.0% f.s. with ±2% at DC when 10 Hz ≤ f < 1 kHz, ±2% at DC when 10 Hz ≤ f < 1 kHz.

Power Calculation Formulas:
- S: Apparent power
- \( Q = \text{si} \times P 
\)
- \( P = S \times \cos \theta 
\)

Voltage/Current/Reactive Power/Power Factor/Phase Angle Measurement Specifications

Measurement types:
- Rectifiers: AC-DC, DC, AC, FND, AC+DC, Umn

Effective measuring range:
- Voltage: ±1% to ±150% of the range. However, up to ±1500 V peak value and 1000 V RMS value
- Current: ±1% to ±150% of the range

Display range:
- Active Power: ±0% to ±225% of the range, however, valid when the voltage and current fall within the effective measuring range.

Polarity:
- Voltage: Current
- Active Power: Displayed when using DC rectifier
- Active Power negative: generation or regenerated power
- Positive: Power consumption (no polarity display)

Voltage Waveform Peak Value/Current Waveform Peak Value Measurement Specifications

Table: Voltage Waveform Peak Value/Current Waveform Peak Value Measurement Specifications

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Voltage Waveform Peak Value</th>
<th>Current Waveform Peak Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>Voltage range</td>
<td>Voltage peak range</td>
</tr>
<tr>
<td></td>
<td>6.000 V</td>
<td>36.00 V</td>
</tr>
<tr>
<td></td>
<td>15.00 V</td>
<td>90.00 V</td>
</tr>
<tr>
<td></td>
<td>20.00 V</td>
<td>180.00 V</td>
</tr>
<tr>
<td></td>
<td>60.00 V</td>
<td>360.00 V</td>
</tr>
<tr>
<td></td>
<td>150.00 V</td>
<td>900.00 V</td>
</tr>
<tr>
<td></td>
<td>300.00 V</td>
<td>1,800 kV</td>
</tr>
<tr>
<td></td>
<td>600.00 V</td>
<td>3,600 kV</td>
</tr>
<tr>
<td></td>
<td>1,050 kV</td>
<td>6,000 kV</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Current</th>
<th>Current range</th>
<th>Current peak range</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.0000 A</td>
<td>6.0000 A</td>
</tr>
<tr>
<td></td>
<td>2.0000 A</td>
<td>12.000 A</td>
</tr>
<tr>
<td></td>
<td>3.0000 A</td>
<td>18.000 A</td>
</tr>
<tr>
<td></td>
<td>5.0000 A</td>
<td>30.000 A</td>
</tr>
<tr>
<td></td>
<td>10.000 A</td>
<td>60.000 A</td>
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<tr>
<td></td>
<td>20.000 A</td>
<td>120.000 A</td>
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<td></td>
<td>50.000 A</td>
<td>300.000 A</td>
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<tr>
<td></td>
<td>100.00 A</td>
<td>600.000 A</td>
</tr>
<tr>
<td></td>
<td>200.00 A</td>
<td>1,200.000 A</td>
</tr>
<tr>
<td></td>
<td>500.00 A</td>
<td>3,000.000 A</td>
</tr>
<tr>
<td></td>
<td>1,000 A</td>
<td>6,000.000 A</td>
</tr>
<tr>
<td></td>
<td>2,000 A</td>
<td>12,000.000 A</td>
</tr>
<tr>
<td></td>
<td>5,000 A</td>
<td>30,000.000 A</td>
</tr>
<tr>
<td></td>
<td>10,000 A</td>
<td>60,000.000 A</td>
</tr>
<tr>
<td></td>
<td>20,000 A</td>
<td>120,000.000 A</td>
</tr>
</tbody>
</table>

Frequency Measurement Specifications

<table>
<thead>
<tr>
<th>Number of measurement channels</th>
<th>2 (Voltage, current)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurement method</td>
<td>Calculated from input waveform period (reciprocal method)</td>
</tr>
<tr>
<td>Measurement ranges</td>
<td>100 Hz/500 Hz/5 kHz/100 kHz (linked to zero-cross filter)</td>
</tr>
<tr>
<td>Measurement accuracy</td>
<td>±0.1% rdg. ±1 dgt. However, for 1 mA range, ±0.2% rdg. ±1 dgt.</td>
</tr>
</tbody>
</table>

