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**User's
Manual**

CW140
CLAMP-ON POWER METER

IM CW140-E

Introduction

Thank you for purchasing our CW140 Clamp-on Power Meter. This User's manual explains the functions of the CW140, as well as its operating methods and handling precautions. Before using the CW140, read this manual thoroughly to ensure correct use of the instrument.

The Operation Guide manual is available separately, in addition to this manual. The Operation Guide manual briefly describes the basic procedures for performing such tasks as measurement operations and settings. Use the manual together with this in-depth User's manual.

When you have finished reading this manual, carefully store it in a place that provides ease of access for later reference. This manual will come in handy when you are unsure of how to operate the instrument.

Notices

The contents of this manual are subject to change without prior notice. In addition, figures and illustrations representing display views in this manual may differ from real views.

Every effort has been made to ensure accuracy in the preparation of this manual. Should any doubts arise or errors come to your attention however, please contact one of the Yokogawa M&C sales offices listed on the back cover of this manual or the sales representative from which you purchased the instrument.

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Examining Items Contained in the Package

After opening the package, be sure to examine the product as instructed below before use. Should the delivered product be the wrong model, lack any item, or show any flaw in its appearance, contact the vendor from which you purchased the product.

CW140 Main Unit

Check the model name and the suffix (specifications) code in the MODEL and SUFFIX fields of the nameplate located at the back of the instrument to ensure that the instrument is exactly as specified in your purchase order.

Model Name and Suffix Codes

| Model | Suffix Code | Specifications |
|--------------|---|---|
| CW140 | | |
| AC adapters | D F R S | Power cord: UL/CSA standard VDE standard SAA standard BS standard |
| Option codes | /DA /C1 /C2 /C3 /C4 /C5 /C6 /PM1 /PM2 | D/A output Clamp-on probe for 20/200A (2 pcs/set) Clamp-on probe for 20/200A (4 pcs/set) Clamp-on probe for 50/500A (2 pcs/set) Clamp-on probe for 50/500A (4 pcs/set) Clamp-on probe for 200/1000A (2 pcs/set) Clamp-on probe for 200/1000A (4 pcs/set) NiMH (nickel-hydrogen) battery pack and carrying case "PM1" and FDD unit |

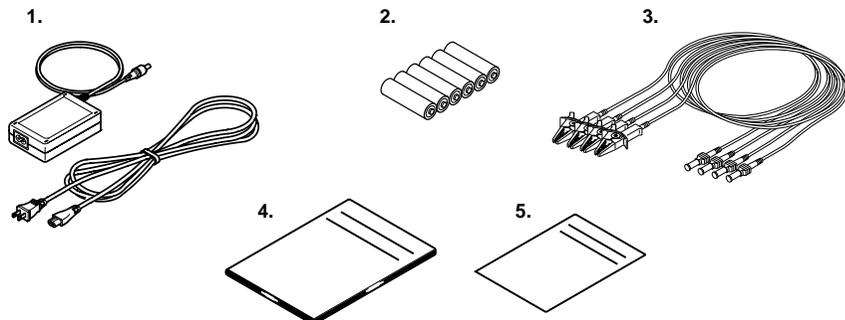
No. field: Denotes the instrument number.

Refer to this number when inquiring to the vendor about the instrument.

Accessories

Make sure that the package contains all the accessories listed below and that they are all free from any damage.

| Product Name | Part Number | Qty | Remarks |
|--------------------------------|-------------|-------|--|
| 1. AC adapter for power supply | 788011 | 1 set | Yokogawa's AC adapter |
| 2. AA alkaline dry cells | — | 6 | (alkaline batteries) |
| 3. Voltage probes | 91007 | 4 | Supplied together with two sets of ring markers of three different colors. |
| 4. Instruction manual | IM CW140-E | 1 | |
| 5. Operation Guide manual | IM CW140P-E | 1 | |



Peripherals (Optional)

The products listed below are available as optional peripherals. For technical and ordering inquiries concerning the peripherals, contact the vendor from which you purchased the instrument. If the instrument you purchased includes any one of the optional peripherals, make sure it is free from any damage.

| Product Name | Part Number | Minimum Order Qty | Remarks |
|----------------------------------|-------------|-------------------|--|
| Clamp-on probe for 20/200 A | 96030 | 1 | * See the option codes for a choice of probe kits. |
| Clamp-on probe for 50/500 A | 96031 | 1 | * |
| Clamp-on probe for 200/1000 A | 96032 | 1 | * |
| Voltage probe | 91007 | 4 | |
| Floppy disk drive unit | 97020 | 1 set | FDD unit |
| Carrying case | 93020 | 1 | |
| AC adapter | 788011 | 1 set | Yokogawa's AC adapter |
| NiMH battery pack | 94004 | 1 | |
| Printer | 97010 | 1 | |
| AC adapter (for printer, Europe) | 94006 | 1 | |
| AC adapter (for printer, USA) | 94007 | 1 | |
| Thermal paper for printers | 97080 | 10 rolls | |

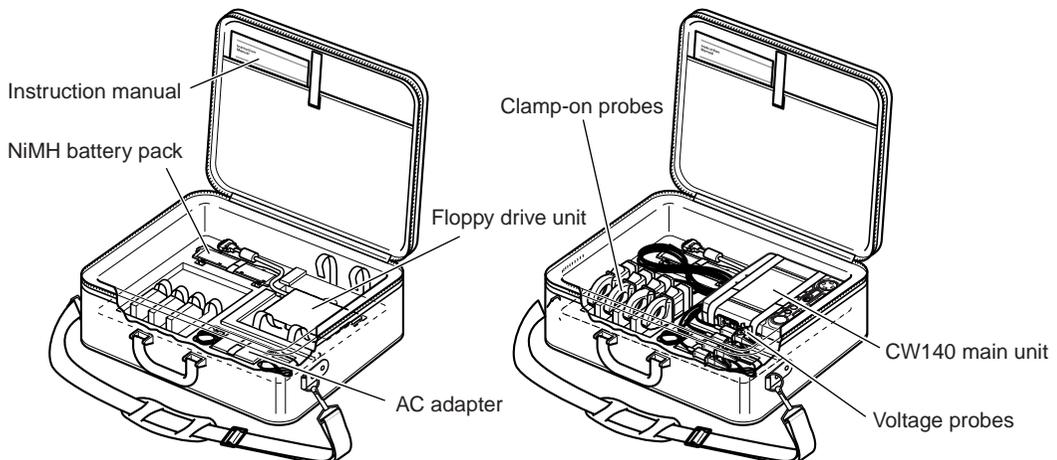
TIP

It is advisable that the packing box be stored, as it is useful when you transport the instrument.

● Housing CW140 Main Unit and Accessories

An optional carrying case can accommodate the CW140 main unit with its current-sensing clamp-on probes and voltage probes connected to the unit. The case can also house such accessories as an AC adapter, NiMH battery pack, floppy drive unit, instruction manual, floppy disks, recording paper, and so on. It therefore comes in handy when transporting a complete kit of tools necessary for your measurement.

Example of Housing:



Precautions for Safe Use of the Instrument

When operating the instrument, be sure to observe the cautionary notes given below to ensure correct and safe use of the instrument. If you use the instrument in any other way than instructed in this manual, the instrument's protective measures may be impaired. Yokogawa M&C Corporation is by no means liable for any damage resulting from use of the instrument in contradiction to these cautionary notes.

The following safety symbols are used in the instrument and this manual.



Danger! Handle with Care.

This symbol indicates that the operator must refer to an explanation in the instruction manual in order to avoid risk of injury or death of personnel or damage to the instrument.



Direct Current

This symbol indicates DC voltage/current.



Alternating Current

This symbol indicates AC voltage/current.



ON

This symbol indicates On (power).



OFF

This symbol indicates Off (power).



Double Insulation

This symbol indicates double insulation.



WARNING

Indicates a hazard that may result in the loss of life or serious injury of the user unless the described instruction is abided by.



CAUTION

Indicates a hazard that may result in an injury to the user and/or physical damage to the product or other equipment unless the described instruction is abided by.



NOTE

Indicates information that is essential for handling the instrument or should be noted in order to familiarize yourself with the instrument's operating procedures and/or functions.

TIP

Indicates information that complements the present topic.

SEE ALSO

Indicates the reference location(s) for further information on the present topic.

Strictly observe the following cautionary notes in order to avoid the risk of injury or death of personnel or damage to the instrument due to such hazards as electrical shock.

WARNING

● Removal of Case from the Instrument

- Do not remove the case from the instrument or disassemble/modify the instrument itself.
- Some parts of the inside of the instrument contain high-voltage and, therefore, access to the internal assembly is extremely hazardous. For inspection and/or adjustment of the internal assembly, contact the vendor from which you purchased the instrument.

● Use of the Instrument in a Gas Atmosphere

Do not operate the instrument in a location where any flammable or explosive gas/vapor is present. It is extremely hazardous to operate the instrument in such an atmosphere.

● Inspection of Power Source

- Before turning on the instrument, always make sure the voltage of the power source to be applied matches the instrument's supply voltage.
- When using alkaline batteries or an NiMH battery pack, carefully read the cautionary notes on battery handling later in this manual.

● Use of Clamp-on Current Probes

- When using clamp-on current probes, keep the circuit voltage below 600 V AC in order to avoid possible short-circuits or accidents resulting in injury or death.
- Avoid using the instrument if it has been exposed to rain or moisture or if your hands are wet.
- Do not use clamp-on current probes with any non-insulated conductors.

● Measures In Case of Anomalies

If the instrument begins to emit smoke, becomes too hot, or gives off an unusual smell, immediately turn it off and disconnect the power cord from the outlet. Also turn off power to the object under measurement that is connected to the instrument's input terminals. Never attempt to use the instrument again. If any such anomalies as noted above occurs, contact the vendor from which you purchased the instrument. Do not attempt to repair the instrument yourself, as doing so is extremely dangerous.

● Handling of Power Cords

Do not place any load on the power cord or allow the power cord to come into accidental contact with any heat source. Hold the plug of the power cord, rather than holding and pulling the cord itself, when disconnecting it from the outlet. If the power cord is damaged, contact the vendor from which you purchased the instrument. See page 2 for information on the AC adapter that is necessary when ordering a replacement power cord.

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1.1 Product Overview

The CW140 clamp-on power meter is basically designed for measuring root-mean-square voltage and current rms values and thereby electric energy. With its computing capabilities, the CW140 can measure and analyze a wide variety of parameters related to electric power.

This section explains the features of the CW140 and shows a schematic diagram representing the functions of the CW140. It also explains the screen views (i.e., measuring objects) presented by each measurement mode of the CW140.

Features

● Supports a variety of measurement modes and continuous measurement.

The CW140 has four measurement modes which support continuous measurement.

- Instant Measure mode (logging)
- Electric Energy Measure mode (integration)
- Demand Measure mode (demand measurement)
- Harmonics Measure mode (logging)

● Efficient Measurement using the Wh Key

This feature simplifies operations required for the Electric Energy Measure mode most often used.

● Supports a variety of wiring methods.

- Supports single-phase two-wire systems, single-phase three-wire systems, three-phase three-wire two-current systems, three-phase three-wire three-current systems, and three-phase four-wire systems.
- Supports dual-load systems in a single-phase two-wire, single-phase three-wire, or three-phase three-wire configuration (except when in the Harmonics Measure mode).

● Data Management

- Measured values or measurement settings can be stored in internal memory or on a 3.5-inch floppy disk inserted in an optional floppy drive attached externally to the CW140.
- Allows simultaneous data saving to internal memory and a floppy disk, or copying internal memory data to a floppy disk.
- An optional printer connected externally to the CW140 allows you to print measured values or measurement settings.

● Communication

With an RS-232-C interface, it is possible to transfer data to or receive measurement settings from a personal computer. The CW140 stores measurement data in CSV format, facilitating data processing (such as creating graphs) using commercial spreadsheet software.

● Setting Operations

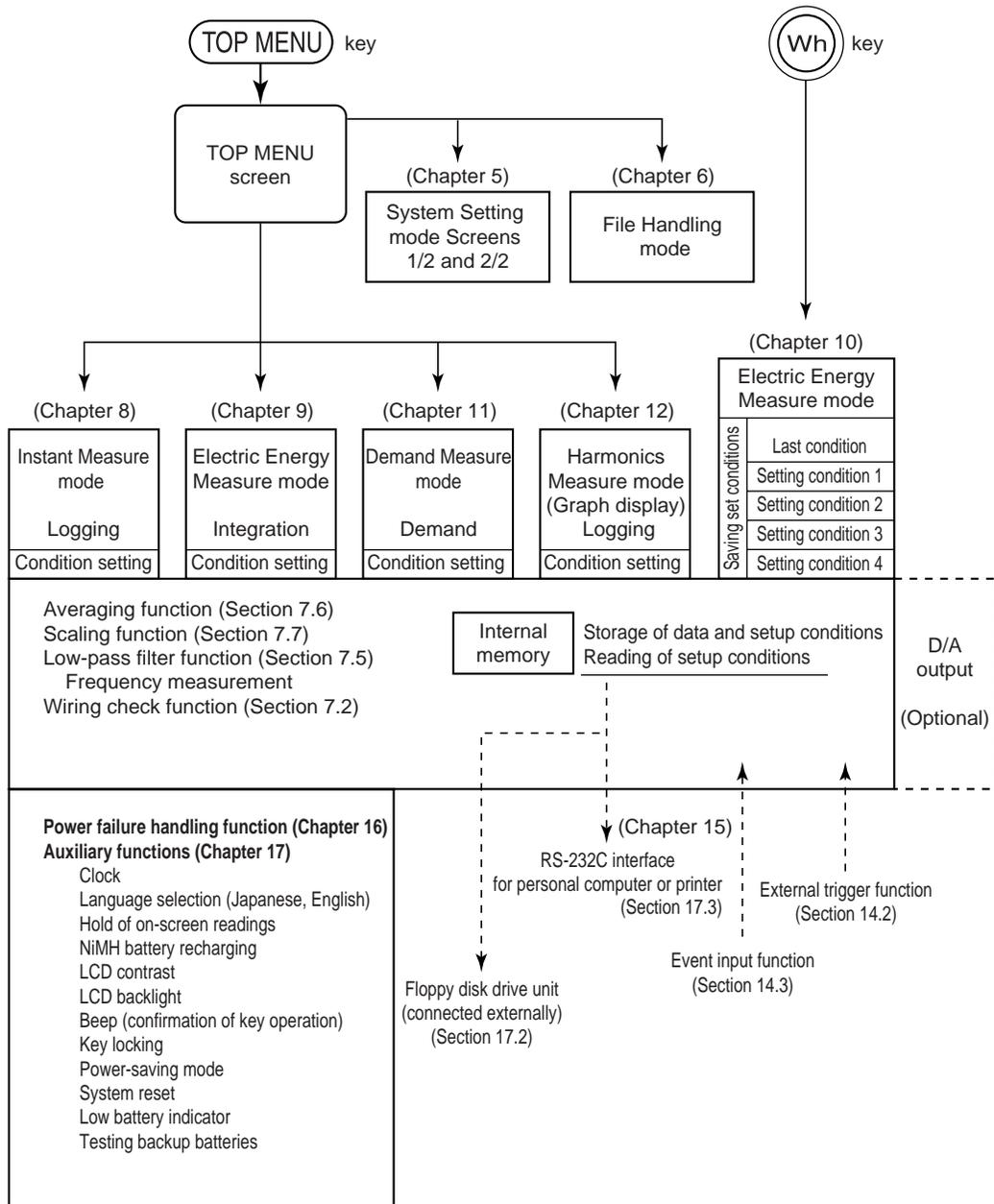
- Easy-to-operate Display Screen

You can easily change settings by selecting items highlighted on the screen using Range keys, Cursor key, and function keys.

● Settings Check Sheet

The settings check sheet in Appendix 6 lists required setting items for each measurement mode. Use this sheet for reference and to improve efficiency when making settings in the field.

Schematic Function Diagram



On-screen Information (Data Items) Provided by Each Measurement Mode

In each measurement mode, you can measure and calculate on-screen data items, as shown below.

| | |
|--|--|
| Instant Measure mode (Chapter 8) | Rms voltage value (V) |
| | Rms current value (A) |
| | Active power (W) |
| | Reactive power 1 and 2 (Var) |
| | 1: With reactive power meter method |
| | 2: Without reactive power meter method |
| | Apparent power (VA) |
| | Power factor |
| | Phase angle (°) |
| | Frequency (Hz) |
| Three-phase unbalance factor (%) (for three-phase wiring only) | |
| Electric Energy Measure mode (Chapter 9) | Active power (Wh) |
| | Regenerative power (Wh) |
| | Lagging reactive power (Varh) |
| | Leading reactive power (Varh) |

**Demand Measure mode
(Chapter 11)**

| Indication During Demand Interval | Indication at the End of Demand |
|---|---|
| <ul style="list-style-type: none"> • Maximum demand and its time • Demand of one demand period earlier • Electric energy integrated since the start of demand • Electric energy integrated during the present demand period • Power factor • Load factor • Remaining time of demand interval | <ul style="list-style-type: none"> • Maximum demand and its time • Average of respective demands • Electric energy integrated from the start to the end of demand • Average power factor • Average load factor |

**Harmonics Measure mode
(Chapter 12)** Analysis of 1st- through 13th-order harmonics

| Table displays | • Voltage/current | Rms value, harmonic content, phase angle Total rms value (All-RMS) Total harmonic distortion IEEE (relative to fundamental wave); CSA (relative to total rms value) Fundamental wave frequency |
|----------------|-------------------|---|
| | • Power | Power value, power content, power phase angle Total power value Total power factor Fundamental wave frequency |
| Graph displays | • Voltage/current | Rms value, harmonic content, phase angle |
| | • Power | Power value, power content, power phase angle |

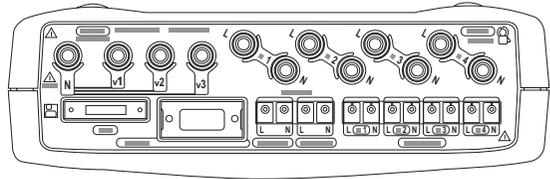
(The CW140 does not support the Harmonics Measure mode when wired to 2-system load.)

**NOTE**

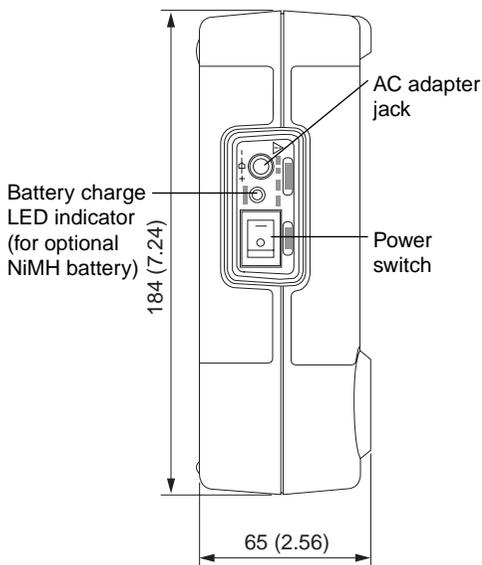
The CW140 can show a screen of instantaneous values whether it is in the Electric Energy Measure mode or the Demand Measure mode.

2.1 Front Panel and Connector Block

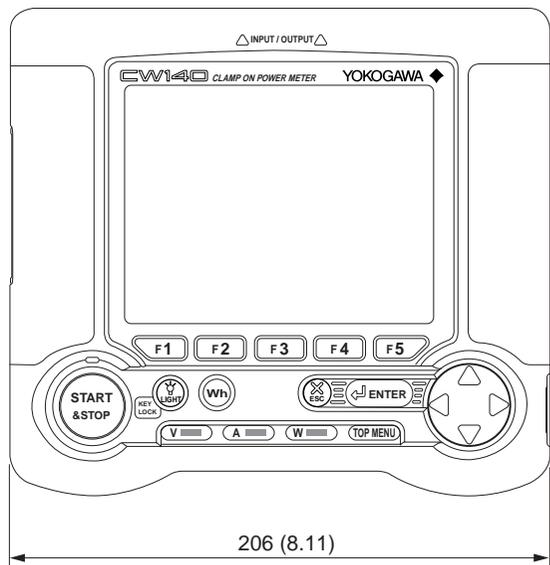
<Connector Block>



<Side View>

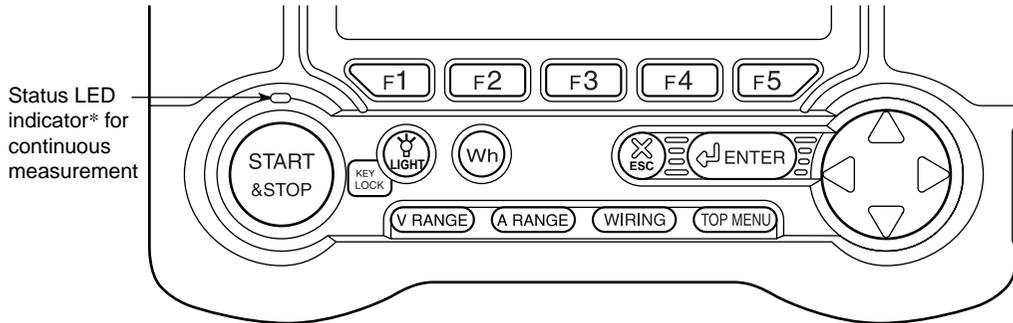


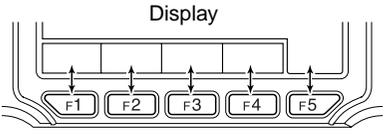
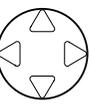
<Front View>



Unit: mm (approx. inches)

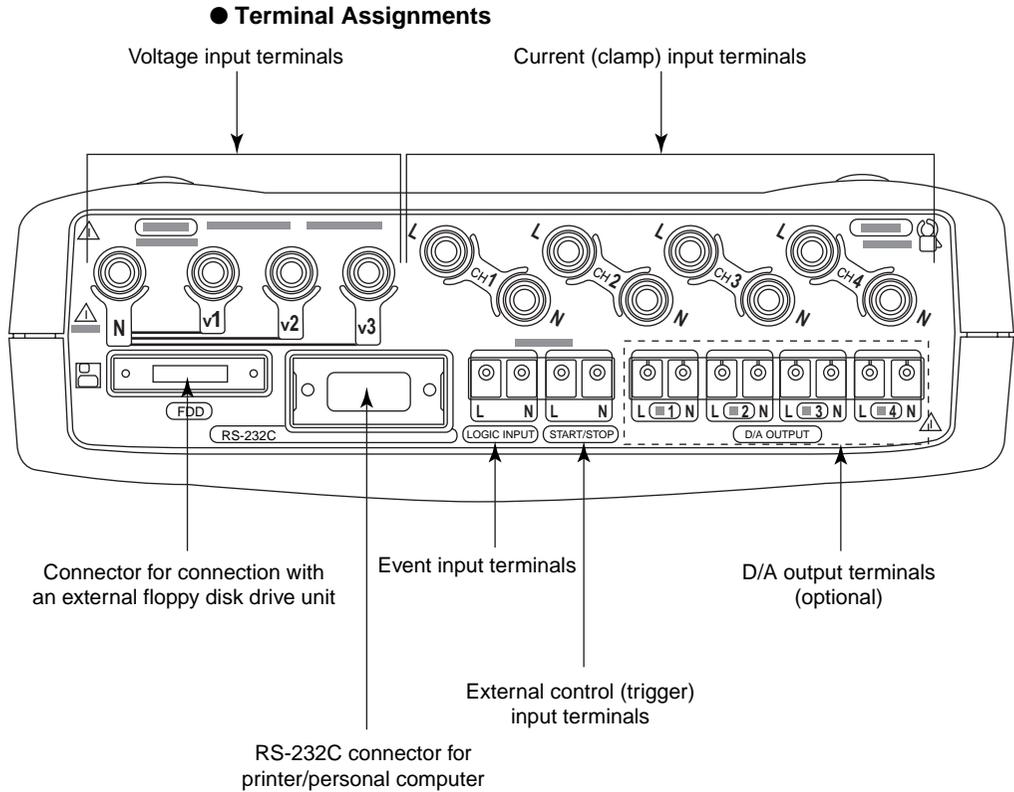
2.2 Operation and Functions Keys



| Name | Key Symbol | Description |
|----------------|---|--|
| Function keys |  to  | Set data appropriate for information shown in their respective corresponding fields along the bottom edge of the display.  |
| START&STOP key |  | Starts/stops logging when the CW140 is in the Instant Measure or Harmonics Measure mode. Starts/stops integration when the CW140 is in the Electric Energy Measure mode. Starts/stops demand when the CW140 is in the Demand Measure mode. |
| Backlight key |  | Turns on/off the backlight. Holding this key down for more than 3 seconds places the CW140 in a key lock state. To cancel the state, hold this key down again for more than 3 seconds. |
| Watt-hour key |  | Allows you to measure electric energy easily without selecting the Electric Energy Measure mode from the TOP MENU screen. |
| Escape key |  | Cancels such data as setup conditions. |
| Enter key |  | Confirms such data as setup conditions. |
| Cursor key |  | Moves the cursor through on-screen data items so an item can be selected. |
| V Range key |  | Shows/resets the voltage range. (You can change the setpoint with a function key.) |
| A Range key |  | Shows/resets the current range. (You can change the setpoint with a function key.) |
| Wiring key |  | Shows/resets the setting of a wiring method. (You can change the setting with a function key.) Also see "Checking Wiring." |
| TOP MENU key |  | Changes the display to the TOP MENU screen for selecting each measurement mode. |

* Status LED indicator: Remains lit when the CW140 is performing continuous measurement (whether the meter is in a stand-by state or taking measurements) in each measurement mode.

2.3 Connecting Input Signals to Be Measured and External Input Terminals



Event input terminals:

Receive ON/OFF signals from equipment under test.

External control input terminals:

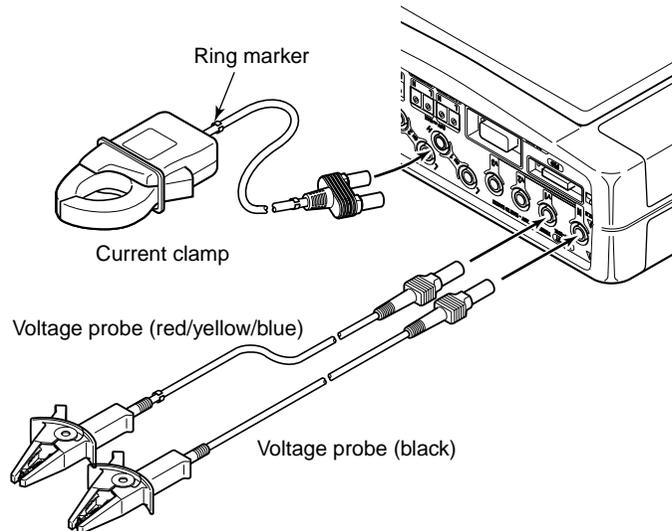
Receive START/STOP signals informing of the start and end of logging, integration or demand measurement.

D/A output terminals:

Terminals for D/A output (not available if the CW140 is not equipped with a D/A output option).

2.3 Connecting Input Signal Lines to Be Measured and External Input Terminals

● Connection of Input Signal Lines to Be Measured and External Input Terminals (Example)



⚠ WARNING

- Thoroughly read Section 3.3, "Precautions for Wiring the Circuit Under Test."
- When wiring the CW140, turn off the circuit under test.
It is extremely dangerous to connect or disconnect measuring lead wires without turning off the circuit under test.
- Be extremely careful not to connect any voltage-mode circuit to the current input terminals or any current-mode circuit to the voltage input terminals. Miswiring can result in not only damage to the circuit or equipment under test but also an injury to personnel.
- The CW140 can be connect to a maximum of four voltage input probes or four current-sensing clamps. Do not connect any probe or clamp that is not necessary for measurement.
- Do not use any other probes or current-sensing clamps than those supplied with the CW140.
- Before connecting a current-sensing clamp to the CW140, make sure the H and L polarities are correctly identified.

● Differentiating among Voltage Input Probes and among Current-sensing Clamps

- Voltage Input Probes

Probe for Input terminal N: Black (one)

Probes for Input terminals V1 to V3: Three different colors: Red, Yellow and Blue.

- Current-sensing Clamps

Clamps for Input terminals CH1 to CH4: Differentiated by ring markers of four different colors

2.3 Connecting Input Signal Lines to Be Measured and External Input Terminals

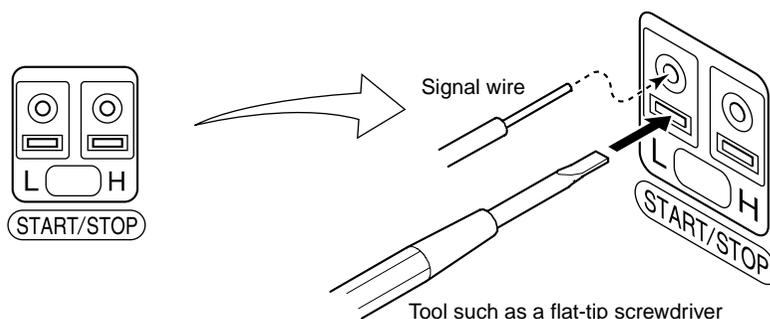
● Use of Ring Markers (Standard Accessories)

Attach ring markers of the same color to both the terminal connection side and alligator clip side of a voltage input probe or to both the terminal connection side and clamping side of a current-sensing clamp. This enables you to differentiate between the input signal lines.

CAUTION

Be careful not to damage a probe when attaching ring markers.

● Connection of External I/O Terminals



● Connection Procedure

Insert the signal wire into the hole while pressing the rectangular area at the bottom of the external I/O terminal using such a tool as a flat-tip screwdriver. Removing the screwdriver from the terminal fixes the signal wire in place.

CAUTION

- Do not apply voltages outside the allowable input voltage range (-0.5 to 5.5 V), otherwise the input circuit may be damaged.
- When wiring the CW140, be careful not to mistake an input terminal for an output terminal.

● Applicable Signal Wires

Standard wire: ϕ 1.0 single-core wire (AWG18) or 0.75 mm² stranded wire

Adaptable wire: ϕ 0.4 to 1.0 single-core wire (AWG26 to 18) or 0.35 to 0.75 mm² stranded wire (AWG22 to 20) with a minimum strand diameter of 0.18 mm; typical length of stripping = 10 mm

● Applied Terminals

LOGIC INPUT: Event input terminals (receive ON/OFF signals from equipment under test)

START/STOP: Terminals for inputting signals informing the start and end of logging, integration or demand measurement.

D/A OUTPUT: Terminals for D/A conversion output (optional)

2.4 Overrange and Other Marks Shown during Measurement

● Overrange Indications during Measurement

I_{ovr}: Conditions for current overrange indication

This mark appears if the sampled value exceeds 300% of the rated current range or if the rms value of the measured current exceeds 110% of the rated range. If a fixed range is used, step up the range.

V_{ovr}: Conditions for voltage overrange indication

This mark appears if the sampled value exceeds 300% of the rated voltage range or if the rms value of the measured voltage exceeds 110% of the rated range. If a fixed range is used, step up the range.

TIP

- The current overrange mark **I_{ovr}** appears if an input signal to one of the terminals CH1 to CH4 satisfies the conditions noted above.
 - The voltage overrange mark **V_{ovr}** appears if an input signal to one of the terminals V1 to V3 satisfies the conditions noted above.
-

Indication of Overrange Marks When Auto-ranging Is Used

The CW140 steps up or down the range, as discussed in Section 7.3, "Ranges and Number of Digits." Then, the CW140 shows the **I_{ovr}** or **V_{ovr}** mark if the conditions noted above become true under the maximum range.

Indication of OR Symbol

The CW140 shows the OR symbol, instead of a usual four-digit value, if the result of measurement (calculation) satisfies the conditions noted above. (If a fixed range is used, step up the range.)

Indication of OR Symbol When Auto-ranging Is Used

The CW140 steps up or down the range, as discussed in Section 7.3, "Ranges and Number of Digits." Then, the CW140 shows the OR symbol if the conditions noted above become true under the maximum range.

WARNING

The CW140 shows an overrange mark under the maximum range only if the input level exceeds the maximum allowable input level. Do not apply any input level higher than the maximum allowable input level.

CAUTION

When measuring an input signal level exceeding the rated range, use a voltage transformer (VT) or a current transformer (CT) - scaling function. When using a VT or CT, thoroughly read Section 3.5, "Wiring the Circuit under Test Using External VT/CT."

- **Frequency-related Overage Indications**

Normal measurement: The measurement range is from 45 Hz to 1 kHz.

The display shows "----" if the input signal is below 40 Hz or above 1.2 kHz.

Three-phase unbalance factor measurement:

The measurement range is from 45 to 440 Hz.

The display shows "----" if the input signal is below 40 Hz or above 440 Hz.

Harmonics measurement: The measurement range is from 45 to 65 Hz.

The display shows "----" if the input signal is below 40 Hz or above 70 Hz.

- **Indications When the Measured Value Is Too Small**

If either a voltage or current input level is below 0.4% of the rated range, the CW140 gives the readings noted below. If a fixed range is used, step down the range.

Reactive power 2 and apparent power: Read zero (0).

Power factor and phase angle: Read as "----".

If the level of active power or reactive power is below 0.7% of the rating, the reading is displayed as shown below.

Active power or reactive power: Read zero (0). The integration stops.

In harmonics measurement, the display reads as shown below if the input level of a frequency-measuring device is below 10% of the rated range.

All measurement data items: Read as "----".

If the voltage, current or power harmonic content in harmonics measurement is below 0.1%, the phase angle of a harmonic component of that order reads as "----".

TIP

Even if the instantaneous value overrange occurs and the OR symbol appears in the electric energy measure mode, the integration processing continues. In this case, the level of accuracy of the on-screen integrated value may become inaccurate (about two times) that of the rated accuracy.

NOTE

If continuous measurement (logging, integration, or demand) is performed when in AUTO range, the range will be fixed to the value when the START&STOP key is pressed.

2.4 Overrange and Other Marks Shown during Measurement

● Other Marks



Screen View

| | |
|---|---|
| DEM, OVER | : Appears if the demand exceeds the reference power level. |
| SCAL | : Denotes the scaling function. |
| Var | : Appears if either the VT or CT ratio is set at a value other than 1. |
| HOLD | : Appears when display hold is enabled. |
| Iovr | : Appears when a current overrange occurs. |
| Vovr | : Appears when a voltage overrange occurs. |
|  | : Appears when the CW140 is configured so that data is stored in internal memory. |
|  | : Appears when the CW140 is configured so that data is stored on a floppy disk. |
|  | : Appears when the CW140 is configured so that data is output to a printer. |
|  | : Appears when the battery becomes low (low-battery mark). |
|  | : Appears when an AC adapter is used. |
|  | : Appears when the CW140 is in a key lock state. |

TIP

- The Floppy Disk mark is only effective if an optional external floppy disk drive is used.
 - The Printer mark is only effective if an optional external printer is used.
 - The Low-Battery mark appears if either an optional NiMH battery pack or alkaline batteries are used.
 - The  (Low-Battery mark) and  (AC Adapter mark) indications share the same position of view on the display.
-

3.1 Handling Precautions

If you are a first-time user, be sure to read "Precautions for Safe Use of the Instrument" on pages 4 and 5.

- **Do not place any load on the instrument.**

Do not place any other equipment of a vessel filled with water on the instrument. Otherwise, the instrument may become defective.

- **Moving the instrument**

Before moving the instrument, make sure the power cord and all other cables are disconnected. When moving the instrument, hold it with both hands.

- **Input Terminals**

Do not bring any electrified substance close to the signal terminals. Otherwise, the internal circuitry may be destroyed. Do not apply any mechanical shock to the signal terminals. Otherwise, such impact may be transformed into electrical noise and input to the instrument.

- **Protection of Case and Operation Panel**

Do not spray any volatile chemical on the case or operation panel. Do not leave any rubber or vinyl product in contact with the instrument for a prolonged period. Otherwise, the instrument may be discolored or deformed.

- **Cleaning**

When cleaning the case and/or operation panel, disconnect the power cord from the outlet. Then, wipe the surfaces of the case and/or operation panel with a soft clean cloth. Do not use chemicals such as benzine or paint thinner. Otherwise, the instrument may be discolored or deformed.

- **Display Screen**

When the instrument is shipped from the factory, the display screen is covered with a protective film. Remove the film before you begin using the instrument.

The LCD backlight lasts a approximately 10,000 hours when kept turned on at room temperature. If it is used longer than that period, the brightness may drastically decrease. If this occurs, the backlight needs to be replaced. Contact the vendor from which you purchased the instrument.

3.1 Handling Precautions

- **After Use**

After use, disconnect the power cord from the outlet.

- **Long Absence of Use**

If the instrument will not be used for a prolonged period, remove the batteries (AA-size alkaline batteries or NiMH battery pack) from the instrument.

Precautions for Use of the Clamp

CAUTION

- The clamping CT (current transformer) is precision assembled to ensure high performance. When using the clamp, do not apply any intense mechanical shock, vibration or force to the clamping CT.
 - If dust or any other foreign matter gets in the clamping CT, do not shut the clamping cores tight. First remove the dust and then make sure the clamping cores on both sides close smoothly.
-
-

3.2 Installation Procedure

Install the instrument in a location that satisfies the following conditions.

- **Ambient Temperature and Humidity**

- Ambient temperature: 5°C to 40°C
- Ambient humidity: 35 to 80% RH (no condensation)

- **Operating altitude**

2000m max. above sea level

- **Level Location**

Do not install the instrument in an unstable or inclined location. Otherwise, this may result in the failure to obtain precision measurements.

- **Do not install the instrument in a location that is:**

- exposed to direct sunlight or close to a heat source;
- close to such a noise source as high-voltage equipment or a motive power supply;
- exposed to a relatively large amount of lampblack, steam, dust or corrosive gas;
- exposed to frequent mechanical vibration;
- close to a source of strong electromagnetic fields; or
- unstable.

3.3 Precautions for Wiring the Circuit under Test

WARNING

- When wiring the instrument or the instrument is turned off, turn off the circuit under test. It is extremely dangerous to connect or disconnect measuring lead wires without turning off the circuit under test.
- Be extremely careful not to connect any voltage-mode circuit to the current input terminals or any current-mode circuit to the voltage input terminals. Miswiring can result in not only damage to the circuit or equipment under test but also an injury to personnel.
- Do not apply any input level higher than the following to the voltage or current input terminals.
 - Maximum allowable input (continuous)

| | | |
|----------------|------------|-----------------|
| Voltage input: | 600 Vrms | |
| Current input: | 250 Arms | Clamp A (96030) |
| | 625 Arms | Clamp C (96031) |
| | * 700 Arms | Clamp B (96032) |

* Refer to Section 19.2, "Specifications of Current Clamps" for details.

In addition to the maximum allowable input, the rated input levels are specified as shown below.

| | | |
|------------------|------------------------|-----------------|
| Voltage ratings: | 150, 300 and 600 V | |
| Current ratings: | 20, 50, 100 and 200 A | Clamp A (96030) |
| | 50, 100, 200 and 500 A | Clamp C (96031) |
| | 200, 500 and 1000 A | Clamp B (96032) |

- If using an external VT (voltage transformer) or CT (current transformer), make sure the transformer can adequately withstand the voltage being measured.
- Be careful not to allow the secondary stage of the CT to become open-circuited while the CT is being electrified. Otherwise, a high-voltage may develop on the secondary stage, causing extreme danger.
- The maximum allowable input voltage range of the external input terminals (external control input and event input terminals) is specified as -0.5 to 5.5 V.
Do not apply voltages exceeding this range, otherwise the input circuitry may be damaged.
(When wiring the input terminals, be careful not confuse them with the optional D/A output terminals.)
- Do not use any probes or clamps other than those voltage input probes or dedicated clamps supplied together with the CW140.
- Do not use a clamp with any non-insulated conductors.

TIP

After wiring the CW140, it is necessary to perform setting/operation for the wiring method using the WIRING key.

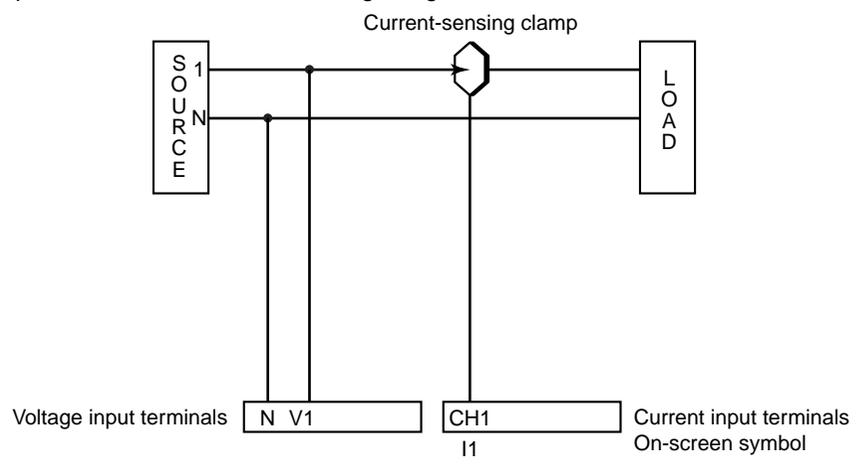
SEE ALSO

Section 7.1, "Wiring," for details on how to set the wiring method.

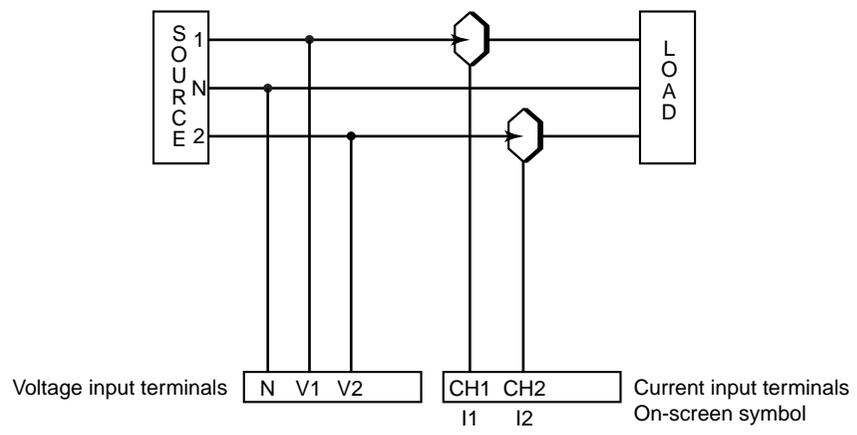
3.4 Diagrams of Basic Wiring

This section explains the methods of basic wiring using illustrations.

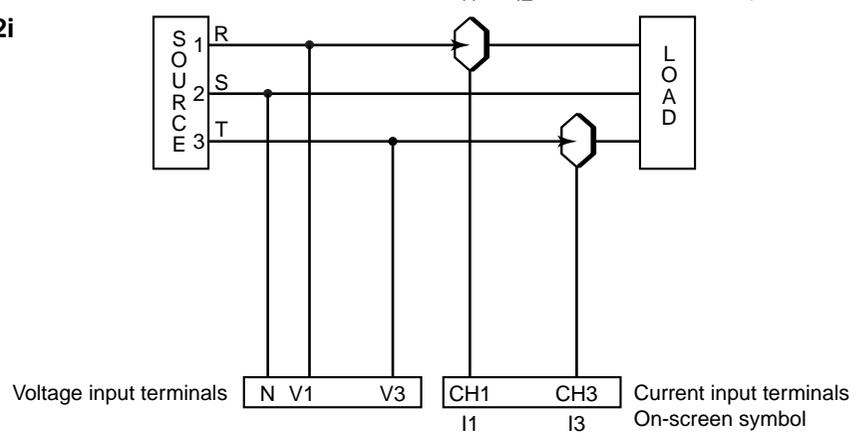
(1) 1 ϕ 2W



(2) 1 ϕ 3W



(3) 3 ϕ 3W2i

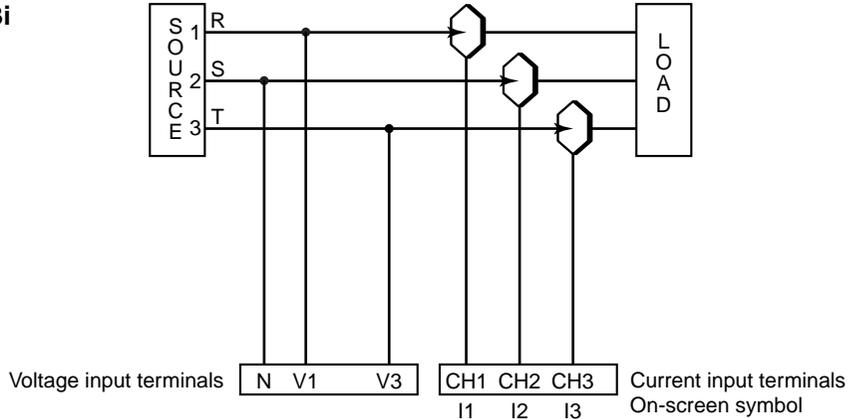


TIP

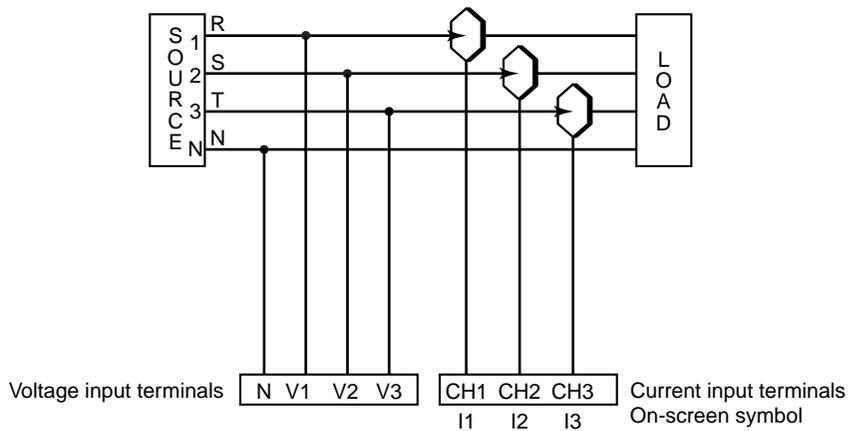
In the case of a current-sensing clamp, the symbol of a current input terminal shown on the CW140 main unit differs from that shown on the display, as indicated in the figures above.

3.4 Diagrams of Basic Wiring

(4) 3 ϕ 3W3i

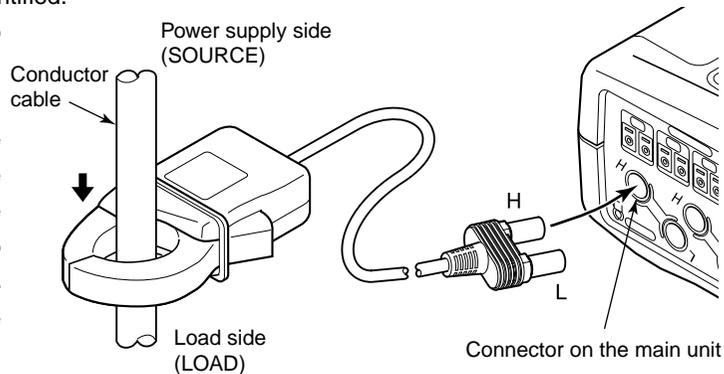


(5) 3 ϕ 4W



When connecting the current-sensing clamp, make sure the following polarities and clamp position are correctly identified.

- 1 When connecting to the CW140 main unit: H and L polarities
- 2 The clamp should be positioned in the direction from the power source side to the load side, as indicated by the arrow.

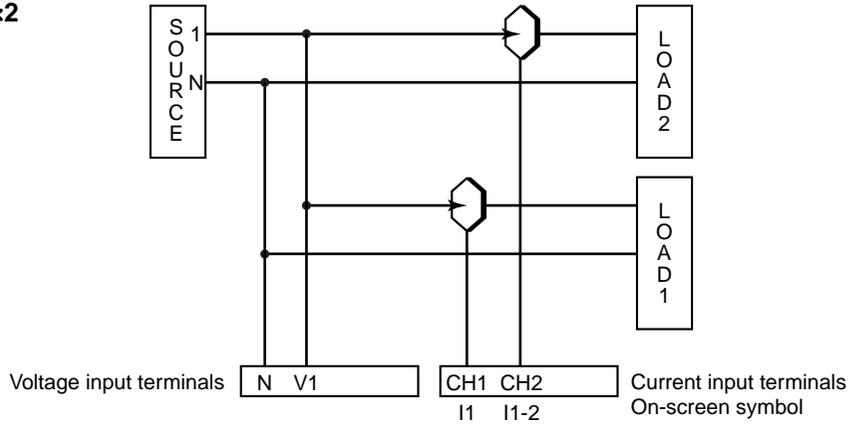


⚠ WARNING

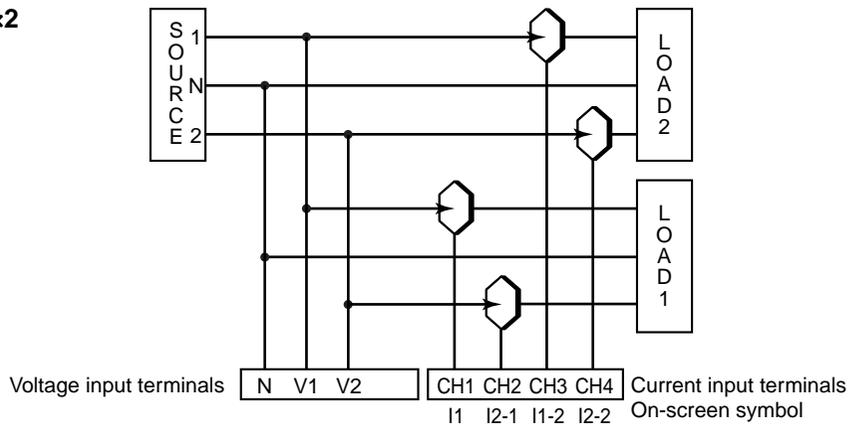
In addition to using the checking wiring function, be sure to verify the actual wiring connections.

- 2-system load -

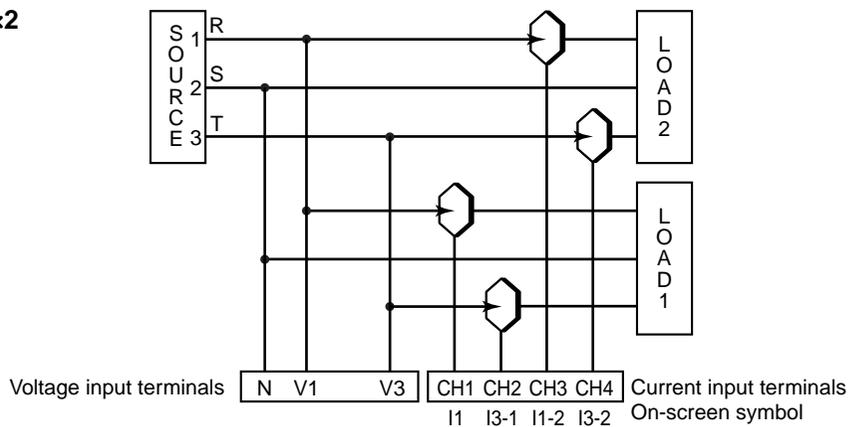
(6) $1\phi 2W \times 2$



(7) $1\phi 3W \times 2$



(8) $3\phi 3W \times 2$



3.5 Wiring the Circuit under Test Using External VT/CT

WARNING

- When using an external CT, be careful not to allow the secondary stage of the CT to become open-circuited while the primary stage is being electrified. Otherwise, a high voltage may develop on the secondary stage, causing extreme danger.
- The current under test flows through the bold lines shown in the figure below. For these lines, use wire that has an adequate margin of current-carrying capacity.

If the maximum voltage or current level being measured exceeds the maximum measurement range of the CW140, use an external VT and/or CT. This strategy enables the measurement of voltage or current levels above the maximum range.

If the maximum voltage level exceeds 600 V, attach an external VT. Then, connect the secondary stage of the VT to the voltage input terminals.

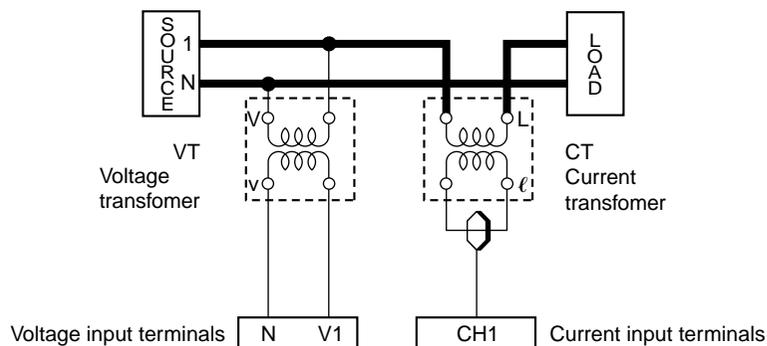
If the maximum current level exceeds the following value, attach an external CT. Then, connect the secondary stage of the CT to the current-sensing clamp.

200 A, when clamp A (20, 50, 100 and 200 A) is used

500 A, when clamp C (50, 100, 200 and 500 A) is used

1000 A, when clamp B (200, 500 and 1000 A) is used

Example of 1 ϕ 2W



TIP

- The CW140 can show the primary stage value even if the scaling function is applied using VT/CT.

SEE ALSO

Section 7.7, "Scaling Function," for details on how to use VT/CT.

- The lowest current range of the CW140 main unit itself is 20 A on full scale and the accuracy also depends on this value. Note therefore that if a CT is used and its secondary output is too small when compared with 20 A, then the error ratio will become higher.

3.6 Connecting a Power Supply and Turning It On/Off

The CW140 can be operated with the following three types of power supply.

- Six AA-size alkaline batteries
- AC power supply through an AC adapter (standard accessory)
Part number: 788011 Yokogawa's AC adapter
- Rechargeable NiMH battery pack (optional accessory)
part number: 94004

Using AA-size Alkaline Batteries

Alkaline Batteries: "AA"-size [LR6], 1.5V

● Handling Precautions

Observe the following cautionary notes when handling alkaline batteries.

WARNING

- Install the alkaline batteries with the positive and negative polarities correctly positioned, otherwise the battery fluid may leak or the batteries may explode.
- Do not disassemble the batteries, heat them, or throw them into a fire.
- Do not short-circuit the batteries.
- Do not attempt to recharge the batteries.
- Do not solder the batteries.
- When replacing the batteries, replace all of the six units at one time with new ones from the same manufacturer. (Do not use manganese batteries as replacements.)
- If the instrument will not be used for a prolonged period, remove the batteries.

● Operating Hours of Alkaline Batteries

The operating hours of an alkaline battery vary depending on its operating environment and conditions. Refer to the following information.

Operating Hours: Approx. 3 hours

Operating Conditions: The LCD backlight is turned off and no floppy drive is connected.

3.6 Connecting a Power Supply and Turning It On/Off

NOTE

- If the voltage of an alkaline battery falls below a given level, the  mark appears in the upper-right corner of the display (low-battery state). If you continue to operate the CW140 in this state, the meter automatically turns off.
- If the low-battery mark appears during measurement, change the power supply to an AC source. Wait until the CW140 finishes or aborts measurement and therefore is ready for shutdown, before replacing the batteries with new ones.

● Procedure for Replacing Alkaline Batteries

Follow the steps below to replace alkaline batteries.

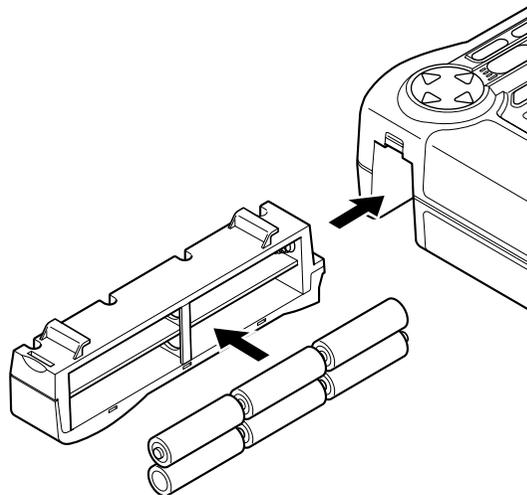
1. Make sure the power switch on the CW140 is turned off and no AC adapter is connected.
2. Remove the battery holder on the back of the CW140.
3. Place six new alkaline batteries in the battery holder.

SEE ALSO

The figure given below.

House the batteries with the positive and negative polarities of each battery positioned correctly.

4. Hold the battery holder so that the battery connector on the CW140 correctly mates with the battery holder connector. Then, slide the battery holder into the slot on the CW140 with the holder's two guides engaged in the groove of the slot. Finally, make sure both connectors are precisely mated with each other.
5. Push down the lock switch on one side of the CW140 to fix the battery holder in place.
(The label changes to "ΔFREE".)



Using the AC Adapter (Standard Accessory)

● Handling Precautions

There is a danger of electrical shock or damage to the meter. Observe the following cautionary notes when handling the AC adapter.

WARNING

- Only use the manufacturer-supplied dedicated power cord.
 - Before connecting the power cord, make sure the power-source voltage matches the supply voltage rating of the AC adapter.
 - Before connecting the power cord, also make sure the power switch on the CW140 is turned off.
 - If the CW140 is not to be used for a prolonged period, disconnect the power cord from the outlet.
 - Do not use any other AC adapter than the one (part number: 788011) dedicated to the CW140.
 - Do not place any load on the power cord or allow the power cord to come into accidental contact with any heat source.
 - Be sure to hold the plug of the power cord, rather than holding and pulling the cord itself, when disconnecting it from the outlet.
-
-

3.6 Connecting a Power Supply and Turning It On/Off

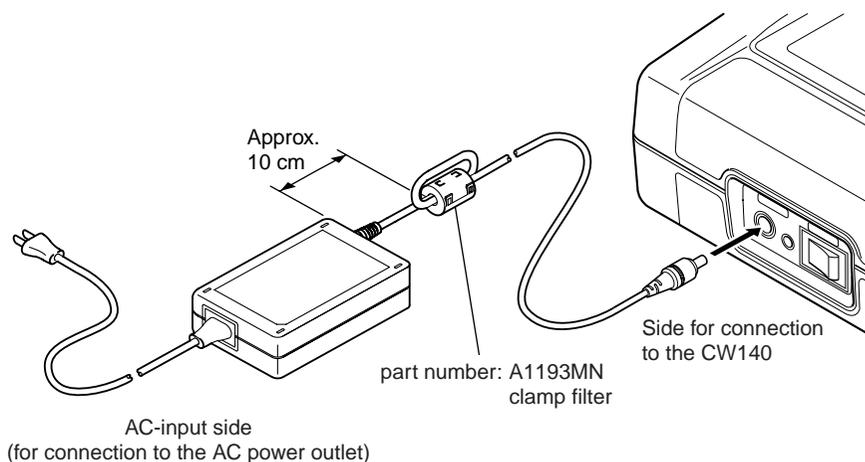
● Procedure for Connecting the AC Adapter

Follow the steps below to connect the AC adapter.

1. Make sure the power switch on the CW140 is turned off.
2. Attach the clamp filter supplied together with the AC adapter to the output-side cable of the power cord.

SEE ALSO

The figure given below.



3. Connect the AC adapter plug to the AC adapter jack of the CW140.
4. Connect the plug of the power cord supplied together with the AC adapter to the power supply connector of the AC adapter.
5. Connect the other end of the power cord to a power outlet that satisfies the power ratings (requirements) shown below.

Power Ratings of AC Adapter

| | |
|---|-----------------|
| Supply voltage rating | 100 to 240 V AC |
| Allowable supply voltage range | 90 to 264 V AC |
| Power supply frequency rating | 50/60 Hz |
| Allowable power supply frequency range | 48 to 62 Hz |
| Maximum power consumption | 70 to 90 VA |
| Output voltage rating of AC adapter | 12 V DC |
| Maximum output current rating of AC adapter | 2.6 A |

Using a NiMH (Nickel-Hydrogen) Battery Pack (Optional Accessory)**● Handling Precautions**

Observe the following cautionary notes when handling the dedicated NiMH battery pack.