Effective measuring range:
- 0.1 Hz to 100 kHz
- For sine wave input that is at least 20% of the measurement source’s measurement range

Display format:
- 0.1000 Hz to 9.9999 Hz
- 9.900 Hz to 99.999 Hz
- 99.00 Hz to 999.99 Hz
- 999.00 Hz to 9999.99 Hz
- 9999.00 Hz to 99999.99 Hz
- 99999.00 Hz to 999999.99 Hz
- 999999.00 Hz to 9999999.99 Hz

Apparent Power/Reactive Power/Power Factor/Phase Angle Measurement Specifications

Measurement types:
- Rectifiers: Apparent Power/Reactive Power/Power Factor
- Phase Angle

Effective measuring range:
- As per voltage, current, and active power effective measurement ranges

Voltage Crest Factor/Current Crest Factor Measurement Specifications

Measurement method:
- Calculates the ratio of the voltage waveform peak value to the voltage RMS value.

Effective measuring range:
- As per voltage and voltage waveform peak value, or current and current waveform peak value effective measurement ranges.

Display range:
- 1.0000 to 612.000 (No polarity)

Voltage Ripple Rate/Current Ripple Rate Measurement Specifications

Measurement method:
- Calculates the AC component (peak to peak [peak width]) as a proportion of the voltage or current DC component.

Effective measuring range:
- As per voltage and voltage waveform peak value, or current and current waveform peak value effective measurement ranges.

Display range:
- 0.00 to 500.00 (No polarity)
### Maximum Current Ratio Measurement Specifications (MCR)

<table>
<thead>
<tr>
<th>Measurement method</th>
<th>Calculates the ratio of the current crest factor to the power factor. (MCR) = (Current Crest Factor) / (Power Factor)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effective measuring range</td>
<td>As per power factor (voltage, current, active power) and current crest factor (current, current waveform peak value) effective measurement ranges.</td>
</tr>
<tr>
<td>Display range</td>
<td>1.0000 to 6.1200 M (no polarity)</td>
</tr>
</tbody>
</table>

### Synchronized control

#### Functions
- **Terminal**
  - BNC terminal × 1 (non-isolated)
- **Terminal name**
  - External synchronization terminal (EXT.SYNC)
- **I/O settings**
  - Off: Synchronized control function off (signals input to the external synchronization terminal (EXT.SYNC) are ignored).
  - In: The external synchronization terminal (EXT.SYNC) is set to input, and a dedicated synchronization signal can be input (slave).
  - Out: The external synchronization terminal (EXT.SYNC) is set to output, and a dedicated synchronization signal can be output (master).
- **Number of units for which synchronized control can be performed**
  - Up to 7 slaves per master (total of 8 units including the PW3336/PW3337 series)

#### Auto-range (AUTO)
- **Range up**
  - Automatically changes the voltage and current range according to the input.
- **Range down**
  - The range is decreased when input falls below 15% of the range. However, the range is not decreased if the peak exceeds at the lower range.
- **Range select**
  - Selects whether to enable (turn on) or disable (turn off) individual voltage and current ranges.
- **Zero-cross filter’s threshold level**
  - Sets the zero-cross filter’s threshold level for voltage and current ranges. Set from 1% to 15% (in 1% intervals). Synchronization with the PW3336 series and PW3337 series is also supported.

### Functional Specifications

#### Auto-range (AUTO)
- **Range up**
  - The range is increased when input exceeds 150% of the range or when the peak is exceeded.
- **Range down**
  - The range is decreased when input falls below 15% of the range. The range is not decreased if the peak exceeds at the lower range.
- **Range select**
  - Switches the current range (200 mA to 20 A) while integration is stopped.
- **Averaging**
  - Averages the voltage, current, active power, apparent power, and reactive power. The power factor and phase angle are calculated from averaged data. Averaging is not performed for parameters other than those listed above.
- **Effective range**
  - 999999 (6 digits + decimal point)

#### System Reset
- **Initialize**
  - Initializes the instrument's settings.

#### Backup
- **Backs up**
  - Settings and integration data if the instrument is turned off and if a power outage occurs.

#### Key-lock
- **Disables**
  - Key input in the measurement state, except for the KEY LOCK key.

### Integration Measurement Specifications

#### Switching between fixed-range integration and auto-range integration.
- **Integration operation modes**
  - Fixed-range integration
    - Integration can be performed for all voltage and current ranges.
  - Auto-range integration
    - Integration can be performed for all voltage and current ranges. The current is set to auto-range operation using ranges from 200 mA to 20 A. The integrated value for each range can be displayed by switching the range (current range: 200 mA to 20 A) while integration is stopped.

#### Measurement items and display
- **Measurement items**
  - Rectifiers: AC+DC, AC+DC Umn
  - Current: Displays the result of integrating current RMS value data (display values) once every display update interval as an integrated value.
  - Active power: Displays the result of integrating active power values by polarity calculated once every cycle for the selected synchronization source as integrated values.

#### Effective measurement range
- **Until PEAK OVER U lamp or PEAK OVER I lamp lights up.**

#### Display resolution
- **999999 (6 digits + decimal point)**

### Time Average Current/ Time Average Active Power Measurement Specifications

#### Number of averaging iterations and display update interval
- **Number of averaging iterations**
  - 1
  - 2
  - 5
  - 10
  - 25
  - 50
  - 100
- **Display update interval**
  - 200 ms
  - 400 ms
  - 1 s
  - 2 s
  - 5 s
  - 10 s

#### Scaling (VT, CT)
- **Applies user-defined VT and CT ratio settings to measured values.**
  - VT ratio setting range: OFF (1.0), 0.001 to 1000
  - CT ratio setting range: OFF (1.0), 0.001 to 1000

#### Hold
- **Stops display updates for all measured values and fixes the display values at that point in time.**
- **Measurement data acquired by communications is also fixed at that point in time.**
- **Internal calculations (including integration and integration elapsed time) will continue.**
- **Analog output and waveform output are not held.**

#### Measurement method
- **Calculates the average by dividing the current or active power integrated value by the integration time.**

#### Measurement accuracy
- **(Current or active power measurement accuracy) + (±0.01% rdg. ±1 dgt.)**

#### Display range
- **Time Average Current: ±0% to ±3745.4% of the range (Has polarity)**
  - Time Average Active Power: ±0% to ±3745.4% of the range (Has polarity)
## Harmonic Measurement Specifications

### Measurement method
- Zero-cross simultaneous calculation method
- Uniform thinning between zero-cross events after processing with a digital antialiasing filter
- Interpolation calculations (Lagrange interpolation)

#### When the synchronization frequency falls within the 45 Hz to 66 Hz range:
- IID 61000-4-7:2002 compliant
- Gaps and overlaps may occur if the measurement frequency is not 50 Hz or 60 Hz.
- When the synchronization frequency falls outside the 45 Hz to 66 Hz range:
  - No gaps or overlap will occur.

### Synchronization source
- Conforms to synchronization source (SYNC) for the basic measurement specifications.

### Measurement items
- Harmonic voltage RMS value
- Harmonic voltage phase angle
- Harmonic current RMS value
- Harmonic current phase angle
- Harmonic active power
- Harmonic active power content percentage
- Harmonic active power content percentage
- Harmonic reactive power
- Harmonic reactive power content percentage
- Total harmonic voltage distortion
- Total harmonic current distortion
- Total harmonic voltage phase difference
- Total harmonic current phase difference
- Fundamental wave active power
- Fundamental wave reactive power
- Fundamental wave phase angle