Specifications

Voltage : 7.2V

Capacity : 2100mAh

Number of times can be changed (life cycle) :

Approx. 300times (varies with the operating environment)

 WARNING

- Since the electrolyte solution inside the battery pack is alkaline, it may damage any clothing or skin it comes into contact with due to a leakage from or rupture in the battery pack. In particular, if the solution enters an eye it may cause loss of eyesight. Therefore in such a case, thoroughly wash the affected eye with clean water immediately. Then, receive treatment from a doctor right away.
- When replacing the NiMH battery pack, be sure to turn off the power switch of the CW140 meter and remove the power cord from the outlet to avoid possible danger, such as a short in the electric circuit or electrical shock.
- Do not use any other battery pack than the manufacturer-supplied NiMH battery pack (part number: 94004).
- Do not leave the NiMH battery pack in a place that is subject to strong direct sunlight, inside a vehicle under a blazing sun, or near a fire. Doing so may cause a solution leakage, or deterioration in the performance and/or the service life of the battery pack.
- Do not disassemble or modify the battery pack. Doing so may damage the protective properties of the battery pack and cause it to heat up and rupture.
- Do not short the battery electrodes, as this may cause burns due to the battery pack heating up.
- Do not place the battery pack into a fire or apply heat to it. Doing so is dangerous, as there is a risk that it will rupture, scattering electrolyte solution.
- Do not apply excessive shock to the battery pack, for example, by throwing it. Doing so may cause solution leakage, battery pack heating, or a rupture.
- Refrain from using a defective battery pack, such as one with leaking solution, a deformation, discoloring or any other abnormality.
- Avoid any metal coming into contact with the battery pack when carrying it, as there is the danger of a short occurring.
- Do not immerse the battery pack in water or make it wet, as this may cause it to heat up or rust, as well as lead to a loss of functions.
- If the battery pack is not used for a prolonged period, remove it from the CW140 main unit and store it in the following environment:

| | |
|-------------------------------------|--|
| Storage period of 1 year or less: | Temperature of -20°C to 35°C (in a place with low humidity) |
| Storage period of 3 months or less: | Temperature of -20°C to 45°C (in a place with low humidity) |

3.6 Connecting a Power Supply and Turning It On/Off

● Procedure for Installing the NiMH Battery Pack

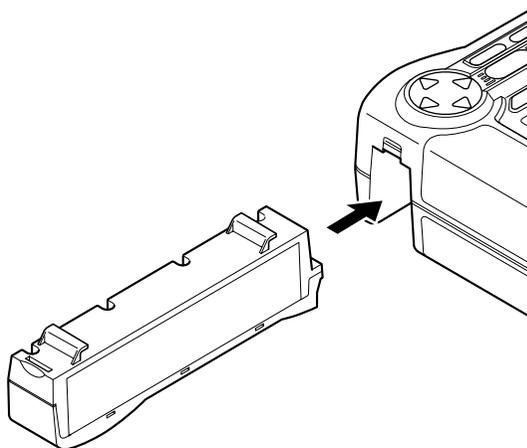
Follow the steps below to install the dedicated NiMH battery pack.

1. Make sure the power switch on the CW140 is turned off.
2. If the AC adapter is in use, disconnect the power cord of the AC adapter from the outlet.
3. If alkaline batteries are in use, remove them from the battery holder and install the NiMH battery pack.
4. Hold the battery holder so that the battery connector on the CW140 correctly mates with the battery holder connector. Then, slide the battery holder into the slot on the CW140 with the holder's two guides engaged in the groove of the slot. Finally, make sure both connectors are precisely mated with each other.
5. Push down the lock switch on one side of the CW140 to fix the battery holder in place.

(The label changes to "ΔFREE".)

SEE ALSO

The figure given below.



● Recharging the NiMH Battery Pack

The optional dedicated NiMH battery pack is not fully charged when shipped from the factory. Before use, recharge the battery pack to its full level. When recharging it, use the AC adapter.

WARNING

- When recharging the NiMH battery pack, be sure to do so through the CW140 main unit.
 - When recharging the NiMH battery pack, keep the ambient temperature within the range from 10°C to 35°C. Recharging the battery pack outside this range may result in an insufficient amount of charge, solution leakage, or battery heating.
-
-

● Procedure for Recharging the NiMH Battery Pack

Follow the steps below to recharge the NiMH battery pack.

1. With the battery pack installed as instructed earlier, connect an AC adapter to the CW140.
2. At this point, keep the power switch on the CW140 turned off. The LED indicator beside the AC adapter jack comes on, indicating that the battery pack is being recharged. When recharging is complete, the LED indicator flashes rapidly.

NOTE

If the power switch on the CW140 is turned on, the NiMH battery pack is not recharged. In that case, the CW140 is powered from the AC adapter.

3.6 Connecting a Power Supply and Turning It On/Off

TIP

- The CW140 is in a wait-for-recharge state when the LED indicator is flashing slowly (lit for approximately one second when on). The meter falls into this state when:
 - the ambient temperature is outside the range from 10°C to 35°C;
 - the battery performance is remarkably low due to over-discharge or for other reasons; or
 - the NiMH battery pack is not installed yet.
 - The LED indicator flashes rapidly if:
 - the battery temperature rises above 55°C, or
 - the ambient temperature changes drastically,indicating that the battery pack has been recharged to its full level.
However in practice, the battery pack may not have been recharged completely for some reason.
-

● Indication that Recharge Is Required



NOTE

- If the voltage of the NiMH battery pack falls below a given level, the  mark appears in the upper-right corner of the display (low-battery state). If you continue to operate the CW140 in this state, the meter automatically turns off.
 - If the low-battery mark appears during measurement, change the power supply to an AC source. Wait until the CW140 finishes or aborts measurement and therefore is ready for shutdown, before replacing the batteries with new ones.
-
-

● Operating Hours of NiMH Battery Pack

The operating hours of an NiMH battery pack vary depending on its operating environment and conditions. Refer to the following table.

Operating Hours: Approx. 7 hours

Operating Conditions: The LCD backlight is turned off and no floppy drive is connected.

● Service Life of NiMH Battery Pack

The NiMH battery pack can be recharged approximately 300 times, though the frequency depends on its operating environment. The life of the battery pack is over if the low-battery mark appears soon after the battery pack has been fully recharged. Replace the battery pack with a new one.

Startup Screen

When you turn on the power switch on the CW140 main unit, the display successively presents the screens described in paragraphs (1) and (2) below.

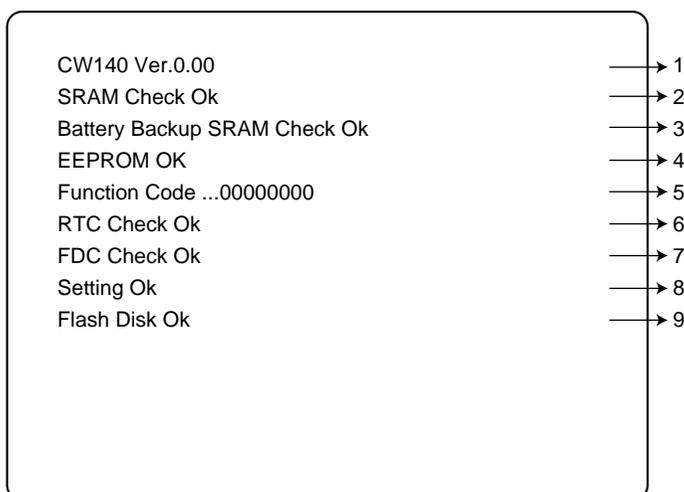
(1) Model Name Screen

The CW140 first shows such a screen as illustrated on the right, then performs a self-test.



(2) Message Screen

- 1 Indication of the model name and version
- 2 Result of SRAM test
- 3 Result of backup SRAM test
- 4 Result of EEPROM
- 5 Indication of function code
- 6 Result of RTC (real-time clock) test
- 7 Result of floppy disk controller test
- 8 Result of checking setup data
- 9 Result of internal flash memory disk test



NOTE

If an error is found with any of the tests shown on the Message screen discussed in paragraph 2 above, the CW140 shows information about that error.

See Section 18.1, "Corrective Actions in Case of Failure," for more information.

3.7 Performing Measurements with Higher Precision

To perform measurements with higher precision, use the CW140 under the following environmental conditions.

Ambient temperature: $23 \pm 5^{\circ}\text{C}$

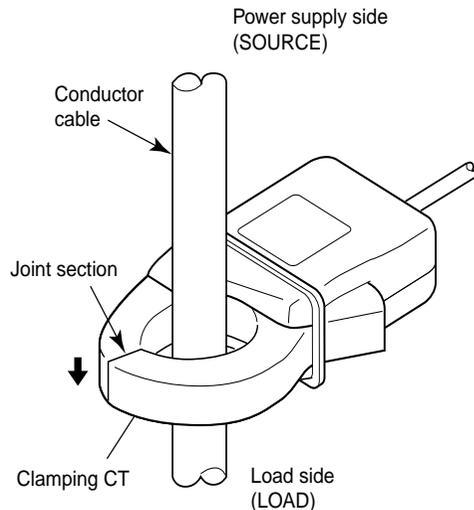
Ambient humidity: 35 to 75% RH (no condensation)

If installing the CW140 in a location where the ambient humidity is 30% or less, use such equipment as an anti-static mat to prevent electrostatic discharge.

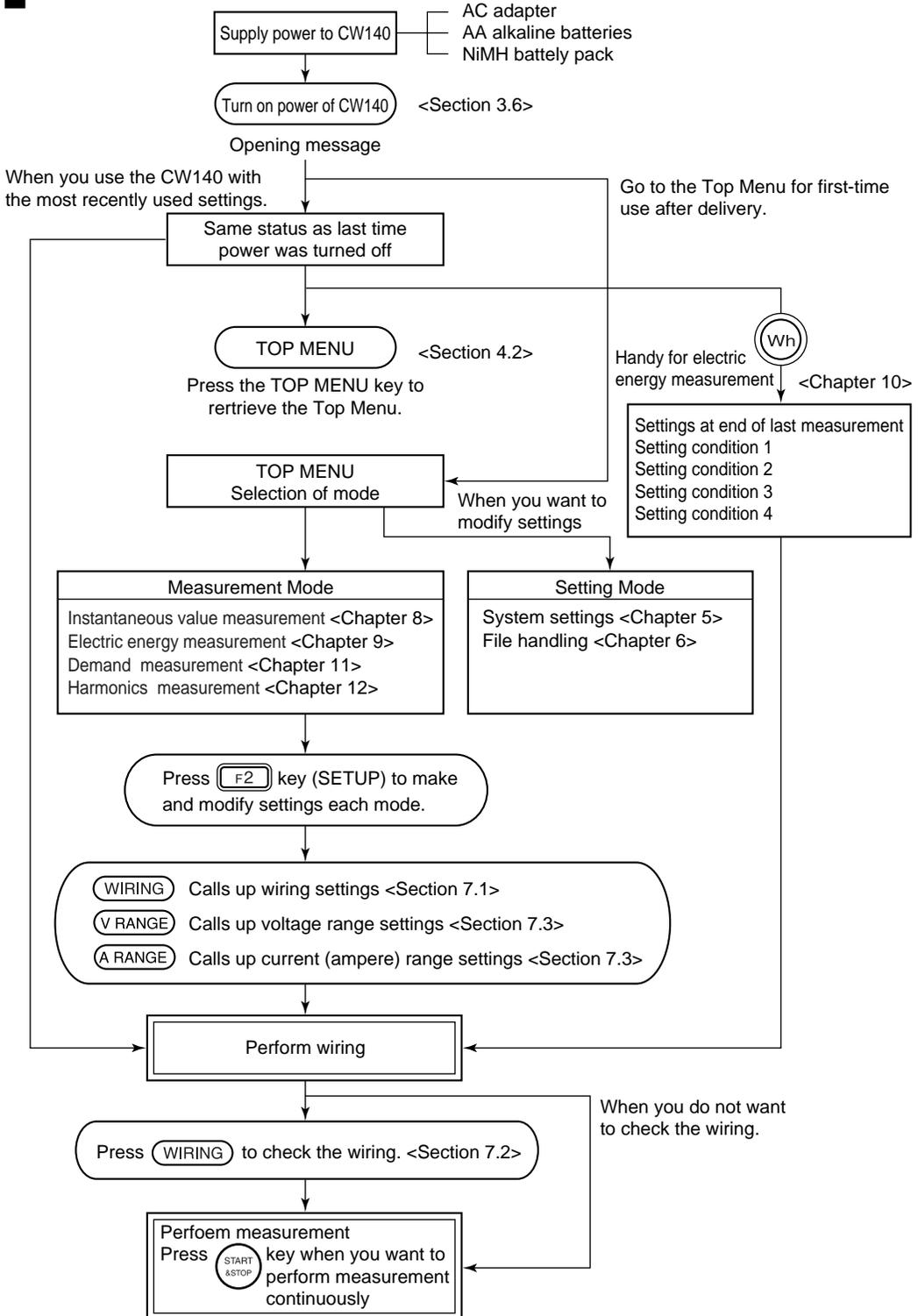
If you move the CW140 from an area of low temperature and humidity to an area of high humidity and temperature or if there is a sudden change in the ambient temperature, condensation may occur in the meter. If this happens, let the meter stand still for at least one hour to allow it to adapt to the new ambient temperature and for condensation to dissolve. Then, begin operating the meter.

● Relationship between Clamp and Conductor

- 1 When performing a measurement, hold the clamp-on probe so that the conductor cable runs through the center of the clamping CT.
- 2 Ensure that the orientation of the clamp to the direction of the conductor cable (from the power supply to the load) is correct, as shown on the right.
- 3 Ensure that the clamping CT is properly closed.



4.1 Basic Operation Flow



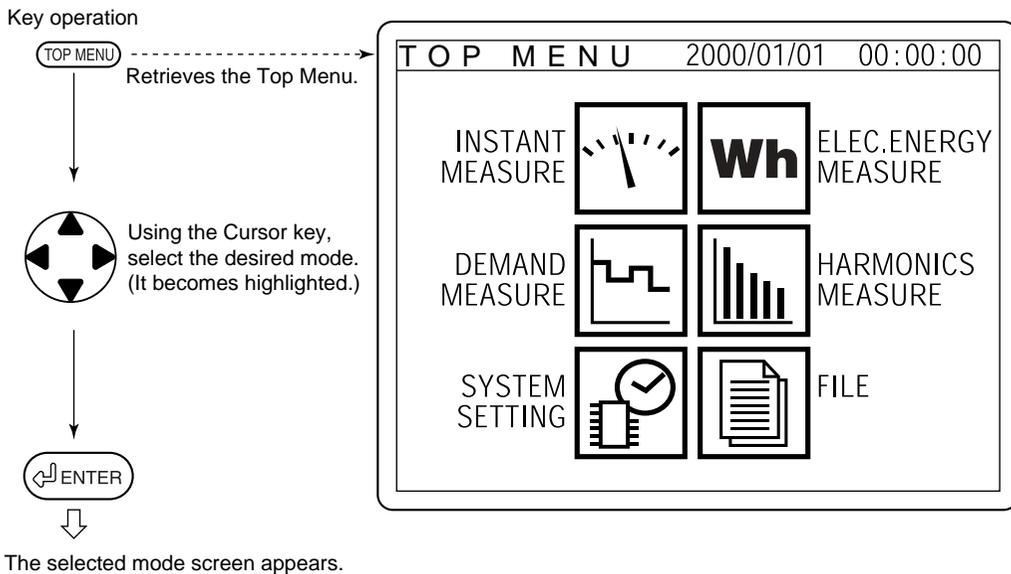
4.2 Top Menu Screen

The Top Menu is used to select measurement and setting modes. Press the  key to retrieve the Top Menu.

● Modes Displayed on Top Menu

| Measurement Mode | See | Setting Mode | See |
|---------------------------------|------------|-----------------|-----------|
| Instantaneous value measurement | Chapter 8 | System settings | Chapter 5 |
| Electric energy measurement | Chapter 9 | File handling | Chapter 6 |
| Demand measurement | Chapter 11 | | |
| Harmonics measurement | Chapter 12 | | |

● Top Menu Display and Selecting Modes



TIP

You can also use the  key to select the electric energy mode.

5.1 System Settings

This section describes system settings, including calculation selection, auxiliary function settings, and RS-232-C settings. Each setting has been set to the default value before shipment and should be changed as required.

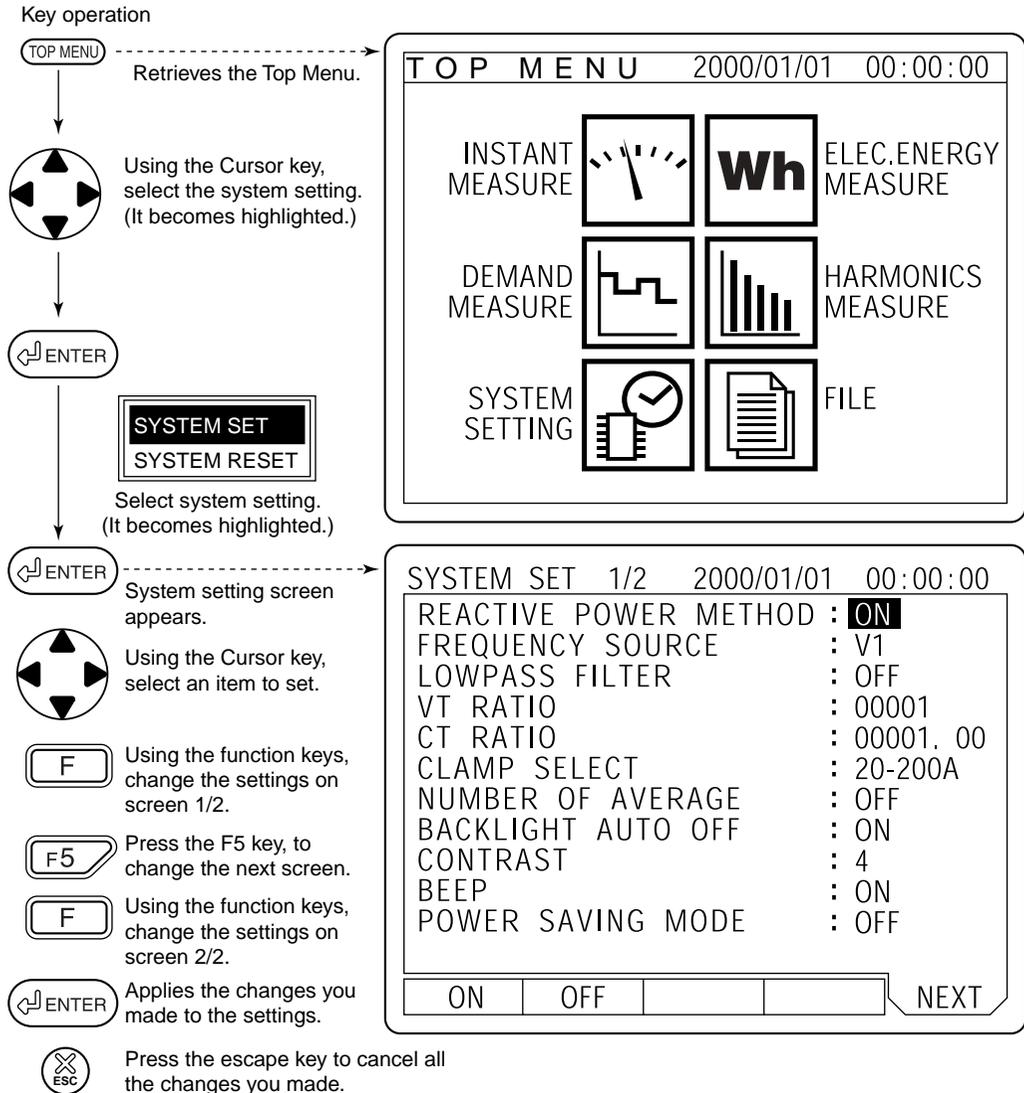
● **Screen Configuration**

The System Setting screen consists of 2 pages, pages 1/2 and 2/2.

SEE ALSO

For the contents of each screen and setting details, see Table "System Settings" on pages 5-2 and 5-3.

● **Basic Operation for Setting/Modification**



5.1 System Settings

System Settings 1/2

| Screen | Item | Items to be selected | See also | Default |
|-------------------------|---|--|---|--------------------------------|
| 1/2 | Reactive power method |  ON (The method is used)  OFF (The method is not used) | Section 8.6, "Computational Expressions" | OFF: The method is not used |
| | Frequency source |  To be changed → Displays the selectable items in the center of the screen.  Select the desired setting.  | Section 7.5, "Frequency Measurement and Low-pass Filters" | V1 |
| | Low-pass filter (Frequency measurement) |  ON (Selected)  OFF (Not selected) | Section 7.5, "Frequency Measurement and Low-pass Filters" | OFF |
| | VT ratio (Ratio of voltage transformation) | Set to a value within 1 to 10,000.  Move to the digit to be changed.  +  - Input values. | Section 7.7, "Scaling Function" | 1 |
| | CT ratio (Ratio of current transformation) | Set to a value within 0.01 to 10,000.  Move to the digit to be changed.  +  - Input values. | Section 7.7, "Scaling Function" | 1 |
| | Clamp selection |  Clamp A (20–200 A)  Clamp B (200–1000 A)  Clamp C (50–500 A) | | 20–200 A Clamp A |
| | Number of averaging cycles |  + OFF → 2 → 3 → ... 10 → OFF  - OFF → 10 → 9 → ... 2 → OFF | Section 7.6, "Averaging Function" | OFF (Not used) |
| | Backlight (LCD) auto-off when |  ON (Auto-off when no key action is performed for 10 minutes)  key is ON  OFF (Not used) | Section 17.1, "Auxiliary Functions" | ON |
| | Contrast (LCD) | Adjusts LCD's contrast (1 to 8).  + Input values.  - | Section 17.1, "Auxiliary Functions" | 4 |
| | Beep |  ON (Beeps for every key action)  OFF (Not used) | Section 17.1, "Auxiliary Functions" | ON |
| Power-saving mode (LCD) |  ON (Used)  OFF (Not used) | Section 17.1, "Auxiliary Functions" | OFF | |

System Settings 2/2

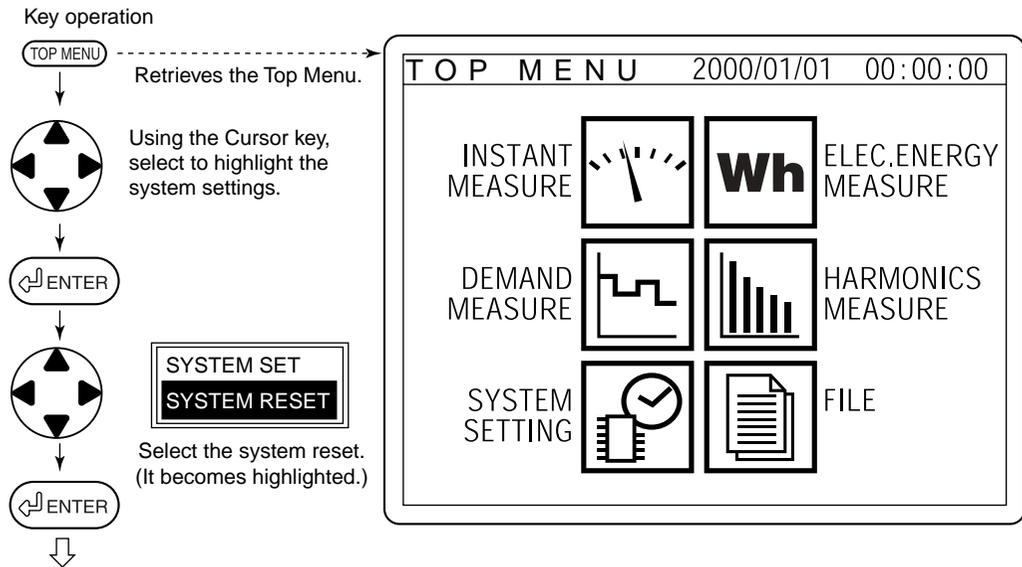
| Screen | Item | Items to be selected | See also | Default | | | | | | | | | |
|-------------|--|--|--|----------|---------|---------|----------|----------|--|--------|-------|-------|-------------------------------------|
| 2/2 | RS-232C settings | Printer PC | Section 17.3, "Optional Printer" | PC | | | | | | | | | |
| | Connected instrument | | | | | | | | | | | | |
| | Baud rate | To be changed → Displays the selectable items in the center of the screen. Select to highlight the desired setting. 1200/2400/4800/9600/19200 bps | Section 15.1, "RS-232C Interface Specifications" | 9600 bps | | | | | | | | | |
| | Data length | 7 8 | Section 15.1, "RS-232C Interface Specifications" | 8 | | | | | | | | | |
| | Parity | None Odd Even | Section 15.1, "RS-232C Interface Specifications" | None | | | | | | | | | |
| | Stop bit | 1 bit 2 bit | Section 15.1, "RS-232C Interface Specifications" | 1 bit | | | | | | | | | |
| | Busy control | <table border="0"> <tr> <td>For printer</td> <td>For PC</td> </tr> <tr> <td> OFF/OFF</td> <td> OFF/OFF</td> </tr> <tr> <td> XON/XOFF</td> <td> XON/XOFF</td> </tr> <tr> <td></td> <td> XON/RS</td> </tr> <tr> <td> CS/RS</td> <td> CS/RS</td> </tr> </table> | For printer | For PC | OFF/OFF | OFF/OFF | XON/XOFF | XON/XOFF | | XON/RS | CS/RS | CS/RS | Section 15.3, "Handshaking Methods" |
| For printer | For PC | | | | | | | | | | | | |
| OFF/OFF | OFF/OFF | | | | | | | | | | | | |
| XON/XOFF | XON/XOFF | | | | | | | | | | | | |
| | XON/RS | | | | | | | | | | | | |
| CS/RS | CS/RS | | | | | | | | | | | | |
| Date/Time | + Input values. - Applies the changes Selects the item to be changed. Year ↔ Month ↔ Day ↔ Time | Section 17.1, "Auxiliary Functions" | JST Japan Standard Time | | | | | | | | | | |
| Language | (CHANGE) Press this key. 日本語 English Francais Deutsch Italiano Español Use the cursor key to select the language. Press this key to confirm the selection. | Section 17.1, "Auxiliary Functions" | English | | | | | | | | | | |

5.2 System Reset

This section describes how to restore the default settings for all of the system settings (except for date, time and language).

The language set before the reset can not be changed even if the system reset is executed. (Refer to “Selecting Language” on page 17-1.)

● Top Menu Operation



● System Reset

System reset confirmation screen

All parameters will be initialized to default. Proceed?

Enter key: YES ESC key: NO

Executes system reset.

Press the key to cancel execution of system reset and to return to the previous screen.

If system reset has been executed, the following message appears:

System reset executed. All parameters are initialized to default.

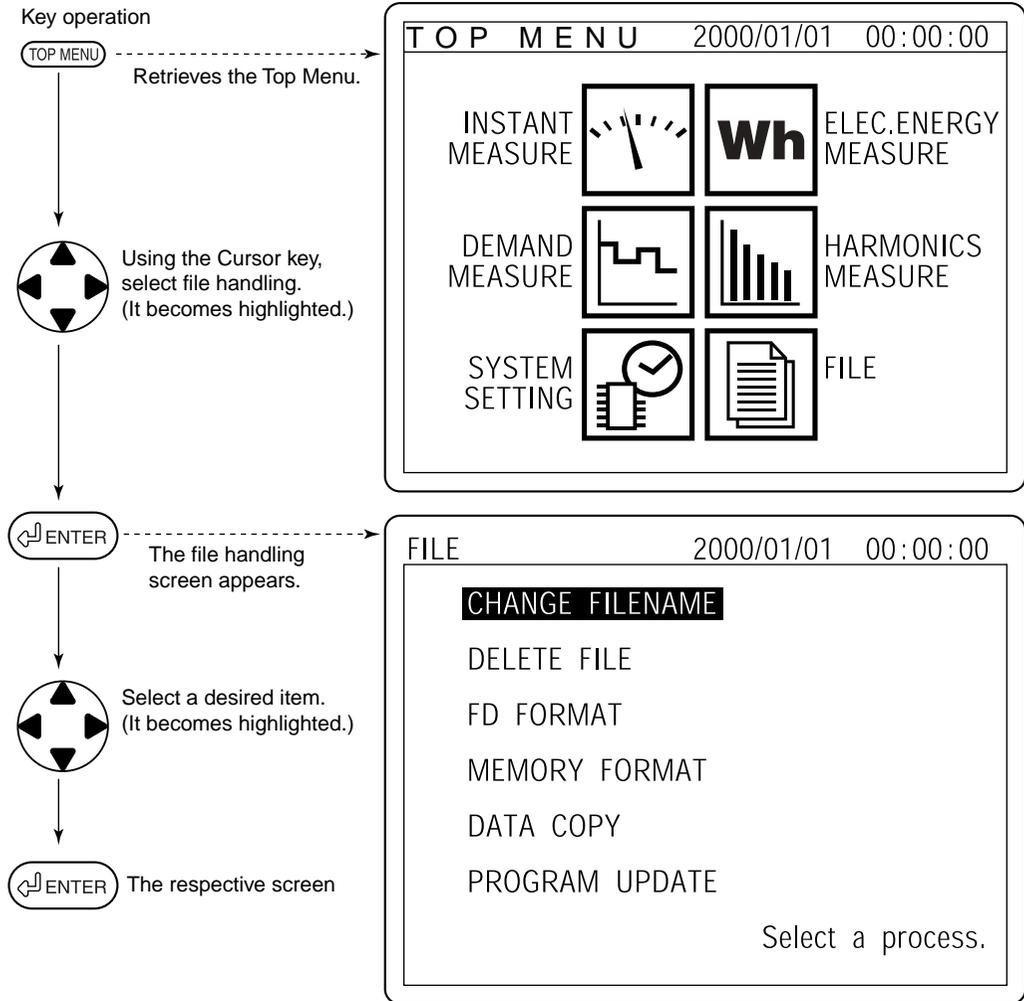
Enter key: OK

Retrieves the Top Menu.

6.1 File Handling

This section describes how to format memory or a floppy disk, and make modifications to saved files.

● Top Menu Operation



SEE ALSO

For details on making settings, see Table "File Handling Items".

● File Handling Items

- Change file name: Renames a saved file.
- Delete file: Deletes a saved file.
- FD format: Formats a floppy disk.
- Memory format: Formats internal memory.
- Data copy: Copies a file in internal memory to a floppy disk.
- Program update: Refer to NOTE on page 6-3.

TIP

To use the floppy disk items, an optional floppy disk drive is required.

6.1 File Handling

File Handling Items 1/2

| Item | Description | Message |
|------------------|---|---|
| Change file name | <p> MEMORY  FD Select media.</p> <hr/> <p> Selects a file to rename.</p> <p> ENTER</p> <p>Enter a new name (Refer to Section 6.3).</p> <p> ENTER</p> | Select media. |
| Delete file | <p> MEMORY  FD Select media.</p> <hr/> <p> Selects a file to delete. Selected file will be deleted.</p> <p> Cancels selection of a file.</p> <p> Selects all files on screen. </p> <p> Cancels selection of all files.</p> <p> NEXT screen.</p> <p>Asterisk (*) is displayed on the left of selected file.</p> <p> ENTER Delete confirmation screen appears.</p> | <p>Select media.</p> <hr/> <p>Selected file will be deleted. Proceed? ENTER key: YES ESC key: NO</p> <p> ENTER</p> <p>File deleted. ENTER key: OK</p> <p> ENTER</p> |
| FD format | <p> 1.44 MB  1.2 MB</p> <hr/> | <p>Format FD. Select capacity type.</p> <hr/> <p>Format FD. (_MB) ENTER key: YES ESC key: NO</p> <p> ENTER</p> <p>Now formatting. (_MB)</p> <p>Format complete. (_MB) ENTER key: OK</p> |
| Memory format | Formats memory. | <p>Format internal memory? ENTER key: YES ESC key: NO</p> <p>Now formatting</p> <p>Format complete. ENTER key: OK</p> |

File Handling Items 2/2

| Item | Description | Message |
|-----------|--|---|
| Data copy | <p> Selects a file to copy.</p> <p> Cancels selection of a file.</p> <p> Selects all files on screen.</p> <p> Cancels selection of all files.</p> <p> Shows more files.</p> <p>Astersik (*) is displayed on the left of selected file.</p> <p> Copy confirmation screen appears.</p> | <p>Selected file will be copied to FD. Proceed? ENTER key: YES ESC key: NO</p> <p>Copying</p> <p>Copy complete. ENTER key: OK</p> |

● File Description

Example : WTH001.SET 2000/01/01 00:00 WTH
 File name Date: Year/Month/Day Time File attribute

SEE ALSO

For more about file names and attributes, see Section 6.2.

● How to Select (Specify) File



Using the Cursor key, select a file.
(It becomes highlighted.)



Press the F1 key to confirm the selection.

Asterisk (*) is displayed on the left of selected file.



A message requesting confirmation appears.

To select all files, press the  key.

To cancel one file, press the  key.

To cancel all files, press the  key.

| DELETE FILE | | 2/2 | 2000/01/01 | 00:00:00 |
|-----------------|------------|-------------------|--------------|-------------|
| AINS007. | CSV | 1999/12/12 | 15:00 | AINS |
| AINS006. | CSV | 1999/12/11 | 15:00 | AINS |
| *AINS005. | CSV | 1999/12/10 | 15:00 | AINS |
| SELECT | | CANCEL | SEL. ALL | CAN. ALL |
| | | | | NEXT |



NOTE

Do not execute program update item. It is only for maintenance.

6.2 File Name and File Attribute

This section describes file names and attributes. The file name (to be specified) can consist of up to eight alphanumeric characters.

SEE ALSO

Section 6.3, "Entering a File Name" for more information on how to enter a file name.

If you do not specify any file name, the CW140 gives the file a default name as follows.

Example:

DINS^{xxx}.CSV



To this field the CW140 allocates the smallest number, between 000 to 999, that has not yet been used.

● Saving Data during Continuous Measurement in Each Mode

| Measurement Mode | Continuous Measurement | File Name | File Attribute |
|------------------------------|------------------------|-------------|----------------|
| Instant Measure mode | Logging | AINSXXX.CSV | AINS |
| Electric Energy Measure mode | Integration | AWTHXXX.CSV | AWTH |
| Demand Measure mode | Demand | ADEMXXX.CSV | ADEM |
| Harmonics Measure mode | Logging | AHRMXXX.CSV | AHRM |

● Saving Data with File Functions (F3) in Each Mode

(see also Chapter 13, "File Functions")

<Saving and Loading On-screen Readings: DISP VAL>

| Measurement Mode | File Name | File Attribute |
|------------------------------|-------------|----------------|
| Instant Measure mode | DINSXXX.CSV | DINS |
| Electric Energy Measure mode | DWTHXXX.CSV | DWTH |
| Demand Measure mode | DDEMXXX.CSV | DDEM |
| Harmonics Measure mode | DHRMXXX.CSV | DHRM |

<Saving Measurement Data Items: SET ITEM>

| Measurement Mode | File Name | File Attribute |
|------------------------------|-------------|----------------|
| Instant Measure mode | MINSXXX.CSV | MINS |
| Electric Energy Measure mode | MWTHXXX.CSV | MWTH |
| Demand Measure mode | MDEMXXX.CSV | MDEM |
| Harmonics Measure mode | MHRMXXX.CSV | MHRM |

<Saving and Loading Condition Settings: SET UP>

| Measurement Mode | File Name | File Attribute |
|------------------------------|------------|----------------|
| Instant Measure mode | INSXXX.SET | INS |
| Electric Energy Measure mode | WTHXXX.SET | WTH |
| Demand Measure mode | DEMXXX.SET | DEM |
| Harmonics Measure mode | HRMXXX.SET | HRM |

6.3 Entering a File Name

You can enter a file name of up to 8 alphanumeric characters (including symbols).

● Operation Keys



: Use this key to select an alphanumeric character or symbol.



(INPUT): Places each selected character in the file name field.



(BS): Backspace
Deletes a character immediately before the cursor.

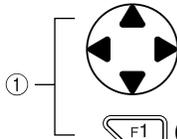


(←): Moves the cursor in the file name field one character to the **left**.



(→): Moves the cursor in the file name field one character to the **right**.

● Entering a File Name



: Use this key to select a character.



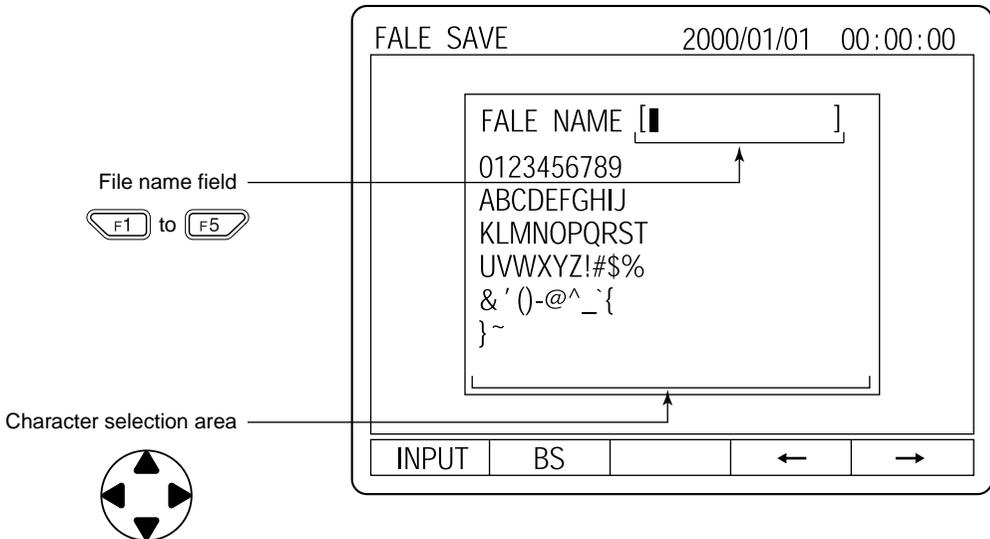
(INPUT): Places each selected character in the file name field.

The cursor moves to the right.

Repeat step ① above for up to 8 characters.



: Press this key to confirm the file name.



6.3 Entering a File Name

- **If There is Another File with the Same Name When Saving**

The following message appears.

Same file name already exists.
Overwrite?
Enter key: YES ESC key: NO



: Press this key to overwrite the existing file.



: Press this key to cancel.

If you do not want to overwrite the existing file, enter another file name.

7.1 Wiring

This section describes how to select and change the type of wiring to measure and wiring check function. To select and change the type of wiring to measure, press the **WIRING** key on the measurement screen.

Refer to Section 3.4, "Diagrams of Basic Wiring." The wiring diagram will be displayed in the wiring check function.

The following marks will be displayed to show the input terminals of the voltage probe and current sensing clamp.

| Wiring | Voltage (RMS) Input | Current (RMS) Input |
|---------------|---------------------|-------------------------------|
| 1 ϕ 2W | V1 | I1 (CH1) |
| 1 ϕ 3W | V1 V2 | I1 I2 (CH1) (CH2) |
| 3 ϕ 3W | V1 V3 | I1 I3 (CH1) (CH3) |
| 3 ϕ 3W3i | V1 V3 | I1 I2 I3 (CH1) (CH2) (CH3) |
| 3 ϕ 4W | V1 V2 V3 | I1 I2 I3 (CH1) (CH2) (CH3) |

2-system load

| Wiring | Voltage (RMS) Input | Load | Current (RMS) Input |
|------------------------|---------------------|------------------|--|
| 1 ϕ 2W \times 2 | V1 | Load 1 Load 2 | I1-1 (CH1) I1-2 (CH2) |
| 1 ϕ 3W \times 2 | V1 V2 | Load 1 Load 2 | I1-1 (CH1), I2-1 (CH2) I1-2 (CH3), I2-2 (CH4) |
| 3 ϕ 3W \times 2 | V1 V3 | Load 1 Load 2 | I1-1 (CH1), I3-1 (CH2) I1-2 (CH3), I3-2 (CH4) |

TIP

The indications I1 to I3 correspond to the wiring displayed on the screen. The indications CH1 to CH4 correspond to the current input terminals.

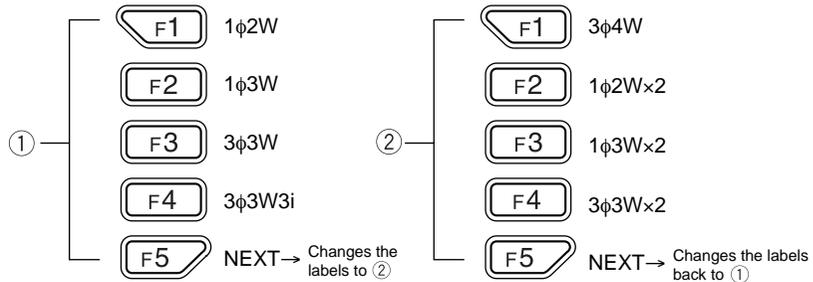
7.1 Wiring

● Selecting Measured Wiring Type

Follow the steps below to set up the wiring in each measurement mode.

Press the **WIRING** key to reveal the screen for selection.

Press the corresponding **F** key to select the type of wiring to measure.



Select the power line type to proceed to the wiring check.

To check: See Section 7.2, "Checking Wiring"

To not check: Return to the measurement screen.

NOTE

- The type of wiring cannot be changed during continuous measurement.
- It also cannot be changed when in electric energy mode and the elapsed time, "PASSAGE TIME", is not at zero, or in demand mode and the remaining time, "DEMAND RESTTIME", is not at zero.
- Be sure to press the **F5** key for three seconds or more and then clear the integrated value before changing the type of wiring.

7.2 Checking Wiring

WARNING

- Checking wiring is important to ensuring safe performance and accurate measurement. Refer to Chapter 3 and then carry out the necessary precautions for safe measurement and ensure that the connections have been made correctly.
- Make sure the connection of the voltage probe, and H/L directions and measurement positions of the current sensing clamp are correct.

● Check Items

The following items will be checked and judged, and then the results of each item will be displayed as either OK or NG.

VOLTAGE INPUT
CURRENT INPUT
VOLT. PHASE SEQUENCE (for three-phase only)
CLAMP DIRECTION ERR.
FREQUENCY SOURCE*

SEE ALSO

Page 7-5, "Check Items."

NOTE

- Measurement is not performed while wiring is being checked (D/A output is 0 V).
- Voltage and current ranges are set to AUTO while wiring is being checked and will retrieve the preset value after checking.

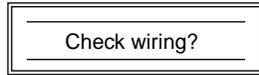
* Frequency source

The frequency source indicates the source selected for measuring the frequency of voltage inputs (V1 to V3) and current inputs (CH1 to CH4) in the system settings.

● **Checking Wiring**

Follow the steps below to check the wiring.

Press the **WIRING** key, and the message shown below appears.



Press corresponding **F** key:

To check **F** (YES)

To not check **F2** (NO) (Returns to the measurement screen.)

F1 (YES): The wiring diagram corresponding to the selected power line type will be displayed.

To carry out the check **F1** (CHECK)

To return to the measurement screen **F5** (END)

F1 (CHECK): Selecting CHECK runs the wiring check program, and then displays the results of the check of each item as OK or NG.

| Check List | |
|----------------------|--------|
| CHECK ITEM | RESULT |
| VOLTAGE INPUT | OK |
| CRRENT INPUT | OK |
| VOLT. PHASE SEQUENCE | OK |
| CLAMP DIRECTION ERR. | NG |
| FREQUENCY SOURCE | OK |
| CHECK END | |

CHECK : when checking

- If all check results are OK, press the **F5** (END) key to return to the measurement screen and proceed to measurement.
- If one or more check results are NG, press:
 - F1** (CHECK): Press this key to check the wiring again after any miswiring has been corrected.
 - F2** (ERROR): Press this key to view the error details.
 - F3** (ITEM): Press this key to view the check list.
 - F4** (WIRE FIG): Press this key to view the wiring diagram for the selected power line type.
 - F5** (END): Press this key to quit the wiring check and return to the measurement screen.

● **Check Item**

The table below shows check items and error conditions.

If one or more check results are NG, the corresponding error messages appear.

| Item | Error condition | Error message |
|---------------------------|---|---|
| 1. Voltage input | 10% or less of range | No voltage input. Check VOLTAGE CLIP connection. |
| 2. Current input | 1% or less of range | No current input. Check CURRENT CLAMP connection. |
| 3. Voltage phase sequence | <ul style="list-style-type: none"> The result of checking item 1 "Voltage input" is NG. For three-phase three-wire line: V3 leads V1 by more than approximately 80° or less than approximately 40°. For three-phase four-wire line: V2 lags behind V1 by more than approximately 140° or less than approximately 100°, or V3 leads V1 by approximately more than 140° or less than approximately 100°. | Possibility of wrong voltage wiring. Check VOLTAGE CLIP wiring. |
| 4. Clamp direction error | <ul style="list-style-type: none"> The active power is 0.17% or less of the rated voltage. Power for one or more phases is negative (The power for the whole three-phase three-wire line is negative). This does not apply when regenerative energy is used. | Polarity of CURRENT CLAMP is inverse. Check the direction of CURRENT CLAMP. |
| 5. Frequency source | <ul style="list-style-type: none"> Frequency measurement is unstable. Input frequency is 40 Hz or less, or 1.2 kHz or more. | Frequency source is not stable. Select a stable frequency source. |

 **NOTE**

As the CW140 judges wiring according to the conditions listed above, there may be some cases where the check result of correct wiring is NG, and vice versa. If measurement values appear erroneous, check these conditions and re-check the wiring.

7.3 Ranges and Number of Digits

Selecting Voltage and Current Ranges

- **Voltage Range**

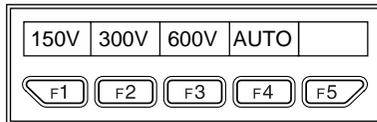
 Press this key to change and set the voltage range.

Fixed ranges: 150 V, 300 V, and 600 V

AUTO range

Pressing the  key changes the function key labels to allow you to select the voltage range as shown below.

Press the corresponding function key to select the desired range.



- **Current Range**

Selecting Clamp Type:

Clamp A (Model: 96030): Fixed ranges: 20 A, 50 A, 100 A, and 200 A

Clamp C (Model: 96031): Fixed ranges: 50 A, 100 A, 200 A, and 500 A

Clamp B (Model: 96032): Fixed ranges: 200 A, 500 A, and 1000 A

Selecting between clamp type A, B and C can be made on the last page for each mode or the system setting screen.

: Clamp A (20-200 A)

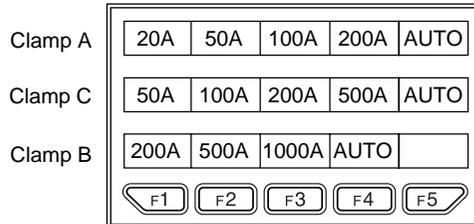
: Clamp B (200-1000 A)

: Clamp C (50-500 A)

The default setting is Clamp A.

Press the **(A RANGE)** key and select the desired current range from AUTO, and fixed ranges (varies depending on the clamp type selected).

Pressing the A RANGE key changes the function key labels to allow you to select the current range as shown below.



Press the corresponding function key to select the desired range.

NOTE

If continuous measurement (logging, integration, or demand) is performed when in AUTO range, the range will be fixed to the value when the START&STOP key is pressed.

TIP

- Ranges cannot be changed during continuous measurement.
- It also cannot be changed when in electric energy mode and the elapsed time, "PASSAGE TIME", is not at zero, or in demand mode and the remaining time, "DEMAND REST TIME" is not at zero.
- Be sure to press the **(F5)** key for 3 seconds or more and then clear the integrated value before changing the ranges.

● Use of AUTO Range

If measurement is performed when in AUTO range, the range may become unstable due to the input of irregular pulse waveforms. In this case, change the range to a fixed value and restart measurement.

When in AUTO range measurement, voltage and current ranges change, which may result in different ranges for the same power or measured value.

7.3 Ranges and Number of Digits

● Active/Reactive/Apparent Power Ranges

The active, reactive and apparent power ranges are determined by the voltage, current ranges and wiring as shown below:

| Wiring | Power range |
|--------|-----------------------------------|
| 1φ2W | Voltage range × current range |
| 1φ3W | Voltage range × current range × 2 |
| 3φ3W | |
| 3φ3Wi | |
| 3φ4W | Voltage range × current range × 3 |

● Range Configuration (Full Scale)

The table below shows active power ranges corresponding to the voltage and current ranges. Each value in the table is its full scale value.

| Voltage range (V) | Wiring | Current range (A) | | | | | |
|-------------------|--------|-------------------|----------|----------|---------------------|---------|---------|
| | | Clamp C (50-500A) | | | Clamp B (200-1000A) | | |
| | | Clamp A (20-200A) | | | | | |
| | | 20.00 | 50.00 | 100.0 | 200.0 | 500.0 | 1000 |
| 150.0 | 1φ2W | 3.000 kW | 7.500 kW | 15.00 kW | 30.00 kW | 75.00kW | 150.0kW |
| | 1φ3W | 6.000 kW | 15.00 kW | 30.00 kW | 60.00 kW | 150.0kW | 300.0kW |
| | 3φ3W | 6.000 kW | 15.00 kW | 30.00 kW | 60.00 kW | 150.0kW | 300.0kW |
| | 3φ4W | 9.000 kW | 22.50 kW | 45.00 kW | 90.00 kW | 225.0kW | 450.0kW |
| 300.0 | 1φ2W | 6.000 kW | 15.00 kW | 30.00 kW | 60.00 kW | 150.0kW | 300.0kW |
| | 1φ3W | 12.00 kW | 30.00 kW | 60.00 kW | 120.0 kW | 300.0kW | 600.0kW |
| | 3φ3W | 12.00 kW | 30.00 kW | 60.00 kW | 120.0 kW | 300.0kW | 600.0kW |
| | 3φ4W | 18.00 kW | 45.00 kW | 90.00 kW | 180.0 kW | 450.0kW | 900.0kW |
| 600.0 | 1φ2W | 12.00 kW | 30.00 kW | 60.00 kW | 120.0 kW | 300.0kW | 600.0kW |
| | 1φ3W | 24.00 kW | 60.00 kW | 120.0 kW | 240.0 kW | 600.0kW | 1200kW |
| | 3φ3W | 24.00 kW | 60.00 kW | 120.0 kW | 240.0 kW | 600.0kW | 1200kW |
| | 3φ4W | 36.00 kW | 90.00 kW | 180.0 kW | 360.0 kW | 900.0kW | 1800kW |

Current range for clamp A : 20/50/100/200A

Model : 96030

Current range for clamp C : 50/100/200/500A

Model : 96031

Current range for clamp B : 200/500/1000A

Model : 96032

TIP

- For reactive and apparent power, the same table applies, however, the units of measurement are different.

For reactive power: kVar

For apparent power: kVA

- If the VT or PT ratio is set to a value other than 1, multiply each value in the table by the ratio.

● **Display Digit**

Display digit, position of decimal point, and unit of measurement are shown in the tables below. The maximum display digit for voltage, current, frequency, and power is four (9999).

Voltage

| Range × VT ratio | Position of decimal point and unit of measurement |
|------------------|---|
| 150 to 999.9 V | 999.9 V |
| 1 to 9.999 kV | 9.999 kV |
| 10 to 99.99 kV | 99.99 kV |
| 100 to 999.9 kV | 999.9 kV |
| 1 to 6 MV | 6.000 MV |

Current

| Range × CT ratio | Position of decimal point and unit of measurement |
|------------------|---|
| 200 to 999.9 mA | 999.9 mA |
| 1 to 9.999 A | 9.999 A |
| 10 to 99.99 A | 99.99 A |
| 100 to 999.9 A | 999.9 A |
| 1 to 9.999 kA | 9.999 kA |
| 10 to 99.99 kA | 99.99 kA |
| 100 to 999.9 kA | 999.9 kA |
| 1 to 9.999 MA | 9.999 MA |
| 10 to 99.99 MA | 99.99 MA |

Frequency

| Input frequency | Position of decimal point and unit of measurement |
|-----------------|---|
| 45 to 99.99 Hz | 99.99 Hz |
| 100 to 999.9 Hz | 999.9 Hz |
| 1 to 1.2 kHz | 1.200 kHz |

7.3 Ranges and Number of Digits

Power

| Rated power × VT ratio × CT ratio | Position of decimal point and unit of measurement |
|-----------------------------------|---|
| 30 to 99.99 W | 99.99 W |
| 100 to 999.9 W | 999.9 W |
| 1 to 9.999 kW | 9.999 kW |
| 10 to 99.99 kW | 99.99 kW |
| 100 to 999.9 kW | 999.9 kW |
| 1 to 9.999 MW | 9.999 MW |
| 10 to 99.99 MW | 99.99 MW |
| 100 to 999.9 MW | 999.9 MW |
| 1 to 9.999 GW | 9.999 GW |
| 10 to 99.99 GW | 99.99 GW |
| 100 to 999.9 GW | 999.9 GW |
| 1 to 9.999 TW | 9.999 TW |
| 10 to 99.99 TW | 99.99 TW |
| 100 to 999.9 TW | 999.9 TW |

Electric Energy

The maximum display digit for electric energy is six (999999).

Display of Electric energy can select the position of decimal point and unit of measurement.

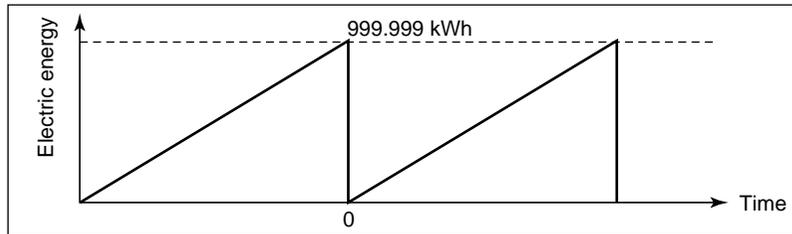
This selection can be set on page 2/3 of setup screen for Electric energy and Demand measurement modes.

When selecting STANDARD for position of decimal point, the position of decimal point and unit of measurement are automatically set following table.

| Rated power × VT ratio × CT ratio (× demand period time: hours)* | Position of decimal point and unit of measurement |
|---|---|
| 1 to 9.999 W | 0.00 to 9999.99 Wh |
| 10 to 99.99 W | 0.0 to 99999.9 Wh |
| 100 to 999.9 W | 0.000 to 999.999 kWh |
| 1 to 9.999 kW | 0.00 to 9999.99 kWh |
| 10 to 99.99 kW | 0.0 to 99999.9 kWh |
| 100 to 999.9 kW | 0.000 to 999.999 MWh |
| 1 to 9.999 MW | 0.00 to 9999.99 MWh |
| 10 to 99.99 MW | 0.0 to 99999.9 MWh |
| 100 to 999.9 MW | 0.000 to 999.999 GWh |
| 1 to 9.999 GW | 0.00 to 9999.99 GWh |
| 10 to 99.99 GW | 0.0 to 99999.9 GWh |
| 100 to 999.9 GW | 0 to 999999 GWh |
| 1 to 9.999 TW | 0 to 999999 GWh |
| 10 to 99.99 TW | 0 to 999999 GWh |
| 100 to 999.9 TW | 0 to 999999 GWh |

* : When Demand measurement mode, Electric energy of period is obtained by multiplying Demand period time (unit: hours) additionally.

For electric energy, if the measured value exceeds the maximum displayable value, the display value will be reset to zero (e.g. 999.999 kWh → 0.000 kWh).



In the graph, this will be shown as follows.

For lagging reactive energy and leading reactive energy, the unit of measurement is Varh.

● Switching Ranges in AUTO Range

When you select AUTO range, the ranges will be automatically switched depending on the condition below.

Effective measurement range: 10% to 110% of each range

(Up to 600 V for the 600 V range)

WARNING

Do not apply a voltage of more than 600 Vrms to the voltage range.

Switching to upper range

For RMS value: When the RMS value becomes 110% or more of the rated range.

For sampled value: When the sampled value becomes 300% or more of the rated range.

Switching to lower range

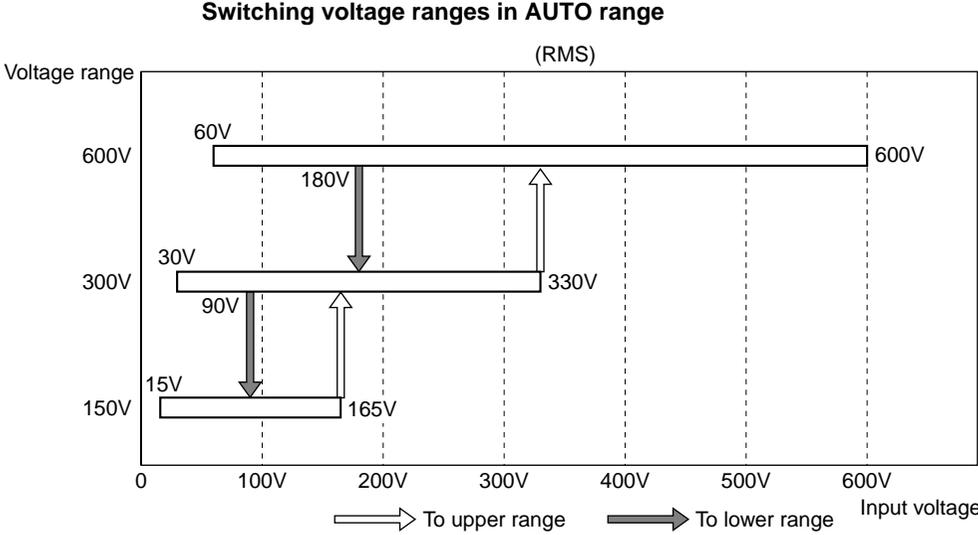
For RMS value: When the RMS value becomes 30% or less of the rated range.

For sampled value: When the sampled value becomes about 300% or more of the rated range (lower range after switching) as a result of switching range, switching will not be performed.

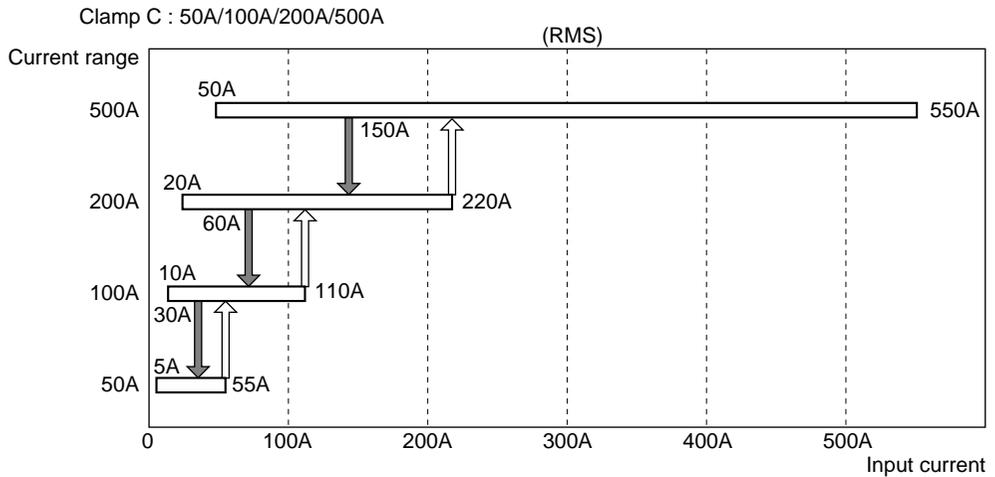
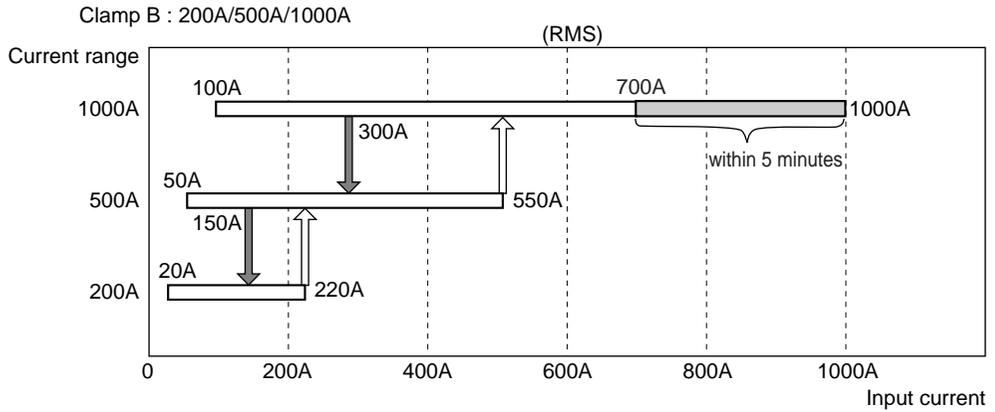
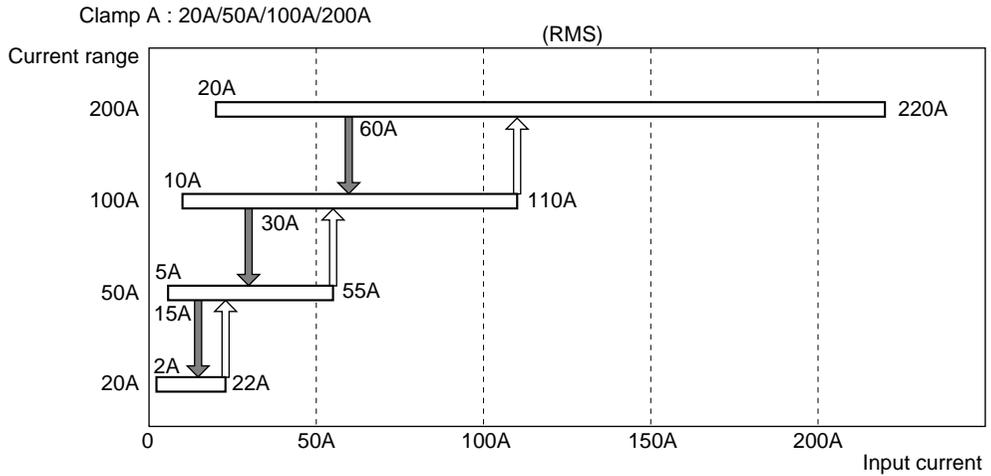
TIP

- Switching is performed depending on the largest input among the voltage inputs V1, V2, and V3. The selected range will be applied to all inputs.
- Switching is performed depending on the largest input among the current inputs CH1 to CH4. The selected range will be applied to all inputs.