#### Data update rate
- Depends on window width.

#### Maximum analysis order
- 4 (display area a, b, c, and d)

### Display Specifications
- 7-segment LED

#### Number of display parameters
- 4 (display area a, b, c, and d)

#### Display resolution
- Other than integrated values: 99999 count (5 digits)
- Integrated values: 99999 count (6 digits)

#### Display update rate
- 200 ms ±50 ms (approx. 5 updates per sec.) to 20 s (varies with number of averaging iterations setting)

### External Current Sensor Input Specifications (PW3335-03 and PW3335-04)

#### Terminal

<table>
<thead>
<tr>
<th>Current sensor type</th>
<th>Isolated BNC terminals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Off/TYPE 1/TYPE 2</td>
<td>Supported current sensors</td>
</tr>
</tbody>
</table>

#### Current sensor options

- **TYPE 1**
  - (Can be directly connected)
  - 9690 CLAMP ON SENSOR (100 A AC)
  - 9691 CLAMP ON SENSOR (500 A AC)
  - 9692 CLAMP ON SENSOR (1000 A AC)
  - CT9665-01U -02 -03 AC FLEXIBLE CURRENT SENSOR (50A/ 200 A AC)

- **TYPE 2**
  - Requires Sensor Unit CT9555 and Connection Cable L9217
  - CT6862-05 AC/DC CURRENT SENSOR (50 A AC/DC)
  - CT6863-05 AC/DC CURRENT SENSOR (200 A AC/DC)
  - CT6864-05 AC/DC CURRENT SENSOR (1000 A AC/DC)
  - CT6841-05 DC CURRENT PROBE (20 A DC)
  - CT6843-05 DC CURRENT PROBE (500 A AC/DC)
  - CT6844-05 DC CURRENT PROBE (500 A AC/DC)
  - CT6845-05 DC CURRENT PROBE (1000 A AC/DC)
  - 9272-05 CLAMP ON SENSOR (20 A/ 200 A AC)

#### Constraints
- Auto-range integration not supported.

#### Power range configuration
- Depends on the combination of voltage and current ranges; from 24,000 W to 5,000 MW (also applies to VA, var)