7.3 Ranges and Number of Digits



Switching current ranges in AUTO range



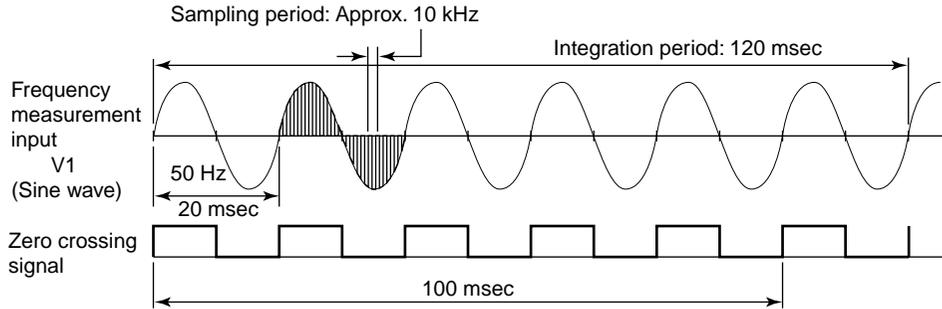
TIP

During switching, the value "----" will be temporarily displayed.

7.4 Sampling Frequencies and Integration Periods

This section describes periods for which the sampling and integrating of measured values are performed.

- **Sampling in Instant, Electric Energy, or Demand Mode**

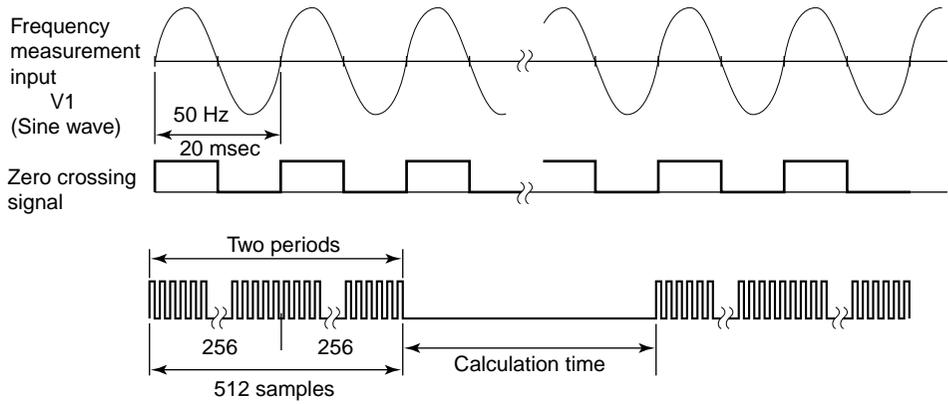


The integration period synchronizes with the zero crossing signal of the frequency measurement input and is defined as a time period which begins with fixed time (100 ms) and ends with the next leading edge of the zero crossing signal. The voltage and current RMS, power, and reactive power (when only the reactive power method is used) values are calculated during the integration period.

Example:

| Frequency (Hz) | Integration period (msec) | Number of sine waves |
|----------------|---------------------------|----------------------|
| 50 | 120 | 6 |
| 60 | 116.67 | 7 |
| 400 | 102.5 | 41 |
| 1K | 101 | 101 |

● **Sampling in Harmonics Mode**
(for Fundamental Wave Frequency of 45 to 65 Hz)



The sampling period synchronizes with the zero crossing signal of the frequency measurement input a PLL. Two periods' worth of samples (i.e., 512 samples) are used to perform the calculation of harmonic parameters.

TIP

In the examples shown above, the waves are sine waves (50 Hz) generated by using the voltage input V1.

7.5 Frequency Measurement and Low-pass Filters

This section describes frequency measurement and settings for a low-pass filter.

● Frequency Measurement Range

Normal measurement: 45 Hz to 1 kHz

Harmonics mode: 45 Hz to 65 Hz (fundamental wave frequency)

Three-phase unbalance rate: 45 Hz to 440 Hz

● Frequency Source Setting

Frequency source can be selected from voltage inputs V1 to V3 and current inputs CH1 to CH4. The default setting is V1.

The frequency source setting depends on the wiring setting.

Key operation

The frequency source can be set on page 1/2 of the system setting screen or the last page of setup screen in each measurement mode by pressing the  key.

<Example: Instant mode>

 (SETUP): Press this key on the Instant mode.

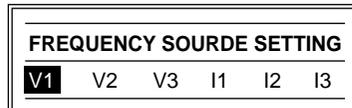
 (NEXT): Press this key to select page 2/3 of setup screen.

 (NEXT): Press this key again to select page 3/3 of setup screen.



Using the Cursor key, select the frequency source item.
(It becomes highlighted.)

 (CHANGE): Press this key to display selectable items (for wiring) in the center of the screen.



Using the Cursor key, select the desired item.

 ENTER Confirms the selection.

 ENTER Confirms the settings.

Return to the measurement screen.

● Low-pass Filter Setting

The low-pass filter can be used in the frequency measurement circuit to eliminate noise from inverted waveforms and distorted waveforms for accurate frequency measurement. The filter cuts off frequencies of 300 Hz or lower.

Key operation

As with frequency source setting, the low-pass filter can be set on page 1/2 of the system setting screen or on the last page of the setup screen in each measurement mode by pressing the  key. The default value is OFF.



Using the Cursor key, select the item "Low-pass filter."



: ON

Press either key to select the desired setting.



: OFF



Confirms the selection.

7.6 Averaging Function

As power in the measured lines may greatly fluctuate, the CW140 is facilitated with a function to calculate the moving average. The averaging function can be set to on or off on page 1/2 of the system setting screen or on the last page of the setup screen in each measurement mode.

Selected number of averaging: 2 to 10 cycles

● Moving Average Equation

$$D_n = \frac{\underbrace{M_n - (m - 1)} + \underbrace{M_n - (m - 2)} + \dots + \underbrace{M_n - 1} + \underbrace{M_n}}{m}$$

|-----|
m cycles

m: Number of averaging cycles to be set

Mn: Measured value at nth measurement

Dn: Moving average at nth measurement (on-screen reading)

TIP

- The averaging function cannot be used when in harmonics measure mode because the sampling method used in this mode is different from other modes.
 - For integrated values of electric power and demand, the averaging function does not work even if it is set to on.
-

SEE ALSO

For details on the settings, see page 1/2 of the system setting screen, p 5-2, or the last page of the setup screen in each measurement mode:

Instant mode: p. 8-13

Electric energy mode: p. 9-11

Demand mode: p. 11-12

7.7 Scaling Function (VT/CT)

If your system has an external VT (Voltage Transformer) or CT (Current Transformer) and uses its secondary output as an input, the scaling function can be used to display the primary value of VT or CT after calculation by setting VT ratio and CT ratio.

Default value: VT ratio: 1
CT ratio: 1

Setting Range

| | |
|----------|---------------|
| VT ratio | 1 to 10000 |
| CT ratio | 0.01 to 10000 |

Example:

If VT: 2200 V → 110 V (20 : 1) then set VT ratio to 20.

If CT: 100 A → 5 A (20 : 1) then set CT ratio to 20.

Display Value

Voltage: Voltage range × VT ratio
Current: Current range × CT ratio
Power: Rated power × VT ratio × CT ratio

If VT or CT ratio is set to a value other than 1, the **SCAL** mark is displayed in the upper-left corner of the screen.

SEE ALSO

For the settings of VT and CT ratios, see page 1/2 of the system setting screen, p. 5-2, or the last page of setup screen in each measurement mode:

Instant mode: p. 8-13

Electric energy mode: p. 9-11

Demand mode: p. 11-12

Harmonics mode: p. 12-12

8.1 Detailed View of Data Items on Instant Measure Mode Screen

In Instant Measure mode, the CW140 measures and calculates the data items listed below and displays the results.

● Display of Measured/Calculated Values

| | | |
|-------------------------|------------------------|--|
| Voltage (rms value) (V) | Active power (W) | Power factor |
| Current (rms value) (A) | Reactive power 1 (Var) | Phase angle (°) |
| | Reactive power 2 (Var) | Frequency (Hz) |
| | Apparent power (VA) | Unbalance factor (%) (Three-phase system) |

Measured data items: Rms-value voltage, rms-value current, active power, reactive power 1 and frequency

Calculated data items: Reactive power 2, apparent power, power factor, phase angle and three-phase unbalance factor

SEE ALSO

Section 8.6, "Computational Expressions," for details on the computational expressions.

● Selection of Reactive Power Method

Reactive power 1: With reactive power meter method.

Reactive power 2: Without reactive power meter method.

SEE ALSO

Section 8.6, "Computational Expressions," for details on the computational expressions when either the reactive power method is used or not used.

Selecting whether or not to use the method can be made in two ways:

- Press the  key and set the data item "Reactive Power Method" on setting screen 3/3 to ON or OFF; or
- Retrieve the System Setting screen to make a selection.

See the list of setup data items on each of these screens.

8.1 Detailed View of Data Items on Instant Measure Mode Screen

● Instant Measure Mode Screen

Press the **TOP MENU** key to show the TOP MENU screen.

Using the  cursor key, select  (INSTANT MEASURE).

Then, press the **ENTER** key. ----->

The Instant Measure Mode screen appears.

Display of measured/calculated values ----->

Display of setup conditions ----->

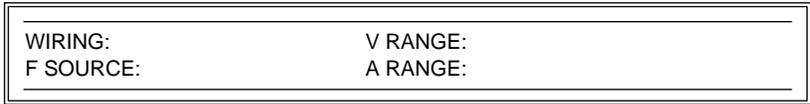
| INSTANT | | 00:00:00 | |
|----------|---------------|----------|-------------|
| VOLT. | V1 : 110.0V | AMP. | I1 : 200.0A |
| | V2 : 110.0V | | I2 : 200.0A |
| | V3 : 110.0V | | I3 : 200.0A |
| P | : 57.00kW | P.F. | : 0.866 |
| Q | : 33.00kVar | P.A. | : 30.0 |
| VA | : 66.00kVA | FREQ. | : 50.00Hz |
| | | U.R. | : 0.0% |
| WIRING | : 3 ϕ 4W | V RANGE | : 150V AUTO |
| F SOURCE | : V1 | A RANGE | : 200A AUTO |
| EXPAND | SETUP | FILE | HOLD |

● Three-phase Unbalance Factor

This data item is shown only when a three-phase wiring method is applied.
The frequency range is specified as 45 to 440 Hz.

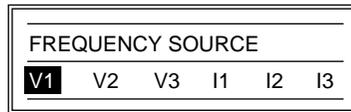
● **Display of Setup Conditions**

As setup conditions, the screen shows the settings of the following four data items.



• **Changing the Setup Conditions**

WIRING field: Change with the **WIRING** key, }
 V RANGE field: Change with the **V RANGE** key, } and then press the
 A RANGE field: Change with the **A RANGE** key, } relevant function key.
 F SOURCE field: Shows the input signal whose frequency is being measured. To change the setting of the data item "Frequency Source," select the Instant Setting screen by pressing the **F2** (SETUP) key. Then, press the **F5** key twice to show page 3/3 of the screen. The default value is V1. Now change the setting and press the **F1** (CHANGE) key.



Press the **ENTER** key.

SEE ALSO

Page 7-16, for details on the setting of the data item "Frequency Source."

8.2 Working with the Function Keys

This section explains how the function keys for the Instant Measure mode work.

 (CHANGE): Switches between the DETAILS and EXPAND display modes (see Section 8.3, "Expanded View of Data Items on Instant Measure Mode Screen").

 (SETUP): Shows setup data items of the Instant Measure mode (see Section 8.5, "Setup Data Items of Instant Measure Mode") on pages 1/3, 2/3 and 3/3 of the Instant Setting screen.



: Selects from the data items.

 to : Changes or sets the value.

 (NEXT): Moves to the next page (screen).

: Confirms the setting.

: Cancels the setting.

 (FILE): Enables you to use the file functions (see Chapter 13, "File Functions").

 (LOAD): Reads a file from internal memory/floppy disk.

 (SAVE): Saves a file in internal memory/on floppy disk.

 (PRINT): Prints data (DISP VAL, SET ITEM and SETUP data items).

 (LOAD_CHG): Switches between Load 1 and Load 2 (if the wiring is for a 2-load system).

 (HOLD): Holds the on-screen readings.

Holding: The screen shows the **HOLD** mark in the upper-middle area of the display.

8.3 Expanded View of Data Items on Instant Measure Mode Screen

You can select as many as three data items from those listed in the DISP. ITEM table to show an expanded view of them.

Press the  (SETUP) key to show the Instant Setting screen.

| |
|------------|
| UPPER: V1 |
| MIDDLE: I1 |
| LOWER: P |

(Default view)

Use the  key to select a data item to be changed.

Press the  (CHANGE) key to change the data item.

| DISP. ITEM | | |
|------------|----|----|
| V1 | V2 | V3 |
| I1 | I2 | I3 |
| P | Q | VA |

Press the  to cancel the procedure of change.

Use the  key to select a data item to be displayed.

Press the  key to confirm your selection.

8.3 Expanded View of Data Items on Instant Measure Mode Screen

- Symbol Description (for selection of data items other than V1, V2, V3, I1, I2 and I3)

| UPPER | MIDDLE | LOWER |
|--------------------|------------------|----------------------------------|
| P: Active power | P: Active power | P: Active power |
| Q: Reactive power | PF: Power factor | F: Frequency |
| VA: Apparent power | PA: Phase angle | UR: Three-phase unbalance factor |

INSTANT **LOAD1** 00:00:00

UPPER → VOLT. V1 : 110.0V

MIDDLE → AMP. I1 : 200.0A

LOWER → P : 57.00kW

WIRING : 3φ3W×2 V RANGE : 150V AUTO
 F SOURCE : V1 A RANGE : 200A AUTO

DETAILS | SETUP | FILE | LOAD_CHG | HOLD

TIP

- The choice of data items V1 to V3 and I1 to I3 varies depending on the type of wiring.
- If the CW140 is wired to a 2-load system, the same data item is selected for both loads.
- If you change the wiring type and the selected data item is not identified as an actual input on the wiring, the default data item is selected.

8.4 Logging in Instant Measure Mode

Using the logging function, you can continuously take measurements and save data. (To save data, set "LOGGING" to ON and select the output destination, or use the file function.)

● Procedure for Starting Logging

-  (TIME): Enters the starting time (default is the current time).
-  (TRIGGER) - Control: Allows you to control logging by inputting a signal to the START/STOP input terminals.
-  (MANUAL): Allows you to start logging by pressing the  key. The default for this key is "Manual".

● Procedure for Stopping Logging

-  (TIME): Enters the ending time.
-  (TIMER): Enters the time taken from the start to the end of logging.
-  (TRIGGER) - Control: Allows you to control logging by inputting a signal to the START/STOP input terminals.
-  (MANUAL): Allows you to stop logging by pressing the  key. The default for this key is "Manual".

Setting the time:

Use the  key to move through the fields of the date and time setting, as shown below.

2000 / 01 / 01 / hour : minute

Year ↔ Month ↔ Day ↔ Hour ↔ Minute

-  (+): Increment
 -  (-): Decrement
- Input a value.

Setting the time:

Use the  key to move through the fields of the time setting, as shown below.

0000 h / 00 m / 00 s

Hour (and no. of digits) ↔ Minute ↔ Second

-  (+): Increment
 -  (-): Decrement
- Input a value.

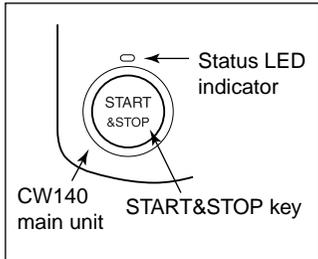
You can set the interval from the starting to the ending time, in 10-second increments, to a maximum of 1000 hours.

Holding down the  (+) or  (-) key during input of a value, increases the speed with which the value changes.

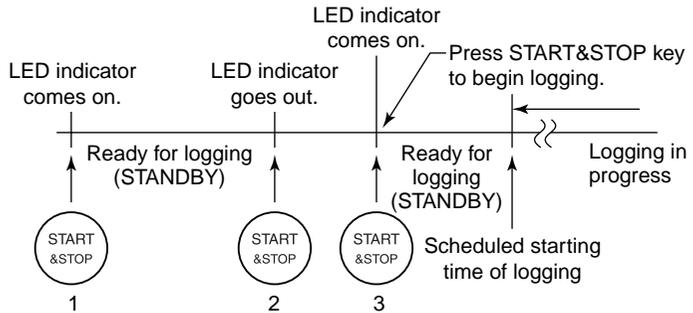
8.4 Logging in Instant Measure Mode

● Start of Logging

Even if you have finished setting the time and commanded the start of logging by an external trigger, logging does not begin unless you press the  key (status LED indicator comes on). Logging begins only when setting of the time has been completed, the START&STOP key has been pressed, and the **STANDBY** mark comes on.



Location of START&STOP key and LED indicator



- 1 Indicates the status in which the starting time of logging is set and that the CW140 is ready for logging.
- 2 Indicates the status in which the START&STOP key is pressed and that the LED indicator comes on.
- 3 Indicates that the START&STOP key should be pressed one more time to begin logging.

TIP

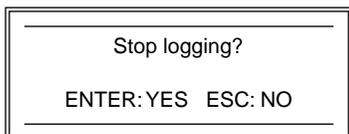
- The changing of settings is not allowed during logging (viewing only).
- The setting of a time earlier than the current time is not allowed. In addition, the CW140 shows an error message if, after time setting, the preset starting time of logging has already expired before logging begins.

● End of Logging

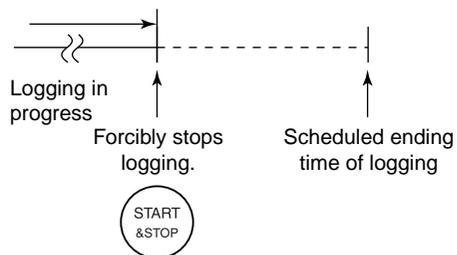
If end of logging is specified by setting the time or using a timer, the CW140 automatically stops logging and the **LOGGING END** mark appears when the preset time is up.

- Forcibly stopping logging before the preset time is up

Press the START&STOP key.
The following message appears.



To stop logging, press the  key.



To cancel the procedure for stopping logging, press the  key.

● Viewing Logging Information

The CW140 shows the **STANDBY** , **LOGGING** and **LOGGING END** marks in the upper-middle area of the display. It also shows information on the start and end of logging in the lower section of the display. Information shown on the display varies depending on whether the CW140 is ready for logging, is performing logging or has finished logging, or how it starts or stops logging.

If you want to show setup conditions (WIRING, V RANGE, A RANGE and FREQUENCY SOURCE data items) in the logging information area (lower section of the display), press the **WIRING** , **V RANGE** or **A RANGE** key. Pressing the same key once again, or pressing the **ENTER** or **ESC** key returns to the view of logging information.

● Outputting Logged Data

This paragraph explains how to output data acquired during an interval from the start to the end of logging. You can change/define settings related to data output by pressing the **F2** (SETUP) key in the Instant Measure mode.

• Logging Setting

LOGGING: Select from the ON and OFF options.

• Condition Settings for Data Output (with "LOGGING" set to ON)

OUTPUT INTERVAL: Set a value between 2 minutes and 1000 hours, in 1-minute increments.

OUTPUT MEDIA: Select:
 "MEMORY" to save in internal memory;
 "FD" to save on a floppy disk; or
 "PRINTER" to print.

FILENAME: Type the file name of data to be saved.

SAVE/PRINT ITEM: Select the data item to be saved or printed.

SEE ALSO

Section 8.5, "Setup Data Items of Instant Measure Mode," for details on the setup data items.

TIP

You are not allowed to set the time interval from the start to the end of logging at a value smaller than the OUTPUT INTERVAL setpoint. If you set such a value, the CW140 shows an error message when you press the **ENTER** key.

8.5 Setup Data Items of Instant Measure Mode

Press the **F2** (SETUP) key in the Instant Measure mode. Page 1/3 of the Instant Setting screen (INST. SET 1/3) appears.

● Screen Configuration and Setup Data Items

The Instant Setting screen consists of pages 1/3, 2/3 and 3/3.

Each page lists setup data items, as shown below.

| | | | |
|---------------------|---|------------|----------|
| INST. SET 1/3 | | 2000/01/01 | 00:00:00 |
| EXPAND DISPLAY ITEM | | | |
| UPPER | : | V1 | |
| MIDDLE | : | I1 | |
| LOWER | : | P | |
| LOGGING | | : | ON |
| LOGGING START | : | MANUAL | |
| LOGGING STOP | | : | MANUAL |
| OUTPUT INTERVAL | : | 0000h 30m | |
| CHANGE | | | NEXT |

Page 1/3

EXPAND (Display item)
 Logging
 Logging start/Logging stop*
 Output interval*

Page 2/3

Output medium*
 Filename*
 Items to be saved/printed
 D/A output

Page 3/3

Reactive power method
 Frequency source
 Low-pass filter
 VT ratio
 CT ratio
 Clamp selection
 Number of averaging cycles

* Shown only if the logging function is used ("Logging" is set to ON).

TIP

The "D/A output" setup data item on the Instant Setting screen page 2/3 is visible only if the CW140 is equipped with a D/A output option.

- Show each page of the screen with the **F5** (NEXT) key, as explained below.



● Basic Setting/Changing Operations

- Selection of setup data item to be set/changed
Using the  key, select the setup data item to be changed. (The item is highlighted.)
For more information, see the tables of setup data items that follow.
- Press the relevant  key to change the setting.
The functionality corresponding to each function key varies depending on the selected setup data item.
- Press the  key to make changes to the next page.
- Pressing the  key completes your settings. (The display changes to a measurement screen.)
- If none of the settings needs to be changed, press the  key. The display changes to a measurement screen.

TIP

-
- The changing of settings is not allowed when the CW140 is in a stand-by state or is performing logging (only viewing is allowed).
-

8.5 Setup Data Items of Instant Measure Mode

Setup Data Items of Instant Measure Mode

Table 1 of Setup Data Items

| Page | Setup Data Item | Items to Be Selected | See Also | Default |
|---|---|---|--|--|
| 1/3 | EXPAND DISPLAY ITEM | Select data items to be shown in the following fields. UPPER MIDDLE LOWER | Section 8.3, "Expanded View of Data Items on Instant Measure Mode Screen" | UPPER: V1 (voltage) MIDDLE: I1 (current) LOWER: P (active power) |
| | LOGGING |  (ON): Logging is enabled.  (OFF): Logging is disabled. | | OFF |
| | LOGGING START METHOD (Only effective if "LOGGING" is set to ON) |  (TIME)  (TRIGGER)  (MANUAL) | Section 8.4, "Logging in Instant Measure Mode" | LOGGING START METHOD: MANUAL |
| | LOGGING STOP METHOD |  (TIME)  (TIMER)  (TRIGGER)  (MANUAL) When setting the time:  Lets you move through the fields of the date and time setting. Year ↔ Month ↔ Day ↔ Hour  (+): Increment  (-): Decrement Input a value. When setting the timer:  Lets you move through the fields of the time setting to set a value, in 10-second increments, to a maximum of 1000 hours. Hour (and no. of digits) ↔ Minute ↔ Second  (+): Increment  (-): Decrement Input a value. | | LOGGING STOP METHOD: MANUAL |
| OUTPUT INTERVAL (Only effective if "LOGGING" is set to ON) | Set to a value between 2 minutes and 1000 hours in 1-minute increments.  Lets you move through the digits.  (+): Increment  (-): Decrement Input a value. | | 30 min (Only effective if "LOGGING" is set to ON) | |
| 2/3 | OUTPUT MEDIA (Only effective if "LOGGING" is set to ON) | MEMORY:  Select from these options with the  (ON) and  (OFF) keys. FD:  PRINTER:  | | MEMORY |
| | FILENAME (Only effective if "LOGGING" is set to ON) MEMORY/FD | Not designated: Named automatically as shown below. AINS XXX.CSV ↳ 000 to 999 Designated:  (CHANGE) : Enters a name of no more than 8 alphanumeric characters. | Section 6.2, "File name and File attribute" Section 6.3, "Entering a File Name" | Not designated |

Setup Data Items of Instant Measure Mode

Table 2 of Setup Data Items

| Page | Setup Data Item | Items to Be Selected | See Also | Default |
|------|--|--|---|--|
| 2/3 | SAVE/PRINT ITEM | Select between ON and OFF under each of the VOLTAGE, CURRENT, POWER and EVENT INPUT data items. ON For a 2-load system, use the to keys. OFF | "Data Items to Be Saved/Printed" on page 8-14 | ON for all items |
| | D/A OUTPUT (Optional) | Select from among CH1 to CH4. (CHANGE) Selects the channel. Shows options in the middle of the screen. Confirms the selection. | Section 14.1, "Optional D/A Output" | OFF for all channels |
| 3/3 | REACTIVE POWER METHOD | (ON): The method is used. (OFF): The method is not used. | Section 8.6, "Computational Expressions" | OFF: The method is not used. |
| | FREQUENCY SOURCE | Press to change the setting. Options appear in the middle of the screen. Selects the desired option. Confirms the selection. | Section 7.5, "Frequency Measurement and Low-pass Filters" | V1 |
| | LOWPASS FILTER (for frequency measurement) | (ON): The filter is inserted. (OFF): The filter is not inserted. | Section 7.5, "Frequency Measurement and Low-pass Filters" | OFF |
| | VT RATIO (Ratio of voltage transformation) | Set to a value between 1 and 10000. Moves the cursor through the digits. (+): Increment (-): Decrement Input a value. | Section 7.7, "Scaling Function" | 1 |
| | CT RATIO (Ratio of current transformation) | Set to a value between 0.01 and 10000. Moves the cursor through the digits. (+): Increment (-): Decrement Input a value. | Section 7.7, "Scaling Function" | 1 |
| | CLAMP SELECTION | (20 – 200 A): Clamp A (200 – 1000 A): Clamp B (50 – 500 A): Clamp C | "Selecting Clamp Type" under "Current Range" on page 7-6 | 20 – 200 A (Clamp A) |
| | NUMBER OF AVERAGE | (+): Cycles through OFF → 2 → 3 → ... 10 → OFF. (-): Cycles through OFF → 10 → 9 → ... 2 → OFF. | Section 7.6, "Averaging Function" | OFF: The averaging function is not used. |

TIP

The Instant Setting screen page 3/3 of Instant Measure mode partially shares the same setup data items with the System Setting screen page 1/2. Consequently, you can change these setup data items of the System Setting screen by pressing the key in Instant Measure mode, rather than by calling the TOP MENU screen and then the System Setting screen.

8.5 Setup Data Items of Instant Measure Mode

Setup Data Items of Instant Measure Mode

To select/deselect data items to be saved/printed, select between the ON and OFF options of each of the fields "VOLT.," "AMP.," "POWER" and "EVENT INPUT" (four items as a group).

For voltage and current, information saved/printed differs depending on the type of wiring. See the following table.

Data Items to Be Saved/Printed

| Wiring | Group | Saved/Printed Items |
|------------------------------|-----------------------------|--|
| 1 ϕ 2W | Voltage Current Power | V1 I1 Active power, reactive power, apparent power, power factor, phase angle, frequency |
| 1 ϕ 3W (3 ϕ 3W) | Voltage Current Power | V1 V2 (V3) (Unbalance factor) I1 I2 (I3) Active power, reactive power, apparent power, power factor, phase angle, frequency |
| 3 ϕ 3W3i | Voltage Current Power | V1 V3 Unbalance factor I1 I2 I3 Active power, reactive power, apparent power, power factor, phase angle, frequency |
| 3 ϕ 4W | Voltage Current Power | V1 V2 V3 Unbalance factor I1 I2 I3 Active power, reactive power, apparent power, power factor, phase angle, frequency |
| Event input | | Status H/L of event input |

The data items "voltage" and "current" take rms values.

(Group of items)

| SAVE/PRINT ITEM | |
|-----------------|------|
| VOLT. | : ON |
| AMP. | : ON |
| POWER | : ON |
| EVENT INPUT: | ON |

With the relevant F key, select the ON or OFF option. (Default: All items are set to ON.)

F1 : ON

F2 : OFF

• When wired to a 2-load system

F1 : ON-1 (Load 1 only)

F2 : ON-2 (Load 2 only)

F3 : ALL (both Loads 1 and 2)

F4 : OFF

TIP

Even if you set data items to be saved/printed, they are not saved/printed if the LOGGING setup data item is set to OFF.

8.6 Computational Expressions

The computational expressions used for the Instant Measure mode are as follows.

- **Rms-value Voltage**

$$V_{\text{rms}} = \sqrt{\frac{1}{T} \int_0^T v(t)^2 dt} = \sqrt{\frac{1}{T} \sum_{\text{eff}} v(t)^2}$$

- **Rms-value Current**

$$I_{\text{rms}} = \sqrt{\frac{1}{T} \int_0^T i(t)^2 dt} = \sqrt{\frac{1}{T} \sum_{\text{eff}} i(t)^2}$$

- **Active Power**

$$P = \frac{1}{T} \int_0^T v(t) \times i(t) dt = \frac{1}{T} \sum_{\text{eff}} v(t) \times i(t)$$

- **Reactive Power**

With reactive power meter method.

$$Q = \frac{-1}{T} \int_0^T v(t) \times i\left(t + \frac{T}{4}\right) dt = \frac{-1}{T} \sum_{\text{eff}} v(t) \times i\left(t + \frac{T}{4}\right)$$

$v(t), i(t)$: Input signal
 T : One period input signal

Polarity
 Lag : +
 Lead: -

- **Three-phase Unbalance Factor**

$$\text{Unbalance factor} = \frac{V_b}{V_a} \times 100 \%$$

- For 3 ϕ 3W

$$V_a = \sqrt{\frac{1}{6} (V_{12}^2 + V_{23}^2 + V_{31}^2) + \frac{2}{\sqrt{3}} \sqrt{V_s (V_s - V_{12})(V_s - V_{23})(V_s - V_{31})}}$$

$$V_b = \sqrt{\frac{1}{6} (V_{12}^2 + V_{23}^2 + V_{31}^2) - \frac{2}{\sqrt{3}} \sqrt{V_s (V_s - V_{12})(V_s - V_{23})(V_s - V_{31})}}$$

$$V_s = \frac{1}{2} (V_{12} + V_{23} + V_{31})$$

V_{12}, V_{23}, V_{31} : line-to-line voltages for the 3 ϕ 3W.

- For 3 ϕ 4W

In the equations, V_{12}, V_{23}, V_{31} for the 3 ϕ 3W are substituted with V_{1n}, V_{2n}, V_{3n} , respectively.

8.6 Computational Expressions

Computational Expressions of Instant Measure Mode

The CW140 performs the computations summarized below by using the measured values of V, A, W and Q variables.

| | Reactive Power 2 (Without reactive power meter method.) | Apparent Power | Power Factor | Phase Angle |
|------------------------------|---|---|---|---|
| 1φ2W | $Q = \sqrt{(VA)^2 - P^2}$ | $VA = V \times A$ | With reactive power meter: $P / \sqrt{P^2 + Q^2}$ | If the reactive power method is used: $\cos^{-1}(P / \sqrt{P^2 + Q^2})$ |
| | | | Without reactive power meter: P / VA | If the reactive power method is not used: $\cos^{-1}(P / VA)$ |
| 1φ3W | $Q_i = \frac{\sqrt{(VA_i)^2 - P_i^2}}{i=1, 2}$ $\Sigma Q = Q_1 + Q_2$ | $VA_i = V_i \times A_i$ $i=1, 2$ $\Sigma VA = VA_1 + VA_2$ | With reactive power meter: $\frac{\Sigma P}{\sqrt{(\Sigma P)^2 + (\Sigma Q)^2}}$ | With reactive power meter: $\cos^{-1}\left(\frac{\Sigma P}{\sqrt{(\Sigma P)^2 + (\Sigma Q)^2}}\right)$ |
| 3φ3W | $Q_i = \frac{\sqrt{(VA_i)^2 - P_i^2}}{i=1, 3}$ $\Sigma Q = Q_1 + Q_3$ | $VA_i = V_i \times A_i$ $i=1, 3$ $\Sigma VA = \sqrt{3}/2 (VA_1 + VA_3)$ | | |
| 3φ3W3i | $Q_i = \frac{\sqrt{(VA_i)^2 - P_i^2}}{i=1, 3}$ $\Sigma Q = Q_1 + Q_3$ | $VA_i = V_i \times A_i$ $i=1, 3$ $\Sigma VA = \sqrt{3}/2 (VA_1 + VA_3)$ | Without reactive power meter: $\Sigma P / \Sigma VA$ | Without reactive power meter: $\cos^{-1}(\Sigma P / \Sigma VA)$ |
| 3φ4W | $Q_i = \frac{\sqrt{(VA_i)^2 - P_i^2}}{i=1, 2, 3}$ $\Sigma Q = Q_1 + Q_2 + Q_3$ | $VA_i = V_i \times A_i$ $i=1, 2, 3$ $\Sigma VA = VA_1 + VA_2 + VA_3$ | | |
| Limits of computation | The rating depends on the ranges of variables V and A. | The rating depends on the ranges of variables V and A. | -1 to +1 | -180 to +180 |
| Read-out resolution | Same as that of active power. | Same as that of active power. | ±1.000 | ±180.0 |

TIP

- In the case of distorted-wave input, the result of computation may differ from that of any other instrument that uses a different measuring principle.

Polarities of Active Power, Reactive Power, Power Factor and Phase Angle

| | Lag | | Lead | | |
|------------------|-----|----|------|----|-----|
| Phase difference | 180 | 90 | 0 | 90 | 180 |
| Active power | - | + | + | - | - |
| Reactive power | + | + | - | - | - |
| Power factor | - | + | - | - | + |
| Phase angle | - | + | - | - | + |

- The phase lag or lead means that of current in reference to voltage.
- Even if the reactive power method is not used, the polarities of reactive power 2, power factor and phase angle are determined by those of reactive power 1.

9.1 Data Items on Electric Energy Measure Mode Screen

In Electric Energy Measure mode, you set the starting and ending times of integration. Then, the CW140 measures/calculates the amount of electric energy (integrated value) consumed during that interval, and shows the value. (This screen can be switched to a screen of instantaneous values.)

● Display of Measured/Calculated Values

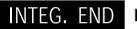
Electric energy (Wh)
 Regenerative energy (Wh)
 Lagging reactive energy (Varh)
 Leading reactive energy (Varh)

● Selection of Regenerative Energy

Regenerative energy: Refers to the amount of integrated regenerative power whose polarity is reverse to that of active power. You can select whether or not to indicate the regenerative energy.

Press the  (SETUP) key in the Electric Energy Measure mode to show page 1/3 of the setting screen. Select the ON or OFF option. (Default: OFF - Not indicated -)

● Display of Information on Integration

The CW140 shows the ,  and  marks in the upper-middle area of the display. It also shows information on the start and end of integration in the lower section of the display. Information shown on the display varies depending on whether the CW140 is ready for integration, is performing integration or has finished integration, or how it starts or stops integration.

If you want to show setup conditions (WIRING, V RANGE, A RANGE and FREQUENCY SOURCE data items) in the integration information area, press the ,  or  key. Pressing the same key once again, or pressing the  or  key returns to the view of integration information.

● Electric Energy Measure Mode Screen

Press the  key to show the TOP MENU screen.

Using the  key, select  (ELEC. ENERGY MEASURE)

9.1 Data Items on Electric Energy Measure Mode Screen

Then, press the  key. ----->

The Electric Energy Measure Mode screen appears.

Display of measured/calculated values ----->

Display of setup conditions ----->

ELEC.ENERGY **LOAD1** **INTEGRATING** 18:00:00

Wh : 12. 345MWh

REGEN. Wh : 0.123MWh

Varh-LAG- : 1. 234MVarh

Varh-LEAD- : 0. 123MVarh

[PASSAGE TIME] 200h 00m 00s

Stop by the 'STOP' key.

START : 2000/01/01 10:00

STOP : MANUAL

| | | | | |
|---------|-------|------|----------|------|
| INSTANT | SETUP | FILE | LOAD_CHG | HOLD |
|---------|-------|------|----------|------|

● Display of Electric Energy Value

Display of Electric energy can select the position of decimal point and unit of measurement.

This selection can be set on page 2/3 of setup screen for Electric energy measurement mode.

| Selection items of position of decimal point | Selection items of unit of measurement |
|--|--|
| STANDARD 000.000 0000.00 00000.0 000000 | Wh kWh MWh GWh |

When selecting STANDARD for position of decimal point, the position of decimal point and unit of measurement are automatically set following table.

| Rated power × VT ratio × CT ratio (× demand period time: hours)* | Position of decimal point and unit of measurement |
|---|---|
| 1 to 9.999 W | 0.00 to 9999.99 Wh |
| 10 to 99.99 W | 0.0 to 99999.9 Wh |
| 100 to 999.9 W | 0.000 to 999.999 kWh |
| 1 to 9.999 kW | 0.00 to 9999.99 kWh |
| 10 to 99.99 kW | 0.0 to 99999.9 kWh |
| 100 to 999.9 kW | 0.000 to 999.999 MWh |
| 1 to 9.999 MW | 0.00 to 9999.99 MWh |
| 10 to 99.99 MW | 0.0 to 99999.9 MWh |
| 100 to 999.9 MW | 0.000 to 999.999 GWh |
| 1 to 9.999 GW | 0.00 to 9999.99 GWh |
| 10 to 99.99 GW | 0.0 to 99999.9 GWh |
| 100 to 999.9 MW | 0 to 999999 GWh |
| 1 to 9.999 TW | 0 to 999999 GWh |
| 10 to 99.99 TW | 0 to 999999 GWh |
| 100 to 999.9 TW | 0 to 999999 GWh |

When the value exceeds the maximum displayable value, the display value will be reset to zero (e.g. 999.999 kWh → 0.000 kWh).

● Display of Instantaneous Values

With the  key, you can show the measured/calculated values of detailed Instant Measure mode data items (except for the unbalance factor).

9.2 Working with the Function Keys

This section explains how the function keys for the Electric Energy Measure mode work.

 (CHANGE): Switches between the INTEGRATE and INSTANT display modes.

 (SETUP): Shows setup data items of the Electric Energy Measure mode (see Section 9.4, "Setup Data Items of Electric Energy Measure Mode") on pages 1/3, 2/3 and 3/3 of the ENERGY SET screen.



: Selects from the data items.

 to : Changes or set the value.

 (NEXT): Moves to the next page (screen).

: Confirms the setting.

: Cancels the setting.

 (FILE): Enables you to use the file functions (see Chapter 13, "File Functions").

 (LOAD): Reads a file from internal memory/floppy disk.

 (SAVE): Saves a file in internal memory/on floppy disk.

 (PRINT): Prints data (DISP VAL, SET ITEM and SETUP data items).

 (LOAD_CHG): Switches between Load 1 and Load 2 (if the wiring is for a 2-load system).

 (HOLD/CLR): Holds the on-screen readings or clears the integrated values.

Holding: The screen shows the **HOLD** mark in the upper-middle area of the display. (Only the hold function is available during integration.)

Clearing: Hold down the  key for more than 3 seconds. The following message appears. Measurement data will be cleared.

Measurement data will be cleared.
Proceed?
ENTER: YES ESC: NO

Press the  key to clear the integrated values.

Press the  key to cancel clearance.

TIP

If you clear integrated values, all the readings of electric energy, regenerative energy, lagging reactive energy and leading reactive energy are reset to zero (0). (The reading of the PASSAGE TIME data item is also reset to zero.)

9.3 Integration in Electric Energy Measure Mode

This section explains how to start/stop continuous measurement (integration) or output data in the Electric Energy Measure mode.

● Procedure for Starting Integration

-  (TIME): Enters the starting time (default is the current time).
-  (TRIGGER) - Control: Allows you to control integration by inputting a signal to the START/STOP input terminals.
-  (MANUAL): Allows you to start integration by pressing the  key. The default for this key is "Manual".

● Procedure for Stopping Integration

-  (TIME): Enters the ending time.
-  (TIMER): Enters the time taken from the start to the end of integration.
-  (TRIGGER) - Control: Allows you to control integration by inputting a signal to the START/STOP input terminals.
-  (MANUAL): Allows you to stop integration by pressing the  key. The default for this key is "Manual".

Setting the time:

Use the  key to move through the fields of the date and time setting, as shown below.

2000 / 01 / 01 / hour : minute
Year ↔ Month ↔ Day ↔ Hour ↔ Minute

-  (+): Increment
 -  (-): Decrement
- Input a value.

Setting the time:

Use the  key to move through the fields of the time setting, as shown below.

0000 h / 00 m / 00 s
Hour (and no. of digits) ↔ Minute ↔ Second

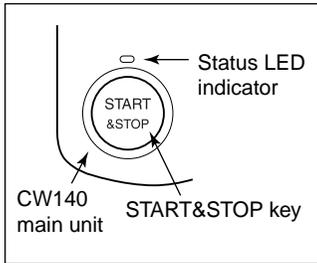
-  (+): Increment
 -  (-): Decrement
- Input a value.

You can set the interval from the starting to the ending time, in 10-second increments, to a maximum of 1000 hours.

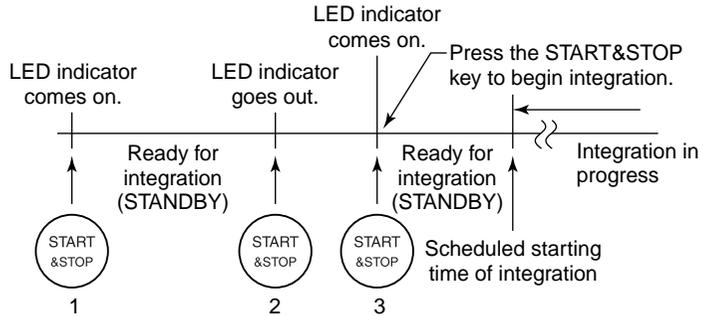
Holding down the  (+) or  (-) key during input of a value, increases the speed with which the value changes.

● **Start of Integration**

Even if you have finished setting the time and commanded the start of integration by an external trigger, integration does not begin unless you press the  key (status LED indicator comes on). Integration begins only when setting of the time has been completed, the START&STOP key has been pressed, and the **STANDBY** mark comes on.



Location of START&STOP key and LED indicator



- 1 Indicates the status in which the starting time of integration is set and that the CW140 is ready for integration.
- 2 Indicates the status in which the START&STOP key is pressed and that the LED indicator comes on.
- 3 Indicates that the START&STOP key should be pressed one more time to begin integration.

TIP

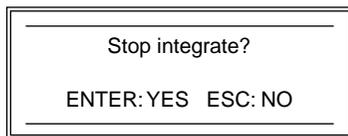
- The changing of settings is not allowed during integration (viewing only).
- The setting of a time that precedes the current time is not allowed. In addition, the CW140 shows an error message if, after time setting, the preset starting time of integration has expired before integration begins.

● **End of Integration**

If the end of integration has been specified by setting the time or using a timer, the CW140 automatically stops integration and the **INTEG. END** mark appears when the preset time is up.

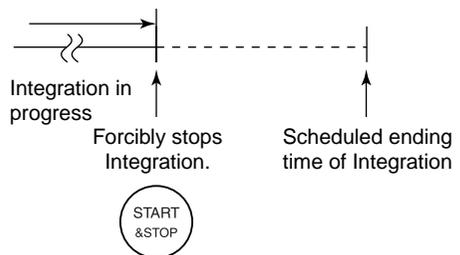
- Forcibly stopping integration before the preset time is up

Press the START&STOP key.
The following message appears.



To stop Integration, press the  key.

To cancel the procedure for stopping Integration, press the  key.



9.3 Integration in Electric Energy Measure Mode

● **Outputting Integrated Data**

This paragraph explains how to output data acquired during an interval from the start to the end of integration. You can change/define settings related to data output by pressing the  (SETUP) key in the Electric Energy Measure mode.

- **Data Output Setting**

DATA OUTPUT: Select from the ON and OFF options.

- **Condition Settings for Data Output (with "DATA OUTPUT" set to ON)**

OUTPUT INTERVAL: Set a value between 2 minutes and 1000 hours, in 1-minute increments.

OUTPUT MEDIA: Select:

 "MEMORY" to save in internal memory;

 "FD" to save on a floppy disk; or

 "PRINTER" to print.

FILENAME: Type the file name of data to be saved.

SAVE/PRINT ITEM: Select the data item to be saved or printed.

SEE ALSO

Section 9.4, "Setup Data Items of Electric Energy Measure Mode," for details on the setup data items.

TIP

You are not allowed to set the time interval from the start to the end of integration at a value smaller than the OUTPUT INTERVAL setpoint. If you set such a value, the CW140 shows an error message when you press the  key.

9.4 Setup Data Items of Electric Energy Measure Mode

Press the **F2** (SETUP) key in the Electric Energy Measure mode. The ENERGY SET 1/3 screen appears.

● Screen Configuration and Setup Data Items

The Energy Setting screen consists of pages 1/3, 2/3 and 3/3.

Each page lists setup data items, as shown below.

| | | | |
|-----------------|-----|------------|--------------|
| ENERGY SET 1/3 | | 2000/01/01 | 00:00:00 |
| REGEN. ENERGY | : | OFF | |
| INTEGRATE START | : | TIME | |
| | | 2000/01/01 | 18:00 |
| INTEGRATE STOP | : | TRIGGER | |
| DATA OUTPUT | : | ON | |
| OUTPUT INTERVAL | : | 0000h 30m | |
| MEDIA | | | |
| MEMORY | : | ON | REST : 897kB |
| FD | : | OFF | |
| PRINTER | : | OFF | |
| FILE NAME | : | | |
| ON | OFF | | NEXT |

Page 1/3

Regenerative energy
Integration start/Integration stop
Data output
Output interval*
Output medium*
Filename*

Page 2/3

Items to be saved/printed
D/A output
Integrated value output rate
Display of Electric energy

Page 3/3

Reactive power method
Frequency source
Low-pass filter
VT ratio
CT ratio
Clamp selection
Number of averaging cycles

* Shown only if "DATA OUTPUT" is set to ON.

TIP

The "D/A output" setup data item on the Energy Setting screen page 2/3 is visible only if the CW140 is equipped with a D/A output option.

- Show each setting screen with the **F5** (NEXT) key, as explained below.



9.4 Setup Data Items of Electric Energy Measure Mode

● Basic Setting/Changing Operations

- Selection of setup data item to be set/changed

Using the  key, select the setup data item to be changed. (The item is highlighted.)

For more information, see the tables of setup data items that follow.

- Press the relevant  key to change the setting.
The functionality corresponding to each function key varies depending on the selected setup data item.
- Press the  key to make changes to the next page.
- Pressing the  key completes your settings. (The display changes to a measurement screen.)
- If none of the settings needs to be changed, press the  key. The display changes to a measurement screen.

TIP

-
- The changing of settings is not allowed when the CW140 is in a stand-by state or is performing integration (only viewing is allowed).
-

Setup Data Items of Electric Energy Measure Mode

Table 1 of Setup Data Items

| Page | Setup Data Item | Items to Be Selected | See Also | Default |
|---|--|--|--|--|
| 1/3 | REGENERATIVE ENERGY | (ON): Indicated. (OFF): Not indicated. | "Selection of Regenerative Energy" on page 9-1 | OFF: Not indicated. |
| | INTEGRATE START METHOD | (TIME) (TRIGGER) (MANUAL) | Section 9.3, Integration in Electric Energy Measure Mode | INTEGRATE START METHOD: MANUAL |
| | INTEGRATE STOP METHOD | (TIME) (TIMER) (TRIGGER) (MANUAL) | | INTEGRATE STOP METHOD: MANUAL |
| | | When setting the time: Lets you move through the fields of the date and time setting. Year ↔ Month ↔ Day ↔ Hour (+): Increment (-): Decrement Input a value. | | |
| | | When setting the timer: Lets you move through the fields of the time setting to set a value, in 10-second increments, to a maximum of 1000 hours. Hour (and no. of digits) ↔ Minute ↔ Second (+): Increment (-): Decrement Input a value. | | |
| | DATA OUTPUT | (ON): Data output is enabled. (OFF): Data output is disabled. | | OFF: Data output is disabled. |
| | OUTPUT INTERVAL (Only effective if "DATA OUTPUT" is set to ON) | Set to a value between 2 minutes and 1000 hours in 1-minute increments. Lets you move through the digits. (+): Increment (-): Decrement Input a value. | | 30 min (Only effective if "DATA OUTPUT" is set to ON) |
| OUTPUT MEDIA (Only effective if "DATA OUTPUT" is set to ON) | MEMORY: FD: PRINTER: Select from these options with the (ON) and (OFF) keys. | | MEMORY | |
| FILENAME (Only effective if "DATA OUTPUT" is set to ON) MEMORY/FD | Not designated: Named automatically as shown below. AWTN XXXX.CSV Designated: 000 to 999 (CHANGE) : Enters a name of no more than 8 alphanumeric characters. | Section 6.2, "File name and File attribute" Section 6.3, "Entering a File Name" | Not designated | |

TIP

The Energy Setting screen page 3/3 of the Electric Energy Measure mode partially shares the same setup data items with the System Setting screen page 1/2. Consequently, you can change these setup data items of the System Setting screen by pressing the key in Electric Energy Measure mode, rather than by calling the TOP MENU screen and then the System Setting screen.

9.4 Setup Data Items of Electric Energy Measure Mode

Setup Data Items of Electric Energy Measure Mode

Table 2 of Setup Data Items

| Page | Setup Data Item | Items to Be Selected | See Also | Default |
|------|---|--|---|----------------------|
| 2/3 | SAVE/PRINT ITEM | Select between ON and OFF under each of the VOLTAGE, CURRENT, POWER and EVENT INPUT data items.  ON For a 2-load system, use the  OFF  to  keys. | "Data Items to Be Saved/Printed" on page 9-11 | ON for all items |
| | D/A OUTPUT (Optional) | Select from among CH1 to CH4.  (CHANGE)  Selects the channel. Shows options in the middle of the screen.  Confirms the selection. | Section 14.1, "Optional D/A Output" | OFF for all channels |
| | INTEGRATION RATE (If D/A output is enabled) | Pressing the  key shows a screen for rate selection. 1 V/5 kWh, 1 V/10 kWh, 1 V/50 kWh, 1 V/100 kWh, 1 V/500 kWh, 1 V/1 MWh  Selects the rate.  Confirms the selection. | | 1 V/5 kWh |
| | ENERGY DISPLAY | <ul style="list-style-type: none"> Position of decimal point Pressing the  key shows a screen for selection. STANDARD 000.000 0000.00 00000.0 000000  Select the position of decimal point.  Confirms the selection. | | STANDARD |
| | <ul style="list-style-type: none"> Unit of measurement Pressing the  key shows a screen for selection. Wh kWh MWh GWh  Selects the unit of measurement.  Confirms the selection. | | kWh | |

Setup Data Items of Electric Energy Measure Mode

Table 3 of Setup Data Items

| Page | Setup Data Item | Items to Be Selected | See Also | Default |
|------|--|---|---|--|
| 3/3 | REACTIVE POWER METHOD |  (ON): The method is used.  (OFF): The method is not used. | Section 8.6, "Computational Expressions" | OFF: The method is not used. |
| | FREQUENCY SOURCE |  Press to change the setting. Options appear in the middle of the screen.  Selects the desired option.  Confirms the selection. | Section 7.5, "Frequency Measurement and Low-pass Filters" | V1 |
| | LOWPASS FILTER (for frequency measurement) |  (ON): The filter is inserted.  (OFF): The filter is not inserted. | Section 7.5, "Frequency Measurement and Low-pass Filters" | OFF |
| | VT RATIO (Ratio of voltage transformation) | Set to a value between 1 and 10000.  Moves the cursor through the digits.  (+): Increment  (-): Decrement Input a value. | Section 7.7, "Scaling Function" | 1 |
| | CT RATIO (Ratio of current transformation) | Set to a value between 0.01 and 10000.  Moves the cursor through the digits.  (+): Increment  (-): Decrement Input a value. | Section 7.7, "Scaling Function" | 1 |
| | CLAMP SELECTION |  (20 – 200 A): Clamp A  (200 – 1000 A): Clamp B  (50 – 500 A): Clamp C | "Selecting Clamp Type" under "Current Range" on page 7-6 | 20 – 200 A (Clamp A) |
| | NUMBER OF AVERAGE |  (+): Cycles through OFF → 2 → 3 → ... 10 → OFF.  (-): Cycles through OFF → 10 → 9 → ... 2 → OFF. | Section 7.6, "Averaging Function" | OFF: The averaging function is not used. |

9.4 Setup Data Items of Electric Energy Measure Mode

Setup Data Items of Electric Energy Measure Mode

To select/deselect data items to be saved/printed, select between the ON and OFF options of each of the fields "VOLT.," "AMP.," "POWER," "ELEC. ENERGY" and "EVENT INPUT" (five items as a group).

For voltage and current, information saved/printed differs depending on the type of wiring. See the following table.

Data Items to Be Saved/Printed

| Wiring | Group | Saved/Printed Items |
|------------------------------|--|---|
| 1 ϕ 2W | Voltage Current Power Electric energy | V1 I1 Active power, reactive power, apparent power, power factor, phase angle, frequency Active electric energy, regenerative energy, lagging reactive electric energy, leading reactive electric energy |
| 1 ϕ 3W (3 ϕ 3W) | Voltage Current Power Electric energy | V1 V2 (V3) I1 I2 (I3) Active power, reactive power, apparent power, power factor, phase angle, frequency Active electric energy, regenerative energy, lagging reactive electric energy, leading reactive electric energy |
| 3 ϕ 3W3i | Voltage Current Power Electric energy | V1 V3 I1 I2 I3 Active power, reactive power, apparent power, power factor, phase angle, frequency Active electric energy, regenerative energy, lagging reactive electric energy, leading reactive electric energy |
| 3 ϕ 4W | Voltage Current Power Electric energy | V1 V2 V3 I1 I2 I3 Active power, reactive power, apparent power, power factor, phase angle, frequency Active electric energy, regenerative energy, lagging reactive electric energy, leading reactive electric energy |
| Event input | | Status H/L of event input |

The data items "voltage" and "current" take rms values.

9.4 Setup Data Items of Electric Energy Measure Mode

| SAVE/PRINT ITEM | |
|-----------------|------|
| VOLT. | : ON |
| AMP. | : ON |
| POWER | : ON |
| ELECTRIC ENERGY | : ON |
| EVENT INPUT | : ON |

With the relevant key, select the ON or OFF option. (Default: All items are set to ON.)

: ON

: OFF

• When wired to a 2-load system

: ON-1 (Load 1 only)

: ON-2 (Load 2 only)

: ALL (both Loads 1 and 2)

: OFF

TIP

Even if you set data items to be saved/printed, they are not saved/printed if the DATA OUTPUT setup data item is set to OFF.

10.1 Simple Electric Energy Measurement with Key

With the  key, electric energy can soon be measured without starting from the TOP MENU screen. The setting screen presented by the  key consists of the LAST CONDITION screen and SETTING CONDITION screens 1 to 4. These SETTING CONDITION screens are given condition settings beforehand, which can be changed and saved as necessary.

● Defaults of Condition Settings

The defaults of SETTING CONDITION screens 1 to 4 are the same as those of the setup data items of the Electric Energy Measure mode, except for the wiring settings shown below.

| SETTING CONDITION 1 | SETTING CONDITION 2 | SETTING CONDITION 3 | SETTING CONDITION 4 |
|---------------------|---------------------|---------------------|---------------------|
| 1φ2W | 1φ3W | 3φ3W | 3φ4W |

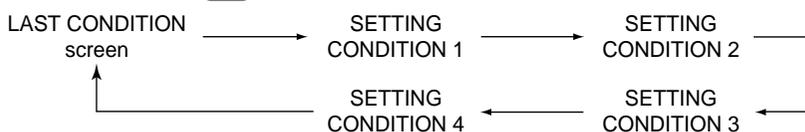
SEE ALSO

Section 9.4, "Setup Data Items of Electric Energy Measure Mode"

● Information of Each Setting

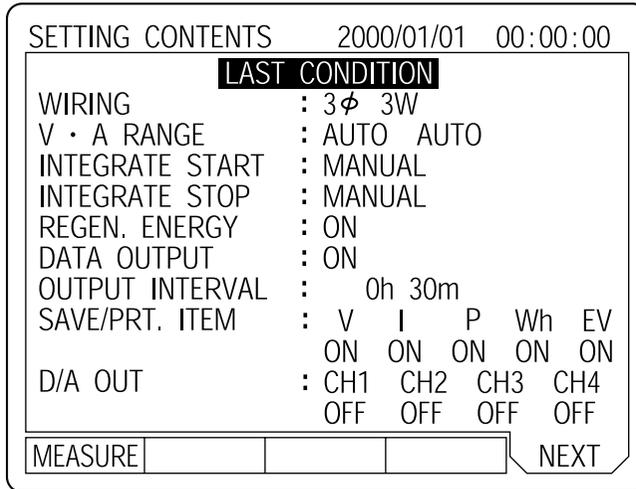
Pressing the  key shows a screen of condition settings. The setting screen consists of the LAST CONDITION screen and SETTING CONDITION screens 1 to 4.

Each press of the  key cycles through the screens, as shown below.



● **Taking Measurements under the Preset Setup Conditions**

To take measurements under the on-screen preset setup conditions, press the  (MEASURE) key. The display changes to a measurement screen. Using the  (SETUP) key of the measurement screen, set the starting/ending times of integration and other data items necessary for electric energy measurement.



● **Measurement**

Display the setup conditions screen necessary to perform your measurement. Pressing the  (MEASURE) key changes to a measurement screen. The actual procedure of this measurement is the same as that of electric energy measurement discussed in Chapter 9. For details on how to set/change such settings as the start/end of integration, use the  (SETUP) key.

SEE ALSO

"Setup Data Items of Electric Energy Measure Mode" on pages 9-7 to 9-13, for more information on the setup data items.

● **Symbol Description**

The following table lists the symbols shown under the SAVE/PRINT ITEM field of the SETTING CONTENTS screen.

| Symbol | V | I | P | Wh | EV |
|----------------|----------|----------|----------|-----------------|-------------|
| Group of Items | Voltage | Current | Power | Electric energy | Event input |

SEE ALSO

"Data Items to Be Saved/Printed" in the paragraph, "Setup Data Items of Electric Energy Measure Mode," on page 9-12.

11.1 About Demand

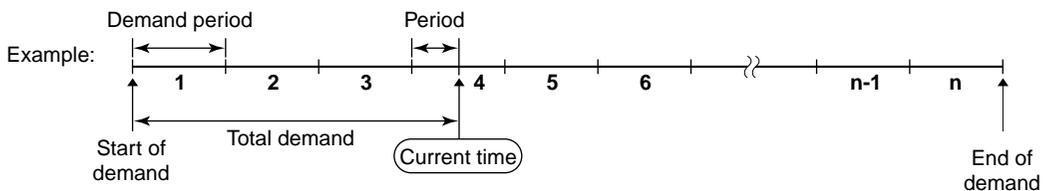
● **Demand**

Demand period: Defined as the length of time specified to determine average power.

The CW140 is designed so that you can set a demand period. (Default of demand period: 30 minutes)

Demand: An average of power consumed during a demand period.

Maximum demand: The maximum value of a demand that occurs during a measurement interval.



TIP

Even if the demand ceases during a demand period, the measured value is not numerically affected at all since the CW140 calculates average power by dividing it by a time length.

● **Reference Power**

You can set a value of reference power between 1 and 1000 kW. (See Section 11.5, "Setup Data Items of Demand Measure Mode.")

If the demand exceeds the preset reference power, the **DEM.OVER** mark appears. The mark disappears each time the CW140 enters a demand period. This mark appears even after the end of demand if there has been a case that the demand has exceeded the reference power.

11.2 Data Items Shown on Demand Measure Mode Screen

In the Demand Measure mode, the interval from the start to the end of demand is segmented into demand periods and the CW140 measures, calculates and indicates the demand.

● Display of Measured/Calculated Values

| Display During Demand Interval | On-screen Data Items | Display at the End of Demand |
|---|--|--|
| Maximum demand (Time of occurrence) | Maximum demand (Time of occurrence) | Maximum demand (Time of occurrence) |
| Demand of one demand period earlier | Demand | Average demand |
| Electric energy integrated since the start of demand | Total | Electric energy integrated from the start to the end of demand |
| Electric energy integrated during the current demand period | Period | — |
| Power factor | Power Fc (factor) | Average power factor |
| Load factor | Load Fc (factor) | Average load factor |

$$\text{Load factor} : \frac{\text{Demand power}}{\text{Reference power}}$$

When the reactive power method is used, the average power factor is not multiplied by a polarity sign.

● Display of Electric Energy Value

Display of Electric Energy of following two items can select the position of decimal point and unit of measurement.

TOTAL: Electric Energy since the start of demand

PERIOD: Electric Energy of demand period

This selection can be set on page 2/3 of setup screen for Electric energy measurement mode.

| Selection items of position of decimal point | Selection items of unit of measurement |
|--|--|
| STANDARD 000.000 0000.00 00000.0 000000 | Wh kWh MWh GWh |

When selecting STANDARD, the position of decimal point and unit of measurement are automatically set.

See the table in "Electric Energy" on Page 7-10.

< Section 7.3, "Ranges and Number of Digits" >

● Display of Instantaneous Values

With the  key, you can show the measured/calculated values of detailed Instant Measure mode data items (except for the unbalance factor).

● **Display of Information on Demand Measurement**

The CW140 shows the **STANDBY**, **DEMAND** and **DEMAND END** marks in the upper-middle area of the display. It also shows information on the start and end of demand in the lower section of the display. Information shown on the display varies depending on whether the CW140 is ready for demand measurement, is performing demand measurement or has finished demand measurement, or how it starts or stops demand measurement.

If you want to show the setup conditions (WIRING, V RANGE, A RANGE and FREQUENCY SOURCE data items) in the demand information area, press the **WIRING**, **V RANGE** or **A RANGE** key. Pressing the same key once again, or pressing the **ENTER** or **Esc** key returns to a view of demand measurement information.

● **Demand Measure Mode Screen**

Press the **TOP MENU** key to show the TOP MENU screen.

Using the  cursor key, select  (DEMAND MEASURE).

Then, press the **ENTER** key. ----->
The Dmand Measure Mode screen appears.

Display of measured/calculated values ----->

Display of Demand information ----->

| | | | |
|----------------------------------|--------------------|---------------|-----------------|
| DEMAND | LOAD1 | DEMAND | 18:00:00 |
| MAX. DEMAND : 60.00kW | | | |
| DATE : 2000/01/01 14:30 | | | |
| DEMAND : 57.00kW [ACTIVE ENERGY] | | | |
| POWER FC : | 0.866 | TOTAL : | 12.345MWh |
| LOAD FC : | 57.0% | PERIOD : | 0.026kWh |
| [DEMAND REST TIME] | | | 0h 30m 00s |
| Stop by the 'STOP' key. | | | |
| START | : 2000/01/01 10:00 | | |
| STOP | : MANUAL | | |
| INSTANT | SETUP | FILE | LOAD_CHG HOLD |

11.3 Working with the Function Keys

This section explains how the function keys for Demand Measure mode work.

 (CHANGE): Switches between the DEMAND and INSTANT display modes.

 (SETUP): Shows setup data items of the Demand Measure mode (see Section 11.5, "Setup Data Items of Demand Measure Mode") on pages 1/3, 2/3 and 3/3 of the DEMAND SET screen.

: Selects from the data items.

 to : Changes or set the value.

 (NEXT): Moves to the next page (screen).

: Confirms the setting.

: Cancels the setting.

 (FILE): Enables you to use the file functions (see Chapter 13, "File Functions").

 (LOAD): Reads a file from internal memory/floppy disk.

 (SAVE): Saves a file in internal memory/on floppy disk.

 (PRINT): Prints data (DISP VAL, SET ITEM and SETUP data items).

 (LOAD_CHG): Switches between Load 1 and Load 2 (if the wiring is for a 2-load system).

 (HOLD/CLR): Holds the on-screen readings or clears the integrated values.

Holding: The screen shows the **HOLD** mark in the upper-middle area of the display. (Only the hold function is available during integration.)

Clearing: Hold down the  key for more than 3 seconds. The following message appears.

Measurement data will be cleared.
Proceed?
ENTER: YES ESC: NO

Press the  key to clear the integrated values.

Press the  key to cancel clearance.

11.4 Demand Measurement in Demand Measure Mode

This section explains how to start/stop continuous measurement (demand measurement) or output data in the Demand Measure mode.

● Procedure for Starting Integration

-  (TIME): Enters the starting time (default is the current time).
-  (TRIGGER) - Control: Allows you to control demand by inputting a signal to the START/STOP input terminals.
-  (MANUAL): Allows you to start demand by pressing the  key. The default for this key is "Manual".

● Procedure for Stopping Integration

-  (TIME): Enters the ending time.
-  (TIMER): Enters the time taken from the start to the end of demand.
-  (TRIGGER) - Control: Allows you to control demand by inputting a signal to the START/STOP input terminals.
-  (MANUAL): Allows you to stop demand by pressing the  key. The default for this key is "Manual".

Setting the time:

Use the  key to move through the fields of the date and time setting, as shown below.

2000 / 01 / 01 / hour : minute

Year ↔ Month ↔ Day ↔ Hour ↔ Minute

-  (+): Increment
 -  (-): Decrement
- Input a value.

Setting the time:

Use the  key to move through the fields of the time setting, as shown below.

0000 h / 00 m / 00 s

Hour (and no. of digits) ↔ Minute ↔ Second

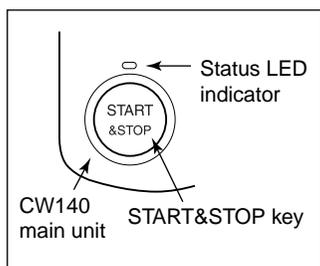
-  (+): Increment
 -  (-): Decrement
- Input a value.

You can set the interval from the starting to the ending time, in 10-second increments, to a maximum of 1000 hours.

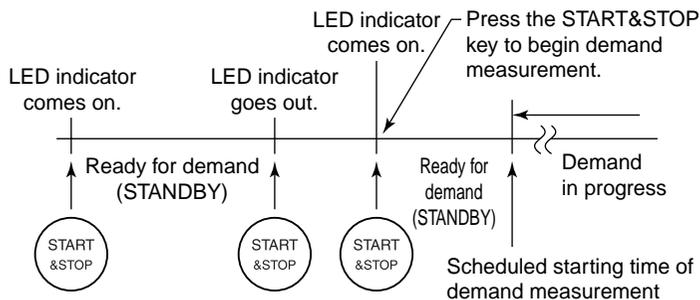
Holding down the  (+) or  (-) key during input of a value, increases the speed with which the value changes.

● **Start of Demand Measurement**

Even if you have finished setting the time and commanded the start of demand measurement by an external trigger, demand measurement does not begin unless you press the  key (status LED indicator comes on). Demand measurement only begins when setting of the time has been completed, the START&STOP key has been pressed, and the **STANDBY** mark comes on.



Location of START&STOP key and LED indicator



- 1 Indicates the status in which the starting time of demand measurement is set and that the CW140 is ready for demand measurement.
- 2 Indicates the status in which the START&STOP key is pressed and that the LED indicator is turned on.
- 3 Indicates that the START&STOP key should be pressed one more time to begin demand measurement.

TIP

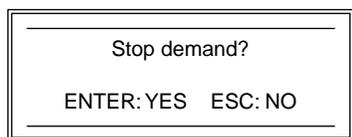
- The changing of settings is not allowed during demand measurement (viewing only).
- The setting of a time that precedes the current time is not allowed. In addition, the CW140 shows an error message if, after time setting, the preset starting time of demand measurement has expired before demand measurement begins.

● **End of Demand Measurement**

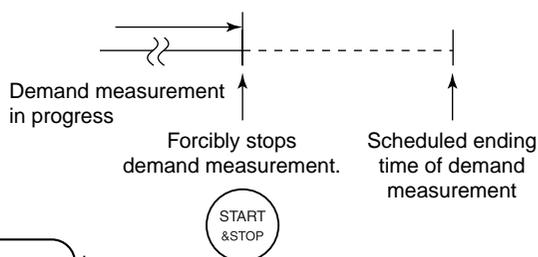
If the end of demand measurement has been specified by setting the time or using a timer, the CW140 automatically stops demand measurement and the **DEMAND END** mark appears when the preset time is up.

- Forcibly stopping demand measurement before the preset time is up

Press the START&STOP key.
The following message appears.



To stop demand measurement, press the  key.



To cancel the procedure for stopping demand measurement, press the  key.

● Outputting Demand Data

This paragraph explains how to output data acquired during an interval from the start to the end of demand measurement. You can change/define settings related to data output by pressing the  (SETUP) key in the Demand Measure mode.

- Data Output Setting

DATA OUTPUT: Select from the ON and OFF options.

- Condition Settings for Data Output (with "DATA OUTPUT" set to ON)

OUTPUT INTERVAL: Same as the demand period setpoint (no setup data item is shown).

For the demand period, select from:

5, 10, 15 and 30 minutes or 1, 2, 3, 4, 6, 8, 10 and 12 hours.

OUTPUT MEDIA: Select:

"MEMORY" to save in internal memory;

"FD" to save on a floppy disk; or

"PRINTER" to print.

FILENAME: Type the file name of data to be saved.

SAVE/PRINT ITEM: Select the data item to be saved or printed.

SEE ALSO

Section 11.5, "Setup Data Items of Demand Measure Mode," for details on the setup data items.

TIP

You are not allowed to set the time interval from the start to the end of demand at a value smaller than the DEMAND PERIOD setpoint. If you set such a value, the CW140 shows an error message when you press the  key.

11.5 Setup Data Items of Demand Measure Mode

Press the **F2** (SETUP) key in Demand Measure mode. The DEMAND SET 1/3 screen appears.

● Screen Configuration and Setup Data Items

The Demand Setting screen consists of pages 1/3, 2/3 and 3/3. Each page lists setup data items, as shown below.

| | | |
|-----------------|------------|------------------|
| DEMAND SET 1/3 | 2000/01/01 | 00:00:00 |
| REFERENCE POWER | : 0001 | kW |
| DEMAND PERIOD | : 0h 30m | |
| DEMAND START | : TIME | |
| | | 2000/01/01 18:00 |
| DEMAND STOP | : TRIGGER | |
| DATA OUTPUT | : ON | |
| MEDIA | | |
| MEMORY | : ON | REST : 897kB |
| FD | : OFF | |
| PRINTER | : OFF | |
| FILE NAME | : | |
| + - | | NEXT |

Page 1/3

Reference power
Demand period
Demand start/Demand stop
Data output
Output medium*
Filename*

Page 2/3

Items to be saved/printed
D/A output
Integrated value output rate
Total of electric energy
Electric energy of demand period

Page 3/3

Reactive power method
Frequency source
Low-pass filter
VT ratio
CT ratio
Clamp selection
Number of averaging cycles

*Shown only if "Data output" is set to ON.

TIP

The "D/A output" setup data items on Demand Setting screen page 2/3 are visible only if the CW140 is equipped with a D/A output option.

- Show each setting screen with the **F5** (NEXT) key, as explained below.



● Basic Setting/Changing Operations

- Selection of setup data item to be set/changed
Using the  key, select the setup data item to be changed. (The item is highlighted.)
For more information, see the tables of setup data items that follow.
- Press the relevant  key to change the setting.
The functionality corresponding to each function key varies depending on the selected setup data item.
- Press the  key to make changes to the next page.
- Pressing the  key completes your settings. (The display changes to a measurement screen.)
- If none of the settings needs to be changed, press the  key. The display changes to a measurement screen.

TIP

-
- The changing of settings is not allowed when the CW140 is in a stand-by state or is performing demand measurement (only viewing is allowed).
-

11.5 Setup Data Items of Demand Measure Mode

Setup Data Items of Demand Measure Mode

Table 1 of Setup Data Items

| Page | Setup Data Item | Items to Be Selected | See Also | Default |
|------|--|--|---|-------------------------------|
| 1/3 | REFERENCE POWER | Set a value between 1 and 1000 kW. (+): Increment (-): Decrement | "Reference Power" on page 11-1 | 100 kW |
| | DEMAND PERIOD (Same as "OUTPUT INTERVAL and effective only when "DATA OUTPUT" is set to ON) | 5, 10, 15 or 30 min, or 1, 2, 3, 4, 6, 8, 10 or 12 hr. (+): (-): Select from the options above. | | 30 min |
| | DEMAND START | (TIME) (TRIGGER) (MANUAL) | Section 11.4, "Demand Measurement in Demand Measure Mode" | DEMAND START : MANUAL |
| | DEMAND STOP | (TIME) (TIMER) (TRIGGER) (MANUAL) When setting the time: Lets you move through the fields of the date and time setting. Year ↔ Month ↔ Day ↔ Hour (+): Increment (-): Decrement Input a value. When setting the timer: Lets you move through the fields of the time setting to set a value, in 10-second increments, to a maximum of 1000 hours. Hour (and no. of digits) ↔ Minute ↔ Second (+): Increment (-): Decrement Input a value. | | DEMAND STOP : MANUAL |
| | DATA OUTPUT | (ON): Data output is enabled. (OFF): Data output is disabled. | | OFF: Data output is disabled. |
| | OUTPUT MEDIA (Only effective if "DATA OUTPUT" is set to ON) | MEMORY: Select from these options with the (ON) and (OFF) keys. FD: PRINTER: | | MEMORY |
| | FILENAME (Only effective if "DATA OUTPUT" is set to ON) MEMORY/FD | Not designated: Named automatically as shown below. ADEM XXX.CSV Designated: (CHANGE) : Enters a name of no more than 8 alphanumeric characters. | Section 6.2, "File name and File attribute" Section 6.3, "Entering a File Name" | Not designated |

TIP

The Demand Setting screen page 3/3 of Demand Measure mode partially shares the same setup data items with the System Setting screen page 1/2. Consequently, you can change these setup data items of the System Setting screen by pressing the key in Demand Measure mode, rather than by calling the TOP MENU screen and then the System Setting screen.

Setup Data Items of Demand Measure Mode

Table 2 of Setup Data Items

| Page | Setup Data Item | Items to Be Selected | See Also | Default |
|---|---|--|--|----------------------|
| 2/3 | SAVE/PRINT ITEM | Select between "ON" and "OFF" under each of the VOLTAGE, CURRENT, POWER, DEMAND and EVENT INPUT data items.  ON For a 2-load system, use the  OFF  to  keys. | "Data Items to Be Saved/Printed" on page 11-13 | ON for all items |
| | D/A OUTPUT (Optional) | Select from among CH1 to CH4.  (CHANGE)  Selects the channel. Shows options in the middle of the screen.  Confirms the selection. | Section 14.1, "Optional D/A Output" | OFF for all channels |
| | INTEGRATION RATE (If D/A output is enabled) | Pressing the  key shows a screen for rate selection. 1 V/5 kWh, 1 V/10 kWh, 1 V/50 kWh, 1 V/100 kWh, 1 V/500 kWh, 1 V/1 MWh  Selects the rate.  Confirms the selection. | | 1 V/5 kWh |
| | TOTAL ENERGY | <ul style="list-style-type: none"> Position of decimal point Pressing the  key shows a screen for selection. STANDARD 000.000 0000.00 00000.0 000000  Select the position of decimal point.  Confirms the selection. | | STANDARD |
| | | <ul style="list-style-type: none"> Unit of measurement Pressing the  key shows a screen for selection. Wh kWh MWh GWh  Selects the unit of measurement.  Confirms the selection. | | kWh |
| | PERIOD ENERGY | <ul style="list-style-type: none"> Position of decimal point Pressing the  key shows a screen for selection. STANDARD 000.000 0000.00 00000.0 000000  Select the position of decimal point.  Confirms the selection. | | STANDARD |
| <ul style="list-style-type: none"> Unit of measurement Pressing the  key shows a screen for selection. Wh kWh MWh GWh  Selects the unit of measurement.  Confirms the selection. | | | kWh | |

11.5 Setup Data Items of Demand Measure Mode

Setup Data Items of Demand Measure Mode

Table 3 of Setup Data Items

| Page | Setup Data Item | Items to Be Selected | See Also | Default |
|------|--|---|--|--|
| 3/3 | REACTIVE POWER METHOD |  (ON): The method is used.  (OFF): The method is not used. | Section 8.6, "Computational Expressions" | OFF: The method is not used. |
| | FREQUENCY SOURCE |  Press to change the setting. Options appear in the middle of the screen.  Selects the desired option.  Confirms the selection. | Section 7.5, "Frequency Measurement and Low-pass Filters" | V1 |
| | LOWPASS FILTER (for frequency measurement) |  (ON): The filter is inserted.  (OFF): The filter is not inserted. | Section 7.5, "Frequency Measurement and Low-pass Filters" | OFF |
| | VT RATIO (Ratio of voltage transformation) | Set to a value between 1 and 10000.  Moves the cursor through the digits.  (+): Increment  (-): Decrement Input a value. | Section 7.7, "Scaling Function" | 1 |
| | CT RATIO (Ratio of current transformation) | Set to a value between 0.01 and 10000.  Moves the cursor through the digits.  (+): Increment  (-): Decrement Input a value. | Section 7.7, "Scaling Function" | 1 |
| | CLAMP SELECTION |  (20 – 200 A): Clamp A  (200 – 1000 A): Clamp B  (50 – 500 A): Clamp C | "Selecting Clamp Type" under "• Current Range" on page 7-6 | 20 – 200 A (Clamp A) |
| | NUMBER OF AVERAGE |  (+): Cycles through OFF → 2 → 3 → ... 10 → OFF.  (-): Cycles through OFF → 10 → 9 → ... 2 → OFF. | Section 7.6, "Averaging Function" | OFF: The averaging function is not used. |

Setup Data Items of Demand Measure Mode

To select/deselect data items to be saved/printed, select between the ON and OFF options of each of the fields "VOLT.," "AMP.," "POWER," "ELEC. ENERGY," "DEMAND" and "EVENT INPUT" (six items in a group).

For voltage and current, information saved/printed differs depending on the type of wiring. See the following table.

Data Items to Be Saved/Printed

| Wiring | Group | Saved/Printed Items |
|----------------|--|--|
| 1φ2W | Voltage Current Power Electric energy Demand | V1 I1 Active power, reactive power, apparent power, power factor, phase angle, frequency Active electric energy Power demand, maximum power demand |
| 1φ3W (3φ3W) | Voltage Current Power Electric energy Demand | V1 V2 (V3) I1 I2 (I3) Active power, reactive power, apparent power, power factor, phase angle, frequency Active electric energy, Power demand, maximum power demand |
| 3φ3W3i | Voltage Current Power Electric energy Demand | V1 V3 I1 I2 I3 Active power, reactive power, apparent power, power factor, phase angle, frequency Active electric energy Power demand, maximum power demand |
| 3φ4W | Voltage Current Power Electric energy Demand | V1 V2 V3 I1 I2 I3 Active power, reactive power, apparent power, power factor, phase angle, frequency Active electric energy Power demand, maximum power demand |
| Event input | | Status H/L of event input |

The data items "voltage" and "current" take rms values.

11.5 Setup Data Items of Demand Measure Mode

| SAVE/PRINT ITEM | |
|-----------------|------|
| VOLT. | : ON |
| AMP. | : ON |
| POWER | : ON |
| ELEC. ENERGY | : ON |
| DEMAND | : ON |
| EVENT INPUT | : ON |

With the relevant F key, select the ON or OFF option. (Default: All items are set to ON.)

F1 : ON

F2 : OFF

• When wired to a 2-load system

F1 : ON-1 (Load 1 only)

F2 : ON-2 (Load 2 only)

F3 : ALL (both Loads 1 and 2)

F4 : OFF

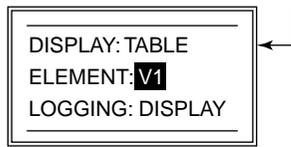
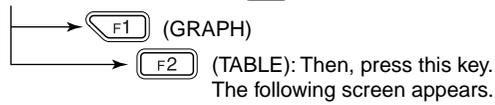
TIP

Even if you set data items to be saved/printed, they are not saved/printed if the DATA OUTPUT setup data item is set to OFF.

12.1 Showing Tables in Harmonics Measure Mode

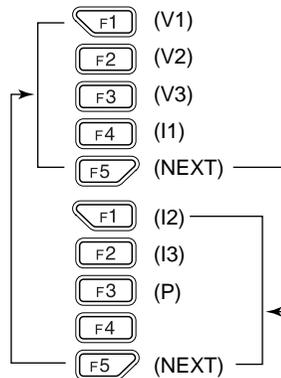
● Selecting from Options of MEASURE ELEMENT Data Item for a Table

In Harmonics Measure mode, press  (DISP.).



With the  key,

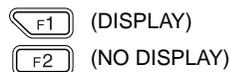
select from the following options of the **ELEMENT** field.



(Available options differ depending on the type of wiring.)

With the  key,

you can select between the DISPLAY and NO DISPLAY options of the **LOGGING** field.



After selection, press the  key to confirm the selection.

The display shows a table.

Press the  key to cancel the selection.

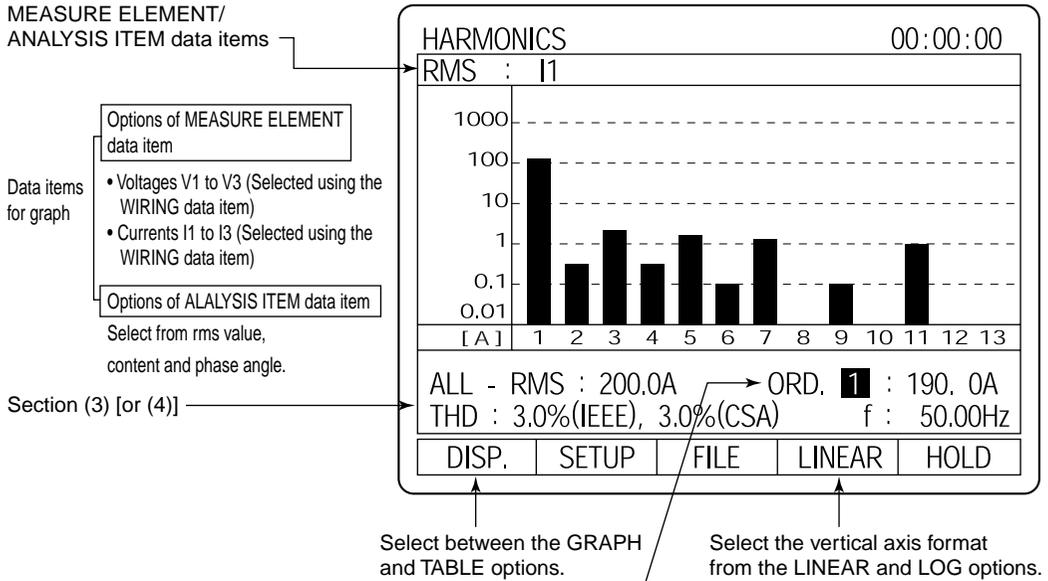
TIP

The LOGGING data item is shown only when "LOGGING" is set to ON.

12.2 Showing Graphs in Harmonics Measure Mode

You can represent the data item selected for the MEASURE ELEMENT/ ANALYSIS ITEM field as a bar graph of 1st- through 13th-order harmonics.

● **When the MEASURE ELEMENT Data Item Is Voltage or Current**



* This field shows the height of a selected bar in the bar graph of 1st- through 13th-order harmonics.

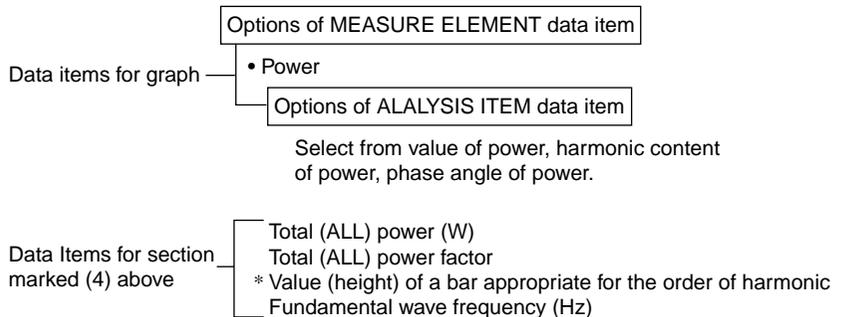


With the key,

you can change the order of harmonic from 1st through 13th. This field shows a value appropriate for the selected order.

- Data items for section marked (3) above
- Total (ALL) rms value (V)
 - Total (ALL) rms value (A)
 - Total Harmonic Distortion
 - Distortion factors - IEEE (%) and CSA (%)
 - * Value (height) of a bar appropriate for the order of harmonic
 - Fundamental wave frequency(Hz)

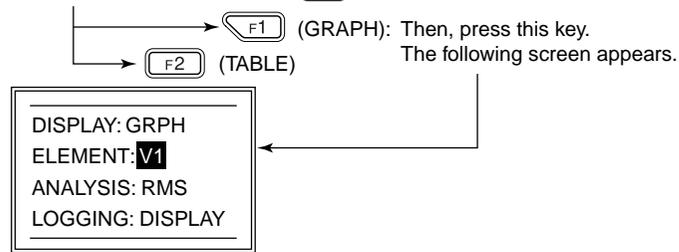
● **When the MEASURE ELEMENT Data Item Is Power**



12.2 Showing Graphs in Harmonics Measure Mode

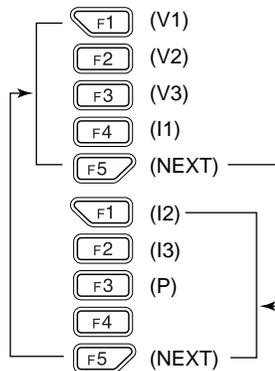
● Selecting from Options of MEASURE ELEMENT and ANALYSIS ITEM Screens for a Graph

In Harmonics Measure mode, press  (DISP.).



With the  key,

select from the following options of the **ELEMENT** field.



(Available options differ depending on the type of wiring.)

With the  key,

select from the following options of the **ANALYSIS** field.

When the MEASURE ELEMENT Data Item Is Voltage or Current

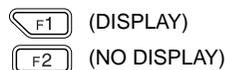


When the MEASURE ELEMENT Data Item Is Power



With the  key,

you can select between the DISPLAY and NO DISPLAY options of the **LOGGING** field.



After selection, press the  key to confirm the selection.

The display shows a table.

Press the  key to cancel the selection.

TIP

The LOGGING data item is shown only when "LOGGING" is set to ON.

12.3 Working with the Function Keys

This section explains how the function keys for the Harmonics Measure mode work.

 (CHANGE): Switches between GRAPH and TABLE display modes (see Sections 12.1 and 12.2, "Showing Tables in Harmonics Measure Mode" and "Showing Graphs in Harmonics Measure Mode").

 (SETUP): Shows setup data items of the Harmonics Measure mode (see Section 12.5, "Setup Data Items of Harmonics Measure Mode") on pages 1/2 and 2/2 of the HARM. SET screen.



: Selects from the data items.

 to : Changes or sets the value.

 (NEXT): Moves to the next page (screen).

: Confirms the setting.

: Cancels the setting.

 (FILE): Enables you to use the file functions (see Chapter 13, "File Functions").

 (LOAD): Reads a file from internal memory/floppy disk.

 (SAVE): Saves a file in internal memory/on floppy disk.

 (PRINT): Prints data (DISP VAL, SET ITEM and SETUP data items).

 • If labeled as "TABLE"; Changes the order of harmonic by selecting between the ODD and EVEN options.

• If labeled as "GRAPH"; Changes the vertical axis format by selecting between the LINEAR and LOG options.

 (HOLD): Holds the on-screen readings.

Holding: The screen shows the **HOLD** mark in the upper-middle area of the display.

12.4 Logging in Harmonics Measure Mode

Using the logging function, you can continuously take measurements and save data. (To save data, set "LOGGING" to ON and select the output destination, or use the file function.)

● Procedure for Starting Logging

-  (TIME): Enters the starting time (default is the current time).
-  (TRIGGER) - Control: Allows you to control logging by inputting a signal to the START/STOP input terminals.
-  (MANUAL): Allows you to start logging by pressing the  key. The default for this key is "Manual".

● Procedure for Stopping Logging

-  (TIME): Enters the ending time.
-  (TIMER): Enters the time taken from the start to the end of logging.
-  (TRIGGER) - Control: Allows you to control logging by inputting a signal to the START/STOP input terminals.
-  (MANUAL): Allows you to stop logging by pressing the  key. The default for this key is "Manual".

Setting the time:

Use the  key to move through the fields of the date and time setting, as shown below.

2000 / 01 / 01 / hour : minute

Year ↔ Month ↔ Day ↔ Hour ↔ Minute

-  (+): Increment
 -  (-): Decrement
- Input a value.

Setting the time:

Use the  key to move through the fields of the time setting, as shown below.

0000 h / 00 m / 00 s

Hour (and no. of digits) ↔ Minute ↔ Second

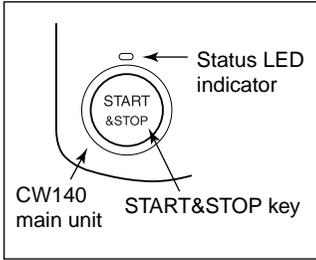
-  (+): Increment
 -  (-): Decrement
- Input a value.

You can set the interval from the starting to the ending time, in 10-second increments, to a maximum of 1000 hours.

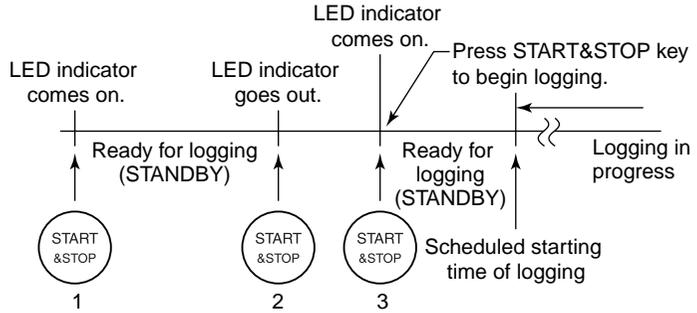
Holding down the  (+) or  (-) key during input of a value, increases the speed with which the value changes.

● **Start of Logging**

Even if you have finished setting the time and commanded the start of logging by an external trigger, logging does not begin unless you press the  key (status LED indicator comes on). Logging begins only when setting of the time has been completed, the START&STOP key has been pressed, and the **STANDBY** mark comes on.



Location of START&STOP key and LED indicator



- 1 Indicates the status in which the starting time of logging is set and that the CW140 is ready for logging.
- 2 Indicates the status in which the START&STOP key is pressed and that the LED indicator comes on.
- 3 Indicates that the START&STOP key should be pressed one more time to begin logging.

TIP

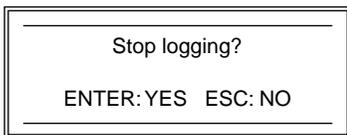
- The changing of settings is not allowed during logging (viewing only).
- The setting of a time earlier than the current time is not allowed. In addition, the CW140 shows an error message if, after time setting, the preset starting time of logging has already expired before logging begins.

● **End of Logging**

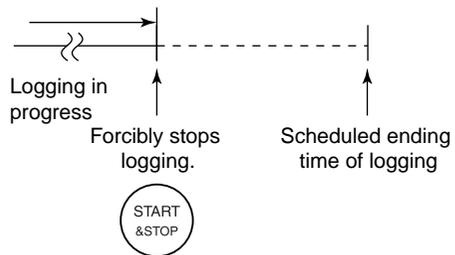
If end of logging is specified by setting the time or using a timer, the CW140 automatically stops logging and the **LOGGING END** mark appears when the preset time is up.

- Forcibly stopping logging before the preset time is up

Press the START&STOP key.
The following message appears.



To stop logging, press the  key.



To cancel the procedure for stopping logging, press the  key.

12.4 Logging in Harmonics Measure Mode

● Viewing Logging Information

The CW140 shows the **STANDBY** , **LOGGING** and **LOGGING END** marks in the upper-middle area of the display. It also shows information on the start and end of logging in the lower section of the display. Information shown on the display varies depending on whether the CW140 is ready for logging, is performing logging or has finished logging, or how it starts or stops logging.

If you want to show setup conditions (WIRING, V RANGE, A RANGE and FREQUENCY SOURCE data items) in the logging information area (bottom edge of the display), press the **WIRING**, **V RANGE** or **A RANGE** key. Pressing the same key once again, or pressing the **ENTER** or **ESC** key returns to the view of logging information.

● Outputting Logged Data

This paragraph explains how to output data acquired during an interval from the start to the end of logging. You can change/define settings related to data output by pressing the **F2** (SETUP) key in the Instant Measure mode.

• Logging Setting

LOGGING: Select from the ON and OFF options.

• Condition Settings for Data Output (with "LOGGING" set to ON)

OUTPUT INTERVAL: Set a value between 2 minutes and 1000 hours, in 1-minute increments.

OUTPUT MEDIA: Select:

"MEMORY" to save in internal memory;

"FD" to save on a floppy disk; or

"PRINTER" to print.

FILENAME: Type the file name of data to be saved.

SAVE/PRINT ITEM: Select the data item to be saved or printed.

SEE ALSO

Section 12.5, "Setup Data Items of Harmonics Measure Mode," for details on the setup data items.

TIP

You are not allowed to set the time interval from the start to the end of logging at a value smaller than the OUTPUT INTERVAL setpoint. If you set such a value, the CW140 shows an error message when you press the **ENTER** key.

12.5 Setup Data Items of Harmonics Measure Mode

Press the **F2** (SETUP) key in the Harmonics Measure mode. Page 1/2 of the Harmonics Setting screen (HARM. SET 1/2) appears.

● Screen Configuration and Setup Data Items

The Harmonics Setting screen consists of pages 1/2 and 2/2. Each page lists setup data items, as shown below.

| | | | |
|-----------------|-----|---------------------|--------------|
| HARM. SET 1/2 | | 2000/01/01 00:00:00 | |
| LOGGING | : | ON | |
| LOGGING START | : | MANUAL | |
| LOGGING STOP | : | MANUAL | |
| OUTPUT INTERVAL | : | 0000h 30m | |
| MEDIA MEMORY | : | ON | REST : 897kB |
| FD | : | OFF | |
| PRINTER | : | OFF | |
| FILE NAME | : | | |
| SAVE/PRT. ITEM | : | CHANGE ITEM | |
| D/A OUTPUT | : | CHANGE ITEM | |
| ON | OFF | | NEXT |

Page 1/2

Logging
 Logging start*/Logging stop*
 Output interval*
 Output medium*
 Filename*
 Items to be saved/printed
 D/A output

Page 2/2

Reactive power method
 Frequency source
 Low-pass filter
 VT ratio
 CT ratio
 Clamp selection

*Shown only if "LOGGING" is set to ON.

TIP

The "D/A output" setup data item on the Instant Setting screen page 1/2 is visible only if the CW140 is equipped with a D/A output option.

- Show each page of the screen with the **F5** (NEXT) key, as explained below.



12.5 Setup Data Items of Harmonics Measure Mode

● Basic Setting/Changing Operations

- Selection of setup data item to be set/changed
Using the  key, select the setup data item to be changed. (The item is highlighted.)
For more information, see the tables of setup data items that follow.
- Press the relevant  key to change the setting.
The functionality corresponding to each function key varies depending on the selected setup data item.
- Press the  key to make changes to the next page.
- Pressing the  key completes your settings. (The display changes to a measurement screen.)
- If none of the settings needs to be changed, press the  key. The display changes to a measurement screen.

TIP

-
- The changing of settings is not allowed when the CW140 is in a stand-by state or is performing logging (only viewing is allowed).
-

Setup Data Items of Harmonics Measure Mode

Table 1 of Setup Data Items

| Page | Setup Data Item | Items to Be Selected | See Also | Default |
|--------------------------|--|--|--|--|
| 1/2 | LOGGING | (ON): Logging is enabled. (OFF): Logging is disabled. | | OFF |
| | LOGGING START METHOD (Only effective if "LOGGING" is set to ON) | (TIME) (TRIGGER) (MANUAL) | Section 12.4, "Logging in Instant Measure Mode" | LOGGING START METHOD: MANUAL |
| | LOGGING STOP METHOD | (TIME) (TIMER) (TRIGGER) (MANUAL) | | LOGGING STOP METHOD: MANUAL |
| | | When setting the time: Lets you move through the fields of the date and time setting. Year ↔ Month ↔ Day ↔ Hour (+): Increment (-): Decrement Input a value. | | |
| | | When setting the timer: Lets you move through the fields of the time setting to set a value, in 10-second increments, to a maximum of 1000 hours. Hour (and no. of digits) ↔ Minute ↔ Second (+): Increment (-): Decrement Input a value. | | |
| | OUTPUT INTERVAL (Only effective if "LOGGING" is set to ON) | Set to a value between 2 minutes and 1000 hours in 1-minute increments. Lets you move through the digits. (+): Increment (-): Decrement Input a value. | | 30 min (Only effective if "LOGGING" is set to ON) |
| | OUTPUT MEDIA (Only effective if "LOGGING" is set to ON) | MEMORY: Select from these options with the (ON) and (OFF) keys. FD: PRINTER: | | MEMORY |
| | FILENAME (Only effective if "LOGGING" is set to ON) MEMORY/FD | Not designated: Named automatically as shown below. AHRM XXX.CSV 000 to 999 Designated: (CHANGE): Enters a name of no more than 8 alphanumeric characters. | Section 6.2, "File name and File attribute" Section 6.3, "Entering a File Name" | Not designated |
| SAVE/PRINT ITEM | (CHANGE) Shows options in the middle of the screen. (If the number of selected data items exceeds 250, an error will result.) Selects the channel. | "Save/Print items" on page 12-13 | ON for all items (Order of harmonics: The ODD option is set to ON.) | |
| D/A OUTPUT (Optional) | Select from among CH1 to CH4. (CHANGE) Shows options in the middle of the screen. Selects the channel. | Section 14.1, "Optional D/A Output" | OFF for all channels | |

12.5 Setup Data Items of Harmonics Measure Mode

Setup Data Items of Instant Measure Mode

Table 2 of Setup Data Items

| Page | Setup Data Item | Items to Be Selected | See Also | Default |
|------|--|---|--|---------------------------------|
| 3/3 | REACTIVE POWER METHOD |  (ON): The method is used.  (OFF): The method is not used. | Section 8.6, "Computational Expressions" | OFF: The method is not used. |
| | FREQUENCY SOURCE |  Press to change the setting. Options appear in the middle of the screen.  Selects the desired option.  Confirms the selection. | Section 7.5, "Frequency Measurement and Low-pass Filters" | V1 |
| | LOWPASS FILTER (for frequency measurement) |  (ON): The filter is inserted.  (OFF): The filter is not inserted. | Section 7.5, "Frequency Measurement and Low-pass Filters" | OFF |
| | VT RATIO (Ratio of voltage transformation) | Set to a value between 1 and 10000.  Moves the cursor through the digits.  (+): Increment  (-): Decrement Input a value. | Section 7.7, "Scaling Function" | 1 |
| | CT RATIO (Ratio of current transformation) | Set to a value between 0.01 and 10000.  Moves the cursor through the digits.  (+): Increment  (-): Decrement Input a value. | Section 7.7, "Scaling Function" | 1 |
| | CLAMP SELECTION |  (20 – 200 A): Clamp A  (200 – 1000 A): Clamp B  (50 – 500 A): Clamp C | "Selecting Clamp Type" under "• Current Range" on page 7-6 | 20 – 200 A (Clamp A) |

TIP

The Instant Setting screen page 2/2 of Harmonics Measure mode partially shares the same setup data items with the System Setting screen page 1/2. Consequently, you can change these setup data items of the System Setting screen by pressing the  key in Harmonics Measure mode, rather than by calling the TOP MENU screen and then the System Setting screen.

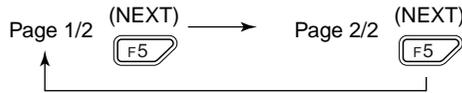
Setup Data Items of Harmonics Measure Mode (Save/Print items)

To select/deselect data items to be saved/printed, select between the ON and OFF options of each of the fields "SELECT ITEM," "SELECT ELEMENT," "SELECT ORDER," "ALL-POWER," "ALL-P.F.," "EVENT INPUT" and "THD (IEEE)" and "THD (CSA)."

● **Configuration of Screen for Setting Output Options**

| Page 1/2 | Page 2/2 |
|----------------|-------------------|
| SELECT ITEM | SELECT ORDER |
| SELECT ELEMENT | ALL-P.F. |
| | EVENT INPUT |
| | THD (IEEE), (CSA) |

- Display each page of the screen with the  (NEXT) key, as explained below.



● **Changing the Settings**

- Page 1/2 of the screen

| | | | | | | |
|--|-------|---------|-------|---------|----|----|
| SELECT ITEM (Default: ON) | | | | | | |
| | RMS | CONTENT | PHASE | ALL-RMS | | |
| VOLT. | ON | ON | ON | ON | | |
| AMP. | ON | ON | ON | ON | | |
| | | | | | | |
| | POWER | CONTENT | PHASE | ALL-POW | | |
| POWER | ON | ON | ON | ON | | |
| | | | | | | |
| SELECT ELEMENT (Default: ON) | | | | | | |
| V1 | V2 | V3 | I1 | I2 | I3 | P |
| ON | ON | ON | ON | ON | ON | ON |
| Information provided by this screen differs depending on the type of wiring. | | | | | | |

With the  key,

select a data item or items under "SELECT ITEM" and/or "SELECT ELEMENT" that you want to change.

With the relevant  key, select between the ON and OFF options of the selected data item or items.

-  : ON
-  : OFF

12.5 Setup Data Items of Harmonics Measure Mode

- Page 2/2 of the screen

| SELECT ORDER (Default: The ODD option is set to ON.) | | | | | | |
|--|-----|-----|-----|-----|-----|-----|
| ORD. | 1 | 2 | 3 | 4 | 5 | 6 |
| ODD | ON | OFF | ON | OFF | ON | OFF |
| 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| ON | OFF | ON | OFF | ON | OFF | ON |

F1

F2

F3

F1 (ALL): Sets all orders to ON.

F2 (ODD): Sets all odd-numbered orders to ON and all even-numbered orders to OFF.

F3 (SELECT): Select ON/OFF for each order.



With the key, select the order whose setting you want to change.

F1 : ON

F2 : OFF

Change the setting.

The default of all four data items is ON, as shown below:

ALL-P.F. : ON

EVENT INPUT : ON

THD (IEEE) : ON

THD (CSA) : ON



With the key, select the order whose setting you want to change.

F1 : ON

F2 : OFF

Change the setting.

TIP

Even if you set data items to be saved/printed, they are not saved/printed if the LOGGING setup data item is set to OFF.

You are not allowed to set the SAVE/PRINT ITEM data item so that the number of selected data items exceeds 250. If you fail to follow this rule, the CW140 shows an error message.

12.6 Computational Expressions

The table below lists the computational expressions used for Harmonic Measure mode.

| | Equations |
|--|---|
| Voltage RMS Current RMS | $V_n = \sqrt{\frac{(V_{nr})^2 + (V_{ni})^2}{2}} \quad A_n = \sqrt{\frac{(A_{nr})^2 + (A_{ni})^2}{2}}$ |
| RMS nth order content | $\frac{\text{nth order RMS}}{\text{fundamental wave RMS}} \times 100\%$ |
| RMS phase angle | $\theta_n = (\text{nth order harmonic voltage phase}) - (\text{fundamental wave phase}) \times n$ $= \tan^{-1}\left(\frac{V_{nr}}{V_{ni}}\right) - \left\{ \tan^{-1}\left(\frac{V_{1r}}{V_{1i}}\right) \right\} \times n$ $\theta_n = (\text{nth order harmonic current phase}) - (\text{fundamental wave phase}) \times n$ $= \tan^{-1}\left(\frac{A_{nr}}{A_{ni}}\right) - \left\{ \tan^{-1}\left(\frac{A_{1r}}{A_{1i}}\right) \right\} \times n$ |
| Total Harmonic Distortion content IEEE: | $\text{THD(IEEE)} = \sqrt{\frac{\sum_{n=2}^{13} (\text{nth order harmonic voltage (current) RMS})^2}{(\text{fundamental wave voltage (current) RMS})^2}}$ |
| Total harmonic distortion content (CSA) | $\text{THD(CSA)} = \sqrt{\frac{\sum_{n=2}^{13} (\text{nth order harmonic voltage (current) RMS})^2}{\sum_{n=1}^{13} (\text{nth order harmonic voltage (current) RMS})^2}}$ |
| Power | $1\phi 2W \quad P_n = V_{nr} \times A_{nr} + V_{ni} \times A_{ni}$ $1\phi 3W \quad P_n = P_{1n} + P_{2n}$ $3\phi 3W \quad P_n = P_{1n} + P_{3n}$ $3\phi 4W \quad P_n = P_{1n} + P_{2n} + P_{3n}$ |
| Power nth order content | $\frac{\text{nth order active power}}{\text{fundamental wave active power}} \times 100\%$ |
| Power phase angle | <ul style="list-style-type: none"> • With reactive power meter method $\theta_{Pn} = \tan^{-1}\left(\frac{Q_n}{P_n}\right)$ $1\phi 2W \quad Q_n = V_{nr} \times A_{ni} - V_{ni} \times A_{nr}$ $1\phi 3W \quad Q_n = Q_{1n} + Q_{2n}$ $3\phi 3W \quad Q_n = Q_{1n} + Q_{3n}$ $3\phi 4W \quad Q_n = Q_{1n} + Q_{2n} + Q_{3n}$ • Without reactive power meter method $\theta_{Pn} = \cos^{-1}\left(\frac{P_n}{V_n A_n}\right)$ $1\phi 2W \quad V_n A_n = V_n \times A_n$ $1\phi 3W \quad V_n A_n = V_{1n} \times A_{1n} + V_{2n} \times A_{2n}$ $3\phi 3W \quad V_n A_n = \frac{\sqrt{3}}{2} (V_{1n} \times A_{1n} + V_{3n} \times A_{3n})$ $3\phi 4W \quad V_n A_n = V_{1n} \times A_{1n} + V_{2n} \times A_{2n} + V_{3n} \times A_{3n}$ |

12.6 Computational Expressions

| | Equations |
|-------------------------|--|
| All-RMS | $\sum_{n=1}^{13} V_n , \sum_{n=1}^{13} A_n$ |
| All-power | $\sum_{n=1}^{13} P_n$ |
| All-power factor | <ul style="list-style-type: none"> • With reactive power meter method $\frac{\sum_{n=1}^{13} P_n}{\sqrt{(\sum_{n=1}^{13} P_n)^2 + (\sum_{n=1}^{13} Q_n)^2}}$ <ul style="list-style-type: none"> • Without reactive power meter method $\frac{\sum_{n=1}^{13} P_n}{\sum_{n=1}^{13} P_n (V_n \times A_n)}$ |

Data representing 512 obtained samples are put through FFT calculations to analyze the nth order harmonic components as follows.

nth order harmonic voltage RMS V_n : (V_{nr} , V_{ni})

nth order harmonic current RMS A_n : (A_{nr} , A_{ni})

n : Number of orders

V_{nr}, A_{nr} : Real-number components following FFT calculation

V_{ni}, A_{ni} : Imaginary-number components following FFT calculation

$P_{1n}-P_{3n}$: Active power (element of nth order)

$Q_{1n}-Q_{3n}$: Reactive power (element of nth order)

RMS phase angle: Phase angle of nth order harmonic components relative to fundamental wave component of input signal

Power phase angle: nth order current phase relative to nth order voltage

● **Polarities of Data Items in Harmonics Measure Mode**

The polarities of data items "power," "phase angle of power" and "power factor" are as follows.

- With reactive power meter method:

| | Lag | | | Lead | |
|----------------------|-----|----|---|------|-----|
| Phase difference | 180 | 90 | 0 | 90 | 180 |
| Power | - | + | + | - | |
| Phase angle of power | + | + | + | - | |
| Power factor | - | + | + | + | |

- Without reactive power meter method:

| | Lag | | | Lead | |
|----------------------|-----|----|---|------|-----|
| Phase difference | 180 | 90 | 0 | 90 | 180 |
| Power | - | + | + | - | |
| Phase angle of power | + | + | + | + | |
| Power factor | - | + | + | - | |

- The phase lag or lead means that of current in reference to voltage.
- Direction of harmonic current

The direction of harmonic current can be identified according to the polarity of power, as shown below.

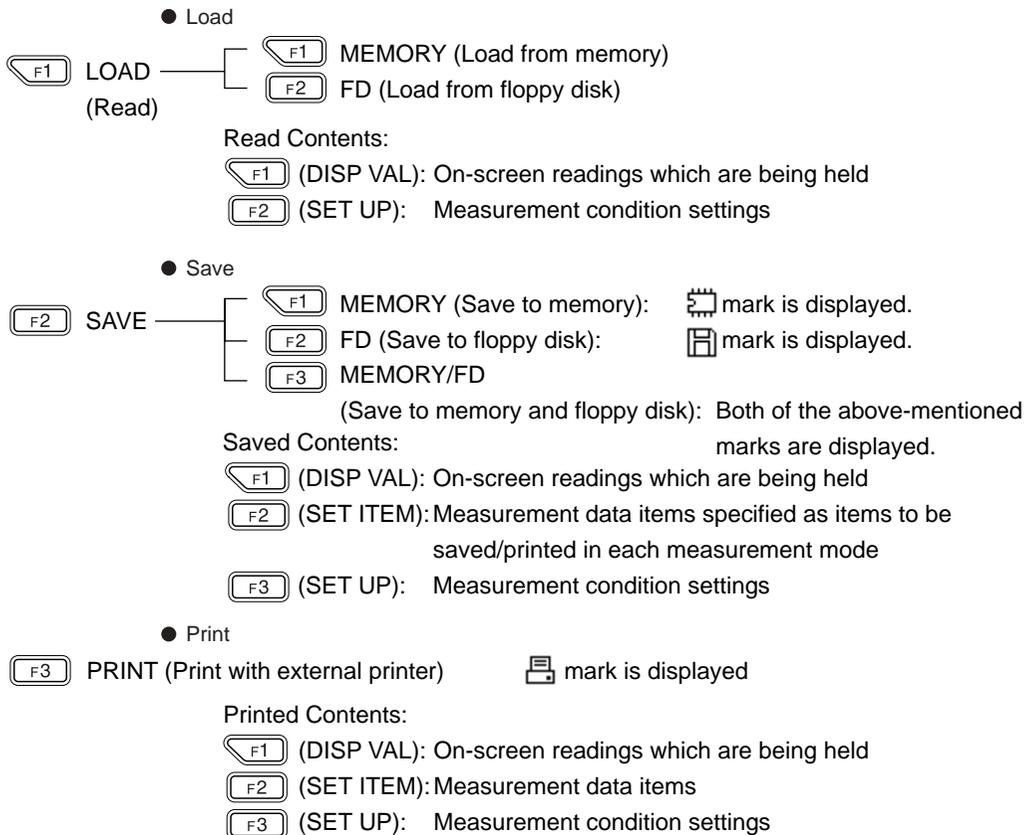
- If the polarity of power is positive (+), the current is flowing inward.
- If the polarity of power is negative (-), the current is flowing outward.

TIP

The CW140 calculates the Harmonics Measure-mode total rms values of voltage/current and power by summing the rms values of their respective fundamental wave components and 1st- through 13th-order harmonic components. Consequently, these total rms values may differ from those of the Instant Measure mode.

13.1 Saving, Loading and Printing with File Functions

In each measurement mode, pressing the  (FILE) key allows you to use the file functions.



TIP

Note that data are saved/printed only for the options of the SAVE/PRINT ITEM which were set to "ON".

- Saving/printing readings

If you use the file functions to save/print the readings without holding the screen from being updated, the following values are saved/printed:

The CW140 saves measured values obtained when the  key is pressed after entering a file name according to the file saving procedure.

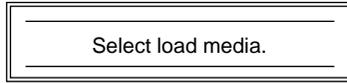
It also prints measured values specified when the data to be printed is selected by pressing one of the  to  keys according to the file printing procedure.

- To save/print screen settings currently displayed in each measurement mode, press the  (HOLD) key to stop the settings from being updated. Then press the  (FILE) key, and select either  (SAVE) or  (PRINT) key.

13.1 Saving, Loading and Printing with File Functions

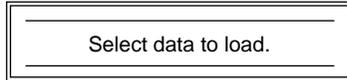
● Loading a File

To load a file, first press the  (LOAD) key. The following message appears.



Then, select:  (MEMORY), or
 (FD).

The following message appears.



Select:  (DISP VAL), or
 (SET UP).

Specify the data file to load.



: Use this key to select a file.



(NEXT): Press this key to go to the next page when there is more than one screen.



: Press this key to begin loading the file.

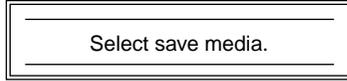
- When selecting "DISP VAL", the data values are displayed and updating stops.
- When pressing the  (NEXT) key, the screen returns to the state before loading was selected.
- When selecting "SET UP", the current settings are updated with the new settings.

TIP

When you select a file to load, files stored in other measurement modes are not displayed.

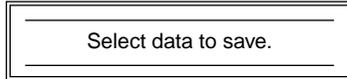
● **Saving a File**

To save a file, first press the  (SAVE) key. The following message appears.



Then, select:  (MEMORY),
 (FD), or
 (MEM/FD).

The following message appears.



Select:  (DISP VAL),
 (SET ITEM), or
 (SET UP).

Enter a file name.

The file name can consist of up to 8 alphanumeric characters (including symbols).

- If you do not enter any file name, the CW140 automatically names the file. You simply press the  key on Entering a File Name screen.
- For further details about entering a file name, "Entering a File Name."
 Press this key to save the file.

SEE ALSO

Section 6.2, "File Name and File Attribute" and Section 6.3, "Entering a File Name" for more information on file names.

13.1 Saving, Loading and Printing with File Functions

● Printing a File

To print a file, first press the  (PRINT) key. The following message appears.

Select data to print.

Select:  (DISP VAL),
 (SET ITEM), or
 (SET UP).

Printing begins.

TIP

If printing is selected but a printer is not correctly connected, RS-232C settings do not match the printer, or there is no paper in the printer, the printing request will not be recognized. Measurement will continue, however.

14.1 Optional D/A Output

You can equip the CW140 with a 4-channel D/A output block as an option.

● D/A Output Specifications

| | |
|-------------------|---|
| Output voltage | ±1 V of full scale for each range rating |
| Output current | ±1 mA Max. |
| Number of outputs | 4 |
| Output data | Selected from measurement data items of each measurement mode |
| Accuracy | ± (Measurement accuracy +0.5% of full scale) |
| Update period | Same as the display update period |

● D/A Output Settings

Setting screen page 2/2 of each measurement mode contains the setup data item "D/A output." By default, all of "CH1" to "CH4" are set to OFF.



In some modes, CH1 to CH4 may be displayed on separate lines.



Use this key to select the channel to change.



Pressing this (CHANGE) key displays the options that correspond to the wiring type and measurement mode.



Use this key to select a measurement data item to be output through the channel.



Press this key to confirm your selection of a data item to be output.



Pressing this key cancels your selection and returns to the setting screen.

TIP

The D/A output settings of the Harmonics Measure mode will be discussed later in this section.

14.1 Optional D/A Output

● Menu Items (and Their Symbols) of Instant Measure Mode

| | | | |
|------------------------------|----|----|----|
| Voltage | V1 | V2 | V3 |
| Current | I1 | I2 | I3 |
| Active power | P | | |
| Reactive power | Q | | |
| Apparent power | VA | | |
| Power factor | PF | | |
| Phase angle | PA | | |
| Three-phase unbalance factor | UR | | |
| Frequency | F | | |

<If wired to a two-load system>

| | Load 1 | Load 2 |
|------------------------------|---|----------------|
| Voltage V1, V2 and V3 | | Common |
| Current | I1-1 I2-1 I3-1 | I1-2 I2-2 I3-2 |
| Active power | P-1 | P-2 |
| Reactive power | Q-1 | Q-2 |
| Apparent power | VA-1 | VA-2 |
| Power factor | PF-1 | PF-2 |
| Phase angle | PA-1 | PA-2 |
| Three-phase unbalance factor | UR-1 | UR-2 |
| Frequency F | (Depends on the frequency source in the system settings.) | |

TIP

The menu items differ depending on the wiring.

● **Menu Items (and Their Symbols) of Electric Energy Measure Mode**

| | | | |
|-------------------------|-------|----|----|
| Voltage | V1 | V2 | V3 |
| Current | I1 | I2 | I3 |
| Active power | P | | |
| Reactive power | Q | | |
| Apparent power | VA | | |
| Power factor | PF | | |
| Phase angle | PA | | |
| Active energy | +Wh | | |
| Regenerative energy | -Wh | | |
| Lagging reactive energy | +Varh | | |
| Leading reactive energy | -Varh | | |
| Frequency | F | | |

<If wired to a two-load system>

| | Load 1 | | | Common | Load 2 | | |
|-------------------------|---|------|------|--------|---------|------|------|
| Voltage V1, V2 and V3 | | | | | | | |
| Current | I1-1 | I2-1 | I3-1 | | I1-2 | I2-2 | I3-2 |
| Active power | P-1 | | | | P-2 | | |
| Reactive power | Q-1 | | | | Q-2 | | |
| Apparent power | VA-1 | | | | VA-2 | | |
| Power factor | PF-1 | | | | PF-2 | | |
| Phase angle | PA-1 | | | | PA-2 | | |
| Active energy | +Wh-1 | | | | -Wh-2 | | |
| Regenerative energy | -Wh-1 | | | | -Wh-2 | | |
| Lagging reactive energy | +Varh-1 | | | | +Varh-2 | | |
| Leading reactive energy | -Varh-1 | | | | -Varh-2 | | |
| Frequency F | (Depends on the frequency source in the system settings.) | | | | | | |

TIP

The menu items differ depending on the wiring.

14.1 Optional D/A Output

● Menu Items (and Their Symbols) of Demand Measure Mode

| | | | |
|----------------|----|----|----|
| Voltage | V1 | V2 | V3 |
| Current | I1 | I2 | I3 |
| Active power | P | | |
| Reactive power | Q | | |
| Apparent power | VA | | |
| Power factor | PF | | |
| Phase angle | PA | | |
| Active energy | Wh | | |
| Frequency | F | | |

<If wired to a two-load system>

| | Load 1 | | | Common | Load 2 | | |
|----------------|---------------|--|------|--------|--------|------|------|
| Voltage | V1, V2 and V3 | | | Common | | | |
| Current | I1-1 | I2-1 | I3-1 | | I1-2 | I2-2 | I3-2 |
| Active power | P-1 | | | | P-2 | | |
| Reactive power | Q-1 | | | | Q-2 | | |
| Apparent power | VA-1 | | | | VA-2 | | |
| Power factor | PF-1 | | | | PF-2 | | |
| Phase angle | PA-1 | | | | PA-2 | | |
| Active energy | Wh-1 | | | | Wh-2 | | |
| Frequency | F | (Depends on the frequency source in the system settings) | | | | | |

TIP

The menu items differ depending on the wiring.

● Setting Integrated Value Output Rate

To select an integrated value as a D/A output, it is necessary to set its output rate.

Select the "integrated value output rate" item and press the  key to display the rate.



Use this key to select the desired rate.



Confirms the output rate.



Pressing this key cancels the change and returns you to the setting screen.

Output rate

| | |
|------|---------|
| 1 V/ | 5 kWh |
| 1 V/ | 10 kWh |
| 1 V/ | 50 kWh |
| 1 V/ | 100 kWh |
| 1 V/ | 500 kWh |
| 1 V/ | 1 MWh |

Default: 1 V/5 kWh

TIP

- When setting an integrated value output rate for reactive energy, read "W" as "Var", as the unit of the data item.
- If more than one channel is used to output the integrated values, the same output rate will be set for all channels.

14.1 Optional D/A Output

● D/A Output Settings in Harmonics Measure Mode

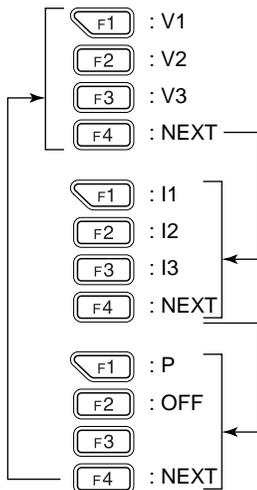
The D/A output item in the Harmonics Measure mode setting screen is set to OFF for CH1 to CH4 by default.