#### Measurement accuracy
- **Current/ Active Power**
  - DC: ±0.1% rdg. ±0.2% F.S.
  - AC: ±0.3% rdg. ±0.5% F.S.

#### Active Power
- DC: ±0.5% rdg.
- AC: ±0.7% rdg.

#### Fundamental wave active power
- DC: ±0.4% rdg. ±0.4% F.S.
- AC: ±0.5% rdg. ±0.5% F.S.

#### Fundamental wave reactive power
- DC: ±0.4% rdg. ±0.4% F.S.
- AC: ±0.5% rdg. ±0.5% F.S.

#### Fundamental wave voltage RMS value
- DC: ±0.3% rdg. ±0.4% F.S.
- AC: ±0.4% rdg. ±0.5% F.S.

#### Fundamental wave current RMS value
- DC: ±0.3% rdg. ±0.4% F.S.
- AC: ±0.4% rdg. ±0.5% F.S.

#### Fundamental wave voltage content percentage
- DC: ±0.3% rdg. ±0.4% F.S.
- AC: ±0.4% rdg. ±0.5% F.S.

#### Fundamental wave current content percentage
- DC: ±0.3% rdg. ±0.4% F.S.
- AC: ±0.4% rdg. ±0.5% F.S.

#### Fundamental wave voltage phase angle
- DC: ±0.5% rdg. ±0.5% F.S.
- AC: ±0.6% rdg. ±0.6% F.S.

#### Fundamental wave current phase angle
- DC: ±0.5% rdg. ±0.5% F.S.
- AC: ±0.6% rdg. ±0.6% F.S.

#### Total harmonic voltage distortion
- DC: ±0.4% rdg. ±0.4% F.S.
- AC: ±0.5% rdg. ±0.5% F.S.

#### Total harmonic current distortion
- DC: ±0.4% rdg. ±0.4% F.S.
- AC: ±0.5% rdg. ±0.5% F.S.

#### Total harmonic voltage phase difference
- DC: ±0.4% rdg. ±0.4% F.S.
- AC: ±0.5% rdg. ±0.5% F.S.

#### Total harmonic current phase difference
- DC: ±0.4% rdg. ±0.4% F.S.
- AC: ±0.5% rdg. ±0.5% F.S.

#### Table 1: Frequency (f) Measurement Range

<table>
<thead>
<tr>
<th>Frequency (f)</th>
<th>Voltage, Current, Active power</th>
<th>Constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 10 Hz</td>
<td>±0.6% rdg. ±0.6% F.S.</td>
<td>Power range configuration depends on the combination of voltage and current ranges; from 24,000 W to 5,000 MW (also applies to VA, var)</td>
</tr>
<tr>
<td>10 Hz ≤ f &lt; 16 Hz</td>
<td>±0.1% rdg. ±0.1% F.S.</td>
<td>-</td>
</tr>
</tbody>
</table>
**D/A Output Specifications (PW3335-02 and PW3335-04)**

<table>
<thead>
<tr>
<th>Number of output channels</th>
<th>7 channels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Configuration</td>
<td>16-bit D/A converter (polarity + 15 bits)</td>
</tr>
</tbody>
</table>

**Output voltage**
- The output level, output speed, and waveform output can be selected.
  - Level output: 2 Vf.s. or 3 Vf.s., linked to display updates
  - High-speed level output: 2 Vf.s. or 3 Vf.s., linked to synchronization interval
  - Waveform output: 1 Vf.s., linked to sampling

**Output parameters**
- Output parameters for all channels
- Available selections vary with the output parameter.
- Level output/High-speed level output: Waveform output
- Voltage, current, active power
- Only Level output
- Apparent power, reactive power, power factor, phase angle, total harmonic voltage distortion, total harmonic current distortion, voltage ripple rate, current ripple rate, voltage crest factor, current crest factor, time average current, time average active power, maximum current ratio
- Only Level output 5 Vf.s.
- Frequency, current integration, active power integration
- The rectifier can be selected.
- Harmonic-order output is not supported.

**Output accuracy**
- F.s.: Relative to the output voltage rated value for each output parameter
- Level output (Output parameter measurement accuracy) + (±0.2% (f.s.)
- High-speed level output (Output parameter measurement accuracy) + (±0.2% (f.s.)
- Waveform output (Output parameter measurement accuracy) + (±1.0% (f.s.)

**Output frequency band**
- Waveform output, high-speed level output: At DC or 10 Hz to 30 kHz, accuracy as defined above.

**Maximum output voltage**
- Approx. ±12 V DC

**Output update rate**
- Level output: Same as the data update period.
- High-speed level output: AC Updated once every cycle for the input waveform set as the synchronization source. However, voltage and current are only updated once every cycle for input signals from 45 to 66 Hz.
- Waveform output: Approx. 1.43 ms (approx. 700 kHz)

**Response time**
- Level output: 0.6 sec. or less
- High-speed level output: 2 ms or less
- Waveform output: 0.2 ms or less

**Temperature coefficient**
- ±0.05%/°C or less

**Output resistance**
- Approx. 100 Ω

**GP-IB interface (PW3335-01 and PW3335-04)**

| Method | Compliant with IEEE488.1 1987, in reference to IEEE488.2 1987 Interface functions SH1, AH1, Th, L4, SR1, RL1, PP0, DC1, DT1, CO |
| Address | 00 to 30 |

| RS-232C interface (PW3335, PW3335-02, PW3335-03, and PW3335-04) |
| Connector | D-sub 9-pin connector × 1 |
| Communication method | Full duplex, Start-stop synchronization |
| Stop bits: | 1 (fixed) |
| Data length: | 8 (fixed) |
| Parity: | None |
| Communication speed | 9600 bps/38400 bps |