To change the D/A output settings, select the item to change and press the  (CHANGE) key. The following screen appears.

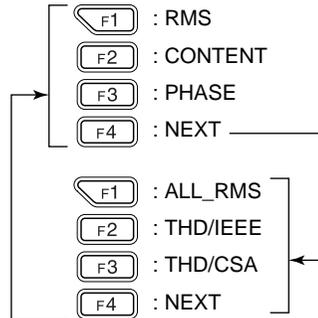
| D/A OUTPUT | | | |
|------------|------|------|------|
| CH | ELEM | ITEM | ORD. |
| CH1 | OFF | RMS | — |
| CH2 | OFF | RMS | — |
| CH3 | OFF | RMS | — |
| CH4 | OFF | RMS | — |

Use the  key to select the item to set.

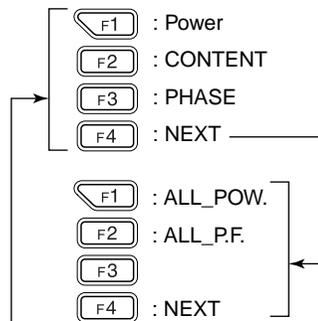
Selecting an Option for ELEM field



Selecting from options of the ITEM field (if any of V1 to V3 or I1 to I3 is selected as an option of the ELEM field)



Selecting from options of the ITEM field (if P is selected as an option of the ELEM field)



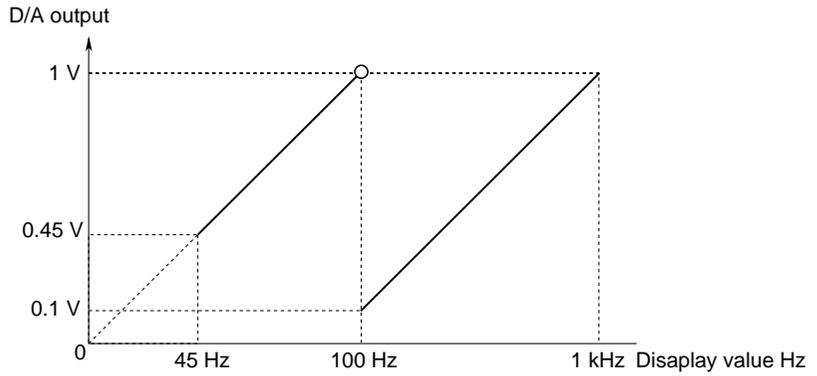
• Selection of order

When you have selected the RMS, POWER, CONTENT or PHASE data item under the SELECT ITEM field for any of the data items under the SELECT ELEMENT field, use

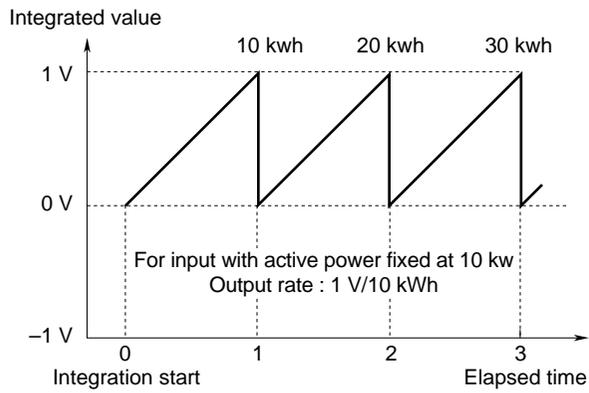
-  (+) : to set the order of harmonic to a value from 1 to 13.
-  (-) :

If you have selected any item other than those noted above, the CW140 shows a '-' sign, prohibiting you from setting the order.

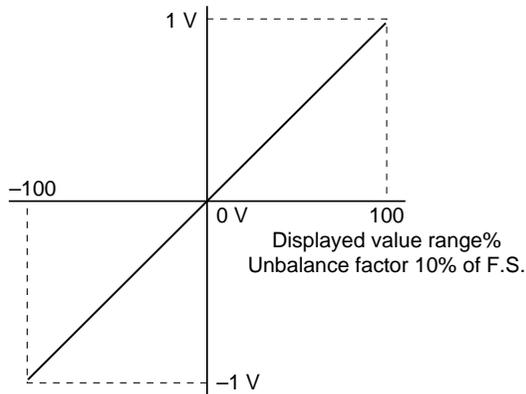
• D/A output: Frequency



• D/A Output: Integrated Value



• D/A Output: Others



14.2 External Control Input

The CW140 can be controlled by an external signal of 5/0 V (high/low (H/L) levels) to start or stop continuous measurement. Refer to the table below. This function is available when the external control trigger is selected in each measurement mode.

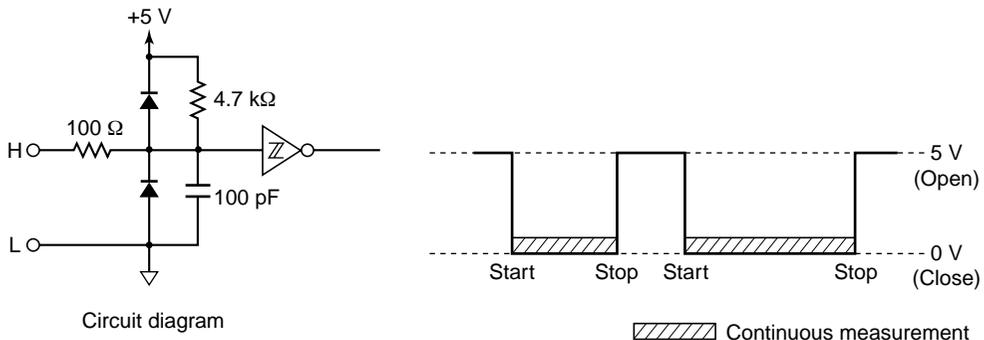
| | |
|------------------------------|--------------------|
| Instant Measure mode | Logging |
| Electric Energy Measure mode | Integration |
| Demand Measure mode | Demand measurement |
| Harmonics Measure mode | Logging |

● Input Terminals (START/STOP)

For details on connection, refer to "• Connection of External I/O Terminals" in Section 2.3.



● Input Circuit



Circuit diagram

Continuous measurement

Press the  key to set the CW140 ready for continuous measurement.

● Input Levels

Low: 0 to 0.8 V

High: 2.0 to 5.0 V

CAUTION

- The allowable voltage range of the input terminals is specified as -0.5 V to 5.5 V. Do not apply a voltage outside this range, as doing so may damage the input circuit.
- If the CW140 is equipped with an optional D/A output, make sure that the terminals are correctly connected.

14.3 Event Input

When continuously measuring such data items as electric energy, you can introduce a signal indicating if a load is active or inactive. It is therefore possible to manage data that informs you of the relationship between electric energy and the way the load is being operated.

- **Input Terminals (LOGIC INPUT)**

For details on connection, refer to "• Connection of External I/O Terminals" in Section 2.3.



- **Input Circuit**

Same as the circuit shown in Section 14.2, "External Control Input."

- **Input Levels**

Same as the level shown in Section 14.2, "External Control Input."

TIP

- To enable event input, set the Event Input option of the SAVE/PRINT ITEM screen to ON.
- The H/L level data of event input is saved or printed at preset output intervals.

15.1 RS-232C Interface Specifications

Receiving Function

With this function, you can make settings via an RS-232C communication interface in basically the same way as you do with the panel keys.

Sending Function

With this function, you can output setup data, measured data, and error codes via the RS-232C communication interface.

RS-232C Interface Specifications

Electrical and Mechanical characteristics: Conforms to EIA RS-232C

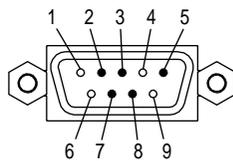
| | |
|------------------------|---|
| Connection: | Point-to-point |
| Communication: | Full duplex |
| Synchronization: | Start-stop synchronization |
| Baud rate: | 1200, 2400, 4800, 9600, and 19200 bps |
| Start bit: | 1 bit (fixed) |
| Data length: | 7 or 8 bits |
| Parity: | Even, odd, or none |
| Stop bit: | 1 or 2 bits |
| Connector: | 9-pin D-sub |
| Hardware handshake: | For CA (RTS) and CB (CTS) signals, a selection can be made as to whether the signals are always logically "true" or are used as control-line signals. |
| Software handshake: | Flow control can be carried out using X-ON and X-OFF codes. X-ON: ASCII 11H X-OFF: ASCII 13H |
| Receive buffer length: | 1024 bytes |

15.2 Connecting CW140 through RS-232C Interface

When connecting the CW140 to a computer, make sure the methods used for handshake, data transmission rate, and data format are the same on both the CW140 and the computer.

For details, see the following pages. Also, be sure to use interface cables that match the specifications of the CW140.

Connector and Signal Names



Pin 2: RD (Receive Data)

Data received from the personal computer.

Signal direction: Input

Pin 3: SD (Send Data)

Data transmitted to a personal computer.

Signal direction: Output

Pin 5: SG (Signal Ground)

Ground for signals.

Pin 7: RS (Request to Send)

Signal used for handshake when receiving data from a personal computer.

Signal direction: Output

Pin 8: CS (Clear to Send)

Signal used for handshake when transmitting data to a personal computer.

Signal direction: Input

* Pins 1, 4, 6, and 9 are not used.

Signal Direction

The figure below shows the directions of the signals used by the RS-232C interface of the CW140.

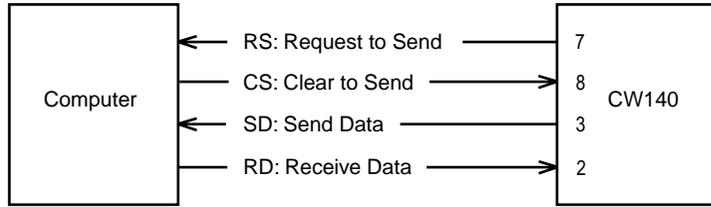


Table of RS-232C Standard Signals and Their CCITT Codes

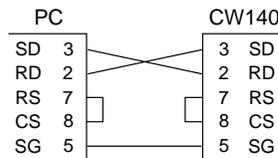
| Pin No. (9-pin connector) | Code | | | Description |
|------------------------------|----------|-------|-----|------------------|
| | RS-232C | CCITT | JIS | |
| 5 | AB (GND) | 102 | SG | Signal Ground |
| 3 | BA (TXD) | 103 | SD | Transmitted Data |
| 2 | BB (RXD) | 104 | RD | Received Data |
| 7 | CA (RTS) | 105 | RS | Request to Send |
| 8 | CB (CTS) | 106 | CS | Clear to Send |

Examples of Connecting Signal Lines

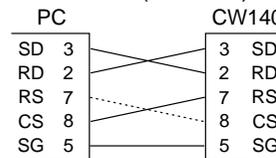
Personal computer

In general, use a cross cable.

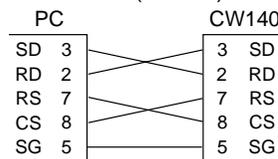
• OFF-OFF/XON-XON



• XON-RTS (XON-RS)

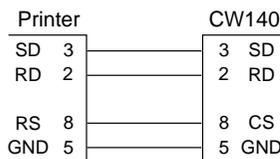


• CTS-RTS (CS-RS)



Printer

Use a straight cable.



For signals on the printer side, refer to Section 17.3, "Printer (Optional)."

15.3 Handshake Methods

For the CW140 power meter to be able to communicate with a personal computer through the RS-232C interface, the equipment on both sides must agree on a set of rules and go through a series of procedures relating to electrical signals to ensure reliable data exchange. This series of procedures is called a handshake. Because there are many handshake methods that can be used in combination with a computer, it is essential that the same method is chosen for the meter and the computer.

You can choose from any of the four methods shown in the following table.

Handshake Methods (○ means it is a valid selection)

| Handshake method | Data Sending Control (Control of sending data to a computer) | | | Data Receiving Control (Control of receiving data from a computer) | | |
|------------------|--|--|--------------|--|---|--------------|
| | Software Handshake | Hardware Handshake | No handshake | Software Handshake | Hardware Handshake | No handshake |
| | Stops sending when X-OFF is received. Resumes when X-ON is received. | Stops sending when CB (CTS) is false. Resumes when it is true. | | Sends X-OFF when receive data buffer is 3/4 full. Sends X-ON when receive data buffer is 1/4 full. | Sets CA (RTS) to False when receive data buffer is 3/4 full. Sets to True when receive data buffer is 1/4 full. | |
| OFF/OFF | | | ○ | | | ○ |
| XON/XON | ○ | | | ○ | | |
| XON/RS | ○ | | | | ○ | |
| CS/RS | | ○ | | | ○ | |

OFF-OFF

- **Send Data Control**

There is no handshake between the meter and the computer. The "X-OFF" and "X-ON" signals are treated as data, and CS is ignored.

- **Receive Data Control**

There is no handshake between the meter and the computer. When the receive buffer is full, all extra data are discarded.

RS is fixed to true.

XON-XON**● Send Data Control**

A software handshake is performed between the meter and the computer. If the "X-OFF" code is received when data is being sent to the computer, the meter stops sending data. When it receives the next "X-ON" code, it resumes data sending. The CS signal from the computer is ignored.

● Receive Data Control

A software handshake is performed between the meter and the computer. When there is 256 bytes of free space in the receive buffer, the meter sends an "X-OFF" code. When the free space is 768 bytes, it sends an "X-ON" code. RS is fixed to true.

XON-RS**● Send Data Control**

A software handshake is performed between the meter and the computer. If the "X-OFF" code is received when data is being sent to the computer, the meter stops sending data. When it receives the next "X-ON" code, it resumes data sending. The CS signal from the computer is ignored.

● Receive Data Control

A hardware handshake is performed between the meter and the computer. When there is 256 bytes of free space in the receive buffer, the meter sets "RS=False." When the free space is 768 bytes, it sets "RS=True".

CS-RS**● Send Data Control**

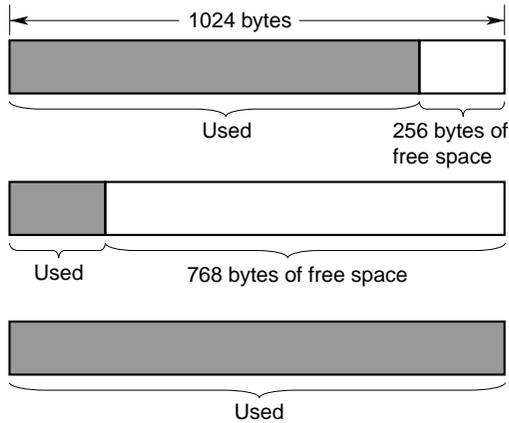
A hardware handshake is performed between the meter and the computer. If CS becomes False when data is being sent to the computer, the meter stops sending data. When CS becomes True, it resumes data sending. The "X-ON" and "X-OFF" are treated as data.

● Receive Data Control

A hardware handshake is performed between the meter and the computer. When there is 256 bytes of free space in the receive buffer, the meter sets "RS=False." When the free space is 768 bytes, it sets "RS=True".

Precautions on Data Receive Control

When the CW140 power meter is controlling receive data by means of a handshake, additional data may be sent from the computer even if there is less than 256 bytes of free space in the receive buffer. If the receive buffer becomes full, all extra data are discarded regardless of the handshake. When the receive buffer recovers free space, it resumes data storing.



In communication based on handshaking, the meter stops receiving data if it cannot transfer data internally fast enough and the buffer's free space becomes less than 256 bytes.

If the free space increases to 768 bytes as a result of continuing internal data transfer, the meter resumes data receiving.

Regardless of the handshake, all extra data will be discarded if the buffer becomes full.

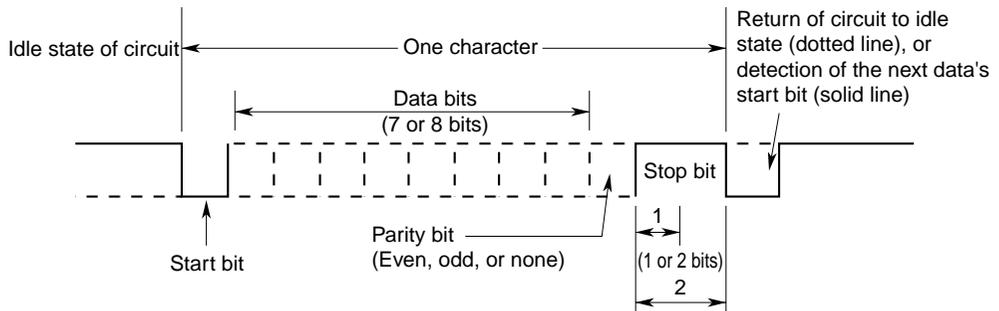
Data Receive Control Using Handshaking

TIP

The program on the personal computer must be designed so that the receive buffers on the meter and the personal computer do not become full.

15.4 Matching the Data Format

The CW140 uses start-stop synchronization to communicate through its RS-232C interface. In communication based on start-stop synchronization, a start bit is added every time a character is transmitted, where the start bit is followed by data, parity, and stop bits (see the figure below).



16.1 In the Event of a Power Failure

● **In the Event of a Power Failure (When Powered by AC Adapter)**

When the CW140 contains a precharged NiMH battery pack or alkaline batteries, it automatically changes to battery-driven operation if a power failure occurs.

When your CW140 does not contain a precharged NiMH battery pack or alkaline batteries, or if the battery pack or batteries have lost their charge or have been removed during operation, it saves the following data on battery back-up memory.

| Measurement mode | Task done during continuous measurement | Data saved |
|----------------------|---|--|
| Instant mode | Logging | Time of power failure occurrence |
| Electric energy mode | Integration | Time of power failure occurrence Integrated values |
| Demand mode | Demand | Time of power failure occurrence Total electric energy from start of demand measurement Total electric energy during current demand period Maximum demand |
| Harmonics mode | Logging | Time of maximum demand Time of power failure occurrence |

 **CAUTION**

In the event of a power failure occurring when data is being saved or printed, the CW140 immediately stops printing or saving and the data will be invalid, or in the case of saving data, the file contents may become corrupt.

16.1 In the Event of a Power Failure

● Recovery after a Power Failure

When the power recovers after the occurrence of a power failure during continuous measurement (logging, integration, or demand), the following will be displayed and the information will be saved to memory or floppy disk, and printed.

Example of Display

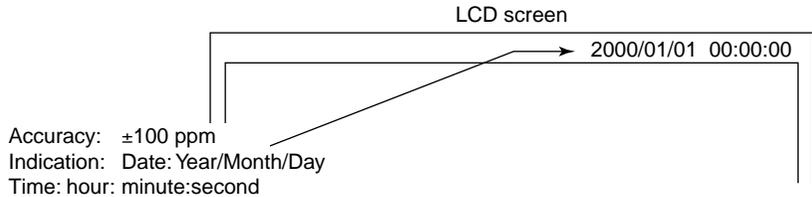
```
POWER OFF TIME : 2000/02/20 10:21:50  
POWER ON TIME  : 2000/02/20 10:21:50  
  
ENTER key : OK
```

TIP

Updating of measurement and display continues even while the message above is displayed. Note that the CW140 does not take into account the period of the power failure when determining when to end logging.

17.1 Auxiliary Functions

● Clock



Date and time can be modified to precise values on the System Setting screen.

Default: JST (Japan st'd Time)

When the power is turned off, a built-in battery is used to save the set date and time.

TIP

Both the date and time are displayed together on the Top Menu and when setting the clock, however, only the time is displayed during continuous measurement.

● Selecting Language

You can switch display language on the LCD between English, French, Spanish, German, Italian and Japanese.

System default setting: English

<<Selecting Operation>>

Operate the following Steps when you select German, for example, from English.

- (1) Press **TOP MENU** key to display the Top Menu screen.
- (2) Select the System Settings on the Top Menu screen with **←** key, and press **ENTER** key to display the System Set Screen.
- (3) Select the [System Set] (highlighted), and press **ENTER** key to display the SYSTEM SET (1/2) screen.
- (4) Press **F5** key to display the SYSTEM SET (2/2) screen.
- (5) Select the [LANGUAGE] with **←** key.
- (6) Press the **→** key to display the language list.
- (7) Select the Deutsch (German) with **→** key and press the **ENTER** key.
- (8) Press the **ENTER** key again to complete the setting.

The Top Menu screen written in German appears.

17.1 Auxiliary Functions

The followings are the main terms displayed on the screen for selecting the language.

Use them to return the language of the language is changed to the other one.

| English | French Français | German Deutsch | Italian Italiano | Spanish Español | Japanese 日本語 |
|----------------|--------------------|-------------------|---------------------|--------------------|-----------------------|
| TOP MENU | MENU | HAUPTMEN | TOP MENU | TOP MENU | トップメニュー TOP MENU |
| SYSTEM SETTING | SYSTÈME CONFIG | SYSTEM EINSTLG | SYSTEM CONFIG. | SISTEMA CONFIG. | システム設定 (トップメニュー画面) |
| SYSTEM SET | REGL SYSTÈME | SYSTEM EINST | CONFIG. SIST | CONF. SIST. | システム設定 (システム画面) |
| NEXT | SUITE | NEXT | PROSS | SIG. | 次頁 |
| LANGUAGE | LANGUE | SPRACHE | LINGUA | IDIOMA | 表示言語 |
| CHANGE | CHANGE | ÄNDERN | CAMBIA | CAMBIO | 変更 |

● Holding display from updating

To stop the display from updating during each measurement, press the  key. The **HOLD** symbol appears in the center of the screen, indicating that updating has stopped.

To restart updating, press the  key once more when updating of the display is in a held state. (Measurement continues even when updating of the display is in a stopped state).

TIP

- It is recommended that you hold the display from updating before saving the displayed value by pressing the  key when in each of the measurement modes. Refer to Chapter 13, "File Functions."
 - Note that if you press the  (HOLD/CLEAR) key for 3 seconds or more in either electric energy or demand measurement mode, the integrated values will be reset to zero.
-

● Charging NiMH battery

If the CW140 contains an NiMH battery pack and the power is off, connecting the AC adapter will start charging the battery. The LED indicator beside the AC adapter jack comes on when charging and quickly blinks when the battery is fully charged.

NOTE

If the power is on, the CW140 does not recharge the battery pack.

SEE ALSO

Section 3.6, "Connecting a Power Supply and Turning It On/Off" for more information on batteries.

● LCD Contrast

You can adjust (set) the LCD contrast to a value within 1 to 8 on the System Setting screen.

Contrast default: 4

● LCD Backlight

The LCD backlight can be turned on/off using the backlight key (.

Auto-off function of backlight key

The backlight will be automatically turned off if no key action is performed for more than 10 minutes while the backlight is on by the  key.

The Auto-off function can be enabled on the System Setting screen.

ON: The backlight is automatically turned off when no key action is performed for 10 minutes.

OFF: The backlight remains lit, even when no key action is performed for 10 minutes.

Default setting: ON (Auto-off)

TIP

If the backlight is turned off by the Auto-off function, press the  key to turn the light back on again.

● Beep

The beep is used to confirm key operations (beeps when a key is pressed). It can be set to on (beep)/off (no beep) on the System Setting screen.

Beep default: On (beep)

17.1 Auxiliary Functions

● Key Lock

You can disable key operations by pressing the  key for at least 3 seconds. When the key lock function is enabled, the  mark is displayed in the upper-right corner of the screen.

To release the key lock, press the  key for at least 3 seconds again.

TIP

Only the  key can be used when in key-lock mode.

● Power Saving Mode

1. During continuous measurement (logging, integration, demand)

If no key action is performed for more than 10 minutes, the LCD will be automatically shut off so that power consumption can be minimized.

Power saving mode can be specified on the System Setting screen.

Default: Off

To recover from power saving mode, press the  key. The LCD is activated and the backlight comes on.

TIP

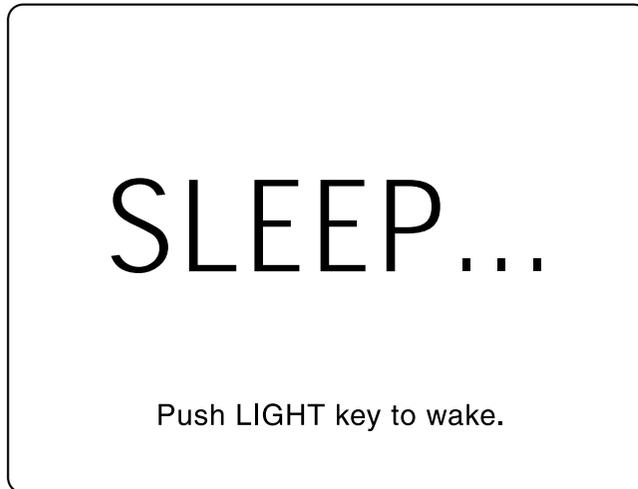
The status LED is lit when continuous measurement is being performed.

2. Other modes

If no key action is performed for more than 10 minutes and all D/A outputs are off, the meter will quit calculation and sleep. The display indicates that the instrument is in sleep mode as shown in the figure below.

As in 1. above, the power saving mode can be specified on the System Settings screen.

To recover from power saving mode, press the  key. The LCD is activated and the backlight comes on.



● System Reset

Resetting the system returns all the settings except time, date and language to the default value set before shipment. Refer to Section 5.2, "System Reset."

● Low Battery Indicator

The low battery mark is displayed when the voltage of the NiMH battery pack or alkaline batteries becomes low. The  mark indicating the battery is low is displayed in the upper-right corner of the screen. If you continue to use the meter when the battery is low, the power will be automatically turned off.

Switch the power supply to an AC power source if the low battery mark is indicated during measurement. Make sure that measurement is complete or has been quit and turn the power off before recharging or replacing the battery.

SEE ALSO

Section 3.6, "Connecting a Power Supply and Turning It On/Off" for more information on the power supply.

17.1 Auxiliary Functions

● Testing Backup Battery

The CW140 contains a battery so that the backup of clock data and memory can be carried out. The battery is tested during the power-on sequence and the results are displayed on the startup screen.

- Checking RTC (Real-time clock)
- Checking set up data

If initialization of either of the above has been performed, the backup battery may be low. (See the NOTE below)

```
CW140 Ver.0.00
SRAM Check Ok
Battery Backup SRAM Check Ok
EEPROM OK
Function Code ...00000000

RTC Initialized
FDC Check Ok
Setting Initialized
Flash Disk Ok

Enter:Ok
```

NOTE

- If the backup battery in your meter becomes low, contact the vendor from which you purchased the instrument.
 - Note that if the battery is low, data backup will not occur when there is a power failure during continuous measurement.
-

TIP

If the initialization sequence detects and displays that the backup battery is low, all the settings will be set to the default value before shipment and/or the date and time will be reset to "2000/01/01 00:00:00".

17.2 Floppy Disk Drive (Optional)

Connecting an external floppy disk drive to the CW140 allows you to save measured data and condition settings to a 3.5-inch floppy disk. Readings and condition settings can also be loaded from a floppy disk to the CW140.

Model: 97020

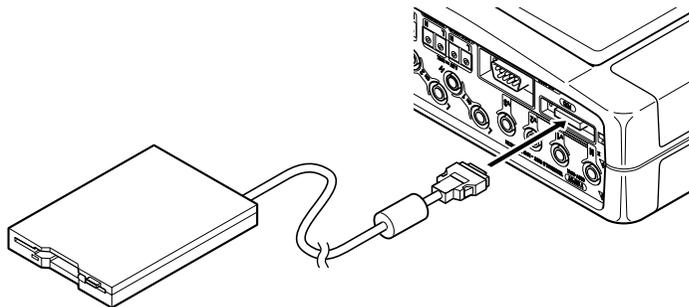
Specifications:

| | |
|---|---|
| Floppy disk | 2HD, 1.2 MB/1.44 MB |
| Interface | Dedicated interface |
| Cable | Length: Approx. 230 mm (excluding connectors and bushings) Structure: Twisted-pair (with shielding) UL20276-28WG Connector: 26-pins |
| Power supply | +5 V DC $\pm 5\%$ Supplied by cable from the CW140 main unit |
| Power consumption | 1.15 W (typical when loading data) |
| Operating temperature and humidity ranges | 5°C to 40°C, 20 to 80% RH (no condensation) |
| Storage temperature and humidity ranges | -40°C to 60°C, 5 to 80% RH (no condensation) |
| External dimensions | Approx. 101.5 (W) \times 147 (D) \times 17.2 (H) mm (excluding protrusions and cable) |
| Weight | Approx. 300 g |

Connection: The CW140 is connected to the floppy disk drive through a dedicated cable.

SEE ALSO

Refer to the figure below for details about connection.



17.3 Printer (Optional)

Connecting a printer to the CW140 allows you to print measured data and condition settings.

Model: 97010
DPU-414 (Seiko Instruments Inc.)

Specifications:

| | |
|---------------------------|--------------------------------------|
| Method | Thermal, serial, dot-matrix printing |
| Number of characters/line | 80 |
| Character matrix | 9 × 7 dot matrix |
| Printing speed | 52.5 mm/sec |
| Paper width | 112 mm |

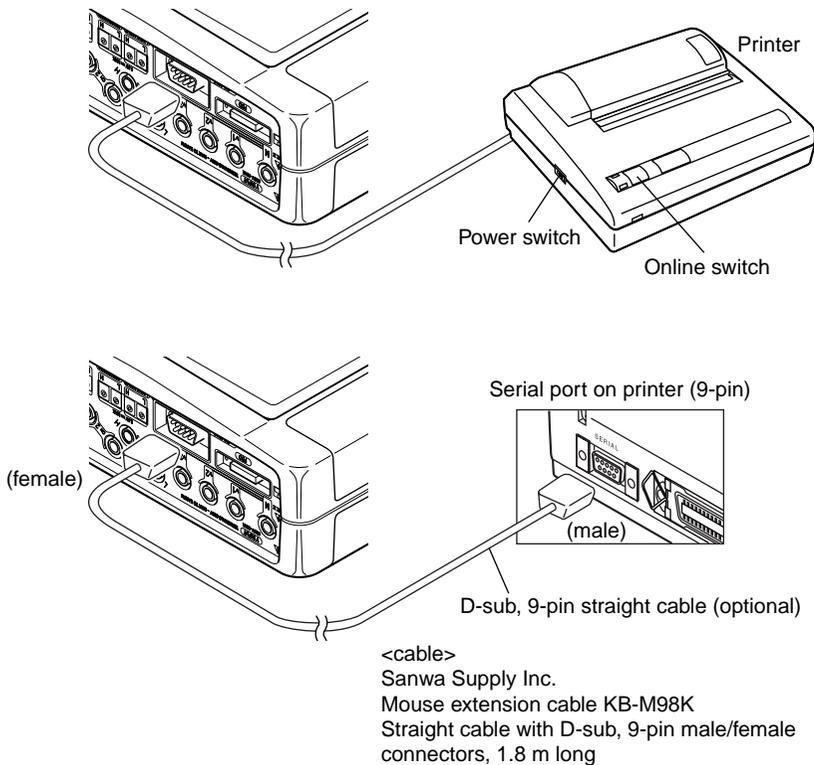
Connection: RS-232C port

Cable: Straight cable with D-sub, 9-pin (male)/D-sub, 9-pin (female) connectors

● Connecting a Printer to the CW140

Use the straight cable (specified above) to connect a printer to the CW140.

1. Turn the printer off. (The power lamp goes out.)
2. Connect the printer to the CW140 using the cable (see the figure below).



● Verifying Printer Settings

1. With holding down the “Online switch” press the “Power switch”.
Then the print settings will be printed.
2. Check that the settings are the same as those in the table below.

Initial Printer settings (DIP switch setting mode)

DIP SW-1

| SW No. | Function | ON | OFF |
|---------|-------------------------------------|-------------------------------|-----------------|
| 1 (OFF) | Input method | Parallel | Serial |
| 2 (ON) | Printing speed | High | Low |
| 3 (ON) | Auto loading | ON | OFF |
| 4 (OFF) | CR function | Carriage return and line feed | Carriage return |
| 5 (ON) | DIP SW setting | Enable | Disable |
| 6 (OFF) |] — Printing density (select: 100%) | | |
| 7 (ON) | | | |
| 8 (ON) | | | |

DIP SW-2

| SW No. | Function | ON | OFF |
|---------|---|---------------------|--------------------|
| 1 (OFF) | Print mode | 40 columns | 80 columns |
| 2 (ON) | User font back-up | ON | OFF |
| 3 (ON) | Character type | Ordinary characters | Special characters |
| 4 (ON) | Zero font | 0 | ∅ |
| 5 (ON) |] — International character set: Japanese | | |
| 6 (ON) | | | |
| 7 (ON) | | | |
| 8 (ON) | | | |

DIP SW-3

| SW No. | Function | ON | OFF |
|---------|----------------------------------|----------|----------|
| 1 (ON) | Data bit length | 8 bits | 7 bits |
| 2 (ON) | Parity setting | NO | YES |
| 3 (ON) | Parity condition | Odd | Even |
| 4 (OFF) | Busy control | H/W BUSY | XON/XOFF |
| 5 (OFF) |] — Baud rate (select): 9600 bps | | |
| 6 (ON) | | | |
| 7 (ON) | | | |
| 8 (ON) | | | |

3. Turn the printer off.

TIP

- For details on how to change the printer settings, refer to the printer's instruction manual.
- If characters produced by the DIP SW-2 print mode default setting of 80 columns (characters/line) are too small, change the setting to 40 columns.

17.3 Printer (Optional)

Printer

Example of printing: (Electric Energy Measure mode; wiring type: 3φ3W)

```

1999/11/16      11:00:00      → Date and time

Integration start time  → Starting time of
1999/11/16      10:00:00      integration
Elapsed time      1:00:00

Instantaneous values → {
V1                : 300.0    V
V3                : 300.0    V
I1                : 20.00   A
I3                : 20.00   A
P                 : 12.00   kW
Q                 : 0.94    kVar
VA                : 12.00   kVA
PF                : 1.000
PA                : 0.4     deg
F                 : 50.00   Hz

Electric energy → {
Wh                : 0.011  MWh
+Varh             : 0.009  MVarh
-Varh             : 0.000  MVarh
EVENT             : 1      → Number of
                                event inputs

P: Active power      PF: Power factor
Q: Reactive power   PA: Phase angle
VA: Apparent power  F: Frequency
  
```

TIP

In the example above, the DIP SW-2 print mode is set at 40 columns. For additional information, see the "SW No" settings of "DIP SW-2" on the previous page.

18.1 Corrective Action in Case of Failure

This section describes corrective action in case a failure occurs with the CW140.

If the meter does not operate properly after taking the corrective measures shown in the table below or any other failure that is not covered in this section occurs, contact the vendor from which you purchased the instrument.

If an error message is displayed, refer to Section 18.2, "Messages and Corrective Measures."

| Problem | Things to Check |
|---|--|
| 1. The meter cannot be turned on. | <p>When an AC adapter is being used:</p> <ul style="list-style-type: none"> • Check that the power cord is firmly plugged into the power outlet. • Check that you are not using power outside the allowable power supply voltage. <p>When a battery pack or batteries are being used:</p> <ul style="list-style-type: none"> • Check that the battery is properly installed. • If you are using a NiMH battery pack, check that the battery is charged. • If you are using alkaline batteries, check that the batteries are not low or the polarities of the batteries are correct. |
| 2. The setting data is initialized when the power is turned off. | <ul style="list-style-type: none"> • If the "RTC Initialized" or "Settings Initialized" message appears on the startup screen, contact the vendor from which you purchased the instrument. The battery needs to be changed. Users are not authorized to change it themselves. <p>The life of the backup battery is about 10 years.</p> |
| 3. Measurement values are erroneous. | <ul style="list-style-type: none"> • May be effected by noise. Check the installation environment. • Check the measuring probes and the clamp are connected correctly. • Check the frequency source setting is correct. • Ambient temperature and humidity are within the allowable ranges. |
| 4. No key action is possible. | <ul style="list-style-type: none"> • Check whether the key lock function has been enabled. The key lock mark is displayed in the upper-right corner of the screen when this function is enabled. |
| 5. Data cannot be saved to or loaded from memory. | <ul style="list-style-type: none"> • Turn the power switch off and on. In some cases, the initial self-test may correct the problem. • A power failure might have occurred when the memory was being accessed. Reformat the memory while in file handling mode. Note that formatting will clear any data saved to memory. |
| 6. The meter cannot be controlled through the RS-232-C interface. | <ul style="list-style-type: none"> • Check that the communication parameters are set correctly for both the controller and meter. • Check that you are using the correct type of cable for the intended application. |
| 7. If the "Error" message appears on the startup screen. | <ul style="list-style-type: none"> • There is an error with the hardware. Contact the vendor from which you purchased the instrument. |

18.2 Messages and Corrective Measures

This section describes error messages and warning messages. It also describes corrective measures to deal with the problems indicated by the messages.

The CW140 main unit can display the messages both in English and Japanese. Messages read on a personal computer will be displayed in English. The error messages are categorized in the following codes:

- Execution errors: 600 to 799
- Setting errors: 800 to 899
- Self-test errors: 950 to 963
- Communication syntax errors: 100 to 199
- Communication execution errors: 200 to 299
- Communication query errors: 400 to 499
- System errors: 912
- Other: 350 and 390

TIP

-
- If an execution error or communication error occurs, the error code and message will be stored in the error queue.
 - If a setting error or self-test error occurs, the meter cannot store the corresponding code or message in the error queue.
-

Execution Errors (600-799)

| Error Code | Error Message | Description and Corrective Measures |
|-------------------|--|--|
| 600 | Same filename already exists. Overwrite? | A file with the same file name already exists. Proceed to overwrite it. |
| 601 | Can not change filename. | Tried to change a filename with read-only attribute. Change the attribute to read-write. |
| 602 | Filename is invalid. | Check the filename. |
| 603 | Connection device is not printer. | Set the printer as connected device. |
| 604 | No media is selected for data output. | Select output media from memory, floppy disk, or a printer. |
| 605 | No data is selected for data output. | All the items to save and print are set to off. Set one or more items to on. |
| 606 | Not enough memory to save. | Delete unnecessary files or save to another floppy disk. |
| 607 | No more files can be created. | Maximum number of files allowed has been exceeded. Delete unnecessary files or save to another floppy disk. |
| 608 | Delete unusable files. | There is not enough free space or a file cannot be created. Delete unnecessary files. |
| 609 | Memory write error. | Check memory. |
| 610 | FD write error. | Check floppy disk. |
| 611 | Print error. | Check printer. |
| 612 | Memory read error. | Check memory. |
| 613 | FD read error. | Check floppy disk. |
| 614 | File data error. | Check the file contents. |
| 615 | Insert FD. | Insert a floppy disk into floppy disk drive. |
| 616 | FD is write-protected. | Clear the write protection of the floppy disk. |
| 617 | FD is not formatted. Format media. | Floppy disk has not been formatted. Perform formatting. |
| 618 | FDD unit is not connected. | Connect a floppy disk drive. |
| 619 | File does not exist. | Check the filename. |
| 620 | File is not selected. | Select a file. |
| 621 | Start time has already passed. | Set start time. |
| 622 | Stop time has already passed. | Stop time has passed due to a power failure or the like. |
| 623 | Set correct time. | There is a mistake in the date and time setting. Correct it. |
| 624 | Start/stop time has already passed during media space check. | As pressing the START key was late, the start/stop time has passed while checking free space on media before starting/stopping measurement. Reset the start/stop time (press the START key one or more minutes before the start time). |

18.2 Messages and Corrective Measures

Setting Errors (800-899)

| Error Code | Error Message | Description and Corrective Measures |
|------------|---|--|
| 800 | WIRING ERROR | Check the setting file. |
| 801 | V RANGE ERROR | Check the setting file. |
| 802 | A RANGE ERROR | Check the setting file. |
| 803 | DISPLAY MODE SETUP ERROR | Check the setting file. |
| 804 | LOAD ERROR | Check the setting file. |
| 805 | EXPAND MODE DISPLAY ITEM SETUP ERROR | Check the setting file. |
| 806 | (Logging) Start time is invalid. | Set the correct start time. |
| 807 | (Logging) Stop time is invalid. | Set the correct stop time. |
| 808 | (Integration) Start time is invalid. | Set the correct start time. |
| 809 | (Integration) Stop time is invalid. | Set the correct stop time. |
| 810 | (Demand) Start time is invalid. | Set the correct start time. |
| 811 | (Demand) Stop time is invalid. | Set the correct stop time. |
| 812 | Timer setting error. | Set the stop timer correctly. |
| 813 | Output interval is invalid. | Set the correct output rate. |
| 814 | No media is selected for data output. | Specify the data output destination from memory, floppy disk or printer. |
| 815 | SETUP ERROR | Check the setting file. |
| 816 | FILENAME SETUP ERROR | Check the setting file. |
| 817 | SAVE/PRINT SETUP ERROR | Check the setting file. |
| 818 | Number of output item exceeds 250. Change output item. | Number of output items in harmonics measurement exceeds 250. Set the number no more than 250. |
| 819 | No item is selected for save/print. | All the items to save and print are set to off. Set one or more items to on. |
| 820 | D/A OUTPUT SETUP ERROR | Check the setting file. |
| 821 | REGENERATIVE ENERGY SETUP ERROR | Check the setting file. |
| 822 | INTEGRATE OUTPUT RATE SETUP ERROR | Check the setting file. |
| 823 | REFERENCE POWER SETUP ERROR | Check the setting file. |
| 824 | DEMAND PERIOD SETUP ERROR | Check the setting file. |
| 825 | LOG/LINEAR SETUP ERROR | Check the setting file. |

18.2 Messages and Corrective Measures

| Error Code | Error Message | Description and Corrective Measures |
|------------|-------------------------------------|-------------------------------------|
| 826 | DEVEN/ODD SETUP ERROR | Check the setting file. |
| 827 | ANALYSIS/ELEMENT SETUPT ERROR | Check the setting file. |
| 828 | LOGGING SETUP ERROR | Check the setting file. |
| 829 | REACTIVE POWER METHOD SETUP ERROR | Check the setting file. |
| 830 | FREQUENCY SOURCE LOAD SETUP ERROR | Check the setting file. |
| 831 | FREQUENCY SOURCE SETUP ERROR | Check the setting file. |
| 832 | LOWPASS FILTER SETUP ERROR | Check the setting file. |
| 833 | VT RATIO SETUP ERROR | Check the setting file. |
| 834 | CT RATIO SETUP ERROR | Check the setting file. |
| 835 | CURRENT CLAMP SETUP ERROR | Check the setting file. |
| 836 | NUMBER OF AVERAGE SETUP ERROR | Check the setting file. |
| 837 | BACKLIGHT AUTO OFF SETUP ERROR | Check the setting file. |
| 838 | CONTRAST SETUP ERROR | Check the setting file. |
| 839 | BEEP SETUP ERROR | Check the setting file. |
| 840 | POWER SAVING SETUP ERROR | Check the setting file. |
| 841 | CONNECT DEVICE SETUP ERROR | Check the setting file. |
| 842 | BAUD RATE SETUP ERROR | Check the setting file. |
| 843 | DATA LENGTH SETUP ERROR | Check the setting file. |
| 844 | PARITY BIT SETUP ERROR | Check the setting file. |
| 845 | STOP BIT SETUP ERROR | Check the setting file. |
| 846 | FLOW CONTROL SETUP ERROR | Check the setting file. |
| 847 | LANGUAGE SETUP ERROR | Check the setting file. |
| 848 | DATE SETUP ERROR | Set the correct date. |
| 849 | ELEC. ENERGY DIGIT/UNIT SETUP ERROR | Check the setting file. |

18.2 Messages and Corrective Measures

Self-test Errors (950-963)

| Error Code | Error Message | Description and Corrective Measures |
|------------|--------------------------------------|--|
| 950 | FDC Check Error | Needs servicing. |
| 951 | SRAM Check Error | Needs servicing. |
| 952 | Battery SRAM Check Error | Needs servicing. |
| 953 | Settings Initialized | Settings have been initialized. If this message is displayed every startup, it needs servicing. |
| 954 | Invalid Settings Corrected | Invalid settings have been found and corrected. |
| 955 | Flash Disk Unformat | Memory has not been formatted. |
| 956 | Flash Disk Formatting | Formatting memory. |
| 957 | Flash Disk Format Completed | Completed formatting. |
| 958 | Flash Disk Recovered | Memory failure has been recovered. |
| 959 | EEPROM Initialized (New EEPROM) | Needs servicing. |
| 960 | EEPROM Initialized (Check Sum Error) | Needs servicing. |
| 961 | EEPROM Initialized (Invalid Data) | Needs servicing. |
| 962 | RTC Initialized | RTC (Real Time Clock) has been initialized. If this message is displayed every startup, it needs servicing. |
| 963 | RTC Error | Needs servicing. |

Communication Syntax Errors (100-199)

| Error Code | Error Message | Description and Corrective Measures |
|------------|----------------------------|---|
| 102 | Syntax Error | Syntax error other than the ones listed below. |
| 103 | Invalid separator | Separate each data with a comma. |
| 104 | Data type error | Use the correct data type. |
| 108 | Parameter not allowed | Too many parameters. Check the number of parameters. |
| 109 | Missing parameter | Specify the necessary parameters. |
| 111 | Header separator error | Separate the header and the data with a space. |
| 112 | Program mnemonic too long | Check the mnemonic (alphanumeric character string). |
| 113 | Undefined header | Check the header. |
| 114 | Header suffix out of range | Check the header. |
| 120 | Numeric data error | Mantissa must be entered before the numeric value in <NRf> format. |
| 123 | Exponent too large | Use a smaller exponent after 'E' in <NR3> format. |
| 124 | Too many digits | Limit the number of digits to 255 or less. |
| 128 | Numeric data not allowed | Use a format other than <NRf> format. |
| 131 | Invalid suffix | Check the unit for <Voltage>, <Current>, and <Frequency>. |
| 134 | Suffix too long | Check the unit for <Voltage>, <Current>, and <Frequency>. |
| 138 | Suffix not allowed | Units are not allowed other than for <Voltage>, <Current>, and <Frequency>. |
| 141 | Invalid character data | Enter one of the character strings in {... }. |
| 144 | Character data too long | Check the character strings in {... }. |
| 148 | Character data not allowed | Enter in a format other than the one in {... }. |
| 150 | String data error | <Character string> must be enclosed by double or single quotation marks. |
| 151 | Invalid string data | <Character string> is too long or contains characters that cannot be used. |
| 158 | String data not allowed | Enter in a data format other than <Character string>. |

18.2 Messages and Corrective Measures

Communication Execution Errors (200-299)

| Error Code | Error Message | Description and Corrective Measures |
|------------|-------------------------|--|
| 200 | Execution error | Cannot execute the command. |
| 221 | Setting conflict | Check the relevant setting parameters. |
| 222 | Data out of range | Check the setting range. |
| 223 | Too much data | Check the data byte length. |
| 224 | Illegal parameter value | Check the setting range. |
| 241 | Hardware missing | Check the availability of options. |

Communication Query Errors (400-499)

| Error Code | Error Message | Description and Corrective Measures |
|------------|---|--|
| 410 | Query INTERRUPTED | Check the transmission and reception order. |
| 420 | Query UNTERMINATED | Check the transmission and reception order. |
| 430 | Query DEADLOCKED | Limit the length of the program message including the <PMT> to 1024 bytes or less. |
| 440 | Query UNTRMINATED after indefinite response | Do not enter queries after *IDN?. |

System Error (912)

| Error Code | Error Message | Description and Corrective Measures |
|------------|----------------------------------|-------------------------------------|
| 912 | Fatal error Communication-driver | Needs servicing. |

Other (350 and 390)

| Error Code | Error Message | Description and Corrective Measures |
|------------|-------------------------|-------------------------------------|
| 350 | Queue overflow | Read the error queue. |
| 390 | Overrun error (RS-232C) | Use a lower baud rate. |

19.1 Specifications

(1) Input

| Input | Input Voltage (V) | Current (A) |
|---|---|---|
| Input type | Resistive potential division | Clamp sensing |
| Ratings (ranges) | 150, 300, 600 (V) | Clamp A: 20, 50, 100, 200 A |
| Input resistance | Approximately 1.3 M Ω | Approximately 100 k Ω (CW140) |
| Maximum allowed continuous input | 600 Vrms | Clamp A: 250 Arms Clamp C: 625 Arms Clamp B: 700 Arms |
| A/D conversion | Simultaneous voltage/current input conversion, 12-bit resolution | |
| Range switching | Manual, automatic, and settings entered through PC | |
| Auto-range functions | Range up: RMS is 110% or more of range rating, or sampled value is approximately 300% or more of rating. Range down: RMS is 30% or less of range rating, or sampled value does not exceed approximately 300% of range rating after range moves down. | |

(2) Measurement functions

| Parameter | Voltage | Current, active power, reactive power |
|--------------------------------|--|--|
| Method | Digital sampling | |
| Frequency range | 45 Hz to 1 kHz (harmonics mode: 45-65 Hz) (unbalance factor: 45-440 Hz) | |
| Crest factor | 3 (for rated input) | |
| Effective input range | 10% to 110% of rated voltage/current range | |
| Temperature coefficient | $\pm 0.03\%$ of $\text{mg}/^{\circ}\text{C}$ | $\pm 0.05\%$ of $\text{mg}/^{\circ}\text{C}$ (including clamp) |
| Display update period | Approximately 1 sec (approximately 3 sec in harmonics mode) | |

(3) Instant mode

| | |
|---|---|
| Display fields | |
| Measured parameters | Voltage RMS (V), current RMS (A), active power (W), reactive power 1 (Var), frequency (Hz) |
| Calculated parameters | Reactive power 2 (Var), apparent power (VA), power factor, phase angle (°), 3-phase unbalance factor (%) Reactive power 1: With reactive power meter method Reactive power 2: Without reactive power meter method |
| Measurement accuracy | Power factor 1 (including clamp) |
| Voltage | 45 Hz ≤ f ≤ 66 Hz: ±(0.1% rdg + 0.2% rng) 66 Hz < f ≤ 1 kHz: ±(0.2% rdg + 0.4% rng) |
| Current, active power, reactive power 1 | |
| When using Clamp A (200A) | |
| When using Clamp C (500A) | 45 Hz ≤ f ≤ 66 Hz: ±(0.6% rdg + 0.4% rng) 66 Hz < f ≤ 1 kHz: ±(1.0% rdg + 0.8% rng) |
| When using Clamp B (1000A) | 45 Hz ≤ f ≤ 66 Hz: ±(1.0% rdg + 0.8% rng) |
| Calculation accuracy | (reactive power 2, power factor, apparent power, phase angle) 45 Hz to 1 kHz: (value calculated from measurement) ± 1 dgt |
| Power factor effects | For 45 Hz ≤ f ≤ 66 Hz |
| When using Clamp A (200A) | |
| Active power | ±1.0% rng cos φ = ±0.5 (relative to power factor 1) |
| Reactive power | ±1.0% rng sin φ = ±0.5 (relative to reactive power 1) |
| When using Clamp C (500A) | |
| When using Clamp B (1000A) | |
| Active power | ±2.0% rng cos φ = ±0.5 (relative to power factor 1) |
| Reactive power | ±2.0% rng sin φ = ±0.5 (relative to reactive power 1) |
| Logging function | |
| The logging function can be used to take continuous measurements. | |
| Start setting: | Manual, specified time, external trigger (controlled) |
| End setting: | Manual, timer, specified time, external trigger |
| Output interval: | Can be set from a range of 2 minutes to 1000 hours (in one-minute increments) |

(4) Equations**Voltage RMS**

$$V_{\text{RMS}} = \sqrt{\frac{1}{T} \int_0^T v(t)^2 dt} = \sqrt{\frac{1}{T} \sum_{i=0}^T v(t)^2}$$

Current RMS

$$I_{\text{RMS}} = \sqrt{\frac{1}{T} \int_0^T i(t)^2 dt} = \sqrt{\frac{1}{T} \sum_{i=0}^T i(t)^2}$$

Active power

$$P = \frac{1}{T} \int_0^T v(t) \times i(t) dt = \frac{1}{T} \sum_{i=0}^T v(t) \times i(t)$$

Reactive power (using reactive power meter method)

$$Q = \frac{1}{T} \int_0^T v(t) \times i \left(t + \frac{T}{4} \right) dt = \frac{1}{T} \sum_{i=0}^T v(t) \times i \left(t + \frac{T}{4} \right)$$

$v(t), i(t)$: Input signals
T: One period of input signal

3 ϕ voltage unbalanced rate

$$\text{Unbalanced rate} = \frac{V_b}{V_a} \times 100\%$$

Frequency: 45–440 Hz

Calculation accuracy:

(aluculation from measurement) $\pm 1\%$

- For 3 ϕ 3W

$$V_a = \sqrt{\frac{1}{6} (V_{12}^2 + V_{23}^2 + V_{31}^2) + \frac{2}{\sqrt{3}} \sqrt{V_s (V_s - V_{12})(V_s - V_{23})(V_s - V_{31})}}$$

$$V_b = \sqrt{\frac{1}{6} (V_{12}^2 + V_{23}^2 + V_{31}^2) - \frac{2}{\sqrt{3}} \sqrt{V_s (V_s - V_{12})(V_s - V_{23})(V_s - V_{31})}}$$

$$V_s = \frac{1}{2} (V_{12} + V_{23} + V_{31})$$

V_{12}, V_{23}, V_{31} : line-to-line voltages for the 3 ϕ 3W.

- For 3 ϕ 4W

In the equations, V_{12}, V_{23}, V_{31} for the 3 ϕ 3W are substituted with V_{1n}, V_{2n}, V_{3n} , respectively.

19.1 Specifications

| | Reactive power (without reactive power meter method) | Apparent power | Power factor | Phase angle |
|-------------------------------|--|---|---|---|
| 1φ2W | $Q = \sqrt{(VA)^2 - P^2}$ | $VA = VA$ | With reactive power meter $P / \sqrt{P^2 + Q^2}$ | With reactive power meter $\cos^{-1}(P / \sqrt{P^2 + Q^2})$ |
| | | | Without reactive power meter P / VA | Without reactive power meter $\cos^{-1}(P / VA)$ |
| 1φ3W | $Q_i = \frac{P_i}{\sqrt{(VA_i)^2 - P_i^2}}$ $i=1, 2$ $\Sigma Q = Q_1 + Q_2$ | $VA_i = V_i \times A_i$ $i=1, 2$ $\Sigma VA = VA_1 + VA_2$ | With reactive power meter | With reactive power meter |
| 3φ3W | $Q_i = \frac{P_i}{\sqrt{(VA_i)^2 - P_i^2}}$ $i=1, 3$ $\Sigma Q = Q_1 + Q_3$ | $VA_i = V_i \times A_i$ $i=1, 3$ $\Sigma VA =$ $\sqrt{3}/2(VA_1 + VA_3)$ | $\frac{\Sigma P}{\sqrt{(\Sigma P)^2 + (\Sigma Q)^2}}$ | $\cos^{-1}\left(\frac{\Sigma P}{\sqrt{(\Sigma P)^2 + (\Sigma Q)^2}}\right)$ |
| 3φ3W3i | $Q_i = \frac{P_i}{\sqrt{(VA_i)^2 - P_i^2}}$ $i=1, 3$ $\Sigma Q = Q_1 + Q_3$ | $VA_i = V_i \times A_i$ $i=1, 3$ $\Sigma VA =$ $\sqrt{3}/2(VA_1 + VA_3)$ | Without reactive power meter $\Sigma P / \Sigma VA$ | Without reactive power meter $\cos^{-1}(\Sigma P / \Sigma VA)$ |
| 3φ4W | $Q_i = \frac{P_i}{\sqrt{(VA_i)^2 - P_i^2}}$ $i=1, 2, 3$ $\Sigma Q = Q_1 + Q_2 + Q_3$ | $VA_i = V_i \times A_i$ $i=1, 2, 3$ $\Sigma VA =$ $VA_1 + VA_2 + VA_3$ | | |
| Calculation range | The ratings depend on the ranges for V and A. | The ratings depend on the ranges for V and A. | -1 to +1 | -180 to +180 |
| Display resolution | Same as for active power. | Same as for active power | ±1.000 | ±180.0 |

- For distortion wave input: There may be discrepancies between the CW140 and other instruments that operate based on other measurement principles.
 - Power factor and phase angle polarity : Determined by reactive power polarity.
 - If either voltage or current input is 0.4% or less of range rating:
 - 0 (zero) is displayed for Reactive power 2* and apparent power.
 - — — — (dashes) are displayed for factor and phase angle.
- Reactive power 2*: without reactive power meter method.

(5) Display functions

- Display screen Semitransparent LCD (320 × 240 pixels)
- Included functions Backlight on/off and contrast adjustment
- Maximum display size Other than electric energy 4 digits
 Electric energy (active, reactive, regenerative) 6 digits
- Japanese/English language switching

Range chart (full scale)

| Voltage range (V) | Wiring | Current range (A) | | | | | |
|-------------------|--------|-------------------|----------|----------|---------------------|---------|---------|
| | | Clamp C (50-500A) | | | Clamp B (200-1000A) | | |
| | | Clamp A (20-200A) | | | | | |
| | | 20.00 | 50.00 | 100.0 | 200.0 | 500.0 | 1000 |
| 150.0 | 1φ2W | 3.000 kW | 7.500 kW | 15.00 kW | 30.00 kW | 75.00kW | 150.0kW |
| | 1φ3W | 6.000 kW | 15.00 kW | 30.00 kW | 60.00 kW | 150.0kW | 300.0kW |
| | 3φ3W | 6.000 kW | 15.00 kW | 30.00 kW | 60.00 kW | 150.0kW | 300.0kW |
| | 3φ4W | 9.000 kW | 22.50 kW | 45.00 kW | 90.00 kW | 225.0kW | 450.0kW |
| 300.0 | 1φ2W | 6.000 kW | 15.00 kW | 30.00 kW | 60.00 kW | 150.0kW | 300.0kW |
| | 1φ3W | 12.00 kW | 30.00 kW | 60.00 kW | 120.0 kW | 300.0kW | 600.0kW |
| | 3φ3W | 12.00 kW | 30.00 kW | 60.00 kW | 120.0 kW | 300.0kW | 600.0kW |
| | 3φ4W | 18.00 kW | 45.00 kW | 90.00 kW | 180.0 kW | 450.0kW | 900.0kW |
| 600.0 | 1φ2W | 12.00 kW | 30.00 kW | 60.00 kW | 120.0 kW | 300.0kW | 600.0kW |
| | 1φ3W | 24.00 kW | 60.00 kW | 120.0 kW | 240.0 kW | 600.0kW | 1200kW |
| | 3φ3W | 24.00 kW | 60.00 kW | 120.0 kW | 240.0 kW | 600.0kW | 1200kW |
| | 3φ4W | 36.00 kW | 90.00 kW | 180.0 kW | 360.0 kW | 900.0kW | 1800kW |

Current range for clamp A : 20/50/100/200A Model : 96030
 Current range for clamp C : 50/100/200/500A Model : 96031
 Current range for clamp B : 200/500/1000A Model : 96032

(6) Averaging function

- The averaging function can be set through system settings.
- Moving average type Number of averages: Set between 2 and 10.

(7) Scaling function

- The VT ratio and CT ratio settings can be set through system settings.
- Setting range VT ratio: 1 to 10000
 CT ratio: 0.01 to 10000

(8) Wiring error check function

- This function checks the wiring connection status based on five parameters, and displays the results.

(9) Save and print functions (file functions)

| | |
|-----------------|---|
| Internal memory | 1 MB |
| Floppy disks | 1.2 MB, 1.44 MB (only when using an externally connected floppy disk drive) |
| Printer | Printing (only when using an externally connected printer) |
| Reading | Display values, set values |
| Saving | Display values, set parameters, set values |
| Printing | Display values, set parameters, set values |

(10) Communication functions (RS-232C)

| | |
|---------------------------|-----------------------------------|
| Electrical specifications | As per EIA RS-232C. |
| Synchronization system | Start-stop synchronization |
| Baud rate | 1200, 2400, 4800, 9600, 19200 bps |

(11) Frequency measurement

| | | |
|-----------------------------|---|---|
| Measurement input | Voltage input: V1, V2, V3 Current input: CH1, CH2, CH3, CH4 | } Select one of the parameters on the left. |
| Measurement frequency range | 45 Hz to 1 kHz (harmonic analysis function: 45 Hz to 65 Hz) | |
| Accuracy | ± (0.1% rdg + 1 dgt) | |
| Low-pass filter function | The low-pass filter function can be set in the system settings. Cutoff frequency: 300 Hz | |

(12) Electric energy mode

| | | |
|-------------------------------|--|---|
| Display fields | Integrate screen | Active power (Wh), recursive power (Wh), lag reactive power (Varh), lead reactive power (Varh) |
| | Instant screen | Instantaneous value measurement function measurement/calculated value display screen (does not apply to unbalance factor) |
| Display accuracy | | With Instantaneous value measurement, an active power measurement accuracy ± 1 dgt is obtained |
| Integration function settings | Start setting | Manual, specified time, external trigger (controlled) |
| | End setting | Manual, timer, specified time, external trigger |
| | Output interval | Can be set from a range of 2 minutes to 1000 hours (in one-minute increments). |
| | Quick actions using Wh (power only) key. | |

(13) Demand mode

Display fields

Demand screen

Display during demand

Maximum demand and time of occurrence, previous power demand, power since start of demand, power during current time limit, power factor, load factor, remaining demand time.

Display after demand ends

Maximum demand and time of occurrence, average for each demand type, power from start to end of demand, average power factor, average load factor.

Instantaneous value screen

Instantaneous value measurement function measurement, calculated value display screen (does not apply to unbalance factor).

Display accuracy With Instantaneous value measurement, an active power measurement accuracy ± 1 dgt is obtained

Demand function settings

Demand time limit settings 5, 10, 15, or 30 minutes

(output intervals): 1, 2, 3, 4, 6, 8, 10, or 12 hours

Load factor calculation (demand/reference power) $\times 100\%$

(14) Harmonics mode

| | |
|---|--|
| System | PLL synchronization |
| Measurement frequency range | Fundamental wave frequency $45 \leq f \leq 65$ Hz |
| Number of analysis orders | 1 to 13 |
| FFT data length | 512 |
| FFT processing word length | 32 bits |
| Window function | Rectangular |
| Sampling rate | $f \times 256$ Hz |
| Window width | 2 periods of f |
| Display fields | |
| Table display | |
| Voltage and current | RMS, content, phase angle, All-RMS, total harmonic distortion (IEEE/CSA), fundamental wave frequency |
| Power | Power, power content, power phase angle, Total electric energy, Total power factor, fundamental wave frequency |
| Graph display | |
| Voltage and current | Total RMS, content, phase angle |
| Power | Power, power content, power phase angle |
| Display accuracy | |
| RMS, power | $\pm(1.5\% \text{ rdg} + 1.5\% \text{ rng}): <1>$ |
| Content | Value calculated from $<1> \pm 2 \text{ dgt}$ |
| Phase angle | $\pm 5 \text{ deg}$ |
| Total harmonic distortion | Value calculated from $<1> \pm 2 \text{ dgt}$ |
| Logging function | |
| The logging function can be used to take continuous measurements. | |
| START setting | MANUAL, TIME, TRIGGER (controlled) |
| STOP setting | MANUAL, TIMER, TIME, TRIGGER |
| Output interval | Can be set from a range of 2 minutes to 1000 hours (in one-minute increments). |

The harmonic measure mode does not work with two-load systems.

(15) Harmonics mode equations

| | Equations |
|--|---|
| Voltage RMS Current RMS | $V_n = \sqrt{\frac{(V_{nr})^2 + (V_{ni})^2}{2}} \quad A_n = \sqrt{\frac{(A_{nr})^2 + (A_{ni})^2}{2}}$ |
| RMS nth order content | $\frac{\text{nth order RMS}}{\text{fundamental wave RMS}} \times 100\%$ |
| RMS phase angle | $\theta_n = (\text{nth order harmonic voltage phase}) - (\text{fundamental wave phase}) \times n$ $= \tan^{-1}\left(\frac{V_{nr}}{V_{ni}}\right) - \left\{ \tan^{-1}\left(\frac{V_{1r}}{V_{1i}}\right) \right\} \times n$ $\theta_n = (\text{nth order harmonic voltage phase}) - (\text{fundamental wave phase}) \times n$ $= \tan^{-1}\left(\frac{A_{nr}}{A_{ni}}\right) - \left\{ \tan^{-1}\left(\frac{A_{1r}}{A_{1i}}\right) \right\} \times n$ |
| Total Harmonic Distortion content IEEE: | $THD(IEEE) = \sqrt{\frac{\sum_{n=2}^{13} (\text{nth order harmonic voltage (current) RMS})^2}{(\text{fundamental wave voltage (current) RMS})^2}}$ |
| Total harmonic distortion content (CSA) | $THD(CSA) = \sqrt{\frac{\sum_{n=2}^{13} (\text{nth order harmonic voltage (current) RMS})^2}{\sum_{n=1}^{13} (\text{nth order harmonic voltage (current) RMS})^2}}$ |
| Power | $1\phi 2W \quad P_n = V_{nr} \times A_{nr} + V_{ni} \times A_{ni}$ $1\phi 3W \quad P_n = P_{1n} + P_{2n}$ $3\phi 3W \quad P_n = P_{1n} + P_{3n}$ $3\phi 4W \quad P_n = P_{1n} + P_{2n} + P_{3n}$ |
| Power nth order content | $\frac{\text{nth order active power}}{\text{fundamental wave active power}} \times 100\%$ |
| Power phase angle | <ul style="list-style-type: none"> • With reactive power meter method $\theta_{Pn} = \tan^{-1}\left(\frac{Q_n}{P_n}\right)$ $1\phi 2W \quad Q_n = V_{nr} \times A_{ni} - V_{ni} \times A_{nr}$ $1\phi 3W \quad Q_n = Q_{1n} + Q_{2n}$ $3\phi 3W \quad Q_n = Q_{1n} + Q_{3n}$ $3\phi 4W \quad Q_n = Q_{1n} + Q_{2n} + Q_{3n}$ <hr/> <ul style="list-style-type: none"> • Without reactive power meter method $\theta_{Pn} = \cos^{-1}\left(\frac{P_n}{V_{An}}\right)$ $1\phi 2W \quad V_{An} = V_n \times A_n$ $1\phi 3W \quad V_{An} = V_{1n} \times A_{1n} + V_{2n} \times A_{2n}$ $3\phi 3W \quad V_{An} = \frac{\sqrt{3}}{2} (V_{1n} \times A_{1n} + V_{3n} \times A_{3n})$ $3\phi 4W \quad V_{An} = V_{1n} \times A_{1n} + V_{2n} \times A_{2n} + V_{3n} \times A_{3n}$ |

19.1 Specifications

| | Equations |
|-------------------------|--|
| All-RMS | $\sum_{n=1}^{13} V_n, \sum_{n=1}^{13} A_n$ |
| All-power | $\sum_{n=1}^{13} P_n$ |
| All-power factor | <ul style="list-style-type: none"> • With reactive power meter method $\frac{\sum_{n=1}^{13} P_n}{\sqrt{(\sum_{n=1}^{13} P_n)^2 + (\sum_{n=1}^{13} Q_n)^2}}$ <ul style="list-style-type: none"> • Without reactive power meter method $\frac{\sum_{n=1}^{13} P_n}{\sum_{n=1}^{13} P_n (V_n \times A_n)}$ |

Data representing 512 obtained samples are put through FFT calculations to analyze the nth order harmonic components as follows.

nth order harmonic voltage RMS V_n : (V_{nr}, V_{ni})

nth order harmonic current RMS A_n : (A_{nr}, A_{ni})

n : Number of orders

V_{nr}, A_{nr} : Real-number components following FFT calculation

V_{ni}, A_{ni} : Imaginary-number components following FFT calculation

$P_{1n}-P_{3n}$: Active power (element of nth order)

$Q_{1n}-Q_{3n}$: Reactive power (element of nth order)

RMS phase angle: Phase angle of nth order harmonic components relative to fundamental wave component of input signal

Power phase angle: nth order current phase relative to nth order voltage

(16) Externally controlled input

Inputs can be externally controlled as logging, integration, and demand start/stop signals.

0 V/5 V

(17) Event input

The CW140 can read a signal indicating whether the load (measured equipment) is on or off.

0 V/5 V

(18) Other auxiliary functions

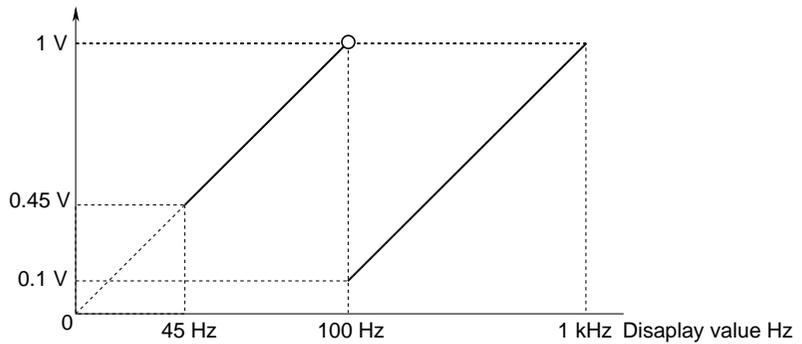
Clock, displayed language switch, displayed value hold, NiMH battery charging, LCD contrast, LCD backlight, beep (key action confirmation), key lock, power saving mode, system reset, low-battery indication

(19) D/A output (optional)

| | |
|-----------------------|---|
| Output voltage | ± 1 V relative to rating for each range |
| Output current | ± 1 mA (at load resistance of 1 k Ω) |
| Number of outputs | 4 |
| Output data selection | Selected from measurement parameters for each mode. |
| Accuracy | \pm (measurement accuracy + 0.5% FS) |
| Updating period | Same as display updating period |

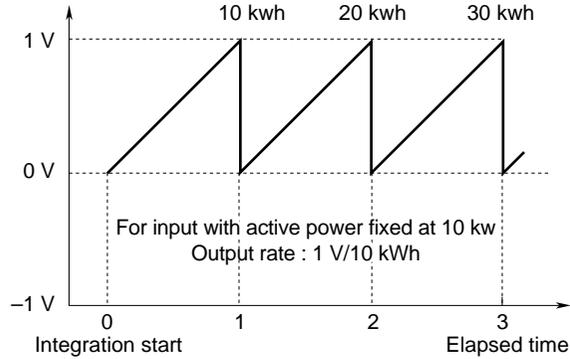
Frequency

D/A output

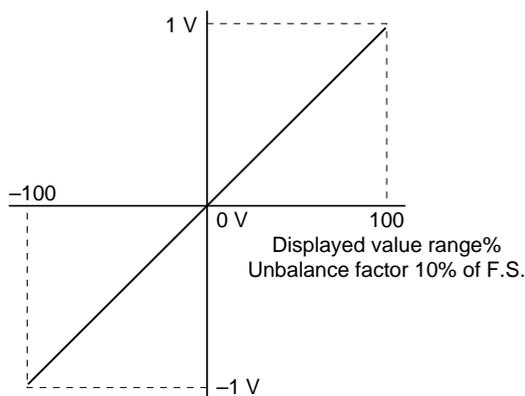


Integrate

Integrated value



Other items



19.1 Specifications

(20) General specifications

| | |
|---|---|
| Environment | Indoor use, Altitude up to 2000 m |
| Operating temperature and humidity ranges | 5°C to 40°C, 35 to 80% RH (no condensation) |
| Storage temperature and humidity ranges | -20°C to 60°C, 90% RH or less (no condensation) |
| Operating altitude | 2000m max. above sea level |
| Insulating resistance | 50 M Ω or more at 500 V DC |
| | Between voltage input terminals (assembled together) and casing |
| | Between voltage input terminals (assembled together) and <1> through <5> (assembled together) |
| | <1> Current input terminal |
| | <2> Communication terminal |
| | <3> Floppy disk drive connector |
| | <4> D/A output terminal |
| | <5> Control input terminal |
| | Across voltage input terminals (assembled together) and special AC adapter power line |
| | Across casing and special AC adapter power line |
| Insulating withstand voltage | |
| | 3700 V AC for one minute |
| | Between voltage input terminals (assembled together) and casing |
| | Between voltage input terminals (assembled together) and <1> through <5> (assembled together) |
| | 2300 V AC for one minute |
| | Between voltage input terminals (assembled together) and special AC adapter power line |
| | Across casing and special AC adapter power line |
| Power supply | |
| | AC voltage |
| | AC adapter: 100 to 240 V (50/60 Hz) |
| | NiMH battery (rechargeable) |
| | Optional NiMH battery pack |
| | (rechargeable while installed in CW140) |
| | Recharge time: Approximately 1.5 hours |
| | Batteries Six AA alkaline dry cells (included) |
| Power consumption | Approx. 20W MAX. (When using NiMH battery) |
| | Approx. 6W MAX. (When operating CW140) |
| Vibration conditions | |
| | Sweep test |
| | Frequency: 8 to 150 Hz (sweep) |
| | Reciprocating movement in each of three directions for one minute |
| | Durability test |
| | Frequency: 16.7 Hz |
| | Compound amplitude: 4 mm |
| | In each of three directions for two hours |

| | |
|---------------------------------|---|
| Impact conditions | |
| Impact test | Acceleration: 490 m/s ² In each of three directions |
| Durability test | When dropped once in the worst direction from a height of one meter, safety should not be affected. |
| External magnetic field effects | Within precision range at 400 A/m |
| External dimensions | Approximately 206 (W) × 65 (H) × 184 (D) mm |
| Weight | Approximately 1.2 kg (batteries not included) |
| Terminals | |
| Voltage input | 4 terminals Banana terminals (safety terminals) |
| Current input | H/L 4 terminals Banana terminals (safety terminals) |
| External control input | H/L 2 terminals × 2 Screwless terminals |
| Event input | H/L 2 terminals × 2 Screwless terminals |
| D/A output (optional) | H/L 2 terminals × 4 Screwless terminals |
| Accessories | Four voltage input probes Six AA alkaline dry cells AC adapter |

Safety standards: The safety standards depend on the suffix code (type of AC adapter) of CW140.

- When the suffix code of CW140 is F, R or S. (For example: CW140-S.)
Safety standards: EN61010-1, EN61010-2-031
 - Overvoltage category II (Max. input voltage: 600 Vrms)
 - Overvoltage category III (Max. input voltage: 300 Vrms)
 - Pollution degree 2
- When the suffix code of CW140 is D. (When the meter is CW140-D.)
Safety standards: UL3111-1, First Edition, CAN C22.2 No.1010.1-92
 - Overvoltage category III (Max. input voltage: 600 Vrms)
 - Pollution degree 2

EMI standards

EN55011 Group 1 Class A, EN61326: 1997

This product is class A for use in an industrial environment and may cause radio interference if used for domestic use. Therefore, appropriate measures must be taken when using it for domestic use.

Conditions of cable

Measured input

When using “Voltage Input Probes” and “Current-sensing Clamps” supplied with the CW140.

19.1 Specifications

External control(trigger)input, Event input, D/A output
Shield cable: less than 3m

Immunity standards

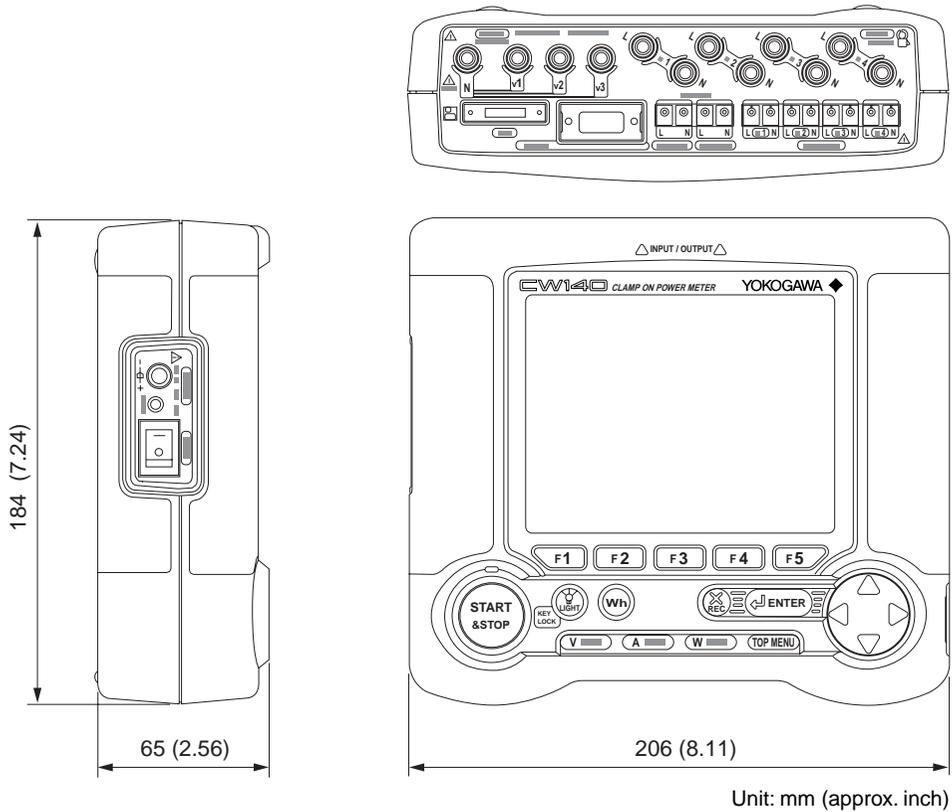
EN61000-6-2: 1999, EN61326: 1997

Effectiveness of radiation immunity

Measuring accuracy of within $\pm 40\%$ of each range

D/A Output of within $\pm 40\%$ of each range

(21) External dimension of CW140



19.2 Specifications of Current Clamps

(1) Specifications of Clamp-on Probe (96030, 96031)

| Model No. | 960 30 (Clamp A) | 200A | 960 31 (Clamp C) | 500A |
|---|--|---|--|------|
| Measurement range | 0-200 Arms AC (300 Apk) | | 0-500 Arms AC (750 Apk) | |
| Output voltage | 0-0.5 Vrms AC (2.5mV/A) | | 0-0.5 Vrms AC (1mV/A) | |
| Accuracy | Amplitude | ±1.5%rdg ±0.4 mV (20 Hz to 45 Hz) ±0.5%rdg ±0.1 mV (45 Hz to 66 Hz) ±0.8%rdg ±0.2 mV (66 Hz to 1 kHz) ±2.0%rdg ±0.4 mV (1 kHz to 20 kHz) | ±1.5% rdg ±0.4 mV (20 Hz to 45 Hz) ±0.5% rdg ±0.1 mV (45 Hz to 66 Hz) ±0.8% rdg ±0.2 mV (66 Hz to 1 kHz) | |
| | Phase | ±0.5° (45 Hz to 1kHz) | ±1° (at 50-500A,45Hz to 1kHz) | |
| Temperature coefficient | ±0.05%/°C in ranges of 5-40°C (for temperature of 23°C ±5°C, relative humidity of 35-75%, and sinewave input) | | | |
| Maximum allowed current | 250 Arms AC (45 Hz to 1kHz) | | 625 Arms (45 Hz to 400Hz) | |
| Output impedance | Approximately 6Ω | | Approximately 2.4Ω | |
| External magnetic field effects | 0.1 A equivalent or less (at 400 A/m, 50/60 Hz) | | 0.2 A equivalent or less (at 400 A/m, 50/60 Hz) | |
| Connector position effects | ±0.5% (at 20-200 A, 45 Hz to 1 kHz) | | ±0.5% (at 50-500 A, 45 Hz to 1 kHz) | |
| Used circuit voltage | 600 Vrms AC maximum | | | |
| Withstand voltage | 3.7 kVrms AC for one minute (across core and casing, and across core and output) | | | |
| Measurable connector diameter | ø30 mm maximum | | | |
| Operating temperature and humidity ranges | 5 to 40°C, 35 to 80% RH or less (no condensation) | | | |
| Storage temperature and humidity ranges | -20 to 60°C, 90% RH or less (no condensation) | | | |
| Operating altitude | 2000m max. above sea level | | | |
| External dimensions | Approx. 73 (W) × 130(H) × 30 (D) mm | | | |
| Weight | Approx. 300g | | | |
| Output cable length | Approx. 3 meters | | | |
| Accessory | Instruction manual (1) Ring markers (4 colors × 2), L4007MG | | | |

Safety standards: The safety standards depend on the type of Current Clamps.

- When the Current Clamp is 960 30 or 960 31

Safety standards: EN61010-1, EN61010-2-032

- Overvoltage category II (Max. input voltage: 600 Vrms)
- Overvoltage category III (Max. input voltage: 300 Vrms)
- Pollution degree 2

- When the Current Clamp is 960 30/D or 960 31/D.

(The following standards can be applied when the clamps are used with CW140-D.)

Safety standards: UL3111-1, First Edition, UL3111-2-032, First Edition, CAN C22.2 No.1010.1-92

- Overvoltage category III (Max. input voltage: 600 Vrms)
- Pollution degree 2

19.2 Specifications of Current Clamps

EMI standards

EN55011 Group 1 Class A, EN61326: 1997

This product is class A for use in an industrial environment and may cause radio interference if used for domestic use. Therefore, appropriate measures must be taken when using it for domestic use.

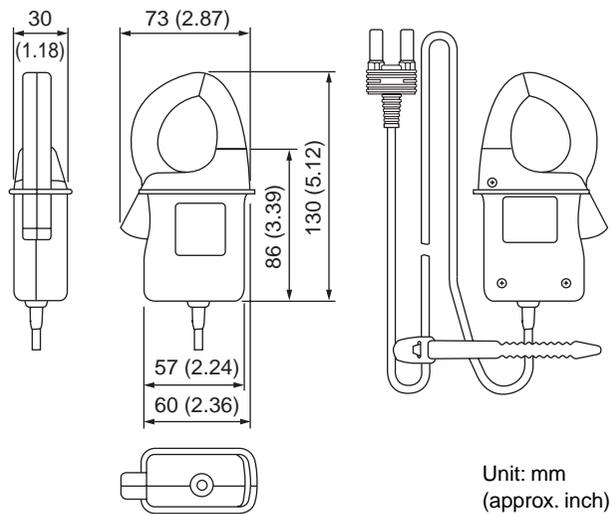
Immunity standards

EN61000-6-2: 1999, EN61326: 1997

Effectiveness of radiation immunity

Measuring accuracy of within $\pm 20\%$ of each range

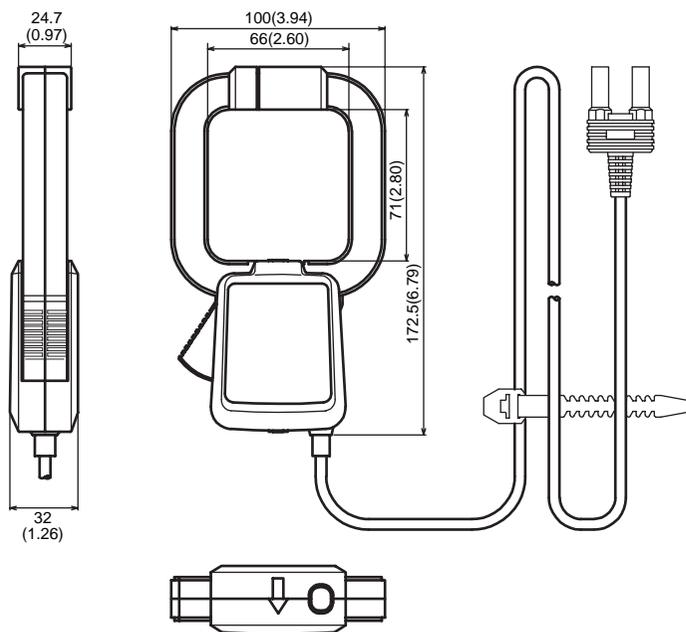
(2) External dimensions of Clamp-on Probe (96030, 96031)



(3) Specifications of Clamp-on Probe (96032)

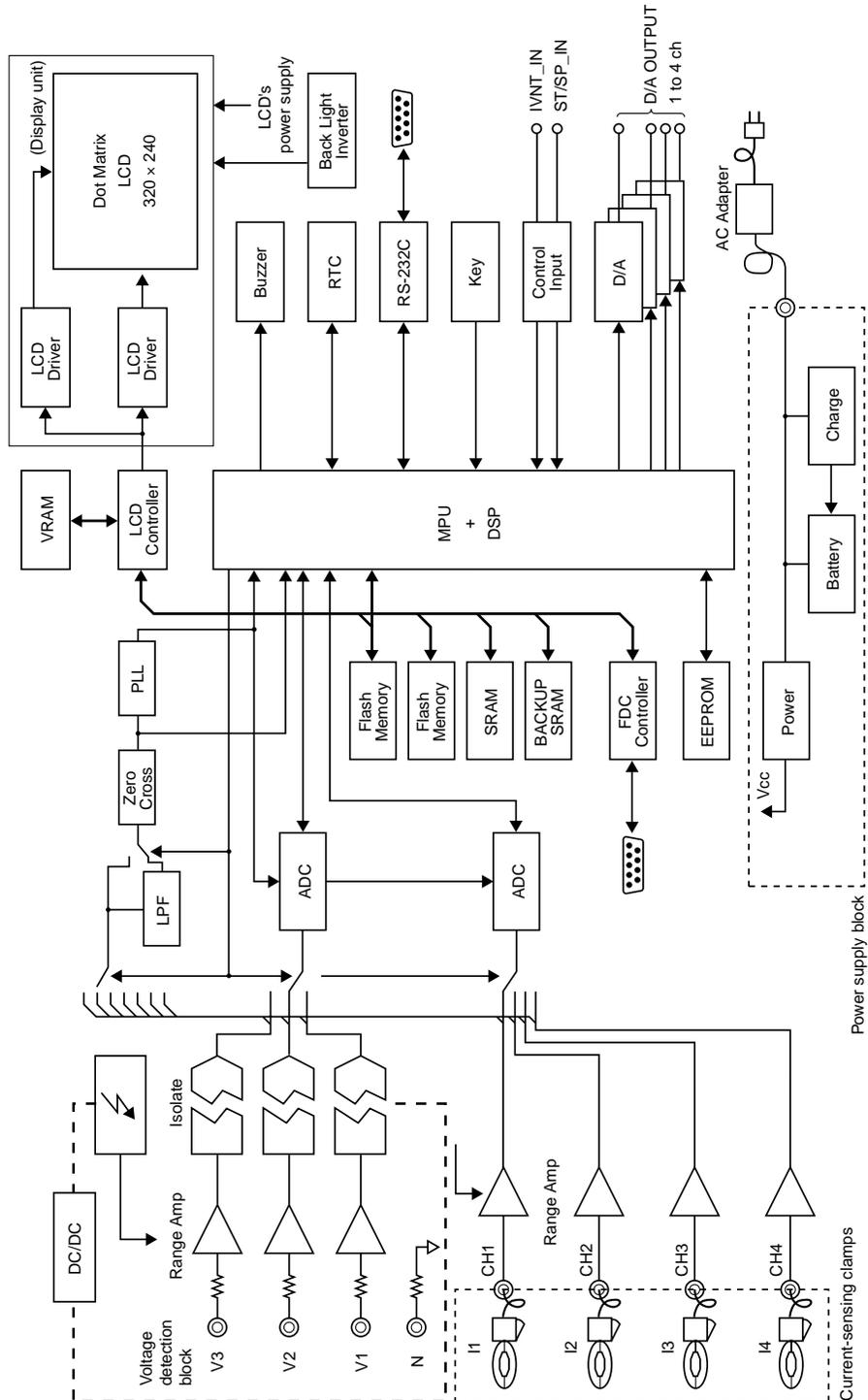
| Model No. | | 960 32 (Clamp B) |
|---|-----------|---|
| Measurement range | | 0-1000 Arms AC (1414 Apk) 5 minutes |
| Output voltage | | 0-0.25 Vrms AC (0.25 mV/A) |
| Accuracy | Amplitude | $\pm 1.0\% \text{rdg} \pm 0.2 \text{ mV}$ (45 Hz to 66 Hz) |
| | Phase | $\pm 1.0^\circ$ (50 A or more, 45 Hz to 66 Hz) (for temperature of $23^\circ\text{C} \pm 5^\circ\text{C}$, relative humidity of 35-75%, and sinewave input) |
| Temperature coefficient | | $\pm 0.05\% / ^\circ\text{C}$ in ranges of 5-40°C |
| Maximum allowed current | | 1000 Arms AC : 5 minutes, 700 Arms AC : Continuous (45 Hz to 66 Hz) |
| Output impedance | | Approximately 100Ω (max.) |
| External magnetic field effects | | 0.5 A equivalent or less (at 400 A/m, 50/60 Hz) |
| Connector position effects | | $\pm 0.5\%$ (at 200-1000 A, 45 Hz to 66 Hz) |
| Used circuit voltage | | 600 Vrms AC maximum |
| Withstand voltage | | 2.2 kVrms AC for one minute (across core and casing, and across core and output) |
| Measurable connector diameter | | Ø65 mm maximum, Bus bar: 65 × 70 mm max. |
| Operating temperature and humidity ranges | | 5 to 40°C, 35 to 80% RH or less (no condensation) |
| Storage temperature and humidity ranges | | -20 to 60°C, 90% RH or less (no condensation) |
| Operating altitude | | 2000 m max. above sea level |
| External dimensions | | Approx. 100 (W) × 172.5 (H) × 32 (D) mm |
| Weight | | Approx. 500g |
| Output cable length | | Approx. 3 meters |
| Accessory | | Instruction manual (1) Ring markers (4 colors × 2), L4007MG |

(4) External dimensions of Clamp-on Probe (96032)



Unit= mm (inch)

Appendix 1. Block Diagram of CW140 Main Unit



Block Diagram of CW140 Main Unit

Appendix 2. Communication Commands

| | | |
|------------|---|-----------------|
| 1.1 | Messages | App 2-2 |
| 1.2 | Commands | App 2-4 |
| 1.3 | Response | App 2-5 |
| 1.4 | Data | App 2-6 |
| 1.5 | Communication Commands | App 2-8 |
| 1.6 | Detailed Description of Communication Commands | App 2-16 |
| 1.6.1 | COMMunicate Group | App 2-16 |
| 1.6.2 | SYSTem Group | App 2-17 |
| 1.6.3 | DEMAAnd Group | App 2-19 |
| 1.6.4 | HARMonics Group | App 2-24 |
| 1.6.5 | INTEgrate Group | App 2-29 |
| 1.6.6 | INSTant Group | App 2-33 |
| 1.6.7 | MEASure Group | App 2-36 |
| 1.6.8 | STATus Group | App 2-41 |
| 1.6.9 | FILE Group | App 2-41 |
| 1.6.10 | Common Group | App 2-42 |
| 1.7 | Valid/Invalid Communication Command Tables | App 2-43 |

1.1 Messages

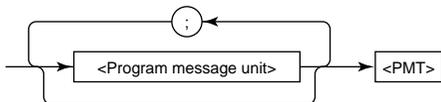
Messages

Communication between the CW140 clamp-on power meter and a personal computer is carried out in blocks of data called messages. Messages sent by the personal computer to the CW140 are called program messages, and messages received by the personal computer from the CW140 are called response messages.

If a received program message contains a query command (a command which requests a response), the CW140 returns a response message. A single response message is always returned in response to a single program message.

Program Messages

As explained above, program messages are sent from the personal computer to the CW140. The format of a program message is shown below.



<Program message unit>

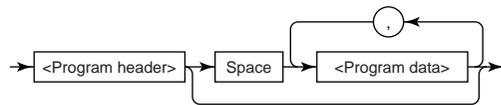
A program message is a train of zero or more program message units; each unit corresponds to one command. The CW140 executes the commands in the order that they are received. Each program unit is separated by a semicolon (;).

<PMT>

PMT is a terminator used to terminate each program message. For the CW140, the terminator is a string of CR (ASCII-code "0DH") and LF (ASCII-code "0AH") characters.

● Format of Program Message Unit

The format of a program message unit is shown below.



<Program header>

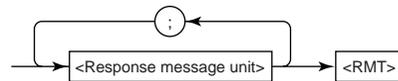
The program header contains the command type.

<Program data>

If there are certain conditions for executing a command, they are appended as program data. The program data follows the program header and is separated from the program header by a space (ASCII-code "20H"). If there are multiple data, they are separated by a comma (,).

Response Messages

As explained earlier, response messages are sent by the CW140 to the personal computer. The format of a response message is shown below.



<Response message unit>

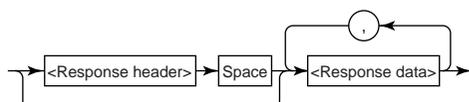
A response message is a train of one or more response message units; each response message unit corresponds to one response. Each response unit is separated by a semicolon (;).

<RMT>

RMT is a terminator used to terminate each response message. For the CW140, the terminator is a string of CR (ASCII-code "0DH") and LF (ASCII-code "0AH") characters.

● Format of Response Message Unit

The format of a response message unit is shown below.



<Response header>

It is possible to program the CW140 so a response header precedes the response data. Response data is separated from the header by a space.

<Response data>

Response data contains the contents of the response. If there are multiple data, they are separated by a comma (,).

If a program message contains multiple queries, the responses are made in the same order as the queries. For most queries, the CW140 returns only one response message unit. The CW140 returns more than one response message unit to some queries, however. The first query is always answered with the first response message unit. However, the nth query does not always agree with the nth response message unit. To be certain that the given response message unit corresponds to the correct query, place one query in each program message.

Precautions when Exchanging Messages

- You can send the next message at any time, if the previously sent message did not contain any queries.
- If the previous program message contained a query, you cannot send the next message until the entire response message is received. If you send the next program message before any response message is received or after only part of a message is received, an error will occur. The response message that was not received at all or completely will be discarded.
- If the personal computer tries to receive a response message when there is none, an error will occur. An error also occurs if the personal computer tries to receive a response message before it finishes sending the program message.

- If a program message contains multiple units and some of the units are incomplete, the CW140 will pick up the incomplete units and attempt to execute them. These attempts may not always be successful, however. In addition, even if the program message contained queries, they may not always be responded to.

Deadlock

The CW140 has receive and send buffers for storing program and response messages. Each buffer has a capacity of at least 1024 bytes. (The number of bytes available will vary depending on the operating condition of the CW140.) If both buffers become full at the same time, the CW140 becomes inoperative. This condition is called a deadlock. To resume normal operation, discard response messages. A deadlock will not occur, however, if the size of the program message including the PMT is kept below 1024 bytes. A deadlock never occurs if the program message does not contain any query.

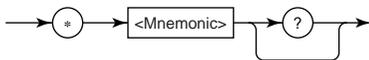
1.2 Commands

Commands

There are two types of command (program header) that can be sent from the personal computer to the CW140. They differ in the format of their program headers.

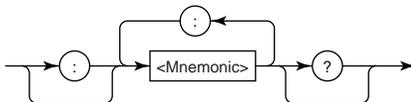
Common Command Header

Commands defined in IEEE 488.2-1987 are called common commands. The header format of a common command is shown below. An asterisk (*) always precedes a common command.



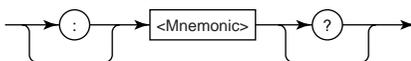
Compound Header

Commands other than common commands, that are dedicated to the CW140, are classified and arranged in a hierarchy according to their functions. The format of a compound header is shown below. A colon (:) is used to specify a lower-level header.



Simple Header

A simple header is a functionally independent command with no hierarchical structure. The format of a simple header is shown below.



When Concatenating Commands

- **Command Group**

A group of commands which share the same compound header is called a command group. A command group may contain sub-groups.

Example: Command group relating to electric energy measurement
 INTEgrate?
 INTEgrate:AOUT:CHANnel1
 INTEgrate:DISPlay:LOAD
 INTEgrate:STORe?

- **When Concatenating Commands of the Same Group**

The CW140 stores information on which hierarchical level the command currently being executed belongs to, and performs analysis on the assumption that the next command will also belong to the same level. Therefore, you may omit the header of the next command if the two commands belong to the same group.

Example: INTEgrate:STORe:FILE FILE0;START:TIME 1999,1,1,0,0<PMT>

- **When Concatenating Commands of Different Groups**

Include a colon (:) before the header, if the following command does not belong to the same group as the preceding command.

Example: SYSTem:CURRent:AUTO ON;
 :INTEgrate:START:EXECute<PMT>

- **When Concatenating Common Commands**

Common commands defined in IEEE 488.2-1987 are independent of hierarchy. A colon (:) is not necessary before a common command.

Example: INTEgrate:STORe:FILE FILE0;*CLS;START:TIME 1999,1,1,0,0<PMT>

- **When Separating Commands with <PMT>**

If a terminator is used to separate two commands, each command is a separate message. Specify the command header for each command even when the commands from the same command group are being concatenated.

Higher-level Query

A query with a question mark (?) on the topmost-level command in a group is called a higher-level query. Executing a higher-level query allows all the setup data items available with the group to be received at one time.

A response to a higher-level query can be sent exactly as it was received, as a program message to the CW140.

Rules of Header Interpretation

The CW140 interprets a received header according to the following rules.

- Mnemonics are not case-sensitive.

Example: SYSTem can also be written as system or System.

- The lower-case portion of a header can be omitted.

Example: SYSTem can also be written as SYSTE or SYST.

- The question mark (?) at the end of the header denotes a query. You cannot omit the question mark.

Example: SYSTem? cannot be abbreviated to anything shorter than SYST?.

- If the x (numeric value) at the end of the header is omitted, it is assumed to be "1".

Example: If CHANnel<x> is written as CHAN, this represents CHAN1.

1.3 Response

Upon receiving a query from the personal computer, the CW140 returns a response message to the computer. A response message is sent in either of the following forms.

- Response consisting of a header and data
If the response can be used directly as a program message, the response message will include the command header.
- Response consisting of data only
If the response cannot be used directly as a program message (i.e., the response is a query-only command), the response message will include only the data. However, some query-only commands will include a header.

● When you want a response without a header

You can have the header removed from a response that has a header and data by using the COMMunicate:HEADer command.

● Abbreviated form

Usually, the lower-case letter portion of a response header is abbreviated when it is returned. You can have it not abbreviate the lower-case letters by using the COMMunicate:VERBose command.

1.4 Data

Data

The data section comes after the header. A space must be included between the header and the data. The data contains conditions and values. It is classified as follows.

| Data | Description |
|-----------------------------------|---|
| <Decimal> | Value expressed as a decimal number |
| <Voltage>, <Current>, <Frequency> | Value with a physical dimension |
| <Character data> | Specified character string (mnemonic). Select from { }. |
| <Boolean> | Indicates ON/OFF. Specify with [ON], [OFF], or a value. |
| <Character string data> | Arbitrary character string |
| <Filename> | Denotes a file name. |

<Decimal>

<Decimal> indicates a value expressed as a decimal number, as shown in the table below. Decimal values are given in the NR form specified in ANSI X3.42-1975.

| Symbol | Description | Example |
|--------|---|----------------------|
| <NR1> | Integer | 125 -1 +1000 |
| <NR2> | Fixed-point number | 125.0 -.90 +00.1 |
| <NR3> | Floating-point number | 125.0E+0 -9E-1 +.1E4 |
| <NRf> | Any of the forms <NR1> to <NR3> is allowed. | |

- <NRf> represents the case when any of the forms <NR1> to <NR3> can be used. The CW140 accepts decimal values from the personal computer in any form.
- The form, among <NR1> to <NR3>, used for the response message is predetermined for each query. The same form is used irrespective of whether the value is large or small.
- When using <NR3>, the "+" after the "E" can be omitted, but the "-" cannot.
- If a value outside the setting range is specified, the closest valid value will be used.
- If the value specified is beyond the precision of the CW140, the value will be rounded.

<Voltage>, <Time>, <Frequency>

<Voltage>, <Time> and <Frequency> indicate decimal values which have a physical dimension. <Multiplier> or <Unit> can be attached to the <NRf> form. The values are specified in any of the following forms.

| Form | Example |
|-------------------------|---------|
| <NRf><Multiplier><Unit> | 5MV |
| <NRf><Unit> | 5E-3V |
| <NRf><Multiplier> | 5M |
| <NRf> | 5E-3 |

<Multiplier>

The following multipliers are available.

| Symbol | Word | Description |
|--------|-------|-------------------|
| EX | Exa | 10 ¹⁸ |
| PE | Peta | 10 ¹⁵ |
| T | Tera | 10 ¹² |
| G | Giga | 10 ⁹ |
| MA | Mega | 10 ⁶ |
| K | Kilo | 10 ³ |
| M | Mili | 10 ⁻³ |
| U | Micro | 10 ⁻⁶ |
| N | Nano | 10 ⁻⁹ |
| P | Pico | 10 ⁻¹² |
| F | Femto | 10 ⁻¹⁵ |

<Unit>

The following units are available.

| Symbol | Word | Description |
|--------|-----------|-------------|
| V | Volt | Voltage |
| A | Ampere | Current |
| HZ | Hertz | Frequency |
| KHZ | Kilohertz | Frequency |

- <Multiplier> and <Unit> are not case-sensitive.
- "U" is used to indicate "μ".
- "MA" is used for Mega (M) to distinguish it from Mili. If used for current, however, "MA" is interpreted as Milliampere. To refer to Megaampere, write as "MAA".
- If both <Multiplier> and <Unit> are omitted, the default unit (V, A or Hz) will be used.

- Response messages are always expressed in the <NR3> form. The default unit is used without the <Multiplier> or the <Unit>.

<Character Data>

<Character data> is a data of specific characters (mnemonic). It is mainly used to indicate options and is chosen from character strings given in { }. For interpretation rules, see "Rules of Header Interpretation."

| Form | Example |
|----------------|---------|
| {V1 V2 V3} | V1 |

- As with the header, the COMMunicate:VERBoSe command can be used to select a full response or an abbreviated response.
- The COMMunicate:HEADer command has no effect on <character data>.

<Boolean>

<Boolean> is a type of data that indicates ON or OFF, and is expressed in one of the following forms.

| Form | Example |
|----------------|------------|
| {ON OFF <NRF>} | ON OFF 1 0 |

- When expressing <Boolean> in <NRf> form, OFF is selected if the rounded integer value is "0" and ON is selected if the rounded integer is "non 0."
- A response message is always "1" if the value is ON and "0" if it is OFF.

<Character String Data>

<Character string data> is an arbitrary character string unlike the <character data>, which uses only specific characters. The character string must be enclosed in single quotation marks (') or double quotation marks (").

| Form | Example |
|-------------------------|-----------------------|
| <Character string data> | 'ABC' "IEE488.2-1987" |

- If a character string contains a double quotation mark ("), use two double quotation marks (" ") to indicate it. This rule also applies to a single quotation mark (') within a character string.
- Response messages always use double quotation marks (") around the character string.
- Since <Character string data> is an arbitrary character string, leaving the end single quotation mark (') or double quotation mark (") will cause the CW140 to interpret the program message unit as part of the <character string data>. As a result, errors may not be detected properly.

<Filename>

<Filename> is data that denotes a file name. It is expressed in one of the following forms.

| Form | Example |
|---|---------------|
| { <NRF> <Character data> <Character string data>} | 1 CASE "CASE" |

- In the <NRF> form, a file name is an ASCII code obtained by rounding an 8-digit value into an integer (for example, "1" denotes "0000001."). A negative value is not allowed, however.
- In the <character data> or <character string data> form, a file name is the first eight characters.
- A response message is always returned in the <character string data> form.

1.5 Communication Commands

| Command | Description |
|--------------------------|--|
| COMMunicate Group | |
| :COMMunicate? | Queries all the communication settings |
| :COMMunicate:HEADer | Sets/queries whether or not the header is returned in response to a query |
| :COMMunicate:STATus? | Queries status specific to the line |
| :COMMunicate:VERBose | Sets/queries whether the response to a query is returned in full or abbreviated form |
| SYSTem Group | |
| :SYSTem? | Queries all the system settings |
| :SYSTem:AVERaging | Sets/queries the averaging function (number of averaging cycles) |
| :SYSTem:BACKlight | Sets/queries whether the LCD backlight is set to ON or OFF |
| :SYSTem:BEEP | Sets/queries whether the beep sound is set to ON or OFF |
| :SYSTem:CLAMp | Sets/queries the type of clamp |
| :SYSTem:CONTRast | Sets/queries the LCD contrast |
| :SYSTem:CURRent? | Queries all the settings relating to the current range |
| :SYSTem:CURRent:AUTO | Sets/queries whether current auto-ranging is set to ON or OFF |
| :SYSTem:CURRent:RANGe | Sets/queries the current range settings |
| :SYSTem:DATE | Sets/queries the date |
| :SYSTem:DISPlay? | Queries the type of screen |
| :SYSTem:FILTer | Sets/queries whether the low-pass filter is set to ON or OFF |
| :SYSTem:FREQuence | Sets/queries the frequency source |
| :SYSTem:HOLD | Sets/queries whether or not the measurement screen is held |
| :SYSTem:KLOCK | Sets/queries the keylock function |
| :SYSTem:OPERationvar | Sets/queries whether the reactive power method is set to ON or OFF |
| :SYSTem:RESEt | Resets the system |
| :SYSTem:SCALing? | Queries all the settings relating to scaling |
| :SYSTem:SCALing:CT | Sets/queries the CT ratio |
| :SYSTem:SCALing:VT | Sets/queries the VT ratio |
| :SYSTem:TIME | Sets/queries the time |
| :SYSTem:VOLTage? | Queries all the settings relating to the voltage range |
| :SYSTem:VOLTage:AUTO | Sets/queries whether voltage auto-ranging is set to ON or OFF |
| :SYSTem:VOLTage:RANGe | Sets/queries the voltage range |
| :SYSTem:WIRIng | Sets/queries the wiring |
| DEMAnd Group | |
| :DEMAnd? | Queries all the settings relating to demand measurement |
| :DEMAnd:AOUT? | Queries all the settings relating to D/A output |
| :DEMAnd:AOUT:CHANnel<x> | Sets/queries D/A-output data items |
| :DEMAnd:AOUT:RATE | Sets/queries the rate of D/A-output integrated values |
| :DEMAnd:CLEAR | Clears integrated values to zero |
| :DEMAnd:DISPlay? | Queries all the settings relating to measurement display |
| :DEMAnd:DISPlay:LOAD | Sets/queries the load whose data is measured and viewed |
| :DEMAnd:DISPlay:MODE | Sets/queries the mode of measurement screen |

| Command | Description |
|--------------------------|---|
| :DEMAnd:INTERval | Sets/queries the demand period |
| :DEMAnd:PERIod? | Queries all the settings relating to decimal point and unit of energy of demand period. |
| :DEMAnd:PERIod:DIGIt | Set/queries position of decimal point of energy of demand period. |
| :DEMAnd:PERIod:UNIT | Set/queries unit of measurement of energy of demand period. |
| :DEMAnd:REFERence | Sets/queries the reference power |
| :DEMAnd:START? | Queries all the settings relating to the start of measurement |
| :DEMAnd:START:EXECute | Starts measurement |
| :DEMAnd:START:METHOD | Sets/queries the method for starting measurement |
| :DEMAnd:START:TIME | Sets/queries the starting time of measurement |
| :DEMAnd:STATe? | Queries the measurement status |
| :DEMAnd:STOP? | Queries all the settings relating to the end of measurement |
| :DEMAnd:STOP:EXECute | Stops measurement |
| :DEMAnd:STOP:INTERval | Sets/queries the end-of-measurement timer setting |
| :DEMAnd:STOP:METHOD | Sets/queries the method for stopping measurement |
| :DEMAnd:STOP:TIME | Sets/queries the ending time of measurement |
| :DEMAnd:STORE? | Queries all the settings relating to output destination and data items to be saved |
| :DEMAnd:STORE:STATe | Sets/queries whether data output is set to ON or OFF |
| :DEMAnd:STORE:FD | Sets/queries whether data output to floppy disks is set to ON or OFF |
| :DEMAnd:STORE:FILENAME | Sets/queries the name of a file to be saved |
| :DEMAnd:STORE:ITEM? | Queries all the settings relating to data items to be saved |
| :DEMAnd:STORE:ITEM:DMGR | Sets/queries whether demand-group data output is set to ON or OFF |
| :DEMAnd:STORE:ITEM:IGR | Sets/queries whether current-group data output is set to ON or OFF |
| :DEMAnd:STORE:ITEM:EVENT | Sets/queries whether event-group data output is set to ON or OFF |
| :DEMAnd:STORE:ITEM:PGR | Sets/queries whether power-group data output is set to ON or OFF |
| :DEMAnd:STORE:ITEM:VGR | Sets/queries whether voltage-group data output is set to ON or OFF |
| :DEMAnd:STORE:ITEM:WHGR | Sets/queries whether electric-energy-group data output is set to ON or OFF |
| :DEMAnd:STORE:MEMORY | Sets/queries whether data output to internal memory is set to ON or OFF |
| :DEMAnd:TOTAL? | Queries all the settings relating to decimal point and unit of total energy. |
| :DEMAnd:TOTAL:DIGIt | Set/queries position of decimal point of total energy. |
| :DEMAnd:TOTAL:UNIT | Set/queries unit of measurement of total energy. |

Appendix 2. Communication Commands

| Command | Description |
|------------------------------------|--|
| HARMonics Group | |
| :HARMonics? | Queries all the settings relating to harmonics measurement |
| :HARMonics:AOUT? | Sets/queries all the settings relating to D/A output |
| :HARMonics:AOUT:CHANnel<x>? | Queries all the settings relating to each D/A-output channel |
| :HARMonics:AOUT:CHANnel<x>:ELEMent | Sets/queries D/A-output elements |
| :HARMonics:AOUT:CHANnel<x>:ITEM | Sets/queries D/A-output data items |
| :HARMonics:AOUT:CHANnel<x>:ORDER | Sets/queries the D/A-output order |
| :HARMonics:DISPlay? | Queries all the settings relating to measurement screen |
| :HARMonics:DISPlay:ELEMent | Sets/queries the element to be shown on measurement screen |
| :HARMonics:DISPlay:ITEM | Sets/queries the analysis item to be shown on measurement screen |
| :HARMonics:DISPlay:MODE | Sets/queries the measurement screen |
| :HARMonics:STATe? | Queries the measurement status |
| :HARMonics:STORe? | Queries all the settings relating to output destination and data items to be saved |
| :HARMonics:STORe:STATe | Sets/queries whether logging is set to ON or OFF |
| :HARMonics:STORe:FD | Sets/queries whether data output to floppy disks is set to ON or OFF |
| :HARMonics:STORe:FILEName | Sets/queries the name of a file to be saved |
| :HARMonics:STORe:INTERVal | Sets/queries the output time interval |
| :HARMonics:STORe:ITEM? | Queries all the settings relating to data items to be saved |
| :HARMonics:STORe:ITEM:CSA | Sets/queries whether THD/CSA data output is set to ON or OFF |
| :HARMonics:STORe:ITEM:EVENT | Sets/queries whether event data output is set to ON or OFF |
| :HARMonics:STORe:ITEM:I<x> | Sets/queries whether current data output is set to ON or OFF |
| :HARMonics:STORe:ITEM:ICONT | Sets/queries whether harmonic current content data output is set to ON or OFF |
| :HARMonics:STORe:ITEM:IEEE | Sets/queries whether THD/IEEE data output is set to ON or OFF |
| :HARMonics:STORe:ITEM:IPA | Sets/queries whether current phase angle data output is set to ON or OFF |
| :HARMonics:STORe:ITEM:IRMS | Sets/queries whether rms current data output is set to ON or OFF |
| :HARMonics:STORe:ITEM:I<x>:ITOTAL | Sets/queries whether total rms current data output is set to ON or OFF |
| :HARMonics:STORe:ITEM:ORDER? | Queries all the settings relating to the order for which data is output |
| :HARMonics:STORe:ITEM:ORDER:TYPE | Sets/queries the type of order for which data is output |
| :HARMonics:STORe:ITEM:ORDER:<x> | Sets/queries the order for which data is output |
| :HARMonics:STORe:ITEM:P | Sets/queries whether power data output is set to ON or OFF |
| :HARMonics:STORe:ITEM:PCONT | Sets/queries whether harmonic power content data output is set to ON or OFF |
| :HARMonics:STORe:ITEM:PF | Sets/queries whether power factor data output is set to ON or OFF |
| :HARMonics:STORe:ITEM:POWER | Sets/queries whether power value data output is set to ON or OFF |
| :HARMonics:STORe:ITEM:PPA | Sets/queries whether power phase angle data output is set to ON or OFF |
| :HARMonics:STORe:ITEM:PTOTAL | Sets/queries whether total power data output is set to ON or OFF |
| :HARMonics:STORe:ITEM:V<x> | Sets/queries whether voltage data output is set to ON or OFF |

| Command | Description |
|--------------------------------|--|
| :HARMonics:STORe:ITEM:VCONt | Sets/queries whether harmonic voltage content data output is set to ON or OFF |
| :HARMonics:STORe:ITEM:VPA | Sets/queries whether voltage phase angle data output is set to ON or OFF |
| :HARMonics:STORe:ITEM:VRMS | Sets/queries whether rms voltage data output is set to ON or OFF |
| :HARMonics:STORe:ITEM:VTOTAL | Sets/queries whether total rms voltage data output is set to ON or OFF |
| :HARMonics:STORe:MEMORy | Sets/queries whether data output to internal memory is set to ON or OFF |
| :HARMonics:STORe:STARt? | Queries all the settings relating to the start of logging |
| :HARMonics:STORe:STARt:EXECute | Starts logging |
| :HARMonics:STORe:STARt:METHod | Sets/queries the method for starting logging |
| :HARMonics:STORe:STARt:TIME | Sets/queries the starting time of logging |
| :HARMonics:STORe:STOP? | Queries all the settings relating to the end of logging |
| :HARMonics:STORe:STOP:EXECute | Stops logging |
| :HARMonics:STORe:STOP:INTERval | Sets/queries the end-of-logging timer setting |
| :HARMonics:STORe:STOP:METHod | Sets/queries the method for stopping logging |
| :HARMonics:STORe:STOP:TIME | Sets/queries the ending time of logging |
| INTEGrate Group | |
| :INTEGrate? | Queries all the settings relating to electric energy measurement |
| :INTEGrate:AOUT? | Queries all the settings relating to D/A output |
| :INTEGrate:AOUT:CHANnel<x> | Sets/queries D/A-output data items |
| :INTEGrate:AOUT:RATE | Sets/queries the rate of D/A-output integrated values |
| :INTEGrate:CLEAr | Clears integrated values to zero |
| :INTEGrate:DISPlay? | Queries all the settings relating to measurement screen |
| :INTEGrate:DISPlay:LOAD | Sets/queries the load whose data is measured and viewed |
| :INTEGrate:DISPlay:MODE | Sets/queries the mode of measurement screen |
| :INTEGrate:NEGWatt | Sets/queries whether regenerative power measurement is set to ON or OFF |
| :INTEGrate:STARt? | Queries all the settings relating to the start of measurement |
| :INTEGrate:STARt:EXECute | Starts measurement |
| :INTEGrate:STARt:METHod | Sets/queries the method for starting measurement |
| :INTEGrate:STARt:TIME | Sets/queries the starting time of measurement |
| :INTEGrate:STATe? | Queries the measurement status |
| :INTEGrate:STOP? | Queries all the settings relating to the end of measurement |
| :INTEGrate:STOP:EXECute | Stops measurement |
| :INTEGrate:STOP:INTERval | Sets/queries the end-of-measurement timer setting |
| :INTEGrate:STOP:METHod | Sets/queries the method for stopping measurement |
| :INTEGrate:STOP:TIME | Sets/queries the ending time of measurement |
| :INTEGrate:STORe? | Queries all the settings relating to output destination and data items to be saved |
| :INTEGrate:STORe:STATe | Sets/queries whether data output is set to ON or OFF |
| :INTEGrate:STORe:FD | Sets/queries whether data output to floppy disks is set to ON or OFF |
| :INTEGrate:STORe:FILEname | Sets/queries the name of a file to be saved |
| :INTEGrate:STORe:INTERval | Sets/queries the output time interval |

Appendix 2. Communication Commands

| Command | Description |
|-----------------------------|---|
| :INTEgrate:STORE:ITEM? | Queries all the settings relating to data items to be saved |
| :INTEgrate:STORE:ITEM:IGR | Sets/queries whether current-group data output is set to ON or OFF |
| :INTEgrate:STORE:ITEM:EVENT | Sets/queries whether event-group data output is set to ON or OFF |
| :INTEgrate:STORE:ITEM:PGR | Sets/queries whether power-group data output is set to ON or OFF |
| :INTEgrate:STORE:ITEM:VGR | Sets/queries whether voltage-group data output is set to ON or OFF |
| :INTEgrate:STORE:ITEM:WHGR | Sets/queries whether electric-energy-group data output is set to ON or OFF |
| :INTEgrate:STORE:MEMORy | Sets/queries whether data output to internal memory is set to ON or OFF |
| :INTEgrate:WH? | Queries all the settings relating to decimal point and unit of electric energy. |
| :INTEgrate:WH:DIGIt | Set/queries position of decimal point of electric energy. |
| :INTEgrate:WH:UNIT | Set/queries unit of measurement of electric energy. |

INSTant Group

| | |
|----------------------------|--|
| :INSTant? | Queries all the settings relating to instantaneous value measurement |
| :INSTant:AOUT? | Queries all the settings relating to D/A output |
| :INSTant:AOUT:CHANnel<x> | Sets/queries D/A-output data items |
| :INSTant:DISPlay? | Queries all the settings relating to measurement screen |
| :INSTant:DISPlay:EXPAnd<x> | Sets/queries the data items for expanded view |
| :INSTant:DISPlay:LOAD | Sets/queries the load whose data is measured and viewed |
| :INSTant:DISPlay:MODE | Sets/queries the mode of measurement screen |
| :INSTant:STATe? | Queries the measurement status |
| :INSTant:STORE? | Queries all the settings relating to output destination and data items to be saved |
| :INSTant:STORE:STATe | Sets/queries whether logging is set to ON or OFF |
| :INSTant:STORE:FD | Sets/queries whether data output to floppy disks is set to ON or OFF |
| :INSTant:STORE:FILEName | Sets/queries the name of a file to be saved |
| :INSTant:STORE:INTErval | Sets/queries the time interval for logging output |
| :INSTant:STORE:ITEM? | Queries all the settings relating to data items to be saved |
| :INSTant:STORE:ITEM:IGR | Sets/queries whether current-group data output is set to ON or OFF |
| :INSTant:STORE:ITEM:EVENT | Sets/queries whether event-group data output is set to ON or OFF |
| :INSTant:STORE:ITEM:PGR | Sets/queries whether power-group data output is set to ON or OFF |
| :INSTant:STORE:ITEM:VGR | Sets/queries whether voltage-group data output is set to ON or OFF |
| :INSTant:STORE:MEMORy | Sets/queries whether data output to internal memory is set to ON or OFF |
| :INSTant:STORE:START? | Queries all the settings relating to the start of logging |

| Command | Description |
|--|--|
| :INSTant:StORe:StARt:EXECute | Starts logging |
| :INSTant:StORe:StARt:MEthod | Sets/queries the method for starting logging |
| :INSTant:StORe:StARt:TIME | Sets/queries the starting time of logging |
| :INSTant:StORe:StOP? | Queries all the settings relating to the end of logging |
| :INSTant:StORe:StOP:EXECute | Stops logging |
| :INSTant:StORe:StOP:INTERval | Sets/queries the end-of-logging timer setting |
| :INSTant:StORe:StOP:MEthod | Sets/queries the method for stopping logging |
| :INSTant:StORe:StOP:TIME | Sets/queries the ending time of logging |
| MEASure Group | |
| :MEASure:DEMAnd? | Queries all the settings relating to Demand Measure mode communication-output data |
| :MEASure:DEMAnd:ITEM? | Queries all the settings relating to Demand Measure mode communication-output data items |
| :MEASure:DEMAnd:ITEM:<Demand Measure mode data item> | Sets/queries whether Demand Measure mode communication-output data items are set to ON or OFF |
| :MEASure:DEMAnd:ITEM:ALL | Sets all effective Demand Measure mode communication-output data to ON |
| :MEASure:DEMAnd:ITEM:CLEAr | Sets all effective Demand Measure mode communication-output data to OFF |
| :MEASure:DEMAnd:VALUe? | Queries the measurement data item set with a command that follows the :MEASure:DEMAnd:ITEM query |
| :MEASure:HARMonics? | Queries all the settings relating to Harmonics Measure mode communication-output data |
| :MEASure:HARMonics:ITEM? | Queries all the settings relating to Harmonics Measure mode communication-output data items |
| :MEASure:HARMonics:ITEM:ALL | Sets all effective Harmonics Measure mode communication-output data to ON |
| :MEASure:HARMonics:ITEM:CLEAr | Sets all effective Harmonics Measure mode communication-output data to OFF |
| :MEASure:HARMonics:ITEM:I<x>? | Queries all the settings relating to Harmonics Measure mode communication-output current data items |
| :MEASure:HARMonics:ITEM:I<x1>:CONT<x2> | Sets/queries whether Harmonics Measure mode communication-output harmonic current content data is set to ON or OFF |
| :MEASure:HARMonics:ITEM:I<x>:CSA | Sets/queries whether Harmonics Measure mode communication-output current THD/CSA data is set to ON or OFF |
| :MEASure:HARMonics:ITEM:I<x>:IEEE | Sets/queries whether Harmonics Measure mode communication-output current THD/IEEE data is set to ON or OFF |
| :MEASure:HARMonics:ITEM:I<x1>:PA<x2> | Sets/queries whether Harmonics Measure mode communication-output current phase angle data is set to ON or OFF |
| :MEASure:HARMonics:ITEM:I<x1>:RMS<x2> | Sets/queries whether Harmonics Measure mode communication-output rms current data is set to ON or OFF |
| :MEASure:HARMonics:ITEM:I<x>:TOTAL | Sets/queries whether Harmonics Measure mode communication-output total rms current data is set to ON or OFF |
| :MEASure:HARMonics:ITEM:EVENT | Sets/queries whether Harmonics Measure mode communication-output event data is set to ON or OFF |

Appendix 2. Communication Commands

| Command | Description |
|---|--|
| :MEASure:HARMonics:ITEM:F | Sets/queries whether Harmonics Measure mode communication-output frequency data is set to ON or OFF |
| :MEASure:HARMonics:ITEM:ORDER | Sets/queries the order of Harmonics Measure mode communication-output data |
| :MEASure:HARMonics:ITEM:PF | Sets/queries whether Harmonics Measure mode communication-output power factor data is set to ON or OFF |
| :MEASure:HARMonics:ITEM:V<x>? | Queries all the settings relating to Harmonics Measure mode communication-output voltage data items |
| :MEASure:HARMonics:ITEM:V<x>:CONT<x> | Sets/queries whether Harmonics Measure mode communication-output harmonic voltage content data is set to ON or OFF |
| :MEASure:HARMonics:ITEM:V<x>:CSA | Sets/queries whether Harmonics Measure mode communication-output voltage THD/CSA data is set to ON or OFF |
| :MEASure:HARMonics:ITEM:V<x>:IEEE | Sets/queries whether Harmonics Measure mode communication-output voltage THD/IEEE data is set to ON or OFF |
| :MEASure:HARMonics:ITEM:V<x>:PA<x> | Sets/queries whether Harmonics Measure mode communication-output voltage phase angle data is set to ON or OFF |
| :MEASure:HARMonics:ITEM:V<x>:RMS<x> | Sets/queries whether Harmonics Measure mode communication-output rms voltage data is set to ON or OFF |
| :MEASure:HARMonics:ITEM:V<x>:TOTAL | Sets/queries whether Harmonics Measure mode communication-output total rms voltage data is set to ON or OFF |
| :MEASure:HARMonics:ITEM:P<x> | Sets/queries whether Harmonics Measure mode communication-output power data is set to ON or OFF |
| :MEASure:HARMonics:ITEM:PCONT<x> | Sets/queries whether Harmonics Measure mode communication-output harmonic power data is set to ON or OFF |
| :MEASure:HARMonics:ITEM:PPA<x> | Sets/queries whether Harmonics Measure mode communication-output power phase angle data is set to ON or OFF |
| :MEASure:HARMonics:ITEM:PTOTAL | Sets/queries whether Harmonics Measure mode communication-output total power data is set to ON or OFF |
| :MEASure:HARMonics:VALUe? | Queries the measurement data item set with a command that follows the :MEASure:HARMonics:ITEM query |
| :MEASure:INTEgrate? | Queries all the settings relating to Electric Energy Measure mode communication-output data |
| :MEASure:INTEgrate:ITEM? | Queries all the settings relating to Electric Energy Measure mode communication-output data items |
| :MEASure:INTEgrate:ITEM<Electric Energy Measure mode data item> | Sets/queries whether Electric Energy Measure mode communication-output data items are set to ON or OFF |
| :MEASure:INTEgrate:ITEM:ALL | Sets all effective Electric Energy Measure mode communication-output data to ON |
| :MEASure:INTEgrate:ITEM:CLEAR | Sets all effective Electric Energy Measure mode communication-output data to OFF |
| :MEASure:INTEgrate:ITEM:VALUe? | Queries the measurement data item set with a command that follows the :MEASure:INTEgrate:ITEM query |
| :MEASure:INSTant? | Queries all the settings relating to Instant Measure mode communication-output data |
| :MEASure:INSTant:ITEM? | Queries all the settings relating to Instant Measure mode communication-output data items |

| Command | Description |
|---|---|
| :MEASure:INSTant:ITEM:<Instant Measure data item> | Sets/queries whether Instant Measure mode communication-output data items are set to ON or OFF |
| :MEASure:INSTant:ITEM:ALL | Sets all effective Instant Measure mode communication-output data to ON |
| :MEASure:INSTant:ITEM:CLEAR | Sets all effective Instant Measure mode communication-output data to OFF |
| :MEASure:INSTant:VALUe? | Queries the measurement data item set with a command that follows the :MEASure:INSTant:ITEM query |
| STATus Group | |
| : STATus? | Queries all the settings relating to the status of the communication function |
| :STATus:ERRor? | Queries the error code and message (head of the error queue) |
| :STATus:OMESsage | Queries whether or not to add to the message contents to the :STATus:ERRor? response |
| FILE Group | |
| :FILE:DIREctory? | Queries the internal memory directory set by the :FILE:TYPE command |
| :FILE:NAME | Sets/queries the file name to load from internal memory |
| :FILE:SEND? | Queries the file information set by the :FILE:TYPE and :FILE:NAME commands |
| :FILE:TYPE | Sets/queries the measurement mode and file type when accessing internal memory |
| Common Command Group | |
| *CLS | Clears the error queue |
| *IDN? | Queries the meter model |

Output Queue and Error Queue

Output Queue

The output queue is provided to store response messages to queries. For example, when the `:MEASure:INTEgrate:VALUe?` query is sent to request output of measured data, the response data will be stored in the output queue until it is read out.