**LAN interface**

| Connector | RJ-45 connector × 1 |
| Electrical specifications | Compliant with IEEE802.3 |
| Transmission method | 10Base-T: 10Base-TX (automatic detection) |
| Protocol | TCP/IP |
| Functions | HTTP server (remote operation, firmware updates) Dedicated ports (command control, data transfer) Remote control by controller |

**General Specifications**

| Product warranty period | 1 year |
| Operating environment | Indoors, altitude up to 2000 m (6562 ft), pollution degree 2 |
| Operating temperature and humidity | 0°C to 40°C (32°F to 104°F), 80% RH or less (no condensation) |
| Storage temperature and humidity | -10°C to 50°C (14°F to 122°F), 80% RH or less (no condensation) |
| Maximum rated voltage to earth | 4290 V min AC (current sensitivity: 1 mA) Between the voltage input terminals and a connection consisting of chassis, interfaces, and output terminals |
| Dielectric strength | Between the current input terminals and a connection consisting of chassis, interfaces, and output terminals Between the voltage input terminals and current input terminals |
| Maximum rated voltage to earth | Voltage input terminal, Current input terminal Measurement category III 600 V (anticipated transient overvoltage: 6000 V) |
| Measurement category II 1000 V (anticipated transient overvoltage: 6000 V) |
| Maximum input voltage | Between the voltage input terminals U and ±1000 V, ±1500 V peak |
| Maximum input current | Between the current input terminals I and ±200 mA to 20 A range 30 A, ±100 A peak 1 mA to 100 mA range 20 A, ±30 A peak |
| Applicable Standards | Safety EN61010 EMC EN61326 Class A EN61000-3-2 EN61000-3-3 |
| Rated supply voltage | 100 V AC to 240 V AC 50 Hz/60 Hz |
| Maximum rated power | 30 VA or less |
| Dimensions | Approx. 210W × 100H × 245D mm (8.27"W × 3.94"H × 9.65"D) (excluding protrusions) |
| Mass | Approx. 3 kg (105.8 oz.) |
| Accessories | Instruction manual × 1 Power cord × 1 Instruction manual × 1 Power cord × 1 |
| Input signal level | 0 to 5 V (high-speed CMOS level) or shorted [Lo]/open [Hi] |
Options

Current measurement options [Type 1] Can be directly connected to the current sensor input terminals on the PW3335-03/ PW3335-04

**CLAMP ON SENSOR 9661**
- 100 A AC, ±0.3%rdg.±0.01%f.s. (Amplitude accuracy 45 Hz to 66 Hz)
- ±1° or less (Phase accuracy 45 Hz to 66 Hz)

**CLAMP ON SENSOR CT9661-01, CT9661-02, CT9661-03**
- 500 A AC, ±0.3%rdg.±0.01%f.s. (Amplitude accuracy 45 Hz to 66 Hz)
- ±0.5° or less (Phase accuracy 45 Hz to 66 Hz)

Requires Sensor Unit CT9555 and Connection Cable L9217

**Current measurement options [Type 2]** Requires Sensor Unit CT9555 and Connection Cable L9217 to be connected to the current sensor input terminals on the PW3335-03/ PW3335-04

**200 A or lower**

- **AC/DC CURRENT SENSOR CT6842-05**
  - 50 A AC/DC, pass-through type, full scale 0.94", DC to 1 MHz
  - ±0.2%rdg.±0.01%f.s. (Amplitude accuracy 16 Hz to 400 Hz)
  - Power supply: SENSOR UNIT CT9555 (option)

- **AC/DC CURRENT SENSOR CT6863-05**
  - 200 A AC/DC, pass-through type, full scale 0.94", DC to 500 kHz
  - ±0.5%rdg.±0.01%f.s. (Amplitude accuracy 16 Hz to 400 Hz)
  - Power supply: SENSOR UNIT CT9555 (option)

- **AC/DC CURRENT PROBE CT6841-05**
  - 20 A AC/DC, clamp-on type, full scale 0.99", DC to 1 MHz
  - ±0.3%rdg.±0.01%f.s. (Amplitude accuracy DC < f ≤ 100 Hz)
  - Power supply: SENSOR UNIT CT9555 (option)