Data items are stored in sequence in the output queue and then read out on a first-in-first-out basis. The output queue is emptied in any of the following cases, in addition to a case when it is entirely read out.

- A new message is received from the personal computer.
- A deadlock occurs.
- The power is turned on again.

Error Queue

The error queue stores the error number and message when an error occurs. For example, if the personal computer sends an illegal program message, the error queue stores error number 113 and the error message "Undefined header." The contents of the error queue can be read using the `STATus:ERRor?` query. As with the output queue, messages in the error queue are read out on a first-in-first-out basis.

If the error queue overflows, the last message is replaced with message 350, "Queue overflow." The error queue is emptied in either of the following cases, in addition to a case when it is entirely read out).

- The `*CLS` command is received.
- The power is turned on again.

1.6 Detailed Description of Communication Commands

1.6.1 COMMunicate Group

The commands in the COMMunicate group are used to set or query communication parameters.

:COMMunicate?

Function Queries all the communication settings.

Syntax `:COMMunicate?`

Example `:COMMUNICATE?`

```
→:COMMUNICATE:HEADER
1;VERBOSE 1;STATUS 0
```

:COMMunicate:HEADer

Function Sets/queries whether or not the header is returned in response to a query.

Syntax `:COMMunicate:HEADer {<Boolean>}`

`:COMMunicate:HEADer?`

Example `:COMMUNICATE:HEADER ON`

```
:COMMUNICATE:HEADER?→
:COMMUNICATE:HEADER 1
```

:COMMunicate:STATus?

Function Queries the status specific to the line.

Syntax `:COMMunicate:STATus?`

Example `:COMMUNICATE:STATUS?→`

```
:COMMUNICATE:STATUS 0
```

Description The status bits have the following meanings.

Bit 0: Parity error

Bit 1: Framing error

Bit 2: BREAK character detected

Bit 3 and later: Always 0

If one of the causes noted above occurs, the corresponding status bit is set. The bit is cleared when the status is read.

:COMMunicate:VERBose

Function Sets/queries whether the response to a query is returned in full or abbreviated form.

Syntax :COMMunicate:VERBose
{<Boolean>}
:COMMunicate:VERBose?

Example :COMMUNICATE:VERBOSE ON
:COMMUNICATE:VERBOSE?→
:COMMUNICATE:VERBOSE 1

1.6.2 SYSTem Group

The commands in the SYSTem group set or query system parameters.

:SYSTem?

Function Queries all the system settings.

Syntax :SYSTem?

:SYSTem:AVERaging

Function Sets/queries the averaging function (number of averaging cycles).

Syntax :SYSTem:AVERaging?
:SYSTem:AVERaing {<NRf>}
<NRf> = 1:OFF, 2, 3, 4, 5, 6, 7, 8, 9, 10

:SYSTem:BACKlight

Function Sets/queries whether the LCD backlight is set to ON or OFF.

Syntax :SYSTem:BACKlight?
:SYSTem:BACKlight
{<Boolean>}

:SYSTem:BEEP

Function Sets/queries whether the beep function is set to ON or OFF.

Syntax :SYSTem:BEEP?
:SYSTem:BEEP {<Boolean>}

:SYSTem:CLAMP

Function Sets/queries the type of clamp.

Syntax :SYSTem:CLAMP?
:SYSTem:CLAMP {<NRf>}
<NRf> = 0: 200 A range
1: 1000 A range
2: 500 A range

:SYSTem:CONTRast

Function Sets/queries the LCD contrast.

Syntax :SYSTem:CONTRast?
:SYSTem:CONTRast {<NRf>}
<NRf> = 1 to 8

:SYSTem:CURREnt?

Function Queries all the settings relating to the current range.

Syntax :SYSTem:CURREnt?

:SYSTem:CURREnt:AUTO

Function Sets/queries whether current auto-ranging is set to ON or OFF.

Syntax :SYSTem:CURREnt:AUTO?
:SYSTem:CURREnt:AUTO
{<Boolean>}

:SYSTem:CURREnt:RANGe

Function Sets/queries the current range.

Syntax :SYSTem:CURREnt:RANGe?
:SYSTem:CURREnt:RANGe
{<NRf>}
<NRf> = 0: 20 A
1: 50 A
2: 100 A
3: 200 A
4: 500 A
5: 1000 A

Appendix 2. Communication Commands

:SYSTEM:DATE

Function Sets/queries the date.

Syntax :SYSTEM:DATE?
:SYSTEM:DATE {<NRf1>,
<NRf2>,<NRf3>}
<NRf1> = Year: 1999 to 2098
<NRf2> = Month: 1 to 12
<NRf3> = Day: 1 to 31

:SYSTEM:DISPlay?

Function Queries the mode of measurement screen.

Syntax :SYSTEM:DISPlay?
<NRf> = 0: TOP MENU
1: Instant Measure mode
2: Electric Energy Measure mode
3: Demand Measure mode
4: Harmonics Measure mode
5: System Setting
6: File Handling
7: Checking Wiring
8: Electric Energy with Wh key

:SYSTEM:FILTer

Function Sets/queries whether the low-pass filter is set to ON or OFF.

Syntax :SYSTEM:FILTer?
:SYSTEM:FILTer {<Boolean>}

:SYSTEM:FREQuence

Function Sets/queries the frequency source.

Syntax :SYSTEM:FREQuence?
:SYSTEM:FREQuence {<NRf>}
<NRf> = 0: V1, 1: V2, 2: V3,
3: I1, 4: I2, 5: I3,
6: I1-2, 7: I2-2, 8: I3-2

:SYSTEM:HOLD

Function Sets/queries the hold status of measurement screen.

Syntax :SYSTEM:HOLD?
:SYSTEM:HOLD {<Boolean>}

:SYSTEM:KLOCK

Function Sets/queries whether the key-lock function is set to ON or OFF.

Syntax :SYSTEM:KLOCK?
:SYSTEM:KLOCK {<Boolean>}

:SYSTEM:OPERationvar

Function Sets/queries whether the reactive power method is set to ON or OFF.

Syntax :SYSTEM:OPERationvar?
:SYSTEM:OPERationvar
{<Boolean>}

:SYSTEM:RESEt

Function Executes system resetting.

Syntax :SYSTEM:RESEt

:SYSTEM:SCALing?

Function Queries all the settings relating to scaling.

Syntax :SYSTEM:SCALing?

:SYSTEM:SCALing:CT

Function Sets/queries the CT ratio.

Syntax :SYSTEM:SCALing:CT?
:SYSTEM:SCALing:CT {<NRf>}
<NRf> = 0.01 to 10000

:SYSTEM:SCALing:VT

Function Sets/queries the VT ratio.

Syntax :SYSTEM:SCALing:VT?
:SYSTEM:SCALing:VT {<NRf>}
<NRf> = 1 to 10000

:SYSTEM:TIME

Function Sets/queries the clock.

Syntax :SYSTEM:TIME?
:SYSTEM:TIME
{<NRf1>,<NRf2>,<NRf3>}
<NRf1> = hour: 0 to 23
<NRf2> = minute: 0 to 59
<NRf3> = second: 0 to 59

:SYSTEM:VOLTage?

Function Queries all the settings relating to the voltage range.

Syntax :SYSTEM:VOLTage?

:SYSTEM:VOLTage:AUTO

Function Sets/queries whether voltage auto-ranging is set to ON or OFF.

Syntax :SYSTEM:VOLTage:AUTO?
:SYSTEM: VOLTage:AUTO
{<Boolean>}

:SYSTEM:VOLTage:RANGE

Function Sets/queries the voltage range.

Syntax :SYSTEM:VOLTage:RANGE?
:SYSTEM:VOLTage:RANGE
{<NRf>}
<NRf> = 0: 150 V
1: 300 V
2: 600 V

:SYSTEM:WIRIng

Function Sets/queries the wiring type.

Syntax :SYSTEM:WIRIng?
:SYSTEM:WIRIng {<NRf>}
<NRf> = 0: 1 ϕ 2W
1: 1 ϕ 3W
2: 3 ϕ 3W
3: 3 ϕ 3W3i
4: 3 ϕ 4W
5: 1 ϕ 2W \times 2
6: 1 ϕ 3W \times 2
7: 3 ϕ 3W \times 2

1.6.3 DEMAnd Group

The commands in the DEMAnd group set or query demand measurement parameters.

:DEMAnd?

Function Queries all the settings relating to demand measurement.

Syntax :DEMAnd?

:DEMAnd:AOUT?

Function Queries all the settings relating to D/A output.

Syntax :DEMAnd:AOUT?

:DEMAnd:AOUT:CHANnel<x>

Function Sets/queries D/A-output data items.

Syntax :DEMAnd:AOUT:CHANnel<x>?
:DEMAnd:AOUT:CHANnel<x>
{<NRf>}

Output channel <x> = 1 to 4

Output data items:

<NRf> =0: OFF,
1: V1, 2: V2, 3: V3,
4: I1, 5: I2, 6: I3,
7: P, 8: Q, 9: VA,
10: PF, 11: PA, 12: F,
13: Wh,
18: I1-2, 19: I2-2, 20: I3-2,
21: P-2, 22: Q-2, 23: VA-2,
24: PF-2, 25: PA-2,
26: Wh-2

:DEMAnd:AOUT:RATE

Function Sets/queries the rate of integrated D/A-output values.

Syntax :DEMAnd:AOUT:RATE?
:DEMAnd:AOUT:RATE {<NRf>}
<NRf> = 0: 1 V/ \pm 5 kWh
1: 1 V/ \pm 10 kWh
2: 1 V/ \pm 50 kWh
3: 1 V/ \pm 100 kWh
4: 1 V/ \pm 500 kWh
5: 1 V/ \pm 1 MWh

Appendix 2. Communication Commands

:DEMAnd:CLEAr

Function Executes clearing of integrated values to zero.

Syntax :DEMAnd:CLEAr

:DEMAnd:DISPlay?

Function Queries all the settings relating to measurement screen.

Syntax :DEMAnd:DISPlay?

:DEMAnd:DISPlay:LOAD

Function Sets/queries the load whose data is measured and viewed.

Syntax :DEMAnd:DISPlay:LOAD?
:DEMAnd:DISPlay:LOAD {<NRf>}
<NRf> = 0: Load 1
1: Load 2

:DEMAnd:DISPlay:MODE

Function Sets/queries the mode of measurement screen.

Syntax :DEMAnd:DISPlay:MODE?
:DEMAnd:DISPlay:MODE {<NRf>}
<NRf> = 0: Demand Measure mode
1: Instant Measure mode

:DEMAnd:INTERval

Function Sets/queries the demand period.

Syntax :DEMAnd:INTERval?
:DEMAnd:INTERval {<NRf>}
<NRf> = 0: 5 minutes
1: 10 minutes
2: 15 minutes
3: 30 minutes
4: 60 minutes
5: 2 hours
6: 3 hours
7: 4 hours
8: 6 hours
9: 8 hours
10: 10 hours
11: 12 hours

:DEMAnd:PERIod?

Function Queries all the settings relating to decimal point and unit of energy of demand period.

Syntax :DEMAnd:PERIod?

:DEMAnd:PERIod:DIGIt

Function Set/queries position of decimal point of energy of demand period.

Syntax :DEMAnd:PERIod:DIGIt?
:DEMAnd:PERIod:DIGIt {<NRf>}
<NRf> = 0: STANDARD
1: 000.000
2: 0000.00
3: 00000.0
4: 000000

:DEMAnd:PERIod:UNIT

Function Set/queries unit of measurement of energy of demand period.

Syntax :DEMAnd:PERIod:UNIT?
:DEMAnd:PERIod:UNIT {<NRf>}
<NRf> = 0: Wh
1: kWh
2: MWh
3: GWh

:DEMAnd:REFERence

Function Sets/queries the reference power.

Syntax :DEMAnd:REFERence?
:DEMAnd:REFERence {<NRf>}
<NRf> = 1 to 1000 KW

:DEMAnd:STARt?

Function Queries all the settings relating to the start of measurement.

Syntax :DEMAnd:STARt?

:DEMAnd:STARt:EXECute

Function Starts measurement.

Syntax :DEMAnd:STARt:EXECute

:DEMAAnd:STARt:MEthod

Function Sets/queries the method for starting measurement.

Syntax :DEMAAnd:STARt:MEthod?
:DEMAAnd:STARt:MEthod {<NRf>}
<NRf> = 0: Time
1: Trigger
2: Manual

:DEMAAnd:STARt:TIME

Function Sets/queries the starting time of measurement.

Syntax :DEMAAnd:STARt:TIME?
:DEMAAnd:STARt:TIME {<NRf1>,
<NRf2>, <NRf3>, <NRf4>, <NRf5>}
<NRf1> = Year: 1999 to 2098
<NRf2> = Month: 1 to 12
<NRf3> = Day: 1 to 31
<NRf4> = Hour: 0 to 23
<NRf5> = Minute: 0 to 59

:DEMAAnd:STATe?

Function Queries the measurement status.

Syntax :DEMAAnd:STATe?
:DEMAAnd:STATe
<NR1>= 0: Stop
1: Ready for measurement
2: Demand measurement
in progress

:DEMAAnd:STOP?

Function Queries all the settings relating to the end of measurement.

Syntax :DEMAAnd:STOP?

:DEMAAnd:STOP:EXECute

Function Stops measurement.

Syntax :DEMAAnd:STOP:EXECute

:DEMAAnd:STOP:INTERval

Function Sets/queries the measurement timer setting.

Syntax :DEMAAnd:STOP:INTERval?
:DEMAAnd:STOP:INTERval
{<NRf1>, <NRf2>, <NRf3>}
<NRf1> = Hour: 0 to 1000
<NRf2> = Minute: 0 to 59
<NRf3> = Second: 0 to 59
(in 10-second increments)

:DEMAAnd:STOP:MEthod

Function Sets/queries the method for stopping measurement.

Syntax :DEMAAnd:STOP:MEthod?
:DEMAAnd:STOP:MEthod {<NRf>}
<NRf> = 0: Time
1: Trigger
2: Manual
3: Timer

:DEMAAnd:STOP:TIME

Function Sets/queries the ending time of measurement.

Syntax :DEMAAnd:STOP:TIME?
:DEMAAnd:STOP:TIME {<NRf1>,
<NRf2>, <NRf3>, <NRf4>, <NRf5>}
<NRf1> = Year: 1999 to 2098
<NRf2> = Month: 1 to 12
<NRf3> = Day: 1 to 31
<NRf4> = Hour: 0 to 23
<NRf5> = Minute: 0 to 59

:DEMAAnd:STORE?

Function Queries all the settings relating to output media and data items to be saved.

Syntax :DEMAAnd:STORE?

:DEMAAnd:STORe:STATe

Function Sets/queries whether the data output is set to ON or OFF.

Syntax :DEMAAnd:STORe:STATe?
:DEMAAnd:STORe:STATe
{<Boolean>}

:DEMAAnd:STORe:FD

Function Sets/queries whether data output to a floppy disk is set to ON or OFF.

Syntax :DEMAAnd:STORe:FD?
:DEMAAnd:STORe:FD {<Boolean>}

:DEMAAnd:STORe:FILEName

Function Sets/queries the name of a file to be saved.

Syntax :DEMAAnd:STORe:FILE?
:DEMAAnd:STORe:FILE <Filename>
<Filename> = Up to 8 characters

:DEMAAnd:STORe:ITEM?

Function Queries all the settings relating to data items to be saved.

Syntax :DEMAAnd:STORe:ITEM?

:DEMAAnd:STORe:ITEM:DMGR

Function Sets/queries whether demand-group data output is set to ON or OFF.

Syntax :DEMAAnd:STORe:ITEM:DMGR?
:DEMAAnd:STORe:ITEM:DMGR
{<NRf>}
<NRf> = 0: OFF
1: ON (ON-1)
2: ON-2
3: All

:DEMAAnd:STORe:ITEM:IGR

Function Sets/queries current-group data output is set to ON or OFF.

Syntax :DEMAAnd:STORe:ITEM:IGR?
:DEMAAnd:STORe:ITEM:IGR
{<NRf>}
<NRf> = 0: OFF
1: ON (ON-1)
2: ON-2
3: All

:DEMAAnd:STORe:ITEM:EVENT

Function Sets/queries whether event-group data output is set to ON or OFF.

Syntax :DEMAAnd:STORe:ITEM:ENENT?
:DEMAAnd:STORe:ITEM:ENENT
{<NRf>}
<NRf> = 0: OFF
1: ON

:DEMAAnd:STORe:ITEM:PGR

Function Sets/queries whether power-group data output is set to ON or OFF.

Syntax :DEMAAnd:STORe:ITEM:PGR?
:DEMAAnd:STORe:ITEM:PGR
{<NRf>}
<NRf> = 0: OFF
1: ON (ON-1)
2: ON-2
3: All

:DEMAAnd:STORe:ITEM:VGR

Function Sets/queries whether voltage-group data output is set to ON or OFF.

Syntax :DEMAAnd:STORe:ITEM:VGR?
:DEMAAnd:STORe:ITEM:VGR
{<NRf>}
<NRf> = 0: OFF
1: ON (ON-1)
2: ON-2
3: All

:DEMAAnd:STORe:ITEM:WHGR

Function Sets/queries whether output electric-energy-group data is set to ON or OFF.

Syntax :DEMAAnd:STORe:ITEM:WHGR?
 :DEMAAnd:STORe:ITEM:WHGR
 {<NRf>}
 <NRf> = 0: OFF
 1: ON (ON-1)
 2: ON-2
 3: All

:DEMAAnd:TOTAL:UNIT

Function Set/queries unit of measurement of total energy.

Syntax :DEMAAnd:TOTAL:UNIT?
 :DEMAAnd:TOTAL:UNIT {<NRf>}
 <NRf> = 0: Wh
 1: kWh
 2: MWh
 3: GWh

:DEMAAnd:STORe:MEMORy

Function Sets/queries whether data output to internal memory is set to ON or OFF.

Syntax :DEMAAnd:STORe:MEMORy?
 :DEMAAnd:STORe:MEMORy
 {<Boolean>}

:DEMAAnd:TOTAL?

Function Queries all the settings relating to decimal point and unit of total energy.

Syntax :DEMAAnd:TOTAL?

:DEMAAnd:PERIod:DIGIt

Function Set/queries position of decimal point of total energy.

Syntax :DEMAAnd:TOTAL:DIGIt?
 :DEMAAnd:TOTAL:DIGIt {<NRf>}
 <NRf> = 0: STANDARD
 1: 000.000
 2: 0000.00
 3: 00000.0
 4: 000000

1.6.4 HARMonics Group

The commands in the HARMonics group set or query harmonics measurement parameters.

:HARMonics?

Function Queries all the settings relating to harmonics measurement.

Syntax :HARMonics?

:HARMonics:AOUT?

Function Queries all the settings relating to D/A output.

Syntax :HARMonics:AOUT?

:HARMonics:AOUT:CHANnel<x>?

Function Queries all the settings relating to each channel of D/A output.

Syntax :HARMonics:AOUT:CHANnel<x>?
<x> = 1 to 4

:HARMonics:AOUT:CHANnel<x>:ELEMEnt

Function Sets/queries D/A-output elements.

Syntax :HARMonics:AOUT:CHANnel<x>:ELEMEnt?
:HARMonics:AOUT:CHANnel<x>:ELEMEnt
{<NRf>}

Output channel <x> = 1 to 4

Output elements:

<NRf> = 0: OFF
1: V1, 2: V2, 3: V3,
4: I1, 5: I2, 6: I3,
7: P

:HARMonics:AOUT:CHANnel<x>:ITEM

Function Sets/queries D/A-output data items.

Syntax :HARMonics:AOUT:CHANnel<x>:ITEM?
:HARMonics:AOUT:CHANnel<x>:ITEM
{<NRf>}

Output channel <x> = 1 to 4

Output data items:

<NRf> = 0: RMS value
1: Content
2: Phase angle
3: Total RMS value
4: Total electric energy
5: Total power factor
6: Total harmonic distortion (IEEE)
7: Total harmonic distortion (CSA)

:HARMonics:AOUT:CHANnel<x>:ORDER

Function Sets/queries the D/A-output order.

Syntax :HARMonics:AOUT:CHANnel<x>:ORDER?
:HARMonics:AOUT:CHANnel<x>:ORDER
{<NRf>}

Output channel <x> = 1 to 4

Output order <NRf> = 1 to 13

:HARMonics:DISPlay?

Function Queries all the settings relating to measurement screen.

Syntax :HARMonics:DISPlay?

:HARMonics:DISPlay:ELEMEnt

Function Sets/queries elements to be shown on measurement screen.

Syntax :HARMonics:DISPlay:ELEMEnt?
:HARMonics:DISPlay:ELEMEnt
{<NRf>}

<NRf> = 0: V1, 2: V2, 2: V3,
3: I1, 4: I2, 5: I3,
6: P

:HARMonics:DISPlay:ITEM

Function Sets/queries the analysis item shown on measurement screen.

Syntax :HARMonics:DISPlay:ITEM?
:HARMonics:DISPlay:ITEM {<NRf>}
<NRf> = 0: Rms value
1: Power
2: Content
3: Phase angle

:HARMonics:DISPlay:MODE

Function Sets/queries the mode of measurement screen.

Syntax :HARMonics:DISPlay:MODE?
:HARMonics:DISPlay:MODE {<NRf>}
<NRf> = 0: Graph
1: Table

:HARMonics:STATe?

Function Queries the measurement status.

Syntax :HARMonics:STATe?
<NRf>= 0: Stop
1: Ready for measurement
2: Logging in progress

:HARMonics:STORe?

Function Queries all the settings relating to output destination and data items to be saved.

Syntax :HARMonics:STORe?

:HARMonics:STORe:STATe

Function Sets/queries whether logging is set to ON or OFF.

Syntax :HARMonics:STORe:STATe?
:HARMonics:STORe:STATe
{<Boolean>}

:HARMonics:STORe:FD

Function Sets/queries whether data output to a floppy disk is set to ON or OFF.

Syntax :HARMonics:STORe:FD?
:HARMonics:STORe:FD
{<Boolean>}

:HARMonics:STORe:FILEName

Function Sets/queries the name of a file to be saved.

Syntax :HARMonics:STORe:FILEName?
:HARMonics:STORe:FILEName
<Filename>
<Filename> = Up to 8 characters

:HARMonics:STORe:INTERval

Function Sets/queries the output time interval.

Syntax :HARMonics:STORe:INTERval?
:HARMonics:STORe:INTERval
{<NRf1>, <NRf2>}
<NRf1> = Hour: 0 to 1000
<NRf2> = Minute: 0 to 59

:HARMonics:STORe:ITEM?

Function Queries all the settings relating to data items to be saved.

Syntax :HARMonics:STORe:ITEM?

:HARMonics:STORe:ITEM:CSA

Function Sets/queries whether THD/CSA data output is set to ON or OFF.

Syntax :HARMonics:STORe:ITEM:CSA?
:HARMonics:STORe:ITEM:CSA
{<Boolean>}

:HARMonics:STORe:ITEM:EVENT

Function Sets/queries whether event data output is set to ON or OFF.

Syntax :HARMonics:STORe:ITEM:EVENT?
:HARMonics:STORe:ITEM:EVENT
{<Boolean>}

:HARMonics:STORe:ITEM:I<x>

Function Sets/queries whether current data output is set to ON or OFF.

Syntax :HARMonics:ITEM:I<x>
{<Boolean>}
Current element <x> = 1 to 3

:HARMonics:STORe:ITEM:ICONT

Function Sets/queries whether harmonic current content data output is set to ON or OFF.

Syntax :HARMonics:STORe:ITEM:ICONT?
:HARMonics:STORe:ITEM:ICONT
{<Boolean>}

:HARMonics:STORe:ITEM:IEEE

Function Sets/queries whether THD/IEEE data output is set to ON or OFF.

Syntax :HARMonics:STORe:ITEM:IEEE?
:HARMonics:STORe:ITEM:IEEE
{<Boolean>}

:HARMonics:STORe:ITEM:IPA

Function Sets/queries whether current phase angle data output is set to ON or OFF.

Syntax :HARMonics:STORe:ITEM:IPA?
:HARMonics:STORe:ITEM:IPA
{<Boolean>}

:HARMonics:STORe:ITEM:IRMS

Function Sets/queries whether rms current data output is set to ON or OFF.

Syntax :HARMonics:STORe:ITEM:IRMS?
:HARMonics:STORe:ITEM:IRMS
{<Boolean>}

:HARMonics:STORe:ITEM:ITOTAL

Function Sets/queries whether total rms current data output is set to ON or OFF.

Syntax :HARMonics:STORe:ITEM:ITOTAL?
:HARMonics:STORe:ITEM:ITOTAL
{<Boolean>}

:HARMonics:STORe:ITEM:ORDER?

Function Sets/queries all the settings relating to the order for which data is output.

Syntax :HARMonics:STORe:ITEM:ORDER?

:HARMonics:STORe:ITEM:ORDER:TYPE

Function Sets/queries the type of order for which data is output.

Syntax :HARMonics:STORe:ITEM:ORDER:TYPE?
:HARMonics:STORe:ITEM:ORDER:TYPE
{<Nrf>}
<Nrf> = 0: All orders
1: Odd
2: Select

:HARMonics:STORe:ITEM:ORDER:<x>

Function Sets/queries the order for which data is output.

Syntax :HARMonics:STORe:ITEM:ORDER:<x>?
:HARMonics:STORe:ITEM:ORDER:<x>
{<Boolean>}
Order <x> = 1 to 13

Description This parameter is configurable only when the type of order is "SELECT."

:HARMonics:STORe:ITEM:P

Function Sets/queries whether power data output is set to ON or OFF.

Syntax :HARMonics:STORe:ITEM:P?
:HARMonics:STORe:ITEM:P
{<Boolean>}

:HARMonics:STORe:ITEM:PCONT

Function Sets/queries whether harmonic power content data output is set to ON or OFF.

Syntax :HARMonics:STORe:ITEM:PCONT?
:HARMonics:STORe:ITEM:PCONT
{<Boolean>}

:HARMonics:STORe:ITEM:PF

Function Sets/queries whether of power factor data output is set to ON or OFF.

Syntax :HARMonics:STORe:ITEM:PF?
:HARMonics:STORe:ITEM:PF
{<Boolean>}

:HARMonics:STORe:ITEM:POWER

Function Sets/queries whether power value data output is set to ON or OFF.

Syntax :HARMonics:STORe:ITEM:POWER?
:HARMonics:STORe:ITEM:POWER
{<Boolean>}

:HARMonics:STORe:ITEM:PPA

Function Sets/queries whether power phase angle data output is set to ON or OFF.

Syntax :HARMonics:STORe:ITEM:PPA?
:HARMonics:STORe:ITEM:PPA
{<Boolean>}

:HARMonics:STORe:ITEM:PTOTAL

Function Sets/queries whether total rms power data output is set to ON or OFF.

Syntax :HARMonics:STORe:ITEM:PTOTAL?
:HARMonics:STORe:ITEM:PTOTAL
{<Boolean>}

:HARMonics:STORe:ITEM:V<x>

Function Sets/queries whether voltage data output is set to ON or OFF.

Syntax :HARMonics:STORe:ITEM:V<x>?
:HARMonics:STORe:ITEM:V<x>
{<Boolean>}

Voltage element <x> = 1 to 3

:HARMonics:STORe:ITEM:VCONT

Function Sets/queries whether harmonic voltage content data output is set to ON or OFF.

Syntax :HARMonics:STORe:ITEM:VCONT?
:HARMonics:STORe:ITEM:VCONT
{<Boolean>}

:HARMonics:STORe:ITEM:VPA

Function Sets/queries whether voltage phase angle data output is set to ON or OFF.

Syntax :HARMonics:STORe:ITEM:VPA?
:HARMonics:STORe:ITEM:VPA
{<Boolean>}

:HARMonics:STORe:ITEM:VRMS

Function Sets/queries whether rms voltage data output is set to ON or OFF.

Syntax :HARMonics:STORe:ITEM:VRMS?
:HARMonics:STORe:ITEM:VRMS
{<Boolean>}

:HARMonics:STORe:ITEM:VTOTAL

Function Sets/queries whether total rms voltage data output is set to ON or OFF.

Syntax :HARMonics:STORe:ITEM:VTOTAL?
:HARMonics:STORe:ITEM:VTOTAL
{<Boolean>}

:HARMonics:STORe:MEMORy

Function Sets/queries whether data output to internal memory is set to ON or OFF.

Syntax :HARMonics:STORe:MEMORy?
:HARMonics:STORe:MEMORy
{<Boolean>}

:HARMonics:STORe:START?

Function Queries all the settings relating to the start of logging.

Syntax :HARMonics:STORe:START?

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:HARMonics:STORe:STARt:EXECute

Function Starts logging.

Syntax :HARMonics:STORe:STARt:EXECute

:HARMonics:STORe:STARt:METhod

Function Sets/queries the method for starting logging.

Syntax :HARMonics:STORe:STARt:METhod?
:HARMonics:STORe:STARt:METhod
{<Nrf>}
<Nrf> = 0: Time
1: Trigger
2: Manual

:HARMonics:STORe:STARt:TIME

Function Sets/queries the starting time of logging.

Syntax :HARMonics:STORe:STARt:TIME?
:HARMonics:STORe:STARt:TIME
{<Nrf1>, <Nrf2>, <Nrf3>,
<Nrf4>, <Nrf5>}
<Nrf1> = Year: 1999 to 2098
<Nrf2> = Month: 1 to 12
<Nrf3> = Day: 1 to 31
<Nrf4> = Hour: 0 to 23
<Nrf5> = Minute: 0 to 59

:HARMonics:STORe:STOP?

Function Queries all the settings relating to the end of logging.

Syntax :HARMonics:STORe:STOP?

:HARMonics:STORe:STOP:EXECute

Function Stops logging.

Syntax :HARMonics:STORe:STOP:EXECute

:HARMonics:STORe:STOP:INTERval

Function Sets/queries the end-of-logging timer.

Syntax :HARMonics:STORe:STOP:INTERval?
:HARMonics:STORe:STOP:INTERval
{<Nrf1>, <Nrf2>, <Nrf3>}
<Nrf1> = Hour: 0 to 1000
<Nrf2> = Minute: 0 to 59
<Nrf3> = Second: 0 to 59
(in 10-second increments)

:HARMonics:STORe:STOP:METhod

Function Sets/queries the method for stopping logging.

Syntax :HARMonics:STORe:STOP:METhod?
:HARMonics:STORe:STOP:METhod
{<Nrf>}
<Nrf> = 0: Time
1: Trigger
2: Manual
3: Timer

:HARMonics:STORe:STOP:TIME

Function Sets/queries the ending time of logging.

Syntax :HARMonics:STORe:STOP:TIME?
:HARMonics:STORe:STOP:TIME
{<Nrf1>, <Nrf2>, <Nrf3>,
<Nrf4>, <Nrf5>}
<Nrf1> = Year: 1999 to 2098
<Nrf2> = Month: 1 to 12
<Nrf3> = Day: 1 to 31
<Nrf4> = Hour: 0 to 23
<Nrf5> = Minute: 0 to 59

1.6.5 INTEgrate Group

The commands in the INTEgrate group set or query electric energy measurement parameters.

:INTEgrate?

Function Queries all the settings relating to electric energy measurement.

Syntax :INTEgrate?

:INTEgrate:AOUT?

Function Queries all the settings relating to D/A output.

Syntax :INTEgrate:AOUT?

:INTEgrate:AOUT:CHANnel<x>

Function Sets/queries D/A-output data items.

Syntax :INTEgrate:AOUT:CHANnel<x>?
:INTEgrate:AOUT:CHANnel<x>
{<Nrf>}

Output channel <x> = 1 to 4

Output data items

<Nrf>= 0: OFF,
1: V1, 2: V2, 3: V3,
4: I1, 5: I2, 6: I3,
7: P, 8: Q, 9: VA,
10: PF, 11: PA, 12: F,
13: +Wh, 14: -Wh
15: +Varh, 16: -Varh
18: I1-2, 19: I2-2, 20: I3-2,
21: P-2, 22: Q-2, 23: VA-2,
24: PF-2, 25: PA-2,
26: +Wh-2, 27: -Wh-2,
28: +Varh-2, 29: -Varh-2

:INTEgrate:AOUT:RATE

Function Sets/queries the rate of D/A-output integrated values.

Syntax :INTEgrate:AOUT:RATE?
:INTEgrate:AOUT:RATE
{<Nrf>}

<Nrf> = 0: 1 V/±5 kWh
1: 1 V/±10 kWh
2: 1 V/±50 kWh
3: 1 V/±100 kWh
4: 1 V/±500 kWh
5: 1 V/±1 MWh

:INTEgrate:CLEAR

Function Clears integrated values to zero.

Syntax :INTEgrate:CLEAR

:INTEgrate:DISPlay?

Function Queries all the settings relating to measurement screen.

Syntax :INTEgrate:DISPlay?
:INTEgrate:DISPlay {<Nrf>}
<Nrf>= 0: Integrated Value screen
1: Instantaneous Value screen

:INTEgrate:DISPlay:LOAD

Function Sets/queries the load whose data is measured and viewed.

Syntax :INTEgrate:DISPlay:LOAD?
:INTEgrate:DISPlay:LOAD
{<Nrf>}
<Nrf> = 0: Load 1
1: Load 2

:INTEgrate:DISPlay:MODE

Function Sets/queries the type of measurement screen.

Syntax :INTEgrate:DISPlay:MODE?
:INTEgrate:DISPlay:MODE
{<Nrf>}
<Nrf>= 0: Integrated Value screen
1: Instantaneous Value screen

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:INTEgrate:NEGWatt

Function Sets/queries whether regenerative power calculation is set to ON or OFF.

Syntax :INTEgrate:NEGWatt?
:INTEgrate:NEGWatt
{<Boolean>}

:INTEgrate:STARt?

Function Queries all the settings relating to the start of measurement.

Syntax :INTEgrate:STARt?

:INTEgrate:STARt:EXECute

Function Starts measurement.

Syntax :INTEgrate:STARt:EXECute

:INTEgrate:STARt:METhod

Function Sets/queries the method for starting measurement.

Syntax :INTEgrate:STARt:METhod?
:INTEgrate:STARt:METhod
{<NRf>}
<NRf> = 0: Time
1: Trigger
2: Manual

:INTEgrate:STARt:TIME

Function Sets/queries the starting time of measurement.

Syntax :INTEgrate:STARt:TIME?
:INTEgrate:STARt:TIME
{<NRf1>, <NRf2>, <NRf3>,
<NRf4>, <NRf5>}
<NRf1> = Year: 1999 to 2098
<NRf2> = Month: 1 to 12
<NRf3> = Day: 1 to 31
<NRf4> = Hour: 0 to 23
<NRf5> = Minute: 0 to 59

:INTEgrate:STATe?

Function Queries the measurement status.

Syntax :INTEgrate:STATe?
:INTEgrate:STATe
<NR1>= 0: Stop
1: Ready for measurement
2: Integration in progress

:INTEgrate:STOP?

Function Queries all the settings relating to the end of measurement.

Syntax :INTEgrate:STOP?

:INTEgrate:STOP:EXECute

Function Stops measurement.

Syntax :INTEgrate:STOP:EXECute

:INTEgrate:STOP:INTERval

Function Sets/queries the end-of-measurement timer setting.

Syntax :INTEgrate:STOP:INTERval?
:INTEgrate:STOP:INTERval
{<NRf1>, <NRf2>, <NRf3>}
<NRf1> = Hour: 0 to 1000
<NRf2> = Minute: 0 to 59
<NRf3> = Second: 0 to 59 (in 10-second increments)

:INTEgrate:STOP:METhod

Function Sets/queries the method for stopping measurement.

Syntax :INTEgrate:STOP:METhod?
:INTEgrate:STOP:METhod
{<NRf>}
<NRf> = 0: Time
1: Trigger
2: Manual
3: Timer

:INTEgrate:STOP:TIME

Function Sets/queries the ending time of measurement.

Syntax :INTEgrate:STOP:TIME?
 :INTEgrate:STOP:TIME
 {<NRf1>, <NRf2>, <NRf3>,
 <NRf4>, <NRf5>}
 <NRf1> = Year: 1999 to 2098
 <NRf2> = Month: 1 to 12
 <NRf3> = Day: 1 to 31
 <NRf4> = Hour: 0 to 23
 <NRf5> = Minute: 0 to 59

:INTEgrate:STORE?

Function Queries all the settings relating to output destination and data items to be saved.

Syntax :INTEgrate:STORE?

:INTEgrate:STORE:STATE

Function Sets/queries whether data output is set to ON or OFF.

Syntax :INTEgrate:STORE:STATE?
 :INTEgrate:STORE:STATE
 {<Boolean>}

:INTEgrate:STORE:FD

Function Sets/queries whether data output to a floppy disk is set to ON or OFF.

Syntax :INTEgrate:STORE:FD?
 :INTEgrate:STORE:FD
 {<Boolean>}

:INTEgrate:STORE:FILENAME

Function Sets/queries the name of a file to be saved.

Syntax :INTEgrate:STORE:FILE?
 :INTEgrate:STORE:FILE
 <Filename>
 <Filename> = Up to 8 characters

:INTEgrate:STORE:INTERval

Function Sets/queries the output time interval.

Syntax :INTEgrate:STORE:INTERval?
 :INTEgrate:STORE:INTERval
 {<NRf1>, <NRf2>}
 <NRf1> = Hour: 0 to 1000
 <NRf2> = Minute: 0 to 59

:INTEgrate:STORE:ITEM?

Function Queries all the settings relating to data items to be saved.

Syntax :INTEgrate:STORE:ITEM?

:INTEgrate:STORE:ITEM:IGR

Function Sets/queries whether current-group data output is set to ON or OFF.

Syntax :INTEgrate:STORE:ITEM:IGR?
 :INTEgrate:STORE:ITEM:IGR
 {<NRf>}
 <NRf> = 0: OFF
 1: ON (ON-1)
 2: ON-2
 3: All

:INTEgrate:STORE:ITEM:EVENT

Function Sets/queries whether event-group data output is set to ON or OFF.

Syntax :INTEgrate:STORE:ITEM:EVENT?
 :INTEgrate:STORE:ITEM:EVENT
 {<NRf>}
 <NRf> = 0: OFF
 1: ON

:INTEgrate:STORE:ITEM:PGR

Function Sets/queries whether power-group data output is set to ON or OFF.

Syntax :INTEgrate:STORE:ITEM:PGR?
 :INTEgrate:STORE:ITEM:PGR
 {<NRf>}
 <NRf> = 0: OFF
 1: ON (ON-1)
 2: ON-2
 3: All

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:INTEgrate:STORe:ITEM:VGR

Function Sets/queries whether voltage-group data output is set to ON or OFF.

Syntax :INTEgrate:STORe:ITEM:VGR?
:INTEgrate:STORe:ITEM:VGR
{<NRf>}
<NRf> = 0: OFF
1: ON (ON-1)
2: ON-2
3: All

:INTEgrate:WH:DIGIt

Function Set/queries position of decimal point of electric energy.

Syntax :INTEgrate:WH:DIGIt?
:INTEgrate:WH:DIGIt {<NRf>}
<NRf> = 0: STANDARD
1: 000.000
2: 0000.00
3: 00000.0
4: 000000

:INTEgrate:STORe:ITEM:WHGR

Function Sets/queries whether electric-energy-group data output is set to ON or OFF.

Syntax :INTEgrate:STORe:ITEM:WHGR?
:INTEgrate:STORe:ITEM:WHGR
{<NRf>}
<NRf> = 0: OFF
1: ON (ON-1)
2: ON-2
3: All

:INTEgrate:WH:UNIT

Function Set/queries unit of measurement of electric energy.

Syntax :INTEgrate:WH:UNIT?
:INTEgrate:WH:UNIT {<NRf>}
<NRf> = 0: Wh
1: kWh
2: MWh
3: GWh

:INTEgrate:STORe:MEMORy

Function Sets/queries whether data output to internal memory is set to ON or OFF.

Syntax :INTEgrate:STORe:MEMORy?
:INTEgrate:STORe:MEMORy
{<Boolean>}

:INTEgrate:WH?

Function Queries all the settings relating to decimal point and unit of electric energy.

Syntax :INTEgrate:WH?

1.6.6 INSTant Group

The commands in the INSTant group set or query parameters relating to instantaneous value measurement.

:INSTant?

Function Queries all the settings relating to instantaneous value measurement.

Syntax :INSTant?

:INSTant:AOUT?

Function Queries all the settings relating to D/A output.

Syntax :INSTant:AOUT?

:INSTant:AOUT:CHANnel<x>

Function Sets/queries D/A-output data items.

Syntax :INSTant:AOUT:CHANnel<x>?
:INSTant:AOUT:CHANnel<x>
{<NRf>}

Output channel <x> = 1 to 4

Output data items:

<NRf>= 0: OFF,
1: V1, 2: V2, 3: V3,
4: I1, 5: I2, 6: I3,
7: P, 8: Q, 9: VA,
10: PF, 11: PA, 12: F,
17: UR,
18: I1-2, 19: I2-2, 20: I3-2,
21: P-2, 22: Q-2, 23: VA-2,
24: PF-2, 25: PA-2,
30: UR-2

:INSTant:DISPlay?

Function Queries all the settings relating to measurement screen.

Syntax :INSTant:DISPlay?

:INSTant:DISPlay:EXPAnd<x>

Function Sets/queries data items to be shown in expanded view format.

Syntax :INSTant:AOUT:EXPAnd<x>?
:INSTant:AOUT:EXPAnd <x>
{<NRf>}

<x> = 1 to 3

<NRf>

- If x = 1:

0: V1, 1: V1, 2: V2,

3: I1, 4: I2, 5: I3,

6: P, 7: Q, 8: VA

- If x = 2:

0: V1, 1: V1, 2: V2,

3: I1, 4: I2, 5: I3,

6: P, 9: PF, 10: PA

- If x = 3:

0: V1, 1: V1, 2: V2,

3: I1, 4: I2, 5: I3,

6: P, 11: F, 12: UR

:INSTant:DISPlay:LOAD

Function Sets/queries the load whose data is measured and viewed.

Syntax :INSTant:DISPlay:LOAD?
:INSTant:DISPlay:LOAD {<NRf>}

<NRf> = 0: Load 1

1: Load 2

:INSTant:DISPlay:MODE

Function Sets/queries the view mode of measurement screen.

Syntax :INSTant:DISPlay:MODE?
:INSTant:DISPlay:MODE {<NRf>}

<NRf> = 0: Detailed view

1: Expanded view

:INSTant:STATe?

Function Queries the measurement status.

Syntax :INSTant:STATe?

<NR1>= 0: Stop

1: Ready for measurement

2: Logging in progress

:INSTant:STORe?

Function Queries all the settings relating to output destination and data items to be saved.

Syntax :INSTant:STORe?

:INSTant:STORe:STATe

Function Sets/queries whether logging is set to ON or OFF.

Syntax :INSTant:STORe:STATe?
:INSTant:STORe:STATe
{<Boolean>}

:INSTant:STORe:FD

Function Sets/queries whether data output to a floppy disk is set to ON or OFF.

Syntax :INSTant:STORe:FD?
:INSTant:STORe:FD
{<Boolean>}

:INSTant:STORe:FILEName

Function Sets/queries the name of a file to be saved.

Syntax :INSTant:STORe:NAME?
:INSTant:STORe:NAME
<Filename>
<Filename> = Up to 8 characters

:INSTant:STORe:INTERval

Function Sets/queries the logging output time interval.

Syntax :INSTant:STORe:INTERval?
:INSTant:STORe:INTERval
{<NRf1>, <NRf2>}
<NRf1> = Hour: 0 to 1000
<NRf2> = Minute: 0 to 59

:INSTant:STORe:ITEM?

Function Queries all the settings relating to data items to be saved.

Syntax :INSTant:STORe:ITEM?

:INSTant:STORe:ITEM:IGR

Function Sets/queries whether current-group data output is set to ON or OFF.

Syntax :INSTant:STORe:ITEM:IGR?
:INSTant:STORe:ITEM:IGR
{<NRf>}
<NRf> = 0: OFF
1: ON (ON-1)
2: ON-2
3: All

:INSTant:STORe:ITEM:EVENT

Function Sets/queries whether event-group data output is set to ON or OFF.

Syntax :INSTant:STORe:ITEM:EVENT?
:INSTant:STORe:ITEM:EVENT
{<NRf>}
<NRf> = 0: OFF
1: ON

:INSTant:STORe:ITEM:PGR

Function Sets/queries whether power-group data output is set to ON or OFF.

Syntax :INSTant:STORe:ITEM:PGR?
:INSTant:STORe:ITEM:PGR
{<NRf>}
<NRf> = 0: OFF
1: ON (ON-1)
2: ON-2
3: All

:INSTant:STORe:ITEM:VGR

Function Sets/queries whether voltage-group data output is set to ON or OFF.

Syntax :INSTant:STORe:ITEM:VGR?
:INSTant:STORe:ITEM:VGR
{<NRf>}
<NRf> = 0: OFF
1: ON (ON-1)
2: ON-2
3: All

:INSTant:STORe:MEMORy

Function Sets/queries whether data output to internal memory is set to ON or OFF.

Syntax :INSTant:STORe:MEMORy?
:INSTant:STORe:MEMORy
{<Boolean>}

:INSTant:STORe:STARt?

Function Queries all the settings relating to the start of logging.

Syntax :INSTant:STORe:STARt?

:INSTant:STORe:STARt:EXECute

Function Starts logging.

Syntax :INSTant:STORe:STARt:EXECute

:INSTant:STORe:STARt:METHod

Function Sets/queries the method for starting logging.

Syntax :INSTant:STORe:STARt:METHod?
:INSTant:STORe:STARt:METHod
{<NRf>}
<NRf> = 0: Time
1: Trigger
2: Manual

:INSTant:STORe:STARt:TIME

Function Sets/queries the starting time of logging.

Syntax :INSTant:STORe:STARt:TIME?
:INSTant:STORe:STARt:TIME
{<NRf1>, <NRf2>, <NRf3>, <NRf4>, <NRf5>}
<NRf1> = Year: 1999 to 2098
<NRf2> = Month: 1 to 12
<NRf3> = Day: 1 to 31
<NRf4> = Hour: 0 to 23
<NRf5> = Minute: 0 to 59

:INSTant:STORe:STOP?

Function Queries all the settings relating to the end of logging.

Syntax :INSTant:STORe:STOP?

:INSTant:STORe:STOP:EXECute

Function Stops logging.

Syntax :INSTant:STORe:STOP:EXECute

:INSTant:STORe:STOP:INTERval

Function Sets/queries the end-of-logging timer setting.

Syntax :INSTant:STORe:STOP:INTERval?
:INSTant:STORe:STOP:INTERval
{<NRf1>, <NRf2>, <NRf3>}
<NRf1> = Hour: 0 to 1000
<NRf2> = Minute: 0 to 59
<NRf3> = Second: 0 to 59 (in 10-second increments)

:INSTant:STORe:STOP:METHod

Function Sets/queries the method for stopping logging.

Syntax :INSTant:STORe:STOP:METHod?
:INSTant:STORe:STOP:METHod
{<NRf>}
<NRf> = 0: Time
1: Trigger
2: Manual
3: Timer

:INSTant:STORe:STOP:TIME

Function Sets/queries the ending time of logging.

Syntax :INSTant:STORe:STOP:TIME?
:INSTant:STORe:STOP:TIME
{<NRf1>, <NRf2>, <NRf3>, <NRf4>, <NRf5>}
<NRf1> = Year: 1999 to 2098
<NRf2> = Month: 1 to 12
<NRf3> = Day: 1 to 31
<NRf4> = Hour: 0 to 23
<NRf5> = Minute: 0 to 59

1.6.7 MEASure Group

The commands in the MEASure group set or query parameters relating to data acquisition in each measurement mode.

:MEASure:DEMAnd?

Function Queries all the settings relating to Demand Measure mode communication-output data.

Syntax :MEASure:DEMAnd?

:MEASure:DEMAnd:ITEM?

Function Queries all the settings relating to Demand Measure mode communication-output data items.

Syntax :MEASure:DEMAnd:ITEM?

:MEASure:DEMAnd:ITEM:

<Demand Measure mode data item>

Function Sets/queries whether Demand Measure mode communication-output data items are set to ON or OFF.

Syntax :MEASure:DEMAnd:ITEM:<Demand Measure mode data item> {<Boolean>} <Demand Measure mode data item>=
 0: V1, 1: V2, 2: V3, 3: I1, 4: I2,
 5: I3, 6: P, 7: Q, 8: VA, 9: PF,
 10: PA, 11: F, 12: Wh,
 13: Demand,
 14: Date of maximum demand occurrence,
 15: Time of maximum demand occurrence,
 16: Load factor,
 17: Maximum demand,
 18: Electric energy integrated during the current demand period,
 19: Average power factor,
 20: Event input,
 21: I1-2, 22: I2-2, 23: I3-2,
 24: P-2, 25: Q-2, 26: VA-2,
 27: PF-2, 28: PA-2, 29: Wh-2,
 30: Demand (Load 2),
 31: Date of maximum demand occurrence (Load 2),
 32: Time of maximum demand occurrence (Load 2),
 33: Load factor (Load 2),
 34: Maximum demand (Load 2),
 35: Electric energy integrated during the current demand period (Load 2),
 36: Average power factor (Load 2)
 37: Number of demand periods

:MEASure:DEMAnd:ITEM:ALL

Function Sets all effective Demand Measure mode communication-output data to ON.

Syntax :MEASure:DEMAnd:ITEM:ALL

:MEASure:DEMAnd:ITEM:CLEAR

Function Sets all effective Demand Measure mode communication-output data to OFF.

Syntax :MEASure:DEMAnd:ITEM:CLEAR

:MEASure:DEMAnd:VALUe?

Function Queries the measurement data item set with a command that follows the :MEASure:DEMAnd:ITEM query.

Syntax :MEASure:DEMAnd:VALUe?

:MEASure:HARMonics?

Function Queries all the settings relating to Harmonics Measure mode communication-output data.

Syntax :MEASure:HARMonics?

:MEASure:HARMonics:ITEM?

Function Queries all the settings relating to Harmonics Measure mode communication-output data items.

Syntax :MEASure:HARMonics:ITEM?

:MEASure:HARMonics:ITEM:ALL

Function Sets all effective Harmonics Measure mode communication-output data items to ON.

Syntax :MEASure:HARMonics:ITEM:ALL

:MEASure:HARMonics:ITEM:CLEAR

Function Sets all effective on Harmonics Measure mode communication-output data items to OFF.

Syntax :MEASure:HARMonics:ITEM:CLEAR

:MEASure:HARMonics:ITEM:I<x>?

Function Queries all the settings relating to Harmonics Measure mode communication-output current data items.

Syntax :MEASure:HARMonics:ITEM:I<x>?
Order <x> = 1 to 3

:MEASure:HARMonics:ITEM:I<x1>:CONT<x2>

Function Sets/queries whether Harmonics Measure mode communication-output harmonic current content data is set to ON or OFF.

Syntax :MEASure:HARMonics:ITEM:I<x1>:CONT<x2>?
:MEASure:HARMonics:ITEM:I<x1>:CONT<x2>
{<Boolean>}
Current element <x1> = 1 to 3
Order <x2> = 1 to 13

:MEASure:HARMonics:ITEM:I<x>:CSA

Function Sets/queries whether Harmonics Measure mode communication-output current THD/CSA data is set to ON or OFF.

Syntax :MEASure:HARMonics:ITEM:I<x>:CSA?
:MEASure:HARMonics:ITEM:I<x>:CSA
{<Boolean>}

Current element <x> = 1 to 3

:MEASure:HARMonics:ITEM:I<x>:IEEE

Function Sets/queries whether Harmonics Measure mode communication-output current THD/IEEE data is set to ON or OFF.

Syntax :MEASure:HARMonics:ITEM:I<x>:IEEE?
:MEASure:HARMonics:ITEM:I<x>:IEEE
{<Boolean>}
Current element <x> = 1 to 3

:MEASure:HARMonics:ITEM:I<x1>:PA<x2>

Function Sets/queries whether Harmonics Measure mode communication-output current phase angle data is set to ON or OFF.

Syntax :MEASure:HARMonics:ITEM:I<x1>:PA<x2>?
:MEASure:HARMonics:ITEM:I<x1>:PA<x2>
{<Boolean>}
Current element <x1> = 1 to 3
Order <x2> = 1 to 13

:MEASure:HARMonics:ITEM:I<x1>:RMS<x2>

Function Sets/queries whether Harmonics Measure mode communication-output rms current data is set to ON or OFF.

Syntax :MEASure:HARMonics:ITEM:I<x1>:RMS<x2>?
:MEASure:HARMonics:ITEM:I<x1>:RMS<x2>
{<Boolean>}
Current element <x1> = 1 to 3
Order <x2> = 1 to 13

:MEASure:HARMonics:ITEM:I<x>:TOTAL

Function Sets/queries whether Harmonics Measure mode communication-output total rms current data is set to ON or OFF.

Syntax :MEASure:HARMonics:ITEM:I<x>:TOTAL?
:MEASure:HARMonics:ITEM:I<x>:TOTAL
{<Boolean>}

:MEASure:HARMonics:ITEM:EVENT

Function Sets/queries whether Harmonics Measure mode communication-output event data is set to ON or OFF.

Syntax :MEASure:HARMonics:ITEM:EVENT?
:MEASure:HARMonics:ITEM:EVENT
{<Boolean>}

:MEASure:HARMonics:ITEM:F

Function Sets/queries whether Harmonics Measure mode communication-output frequency data is set to ON or OFF.

Syntax MEASure:HARMonics:ITEM:F?
MEASure:HARMonics:ITEM:F
{<Boolean>}

:MEASure:HARMonics:ITEM:ORDER

Function Sets/queries the order of Harmonics Measure mode communication-output data.

Syntax :MEASure:HARMonics:ITEM:ORDER?
:MEASure:HARMonics:ITEM:ORDER
{<NRf>}
<NRf> = 0: All orders
1: Odd
2: Select

:MEASure:HARMonics:ITEM:PF

Function Sets/queries whether Harmonics Measure mode communication-output power factor data is set to ON or OFF.

Syntax :MEASure:HARMonics:ITEM:PF?
:MEASure:HARMonics:ITEM:PF
{<Boolean>}

:MEASure:HARMonics:ITEM:V<x>?

Function Queries all the settings relating to Harmonics Measure mode communication-output voltage data items.

Syntax :MEASure:HARMonics:ITEM:V<x>?
Voltage element <x> = 1 to 3

:MEASure:HARMonics:ITEM:V<x1>:CONT<x2>

Function Sets/queries whether Harmonics Measure mode communication-output harmonic voltage content data is set to ON or OFF.

Syntax :MEASure:HARMonics:ITEM:V<x1>:CONT<x2>?
:MEASure:HARMonics:ITEM:V<x1>:CONT<x2>
{<Boolean>}
Voltage element <x1> = 1 to 3
Order <x2> = 1 to 13

:MEASure:HARMonics:ITEM:V<x>:CSA

Function Sets/queries whether Harmonics Measure mode communication-output voltage THD/CSA data is set to ON or OFF.

Syntax :MEASure:HARMonics:ITEM:V<x>:CSA?
:MEASure:HARMonics:ITEM:V<x>:CSA
{<Boolean>}
Voltage element <x> = 1 to 3

:MEASure:HARMonics:ITEM:V<x>:IEEE

Function Sets/queries whether Harmonics Measure mode communication-output voltage THD/IEEE data is set to ON or OFF.

Syntax :MEASure:HARMonics:ITEM:V<x>:IEEE?
:MEASure:HARMonics:ITEM:V<x>:IEEE
{<Boolean>}
Voltage element <x> = 1 to 3

:MEASure:HARMonics:ITEM:V<x1>:PA<x2>

Function Sets/queries whether Harmonics Measure mode communication-output voltage phase angle data is set to ON or OFF.