- **AC/DC CURRENT PROBE CT6843-05**
  - 200 A AC/DC, clamp-on type, full scale 0.99", DC to 500 kHz
  - ±0.3%rdg.±0.01%f.s. (Amplitude accuracy DC < f ≤ 100 Hz)
  - Power supply: SENSOR UNIT CT9555 (option)

- **CLAMP ON SENSOR 9272-05** (Scheduled for release in 2017)
  - 29 A, 200 A AC: Switchable, clamp-on type, full scale 1.81", 1 Hz to 100 kHz
  - ±0.3%rdg.±0.01%f.s. (Amplitude accuracy 45 Hz to 66 Hz)
  - ±0.2° or less (Phase accuracy 45 Hz to 66 Hz)
  - Power supply: SENSOR UNIT CT9555 (option)

**500 A or lower**

- **AC/DC CURRENT SENSOR 9709-05**
  - 500 A AC/DC, pass-through type, full scale 1.42", DC to 100 kHz
  - ±0.2%rdg.±0.01%f.s. (Amplitude accuracy 45 Hz to 66 Hz)
  - Power supply: SENSOR UNIT CT9555 (option)

- **AC/DC CURRENT PROBE CT6844-05**
  - 500 A AC/DC, clamp-on type, full scale 0.99", DC to 200 kHz
  - ±0.3%rdg.±0.01%f.s. (Amplitude accuracy DC < f ≤ 100 Hz)
  - Power supply: SENSOR UNIT CT9555 (option)

- **AC/DC CURRENT PROBE CT6845-05**
  - 500 A AC/DC, clamp-on type, full scale 0.99", DC to 100 kHz
  - ±0.1° or less (Phase accuracy DC < f ≤ 100 Hz)
  - Power supply: SENSOR UNIT CT9555 (option)

- **AC/DC CURRENT SENSOR CT6865-05**
  - 1000 A AC/DC, pass-through type, full scale 1.42", DC to 20 kHz
  - ±0.5%rdg.±0.01%f.s. (Amplitude accuracy 16 Hz to 66 Hz)
  - ±0.2° or less (Phase accuracy 16 Hz to 66 Hz)
  - Power supply: SENSOR UNIT CT9555 (option)

- **AC/DC CURRENT PROBE CT6846-05**
  - 1000 A AC/DC, clamp-on type, full scale 0.99", DC to 20 kHz
  - ±0.3%rdg.±0.01%f.s. (Amplitude accuracy DC < f ≤ 100 Hz)
  - ±0.1° or less (Phase accuracy DC < f ≤ 100 Hz)
  - Power supply: SENSOR UNIT CT9555 (option)

**1000 A or lower**

- **AC/DC CURRENT SENSOR CT6866-05**
  - 1000 A AC/DC, pass-through type, full scale 1.42", DC to 20 kHz
  - ±0.5%rdg.±0.01%f.s. (Amplitude accuracy 16 Hz to 66 Hz)
  - ±0.2° or less (Phase accuracy 16 Hz to 66 Hz)
  - Power supply: SENSOR UNIT CT9555 (option)

Type 2 Current sensor options

- **SENSOR UNIT CT9555**
  - POWER SUPPLY 100 V to 240 V AC (50Hz/ 60Hz)

Communications and control options

**RS-232C CABLE 9637**
- 9pin to 9pin
- Cable length: 1.8 m (5.91 ft)

**RS-232C CABLE 9638**
- 9pin to 25pin
- Cable length: 1.8 m (5.91 ft)

**GP-IB CONNECTOR CABLE 9151-02**
- Connection CORD 2217
- Cable length: 1.5 m (4.92 ft), metal BNC to metal BNC

**LAN CABLE 9642**
- 5m (16.41 ft), supplied with straight to cross conversion cable

**CONNECTION CORD 9165**
- For synchronized control
- Cable length: 1.5 m (4.92 ft)

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