Syntax :MEASure:HARMonics:ITEM:V<x1>:PA<x2>?
:MEASure:HARMonics:ITEM:V<x1>:PA<x2>
{<Boolean>}
Voltage element <x1> = 1 to 3
Order <x2> = 1 to 13

:MEASure:HARMonics:ITEM:V<x1>:RMS<x2>

Function Sets/queries whether Harmonics Measure mode communication output rms voltage data is set to ON or OFF.

Syntax :MEASure:HARMonics:ITEM:V<x1>:RMS<x2>?
:MEASure:HARMonics:ITEM:V<x1>:RMS<x2>
{<Boolean>}
Voltage element <x1> = 1 to 3
Order <x2> = 1 to 13

:MEASure:HARMonics:ITEM:V<x>:TOTAL

Function Sets/queries whether Harmonics Measure mode communication-output total rms voltage data is set to ON or OFF.

Syntax :MEASure:HARMonics:ITEM:V<x>:TOTAL?
:MEASure:HARMonics:ITEM:V<x>:TOTAL
{<Boolean>}
Voltage element <x> = 1 to 3

:MEASure:HARMonics:ITEM:P<x>

Function Sets/queries whether Harmonics Measure mode communication-output power data is set to ON or OFF.

Syntax :MEASure:HARMonics:ITEM:P<x>?
MEASure:HARMonics:ITEM:P<x>
{<Boolean>}
Order <x> = 1 to 13

:MEASure:HARMonics:ITEM:PCONT<x>

Function Sets/queries whether Harmonics Measure mode communication-output harmonic power content data is set to ON or OFF.

Syntax :MEASure:HARMonics:ITEM:PCONT<x>?
:MEASure:HARMonics:ITEM:PCONT<x>
{<Boolean>}
Order <x> = 1 to 13

:MEASure:HARMonics:ITEM:PPA<x>

Function Sets/queries whether Harmonics Measure mode communication-output power phase angle data is set to ON or OFF.

Syntax :MEASure:HARMonics:ITEM:PPA<x>?
:MEASure:HARMonics:ITEM:PPA<x>
{<Boolean>}
Order <x> = 1 to 13

:MEASure:HARMonics:ITEM:PTOTAL

Function Sets/queries whether Harmonics Measure mode communication-output electric energy data is set to ON or OFF.

Syntax :MEASure:HARMonics:ITEM:PTOTAL?
:MEASure:HARMonics:ITEM:PTOTAL
{<Boolean>}

:MEASure:HARMonics:VALUE?

Function Queries the measurement data item set with a command that follows the “:MEASure:HARMonics:ITEM” group (:ALL to: PTOTAL)

Syntax :MEASure:HARMonics:VALUE?

:MEASure:INTEgrate?

Function Queries all the settings relating to Electric Energy Measure mode communication-output data.

Syntax :MEASure:INTEgrate?

:MEASure:INTEgrate:ITEM?

Function Queries all the settings relating to Electric Energy Measure mode communication-output data items.

Syntax :MEASure:INTEgrate:ITEM?

:MEASure:INTEgrate:ITEM:<Electric Energy Measure mode data item>

Function Sets/queries whether Electric Energy Measure mode communication-output data items are set to ON or OFF.

Appendix 2. Communication Commands

Syntax :MEASure:INTEgrate:ITEM:<Electric Energy Measure mode data item> {<Boolean>}
<Electric Energy Measure mode data item> =
0: V1, 1: V2, 2: V3, 3: I1, 4: I2,
5: I3, 6: P, 7: Q, 8: VA, 9: PF,
10: PA, 11: F, 12: +Wh, 13: -Wh,
14: +Varh, 15: -Varh,
16: EVENT, 17: I1-2, 18: I2-2,
19: I3-2, 20: P-2, 21: Q-2,
22: VA-2, 23: PF-2, 24: PA-2,
25: +Wh-2, 26: -Wh-2,
27: +Varh-2, 28: -Varh-2

:MEASure:INTEgrate:ITEM:ALL

Function Sets all effective Electric Energy Measure mode communication-output data items to ON.

Syntax :MEASure:INTEgrate:ITEM:ALL

:MEASure:INTEgrate:ITEM:CLEAR

Function Sets all effective Electric Energy Measure mode communication-output data items to OFF.

Syntax :MEASure:INTEgrate:ITEM:CLEAR

:MEASure:INTEgrate:VALUE?

Function Queries the measurement data item set with a command that follows the :MEASure:INTEgrate:ITEM query.

Syntax :MEASure:INTEgrate:VALUE?

:MEASure:INSTant?

Function Queries all the settings relating to Instant Measure mode communication-output data.

Syntax :MEASure:INSTant?

:MEASure:INSTant:ITEM?

Function Queries all the settings relating to Instant Measure mode communication-output data items.

Syntax :MEASure:INSTant:ITEM?

:MEASure:INSTant:ITEM:<Instant Measure mode data item>

Function Sets/queries whether Instant Measure mode communication-output data items are set to ON or OFF.

Syntax :MEASure:INSTant:ITEM:<Instant Measure mode data item> {<Boolean>}
<Instant Measure mode data item> =
0: V1, 1: V2, 2: V3, 3: UR, 4: I1,
5: I2, 6: I3, 7: P, 8: Q, 9: VA,
10: PF, 11: PA, 12: F,
13: EVENT, 14: UR-2, 15: I1-2,
16: I2-2, 17: I3-2, 18: P-2, 19: Q-2,
20: VA-2, 21: PF-2, 22: PA-2

:MEASure:INSTant:ITEM:ALL

Function Sets all effective Instant Measure mode communication-output data items to ON.

Syntax :MEASure:INSTant:ITEM:ALL

:MEASure:INSTant:ITEM:CLEAR

Function Sets all effective Instant Measure mode communication-output data items to OFF.

Syntax :MEASure:INSTant:ITEM:CLEAR

:MEASure:INSTant:VALUE?

Function Queries the measurement data item set with a command that follows the :MEASure:INSTant:ITEM query.

Syntax :MEASure:INSTant:VALUE?

1.6.8 STATus Group

The commands in the STATus group deal with the status report.

:STATus?

Function Queries all the settings relating to the status of the communication function.

Syntax :STATus?

:STATus:ERRor?

Function Queries the error code and message (head of the error queue).

Syntax :STATus:ERRor?

Description

- If there is no error, '0, "No error" ' is returned.
- You can set whether or not to add the message contents using the "STATus:QMESsage" command.

:STATus:OMESsage

Function Sets/queries whether or not to add the message contents to the STATus:ERRor? response.

Syntax :STATus:OMESsage {<Boolean>}
:STATus:OMESsage?

1.6.9 FILE Group

The commands in the FILE group deal with data acquisition from internal memory.

:FILE:DIREctory?

Function Queries the internal memory directory set by the :FILE:TYPE command.

Syntax :FILE:DIREctory?

Description This command can only be accessed from the TOP MENU screen.

:FILE:NAME

Function Sets/queries the file name to load from internal memory.

Syntax :FILE:NAME {<Filename>}
:FILE:NAME?
{<Filename>} = Up to eight characters

:FILE:SEND?

Function Queries the file information set by the :FILE:TYPE and :FILE:NAME commands.

Syntax :FILE:SEND?
:FILE:SEND? → STX
(ASCII-code "02H"),
File information, ETX (ASCII-code "03H") <RMT>

Description This command can only be accessed from the TOP MENU screen.

:FILE:TYPE

Function Sets/queries the measurement mode and file type when accessing internal memory.

Syntax :FILE:TYPE {<Nrf1>, <Nrf2>}
:FILE:TYPE?
<Nrf1> = 1: Instant Measure mode
2: Electric Energy Measure mode
3: Demand Measure mode
4: Harmonics Measure mode
<Nrf2> = 1: Continuous measurement file
2: On-screen reading file
3: Measurement data item file
4: Condition setting file

1.6.10 Common Group

***CLS (ClearStatus)**

Function Clears the error queue.

Syntax *CLS

***IDN? (IDeNtify)**

Function Queries the meter model.

Syntax *IDN?

Description A reply sequence is returned as follows:
<Manufacturer>, <Model>, <Serial No.>, <Firmware version>.
<Serial No.> is not returned in actual applications (always 0).

Appendix 2. Communication Commands

(2) SYSTEM Group

- : Indicates the command is valid.
- × : Indicates the command is invalid.
- △ : Indicates the command is invalid when electric energy is integrated.

| Mode / State Command | TOP MENU | System Setting | File Handling | Instant Mode | | | Electric Energy mode | | | Demand mode | | | Harmonics Mode | | | | | |
|-------------------------|----------|----------------|---------------|-----------------|--------------|-----------------|----------------------|-------------|---------|------------------|-----------------|------|----------------|----------------|-----------------|------|-----------------|--------------|
| | | | | Logging stopped | Logging Hold | Checking Wiring | File | Integrating | stopped | Integration Hold | Checking Wiring | File | Demand | Demand stopped | Checking Wiring | File | Logging stopped | Logging Hold |
| : SYSTem? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : AVERaging? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : AVERaging | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | |
| : BACKlight? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : BACKlight | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : BEEP? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : BEEP | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : CLAMp? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : CLAMp | × | × | × | × | × | × | × | △ | × | × | × | × | △ | × | × | × | × | |
| : CONTrast? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : CONTrast | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : CURRent? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : CURRent | | | | | | | | | | | | | | | | | | |
| : AUTO? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : AUTO | × | × | × | × | × | × | × | △ | × | × | × | × | △ | × | × | × | × | |
| : RANGe? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : RANGe | × | × | × | × | × | × | × | △ | × | × | × | × | △ | × | × | × | × | |
| : DATE? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : DATE | ○ | × | ○ | × | × | ○ | × | × | ○ | × | × | ○ | × | × | ○ | × | × | ○ |
| : DISPlay? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : FILTer? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : FILTer | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : FREQuence? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : FREQuence | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : HOLD? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : HOLD | × | × | × | ○ | ○ | ○ | × | × | ○ | ○ | ○ | ○ | ○ | × | × | × | × | |
| : KLOCK? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : KLOCK | × | × | × | ○ | ○ | ○ | × | × | ○ | ○ | ○ | ○ | ○ | × | × | × | × | |
| : OPERationvar? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : OPERationvar | × | × | × | × | × | × | × | △ | × | × | × | × | △ | × | × | × | × | |
| : RESEt | ○ | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | |
| : SCALing? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : SCALing | | | | | | | | | | | | | | | | | | |
| : CT? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : CT | × | × | × | × | × | × | × | △ | × | × | × | × | △ | × | × | × | × | |
| : VT? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : VT | × | × | × | × | × | × | × | △ | × | × | × | × | △ | × | × | × | × | |
| : TIME? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : TIME | ○ | × | ○ | × | × | ○ | × | × | ○ | × | × | ○ | × | × | ○ | × | × | ○ |
| : VOLTage? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : VOLTage | | | | | | | | | | | | | | | | | | |
| : AUTO? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : AUTO | × | × | × | × | × | × | × | △ | × | × | × | × | △ | × | × | × | × | |
| : RANGe? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : RANGe | × | × | × | × | × | × | × | △ | × | × | × | × | △ | × | × | × | × | |
| : WIRIng? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : WIRIng | × | × | × | × | × | × | × | △ | × | × | × | × | △ | × | × | × | × | |

(3) DEMand Group (1/2)

- : Indicates the command is valid.
- × : Indicates the command is invalid.

| Mode / State Command | TOP MENU | System Setting | Instant Mode | | | | Electric Energy mode | | | | Demand mode | | | | Harmonics Mode | | | | | | | | |
|-------------------------|----------|----------------|--------------|-----------------|-----------------|---------|----------------------|-------------|---------------------|-----------------|-------------|------|--------|----------------|-----------------|---------|------|---------|-----------------|-----------------|---------|------|---|
| | | | Logging | Logging stopped | Checking Wiring | Setting | File | Integrating | Integration stopped | Checking Wiring | Setting | File | Demand | Demand stopped | Checking Wiring | Setting | File | Logging | Logging stopped | Checking Wiring | Setting | File | |
| : DEMand? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : AOUT? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : AOUT | | | | | | | | | | | | | | | | | | | | | | | |
| : CHANnel<x>? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : CHANnel<x> | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : RATE? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : RATE | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : CLEAr | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : DISPlay? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : DISPlay | | | | | | | | | | | | | | | | | | | | | | | |
| : Load? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : Load | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : MODE? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : MODE | ○ | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : INTErval? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : INTErval | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : PERlod? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : PERlod | | | | | | | | | | | | | | | | | | | | | | | |
| : DIGit? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : DIGit | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : UNIT? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : UNIT | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : STANdard? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : STANdard | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : STARt? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : STARt | | | | | | | | | | | | | | | | | | | | | | | |
| : EXECute | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : METHod? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : METHod | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : TIME? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : TIME | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : STATe? | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : STOP? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : STOP | | | | | | | | | | | | | | | | | | | | | | | |
| : EXECute | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : INTErval? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : INTErval | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : METHod? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : METHod | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : TIME? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : TIME | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : STORe? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : STORe | | | | | | | | | | | | | | | | | | | | | | | |
| : STATe? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : STATe | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : FD? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : FD | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : FILEname? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : FILEname | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |

(4) HARMonics Group (1/2)

○ : Indicates the command is valid.
 × : Indicates the command is invalid.

| Mode / State Command | TOP MENU | System Setting | File Handling | Instant Mode | | | Electric Energy mode | | | Demand mode | | | Harmonics Mode | | |
|-------------------------|----------|----------------|---------------|--------------|------------|---------|----------------------|---------|-------------|-------------|------------|---------|----------------|---------|------------|
| | | | | Logging | stopped | Setting | Integrating | stopped | Integration | Setting | Demand | stopped | Setting | Logging | stopped |
| | | | Continuous | Hold | Continuous | Hold | Continuous | Hold | Continuous | Hold | Continuous | Hold | Continuous | Hold | Continuous |
| HARMonics? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : AOUT? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : AOUT | | | | | | | | | | | | | | | |
| : CHANnel<x>? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : CHANnel<x> | | | | | | | | | | | | | | | |
| : ELEMeNt? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : ELEMeNt | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : ITEM? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : ITEM | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : ORDER? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : ORDER | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : DISPlay? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : DISPlay | | | | | | | | | | | | | | | |
| : ELEMeNt? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : ELEMeNt | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : ITEM? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : ITEM | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : MODE? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : MODE | ○ | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : STATe? | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : STORe? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : STORe | | | | | | | | | | | | | | | |
| : STATe? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : STATe | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : FD? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : FD | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : FILEName? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : FILEName | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : INTERval? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : INTERval | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : ITEM? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : ITEM | | | | | | | | | | | | | | | |
| : CSA? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : CSA | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : EVENt? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : EVENt | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : I<x>? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : I<x> | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : ICONt? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : ICONt | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : IEEE? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : IEEE | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : IPA? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : IPA | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : IRMS? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : IRMS | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : ITOTal? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : ITOTAL | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |

Appendix 2. Communication Commands

(4) HARMonics Group (2/2)

| Mode / State Command | TOP MENU | System Setting | File Handling | Instant Mode | | | | Electric Energy mode | | | | Demand mode | | | | Harmonics Mode | | | | | | |
|-------------------------|----------|----------------|---------------|--------------|-----------------|-----------------|---------|----------------------|-------------|---------|------------------|-------------|------|--------|----------------|-----------------|---------|------|---------|-----------------|-----------------|---------|
| | | | | Logging | Logging stopped | Checking Wiring | Setting | File | Integrating | stopped | Integration Hold | Setting | File | Demand | Demand stopped | Checking Wiring | Setting | File | Logging | Logging stopped | Checking Wiring | Setting |
| : ORDER? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : ORDER | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : TYPE? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : TYPE | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : <x>? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : <x> | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : P? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : P | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : PCONt<x>? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : PCONt | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : PF? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : PF | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : PPA<x>? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : PPA | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : POWER? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : POWER | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : PTOTal? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : PTOTal | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : V<x>? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : V<x> | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : VCONt? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : VCONt | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : VPA? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : VPA | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : VRMS? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : VRMS | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : VTOTal? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : VTOTal | ○ | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : MEMORy? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : MEMORy | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : START? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : START | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : EXECute | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : METHod? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : METHod | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : TIME? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : TIME | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : STOP? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : STOP | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : EXECute | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : INTerval? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : INTerval | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : METHod? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : METHod | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : TIME? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : TIME | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |

(5) INTEgrate Group (1/2)

○ : Indicates the command is valid.
 × : Indicates the command is invalid.

| Mode / State Command | TOP MENU | System Setting | Instant Mode | | | | Electric Energy mode | | | | Demand mode | | | | Harmonics Mode | | | | | | | | |
|-------------------------|----------|----------------|--------------|-----------------|-----------------|---------|----------------------|-------------|---------------------|-----------------|-------------|------|--------|----------------|-----------------|---------|------|---------|-----------------|-----------------|---------|------|---|
| | | | Logging | Logging stopped | Checking Wiring | Setting | File | Integrating | Integration stopped | Checking Wiring | Setting | File | Demand | Demand stopped | Checking Wiring | Setting | File | Logging | Logging stopped | Checking Wiring | Setting | File | |
| : INTEgrate? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : AOUT? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : AOUT | | | | | | | | | | | | | | | | | | | | | | | |
| : CHANnel<x>? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : CHANnel<x> | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : RATE? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : RATE | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : CLEAr | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : DISPlay? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : DISPlay | | | | | | | | | | | | | | | | | | | | | | | |
| : Load? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : Load | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : MODE? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : MODE | ○ | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : NEGWatt? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : NEGWatt | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : START? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : START | | | | | | | | | | | | | | | | | | | | | | | |
| : EXECute | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : METHod? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : METHod | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : TIME? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : TIME | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : STATE? | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : STOP? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : STOP | | | | | | | | | | | | | | | | | | | | | | | |
| : EXECute | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : INTErval? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : INTErval | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : METHod? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : METHod | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : TIME? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : TIME | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : STORe? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : STORe | | | | | | | | | | | | | | | | | | | | | | | |
| : STATE? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : STATE | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : FD? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : FD | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : FILEname? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : FILEname | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : INTErval? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : INTErval | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : ITEM? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : ITEM | | | | | | | | | | | | | | | | | | | | | | | |
| : IGR? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : IGR | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : EVENt? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : EVENt | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : PGR? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

Appendix 2. Communication Commands

(5) INTEgrate Group (2/2)

| Mode / State Command | TOP MENU | Instant Mode | | | | Electric Energy mode | | | | Demand mode | | | | Harmonics Mode | | | | | | | | | | |
|-------------------------|----------|-----------------|--------------|--------------------|---------|----------------------|-------------|---------|------------------|-------------|------|--------|---------|----------------|------------|---------|------|---------|-----------------|--------------|--------------------|---------|------|---|
| | | Logging stopped | Logging Hold | Logging Continuous | Setting | File | Integrating | stopped | Integration Hold | Setting | File | Demand | stopped | Hold | Continuous | Setting | File | Logging | Logging stopped | Logging Hold | Logging Continuous | Setting | File | |
| : PGR | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| : VGR? | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O |
| : VGR | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| : WHGR? | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O |
| : WHGR | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| : MEMORy? | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O |
| : MEMORy | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| : WH? | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O |
| : WH | | | | | | | | | | | | | | | | | | | | | | | | |
| : DIGI? | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O |
| : DIGI | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| : UNIT? | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O |
| : UNIT | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |

(6) INSTant Group (1/2)

- : Indicates the command is valid.
- × : Indicates the command is invalid.

| Mode / State Command | TOP MENU | System Setting | Instant Mode | | | | Electric Energy mode | | | | Demand mode | | | | Harmonics Mode | | | | | | | | |
|-------------------------|----------|----------------|--------------|-----------------|-----------------|---------|----------------------|-------------|---------------------|-----------------|-------------|------|--------|----------------|-----------------|---------|------|---------|-----------------|-----------------|---------|------|---|
| | | | Logging | Logging stopped | Checking Wiring | Setting | File | Integrating | Integration stopped | Checking Wiring | Setting | File | Demand | Demand stopped | Checking Wiring | Setting | File | Logging | Logging stopped | Checking Wiring | Setting | File | |
| : INSTant? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : AOUT? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : AOUT | | | | | | | | | | | | | | | | | | | | | | | |
| : CHANnel<x>? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : CHANnel<x> | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : DISPlay? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : DISPlay | | | | | | | | | | | | | | | | | | | | | | | |
| : LARGe? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : LARGe | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : LINE? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : LINE | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : MODE? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : MODE | ○ | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : STATe? | × | × | × | ○ | ○ | ○ | ○ | ○ | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : STORe? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : STORe | | | | | | | | | | | | | | | | | | | | | | | |
| : STATe? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : STATe | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : FD? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : FD | × | × | × | × | ○ | ○ | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : FILEName? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : FILEName | × | × | × | × | ○ | ○ | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : INTERval? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : INTERval | × | × | × | × | ○ | ○ | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : ITEM? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : ITEM | | | | | | | | | | | | | | | | | | | | | | | |
| : IGR? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : IGR | × | × | × | × | ○ | ○ | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : EVENt? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : EVENt | × | × | × | × | ○ | ○ | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : PGR? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : PGR | × | × | × | × | ○ | ○ | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : VGR? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : VGR | × | × | × | × | ○ | ○ | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : MEMORy? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : MEMORy | × | × | × | × | ○ | ○ | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : STARt? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : STARt | | | | | | | | | | | | | | | | | | | | | | | |
| : EXECute | × | × | × | × | ○ | ○ | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : METHod? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : METHod | × | × | × | × | ○ | ○ | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : TIME? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : TIME | × | × | × | × | ○ | ○ | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : STOP? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : STOP | | | | | | | | | | | | | | | | | | | | | | | |
| : EXECute | × | × | × | ○ | ○ | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : INTERval? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : INTERval | × | × | × | × | ○ | ○ | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| : METHod? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : METHod | × | × | × | × | ○ | ○ | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |

Appendix 2. Communication Commands

(6) INSTant Group (2/2)

| Mode / State Command | Instant Mode | | Electric Energy mode | | Demand mode | | Harmonics Mode | |
|-------------------------|-----------------|---------|----------------------|-------------|-------------|--------|----------------|-----------------|
| | Logging stopped | Logging | stopped | Integrating | stopped | Demand | Logging | Logging stopped |
| : TIME? | | | | | | | | |
| : TIME | | | | | | | | |

(7) MEASure Group (1/2)

- : Indicates the command is valid.
- × : Indicates the command is invalid.

| Mode / State Command | TOP MENU | Instant Mode | | | | Electric Energy mode | | | | Demand mode | | | | Harmonics Mode | | | | | | | |
|-------------------------|----------|--------------|-----------------|-----------------|---------|----------------------|-------------|---------------------|-----------------|-------------|------|--------|----------------|-----------------|---------|------|---------|-----------------|-----------------|---------|---|
| | | Logging | Logging stopped | Checking Wiring | Setting | File | Integrating | Integration stopped | Checking Wiring | Setting | File | Demand | Demand stopped | Checking Wiring | Setting | File | Logging | Logging stopped | Checking Wiring | Setting | |
| : MEASure | | | | | | | | | | | | | | | | | | | | | |
| : DEMAnd? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : DEMAnd | | | | | | | | | | | | | | | | | | | | | |
| : ITEM? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : ITEM | | | | | | | | | | | | | | | | | | | | | |
| : <Demand mode> | × | × | × | × | × | × | × | × | × | × | × | ○ | ○ | ○ | × | × | × | × | × | × | × |
| : ALL | × | × | × | × | × | × | × | × | × | × | × | ○ | ○ | ○ | × | × | × | × | × | × | × |
| : CLEAr | × | × | × | × | × | × | × | × | × | × | × | ○ | ○ | ○ | × | × | × | × | × | × | × |
| : VALUe? | × | × | × | × | × | × | × | × | × | × | × | ○ | ○ | ○ | × | × | × | × | × | × | × |
| : HARMonics? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : HARMonics | | | | | | | | | | | | | | | | | | | | | |
| : ITEM? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : ITEM | | | | | | | | | | | | | | | | | | | | | |
| : ALL | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | ○ | ○ | ○ | × | × | × |
| : CLEAr | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | ○ | ○ | ○ | × | × | × |
| : EVENt? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : EVENt | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | ○ | ○ | × | × | × |
| : F? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : F | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | ○ | ○ | × | × | × |
| : l<x>? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : l<x> | | | | | | | | | | | | | | | | | | | | | |
| : CONT<x>? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : CONT<x> | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | ○ | ○ | × | × | × |
| : CSA? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : CSA | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | ○ | ○ | × | × | × |
| : IEEE? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : IEEE | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | ○ | ○ | × | × | × |
| : PA<x>? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : PA<x> | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | ○ | ○ | × | × | × |
| : RMS<x>? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : RMS<x> | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | ○ | ○ | × | × | × |
| : TOTAl? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : TOTAl | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | ○ | ○ | × | × | × |
| : ORDEr? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : ORDEr | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | ○ | ○ | × | × | × |
| : P<x>? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : P<x> | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | ○ | ○ | × | × | × |
| : PCONT<x>? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : PCONT<x> | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | ○ | ○ | × | × | × |
| : PF? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : PF | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | ○ | ○ | × | × | × |
| : PPA<x>? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : PPA<x> | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | ○ | ○ | × | × | × |
| : PTOTal? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : PTOTal | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | ○ | ○ | × | × | × |
| : V<x>? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : V<x> | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | ○ | ○ | × | × | × |
| : CONT<x>? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : CONT<x> | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | ○ | ○ | × | × | × |
| : CSA? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

Appendix 2. Communication Commands

(7) MEASure Group (2/2)

| Mode / State Command | TOP MENU | System Setting | Instant Mode | | | | Electric Energy mode | | | | Demand mode | | | | Harmonics Mode | | | | | |
|--------------------------|----------|----------------|--------------|-----------------|-----------------|------------|----------------------|---------|-----------------|------------|-------------|------------|-----------------|------------|----------------|-----------------|-----------------|------------|------------|------------|
| | | | Logging | Logging stopped | Setting | File | Integrating | stopped | Integration | Setting | File | Demand | Setting | File | Logging | Logging stopped | Setting | File | | |
| | | | Hold | Continuous | Checking Wiring | Continuous | Hold | Hold | Checking Wiring | Continuous | Hold | Continuous | Checking Wiring | Continuous | Hold | Continuous | Checking Wiring | Continuous | Hold | Continuous |
| | | | Continuous | Hold | Continuous | Hold | Continuous | Hold | Continuous | Hold | Continuous | Hold | Continuous | Hold | Continuous | Hold | Continuous | Hold | Continuous | Hold |
| : CSA | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | |
| : IEEe? | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | |
| : IEEe | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | |
| : PA<x>? | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | |
| : PA<x> | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | |
| : RMS<x>? | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | |
| : RMS<x> | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | |
| : TOTA! | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | |
| : TOTA! | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | |
| : VALUe? | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | |
| : INTEGrate? | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | |
| : INTEGrate | | | | | | | | | | | | | | | | | | | | |
| : ITEM? | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | |
| : ITEM | | | | | | | | | | | | | | | | | | | | |
| : <Electric Energy mode> | X | X | X | X | X | X | X | O | O | O | X | X | X | X | X | X | X | X | X | |
| : ALL | X | X | X | X | X | X | X | O | O | O | X | X | X | X | X | X | X | X | X | |
| : CLEAr | X | X | X | X | X | X | X | O | O | O | X | X | X | X | X | X | X | X | X | |
| : VALUe? | X | X | X | X | X | X | X | O | O | O | X | X | X | X | X | X | X | X | X | |
| : INSTant? | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | |
| : INSTant | | | | | | | | | | | | | | | | | | | | |
| : ITEM? | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O | |
| : IMEM | | | | | | | | | | | | | | | | | | | | |
| : <Instant mode> | X | X | X | O | O | O | X | X | X | X | X | X | X | X | X | X | X | X | X | |
| : ALL | X | X | X | O | O | O | X | X | X | X | X | X | X | X | X | X | X | X | X | |
| : CLEAr | X | X | X | O | O | O | X | X | X | X | X | X | X | X | X | X | X | X | X | |
| : VALUe? | X | X | X | O | O | O | X | X | X | X | X | X | X | X | X | X | X | X | X | |

(8) STATus Group

○ : Indicates the command is valid.
 ✕ : Indicates the command is invalid.

| Mode / State Command | TOP MENU | Instant Mode | | | Electric Energy mode | | | Demand mode | | | Harmonics Mode | | | | | |
|-------------------------|----------|--------------|-----------------|-----------------|----------------------|-------------|---------------------|-------------|-----------------|--------|----------------|-----------------|------|---------|-----------------|-----------------|
| | | Logging | Logging stopped | Checking Wiring | File | Integrating | Integration stopped | Setting | Checking Wiring | Demand | Setting | Checking Wiring | File | Logging | Logging stopped | Checking Wiring |
| : STATus? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : STATus | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : ERRor? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : OMESsage? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : OMESsage | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

(9) FILE Group

○ : Indicates the command is valid.
 ✕ : Indicates the command is invalid.

| Mode / State Command | TOP MENU | Instant Mode | | | Electric Energy mode | | | Demand mode | | | Harmonics Mode | | | | | |
|-------------------------|----------|--------------|-----------------|-----------------|----------------------|-------------|---------------------|-------------|-----------------|--------|----------------|-----------------|------|---------|-----------------|-----------------|
| | | Logging | Logging stopped | Checking Wiring | File | Integrating | Integration stopped | Setting | Checking Wiring | Demand | Setting | Checking Wiring | File | Logging | Logging stopped | Checking Wiring |
| : FILE? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : DIREctory? | ○ | ✕ | ✕ | ✕ | ✕ | ✕ | ✕ | ✕ | ✕ | ✕ | ✕ | ✕ | ✕ | ✕ | ✕ | ✕ |
| : NAME? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : NAME | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : SEND? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : TYPE? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| : TYPE | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

(10) Common Group

○ : Indicates the command is valid.
 ✕ : Indicates the command is invalid.

| Mode / State Command | TOP MENU | Instant Mode | | | Electric Energy mode | | | Demand mode | | | Harmonics Mode | | | | | |
|-------------------------|----------|--------------|-----------------|-----------------|----------------------|-------------|---------------------|-------------|-----------------|--------|----------------|-----------------|------|---------|-----------------|-----------------|
| | | Logging | Logging stopped | Checking Wiring | File | Integrating | Integration stopped | Setting | Checking Wiring | Demand | Setting | Checking Wiring | File | Logging | Logging stopped | Checking Wiring |
| *CLS | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| *IDX? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

Appendix 3. Explanation of Data Item to be Saved/Printed

File Output Format

Each of the measurement data files (Continuous measurement data, on-screen readings data, and measurement data items) is output in the following CSV formats.

● File Contents

| Item | Description |
|---|---|
| "CW140"↓ | Identification of the CW140 file |
| "FileType",0↓ | File type |
| "MeasureMode",0↓ | Measurement mode |
| (Additional information)↓ | In the case of an on-screen reading file, it contains various setting information for reading a file. |
| "OUTPUT DATE", "OUTPUT TIME", ... (Measurement data title) ..., "EVENT"↓ | Title line for output data |
| yy/mm/dd,hh:mm:ss,... (Measurement data) ...,X↓ | Measurement data 1 |
| yy/mm/dd,hh:mm:ss,... (Measurement data) ...,X↓ | Measurement data 2* |

*: In the case of a continuous measurement data file, measurement data other than measurement data 1 is added for each logging. For other files, as only the measurement data at file saving is stored, measurement data 2 and above does not exist.

● File Type ("FileType")

| File Type | Code |
|-----------------------------|------|
| Continuous measurement data | 0 |
| On-screen readings | 1 |
| Measurement data items | 2 |
| Condition settings | 3 |

● Measurement Mode ("MeasureMode")

| Measurement Mode | Code |
|------------------------------|------|
| Instant Measure mode | 0 |
| Electric Energy Measure mode | 1 |
| Demand Measure mode | 2 |
| Harmonics Measure mode | 3 |

Appendix 3. Explanation of Data Item to be Saved/Printed

Additional Information

● Instant Measure Mode

| Output Item | Description | |
|-----------------------------|---|---|
| Wiring | Wiring | 0:1φ2W/1:1φ3W/2:3φ3W 3:3φ3W3I/4:3φ4W 5:1φ2W×2/6:1φ3W×2/7:3φ3W×2 |
| SetVRRange | Voltage range setting | 0:AUTO/1:150V/2:300V/3:600V |
| MeasVRRange | Measurement voltage range | 1:150V/2:300V/3:600V |
| SetARange | Current range setting | 0:AUTO/1:20A/2:50A/3:100A/4:200A 5:500A/6:1000A |
| MeasARange | Measurement current range | 1:20A/2:50A/3:100A/4:200A/5:500A 6:1000A |
| Inst_ViewType | Display mode | 0:Details/1:Expand |
| Inst_ViewLine | Load display | 0:Load 1/1:Load 2 |
| Inst_LargeChar 1 to 3 | Expanded view: upper, middle, and lower | 0:V1/1:V2/2:V3 3:I1/4:I2/5:I3 6:P/7:Var/8:VA/9:PF/10:PA 11:F/12:UR |
| Inst_Log_StartMethod | Start method of logging | 0:Time/1:Trigger/2:Manual |
| Inst_Log_StartDate | Start date of logging | yyyy/mm/dd |
| Inst_Log_StartTime | Start time of logging | hh:mm:dd |
| Inst_Log_EndMethod | End method of logging | 0:Time/1:Trigger/ 2:Manual/3:Timer |
| Inst_Log_EndDate | End date of logging | yyyy/mm/dd |
| Inst_Log_EndTime | End time of logging | hh:mm:ss |
| Inst_Log_EndTimer | End timer of logging | hhhh:mm:ss |
| VarCalc | Reactive power method | 0:OFF/1:ON |
| FreqSource | Frequency source | 0:V1/1:V2/2:V3 3:I1/4:I2/5:I3 6:I1-2/7:I2-2/8:I3-2 |
| Vt | VT ratio | 1 to 10,000 |
| Ct | CT ratio | 0.001 to 10,000.00 |
| Inst_Integ_StartDate_Actual | Actual start date of logging | yyyy/mm/dd |
| Inst_Integ_StartTime_Actual | Actual start time of logging | hh:mm:ss |
| Inst_Integ_EndDate_Actual | Actual end date of logging | yyyy/mm/dd |
| Inst_Integ_EndTime_Actual | Actual end time of logging | hh:mm:ss |

Appendix 3. Explanation of Data Item to be Saved/Printed

● Electric Energy Measure Mode

| Output Item | Description | |
|----------------------------|--|---|
| Wiring | Wiring | 0:1φ2W/1:1φ3W/2:3φ3W 3:3φ3W3I/4:3φ4W 5:1φ2W×2/6:1φ3W×2/7:3φ3W×2 |
| SetVRange | Voltage range setting | 0:AUTO/1:150V/2:300V/3:600V |
| MeasVRange | Measurement voltage range | 1:150V/2:300V/3:600V |
| SetARange | Current range setting | 0:AUTO/1:20A/2:50A/3:100A/4:200A 5:500A/6:1000A |
| MeasARange | Measurement current range | 1:20A/2:50A/3:100A/4:200A/5:500A 6:1000A |
| Wth_ViewType | Display mode | 0:Integrate/1:Instant |
| Wth_ViewLine | Load display | 0:Load 1/1:Load 2 |
| Wth_Integ_StartMethod | Start method of integration | 0:Time/1:Trigger/2:Manual |
| Wth_Integ_StartDate | Start date of integration | yyyy/mm/dd |
| Wth_Integ_StartTime | Start time of integration | hh:mm:ss |
| Wth_Integ_EndMethod | End method of integration | 0:Time/1:Trigger/ 2:Manual/3:Timer |
| Wth_Integ_EndDate | End date of integration | yyyy/mm/dd |
| Wth_Integ_EndTime | End time of integration | hh:mm:ss |
| Wth_Integ_EndTimer | End timer of integration | hhhh:mm:ss |
| Wth_W_MinusCalc | Regenerative energy calculation | 0:OFF/1:ON |
| Wth_WhDigit | Position of decimal point of electric energy | 0:STANDARD/1:000.000/2:0000.00 3:00000.0/4:000000 |
| Wth_WhUnit | Unit of electric energy | 0:Wh/1:kWh/2:MWh/3:GWh |
| VarCalc | Reactive power method | 0:OFF/1:ON |
| FreqSource | Frequency source | 0:V1/1:V2/2:V3 3:I1/4:I2/5:I3 6:I1-2/7:I2-2/8:I3-2 |
| Vt | VT ratio | 1 to 10,000 |
| Ct | CT ratio | 0.001 to 10,000.00 |
| Wth_Integ_StartDate_Actual | Actual start date of integration | yyyy/mm/dd |
| Wth_Integ_StartTime_Actual | Actual start time of integration | hh:mm:ss |
| Wth_Integ_EndDate_Actual | Actual end date of integration | yyyy/mm/dd |
| Wth_Integ_EndTime_Actual | Actual end time of integration | hh:mm:ss |

Appendix 3. Explanation of Data Item to be Saved/Printed

● Demand Measure Mode

| Output Item | Description | |
|----------------------------|--|---|
| Wiring | Wiring | 0:1φ2W/1:1φ3W/2:3φ3W 3:3φ3W3I/4:3φ4W 5:1φ2W×2/6:1φ3W×2/7:3φ3W×2 |
| SetVRange | Voltage range setting | 0:AUTO/1:150V/2:300V/3:600V |
| MeasVRange | Measurement voltage range | 1:150V/2:300V/3:600V |
| SetARange | Current range setting | 0:AUTO/1:20A/2:50A/3:100A/4:200A 5:500A/6:1000A |
| MeasARange | Measurement current range | 1:20A/2:50A/3:100A/4:200A/5:500A 6:1000A |
| Dem_ViewType | Display mode | 0:Demand/1:Instant |
| Dem_ViewLine | Load display | 0:Load 1/1:Load 2 |
| Dem_Integ_StartMethod | Start method of demand | 0:Time/1:Trigger/2:Manual |
| Dem_Integ_StartDate | Start date of demand | yyyy/mm/dd |
| Dem_Integ_StartTime | Start time of demand | hh:mm:ss |
| Dem_Integ_EndMethod | End method of demand | 0:Time/1:Trigger/ 2:Manual/3:Timer |
| Dem_Integ_EndDate | End date of demand | yyyy/mm/ss |
| Dem_Integ_EndTime | End time of demand | hh:mm:ss |
| Dem_Integ_EndTimer | End timer of demand | hhhh:mm:ss |
| Dem_Integ_Interval | Demand period | hh:mm:00 |
| Dem_StdW | Demand reference power | 1 to 1000kW |
| Dem_WhTotalDigit | Position of decimal point of total energy | 0:STANDARD/1:000.000/2:0000.00 3:00000.0/4:000000 |
| Dem_WhTotalUnit | Unit of total energy | 0:Wh/1:kWh/2:MWh/3:GWh |
| Dem_WhPeriodDigit | Position of decimal point of energy of demand period | 0:STANDARD/1:000.000/2:0000.00 3:00000.0/4:000000 |
| Dem_WhPeriodUnit | Unit of energy of demand period | 0:Wh/1:kWh/2:MWh/3:GWh |
| VarCalc | Reactive power method | 0:OFF/1:ON |
| FreqSource | Frequency source | 0:V1/1:V2/2:V3 3:I1/4:I2/5:I3 6:I1-2/7:I2-2/8:I3-2 |
| Vt | VT ratio | 1 to 10,000 |
| Ct | CT ratio | 0.001 to 10,000.00 |
| Dem_Integ_StartDate_Actual | Actual start date of demand | yyyy/mm/ss |
| Dem_Integ_StartTime_Actual | Actual start time of demand | hh:mm:ss |
| Dem_Integ_EndDate_Actual | Actual end date of demand | yyyy/mm/ss |
| Dem_Integ_EndTime_Actual | Actual end time of demand | hh:mm:ss |

Appendix 3. Explanation of Data Item to be Saved/Printed

● Harmonics Measure Mode

| Output Item | Description | |
|----------------------------|------------------------------|--|
| Wiring | Wiring | 0:1 ϕ 2W/1:1 ϕ 3W/2:3 ϕ 3W 3:3 ϕ 3W3I/4:3 ϕ 4W 5:1 ϕ 2W \times 2/6:1 ϕ 3W \times 2/7:3 ϕ 3W \times 2 |
| SetVRange | Voltage range setting | 0:AUTO/1:150V/2:300V/3:600V |
| MeasVRange | Measurement voltage range | 1:150V/2:300V/3:600V |
| SetARange | Current range setting | 0:AUTO/1:20A/2:50A/3:100A/4:200A 5:500A/6:1000A |
| MeasARange | Measurement current range | 1:20A/2:50A/3:100A/4:200A/5:500A 6:1000A |
| Hrm_ViewType | Display mode | 0:Graph/1:Table |
| Hrm_Analysis | Harmonic analysis item | 0:Rms/1:Power/2:Content/3:Phase angle |
| Hrm_Element | Measured element | 0:V1/1:V2/2:V3 3:I1/4:I2/5:I3 6:P |
| Hrm_GraphAxis | Graph axis | 0:Linear/1:Log |
| Hrm_Table | Table display order | 0:Odd/1:Even |
| Hrm_Log_StartMethod | Start method of logging | 0:Time/1:Trigger/2:Manual |
| Hrm_Log_StartDate | Start date of logging | yyyy/mm/dd |
| Hrm_Log_StartTime | Start time of logging | hh:mm:ss |
| Hrm_Log_EndMethod | End method of logging | 0:Time/1:Trigger/ 2:Manual/3:Timer |
| Hrm_Log_EndDate | End date of logging | yyyy/mm/dd |
| Hrm_Log_EndTime | End time of logging | hh:mm:ss |
| Hrm_Log_EndTimer | End timer of logging | hhhh:mm:ss |
| VarCalc | Reactive power method | 0:OFF/1:ON |
| FreqSource | Frequency source | 0:V1/1:V2/2:V3 3:I1/4:I2/5:I3 6:I1-2/7:I2-2/8:I3-2 |
| Vt | VT ratio | 1 to 10,000 |
| Ct | CT ratio | 0.001 to 10,000.00 |
| Hrm_Integ_StartDate_Actual | Actual start date of logging | yyyy/mm/dd |
| Hrm_Integ_StartTime_Actual | Actual start time of logging | hh:mm:ss |
| Hrm_Integ_EndDate_Actual | Actual end date of logging | yyyy/mm/dd |
| Hrm_Integ_EndTime_Actual | Actual end time of logging | hh:mm:ss |

Appendix 3. Explanation of Data Item to be Saved/Printed

● Measurement Data

Measurement data to be stored is output in exponential format with the following level of accuracy.

Electric energy, regenerative energy, leading reactive power, and lagging reactive power: $\pm 0.00000E \pm 00$

Other data: $\pm 0.000E \pm 00$

For invalid or overrange data, the display shows the “----” or “OR” respectively.

File Output Items in Instant Measure Mode

1 Single-load Measurement

| | |
|----------------------------------|-------------|
| Output date | OUTPUT DATE |
| Output time | OUTPUT TIME |
| Voltage (V) | V1, V2, V3 |
| Three-phase unbalance factor (%) | UR |
| Current (A) | 1, 2, 3 |
| Active power (W) | P |
| Reactive power (Var) | Q |
| Apparent power (VA) | VA |
| Power factor | PF |
| Phase angle (°) | PA |
| Frequency (Hz) | F |
| Event input | EVENT |

2 Dual-load Measurement

| | | |
|----------------------------------|------------------|---------------------------------------|
| Output date | OUTPUT DATE | |
| Output time | OUTPUT TIME | |
| | Load 1 | Load 2 |
| Voltage (V) | V1-1, V2-1, V3-1 | V1-2, V2-2, V3-2 <small>Note1</small> |
| Three-phase unbalance factor (%) | UR-1 | UR-2 |
| Current (A) | 1-1, 2-1, 3-1 | 1-2, 2-2, 3-2 |
| Active power (W) | P-1 | P-2 |
| Reactive power (Var) | Q-1 | Q-2 |
| Apparent power (VA) | VA-1 | VA-2 |
| Power factor | PF-1 | PF-2 |
| Phase angle (°) | PA-1 | PA-2 |
| Frequency (Hz) | F-1 | F-2 <small>Note1</small> |
| Event input | EVENT | |

Note 1: As load 1 and load 2 have the same voltages and frequencies, the same values are output.

File Output Items in Electric Energy Measure Mode

1 Single-load Measurement

| | |
|--------------------------------|------------------|
| Output date | OUTPUT DATE |
| Output time | OUTPUT TIME |
| Integration start date | INTEG START DATE |
| Integration start time | INTEG START TIME |
| Elapsed time | ELAPSED TIME |
| Voltage (V) | V1, V2, V3 |
| Current (A) | 1, 2, 3 |
| Active power (W) | P |
| Reactive power (Var) | Q |
| Apparent power (VA) | VA |
| Power factor | PF |
| Phase angle (°) | PA |
| Frequency (Hz) | F |
| Electric energy (Wh) | Wh(+), Wh |
| Regenerative energy (Wh) | Wh(-) |
| Lagging reactive energy (Varh) | Varh(+) |
| Leading reactive energy (Varh) | Varh(-) |
| Event input | EVENT |

2 Dual-load Measurement

| | | | |
|--------------------------------|------------------|----------------|-------|
| Output date | OUTPUT DATE | | |
| Output time | OUTPUT TIME | | |
| Integration start date | INTEG START DATE | | |
| Integration start time | INTEG START TIME | | |
| Elapsed time | ELAPSED TIME | | |
| | <hr/> | | |
| | Load 1 | Load 2 | |
| | <hr/> | <hr/> | |
| Voltage (V) | V1-1,V2-1,V3-1 | V1-2,V2-2,V3-2 | Note1 |
| Current (A) | 1-1, 2-1, 3-1 | 1-2, 2-2, 3-2 | |
| Active power (W) | P-1 | P-2 | |
| Reactive power (Var) | Q-1 | Q-2 | |
| Apparent power (VA) | VA-1 | VA-2 | |
| Power factor | PF-1 | PF-2 | |
| Phase angle (°) | PA-1 | PA-2 | |
| Frequency (Hz) | F-1 | F-2 | Note1 |
| Electric energy (Wh) | Wh(+)-1,Wh-1 | Wh(+)-2,Wh-2 | |
| Regenerative energy (Wh) | Wh(-)-1 | Wh(-)-2 | |
| Lagging reactive energy (Varh) | Varh(+)-1 | Varh(+)-2 | |
| Leading reactive energy (Varh) | Varh(-)-1 | Varh(-)-2 | |
| Event input | EVENT | | |

Note 1: As load 1 and load 2 have the same voltages and frequencies, the same values are output.

File Output Items in Demand Measure Mode

1 Single-load Measurement

| | |
|--|----------------|
| Output date | OUTPUT DATE |
| Output time | OUTPUT TIME |
| Demand start date/ demand period start date | DEM START DATE |
| Demand start time/ demand period start time | DEM START TIME |
| Demand end date/ demand period end date | DEM END DATE |
| Demand end time/ demand period end time | DEM END TIME |
| Elapsed time | ELAPSED TIME |
| Number of demand periods | DEMAND |
| Voltage (V) | V1,V2,V3 |
| Current (A) | 1, 2, 3 |
| Active power (W) | P |
| Reactive power (Var) | Q |
| Apparent power (VA) | VA |
| Power factor | PF |
| Phase angle (°) | PA |
| Frequency (Hz) | F |
| Total electric energy (Wh) | Wh |
| Demand (W) | Dem_P |
| Date of maximum demand | Dem_P_Max_Date |
| Time of maximum demand | Dem_P_Max_Time |
| Maximum demand (W) | Dem_P_Max |
| Load factor (%) | Dem_Load |
| Electric energy of demand period (Wh) | Dem_Wh |
| Event input | EVENT |

Appendix 3. Explanation of Data Item to be Saved/Printed

2 Dual-load Measurement

| | | | |
|--|------------------|------------------|-------|
| Output date | OUTPUT DATE | | |
| Output time | OUTPUT TIME | | |
| Demand start date/ demand period start date | DEM START DATE | | |
| Demand start time/ demand period start time | DEM START TIME | | |
| Demand end date/ demand period end date | DEM END DATE | | |
| Demand end time/ demand period end time | DEM END TIME | | |
| Elapsed time | ELAPSED TIME | | |
| Number of demand periods | DEMAND | | |
| | Load 1 | Load 2 | |
| Voltage (V) | V1-1,V2-1,V3-1 | V1-2,V2-2,V3-2 | Note1 |
| Current (A) | 1-1, 2-1, 3-1 | 1-2, 2-2, 3-2 | |
| Active power (W) | P-1 | P-2 | |
| Reactive power (Var) | Q-1 | Q-2 | |
| Apparent power (VA) | VA-1 | VA-2 | |
| Power factor | PF-1 | PF-2 | |
| Phase angle (°) | PA-1 | PA-2 | |
| Frequency (Hz) | F-1 | F-2 | Note1 |
| Total electric energy (Wh) | Wh-1 | Wh-2 | |
| Demand (W) | Dem_P-1 | Dem_P-2 | |
| Date of maximum demand | Dem_P_Max_Date-1 | Dem_P_Max_Date-2 | |
| Time of maximum demand | Dem_P_Max_Time-1 | Dem_P_Max_Time-2 | |
| Maximum demand (W) | Dem_P_Max-1 | Dem_P_Max-2 | |
| Load factor (%) | Dem_Load-1 | Dem_Load-2 | |
| Electric energy of demand period (Wh) | Dem_Wh-1 | Dem_Wh-2 | |
| Event input | EVENT | | |

Note 1: As load 1 and load 2 have the same voltages and frequencies, the same values are output.

Appendix 3. Explanation of Data Item to be Saved/Printed

File Output Items in Harmonics Measure Mode

| | |
|---|---|
| Output date | OUTPUT DATE |
| Output time | OUTPUT TIME |
| Voltage (V): 1st through 13th order | V1(1) to V1(13) V2(1) to V2(13) V3(1) to V(13) |
| Voltage content (%): 1st through 13th order | V1CONT(1) to V1CONT(13) V2CONT(1) to V2CONT(13) V3CONT(1) to V3CONT(13) |
| Voltage phase angle (°): 1st through 13th order | V1PA(1) to V1PA(13) V2PA(1) to V2PA(13) V3PA(1) to V3PA(13) |
| Total rms voltage value (V) [All-RMS] | TOTAL_V1 TOTAL_V2 TOTAL_V3 |
| Voltage THD (IEEE) (%) | THD(IEEE)_V1 THD(IEEE)_V2 THD(IEEE)_V3 |
| Voltage THD (CSA) (%) | THD(CSA)_V1 THD(CSA)_V2 THD(CSA)_V3 |
| Current (A): 1st through 13th order | 1(1) to 1(13) 2(1) to 2(13) 3(1) to 3(13) |
| Current content (%): 1st through 13th order | 1CONT(1) to 1CONT(13) 2CONT(1) to 2CONT(13) 3CONT(1) to 3CONT(13) |
| Current phase angle (°): 1st through 13th order | 1PA(1) to 1PA(13) 2PA(1) to 2PA(13) 3PA(1) to 3PA(13) |
| Total rms current value (A) [All-RMS] | TOTAL_I1 TOTAL_I2 TOTAL_I3 |
| Current THD (IEEE) (%) | THD(IEEE)_I1 THD(IEEE)_I2 THD(IEEE)_I3 |
| Current THD (CSA) (%) | THD(CSA)_I1 THD(CSA)_I2 THD(CSA)_I3 |
| Active power (W): 1st through 13th order | P(1) to P(13) |
| Power content (%): 1st through 13th order | PCONT(1) to PCONT(13) |
| Power phase angle (°): 1st through 13th order | PPA(1) to PPA(13) |
| Total power (W) | TOTAL_P |

Appendix 3. Explanation of Data Item to be Saved/Printed

| | |
|--------------------|----------|
| Total power factor | TOTAL_PF |
| Frequency (Hz) | F |
| Event input | EVENT |

Printout Format

The CW140 prints out one measurement data item per line. It prints out numeric values in predefined significant digits in the same form as readings shown on the screen.

Print Items in Instant Measure Mode

| | | |
|----------------|------------|---------------------|
| yyyy/mm/dd | hh:mm:ss ↓ | Print date and time |
| V1 : xxx.x V ↓ | | |
| V3 : xxx.x V ↓ | | |
| : | | |

1 Single-load Measurement

| | | |
|----------------------------------|------------|----------|
| Print date and time | yyy/mm/dd | hh:mm:ss |
| Voltage (V) | V1, V2, V3 | |
| Three-phase unbalance factor (%) | UR | |
| Current (A) | 1, 2, 3 | |
| Active power (W) | P | |
| Reactive power (Var) | Q | |
| Apparent power (VA) | VA | |
| Power factor | PF | |
| Phase angle (°) | PA | |
| Frequency (Hz) | F | |
| Event input | EVENT | |

2 Dual-load Measurement

| | | | |
|----------------------------------|----------------|----------------|-------|
| Print date and time | yyy/mm/dd | hh:mm:ss | |
| | Load 1 | Load 2 | |
| Voltage (V) | V1-1,V2-1,V3-1 | V1-2,V2-2,V3-2 | Note1 |
| Three-phase unbalance factor (%) | UR-1 | UR-2 | |
| Current (A) | 1-1, 2-1, 3-1 | 1-2, 2-2, 3-2 | |
| Active power (W) | P-1 | P-2 | |
| Reactive power (Var) | Q-1 | Q-2 | |
| Apparent power (VA) | VA-1 | VA-2 | |
| Power factor | PF-1 | PF-2 | |
| Phase angle (°) | PA-1 | PA-2 | |
| Frequency (Hz) | F-1 | F-2 | Note1 |
| Event input | EVENT | | |

Note 1: As load 1 and load 2 have the same voltages and frequencies, the same values are output.

Print Items in Electric Energy Measure Mode

```

yyyy/mm/dd      hh:mm:ss ↓
Integration start time ↓
yyyy/mm/dd      hh:mm:ss ↓
Elapsed time    hhhh:mm:ss ↓

V1      :   xxx.x V ↓
V3      :   xxx.x V ↓
:
    
```

Print date and time

Integration start time

Elapsed time

1 Single-load Measurement

| | | |
|---------------------------------|------------------------|------------|
| Print date and time | yyyy/mm/dd | hh:mm:ss |
| Integration start date and time | Integration start time | yyyy/mm/dd |
| | Elapsed time | hh:mm:ss |
| | Elapsed time | hhhh:mm:ss |
| Voltage (V) | V1, V2, V3 | |
| Current (A) | 1, 2, 3 | |
| Active power (W) | P | |
| Reactive power (Var) | Q | |
| Apparent power (VA) | VA | |
| Power factor | PF | |
| Phase angle (°) | PA | |
| Frequency (Hz) | F | |
| Electric energy (Wh) | +Wh, Wh | |
| Regenerative energy (Wh) | -Wh | |
| Lagging reactive energy (Varh) | +Varh | |
| Leading reactive energy (Varh) | -Varh | |
| Event input | EVENT | |

Appendix 3. Explanation of Data Item to be Saved/Printed

2 Dual-load Measurement

| | | |
|---------------------------------|------------------------|----------|
| Print date and time | yyyy/mm/dd | hh:mm:ss |
| Integration start date and time | Integration start time | |
| | yyyy/mm/dd | hh:mm:ss |
| Elapsed time | Elapsed time | |
| | hhhh:mm:ss | |

| | Load 1 | Load 2 | |
|--------------------------------|----------------|----------------|-------|
| Voltage (V) | V1-1,V2-1,V3-1 | V1-2,V2-2,V3-2 | Note1 |
| Current (A) | 1-1, 2-1, 3-1 | 1-2, 2-2, 3-2 | |
| Active power (W) | P-1 | P-2 | |
| Reactive power (Var) | Q-1 | Q-2 | |
| Apparent power (VA) | VA-1 | VA-2 | |
| Power factor | PF-1 | PF-2 | |
| Phase angle (°) | PA-1 | PA-2 | |
| Frequency (Hz) | F-1 | F-2 | Note1 |
| Electric energy (Wh) | +Wh-1,Wh-1 | -Wh-2,Wh-2 | |
| Regenerative energy (Wh) | -Wh-1 | -Wh-2 | |
| Lagging reactive energy (Varh) | +Varh-1 | +Varh-2 | |
| Leading reactive energy (Varh) | -Varh-1 | -Varh-2 | |
| Event input | EVENT | | |

Note 1: As load 1 and load 2 have the same voltages and frequencies, the same values are output.

Appendix 3. Explanation of Data Item to be Saved/Printed

Print Items in Demand Measure Mode

| | | |
|---------------------|--------------|--|
| yyyy/mm/dd | hh:mm:ss ↓ | Print date and time |
| Demand start time ↓ | | |
| yyyy/mm/dd | hh:mm:ss ↓ | Demand start date and time/ demand period start date and time |
| Demand end time | | |
| yyyy/mm/dd | hh:mm:ss | Demand end date and time/ demand period end date and time |
| Elapsed time | hhhh:mm:ss ↓ | Elapsed time |
| Demand | xx ↓ | Number of demand periods |
| V1 | : xxx.x V ↓ | |
| V3 | : xxx.x V ↓ | |
| | : | |

1 Single-load Measurement

| | | |
|--|-------------------|------------|
| Print date and time | yyyy/mm/dd | hh:mm:ss |
| Demand start date and time/ demand period start date and time | Demand start time | yyyy/mm/dd |
| | | hh:mm:ss |
| Demand end date and time/ demand period end date and time | Demand end time | yyyy/mm/dd |
| | | hh:mm:ss |
| Elapsed time | Elapsed time | hhhh:mm:ss |
| Number of demand periods | Demand | |
| Voltage (V) | V1, V2, V3 | |
| Current (A) | 1, 2, 3 | |
| Active power (W) | P | |
| Reactive power (Var) | Q | |
| Apparent power (VA) | VA | |
| Power factor | PF | |
| Phase angle (°) | PA | |
| Frequency (Hz) | F | |
| Total electric energy (Wh) | Wh | |
| Demand (W) | Dem_P | |
| Date of maximum demand | Dem_P_Max_Date | |
| Time of maximum demand | Dem_P_Max_Time | |
| Maximum demand (W) | Dem_P_Max | |
| Load factor (%) | Dem_Load | |
| Electric energy of demand period (Wh) | Dem_Wh | |
| Event input | EVENT | |

Appendix 3. Explanation of Data Item to be Saved/Printed

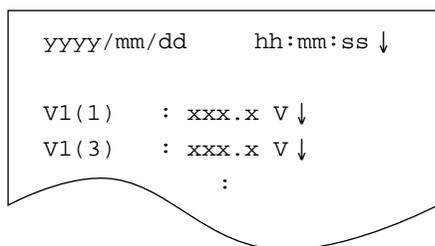
2 Dual-load Measurement

| | | |
|--|---------------------------------|----------|
| Print date and time | yyyy/mm/dd | hh:mm:ss |
| Demand start date and time/ demand period start date and time | Demand start time yyyy/mm/dd | hh:mm:ss |
| Demand end date and time/ demand period end date and time | Demand end time yyyy/mm/dd | hh:mm:ss |
| Elapsed time | Elapsed time hhhh:mm:ss | |
| Number of demand periods | Demand | |

| | Load 1 | Load 2 | |
|--|------------------|------------------|-------|
| Voltage (V) | V1-1,V2-1,V3-1 | V1-2,V2-2,V3-2 | Note1 |
| Current (A) | 1-1, 2-1, 3-1 | 1-2, 2-2, 3-2 | |
| Active power (W) | P-1 | P-2 | |
| Reactive power (Var) | Q-1 | Q-2 | |
| Apparent power (VA) | VA-1 | VA-2 | |
| Power factor | PF-1 | PF-2 | |
| Phase angle (°) | PA-1 | PA-2 | |
| Frequency (Hz) | F-1 | F-2 | |
| Total electric energy (Wh) | Wh-1 | Wh-2 | |
| Demand (W) | Dem_P-1 | Dem_P-2 | |
| Date of maximum demand | Dem_P_Max_Date-1 | Dem_P_Max_Date-2 | |
| Time of maximum demand | Dem_P_Max_Time-1 | Dem_P_Max_Time-2 | |
| Maximum demand (W) | Dem_P_Max-1 | Dem_P_Max-2 | |
| Load factor (%) | Dem_Load-1 | Dem_Load-2 | |
| Electric energy of demand period (Wh) | Dem_Wh-1 | Dem_Wh-2 | |
| Event input | EVENT | | |

Note 1: As load 1 and load 2 have the same voltages and frequencies, the same values are output.

Print Items in Harmonics Measure Mode



Print date and time

| | |
|---|---|
| Print date and time | yyyy/mm/dd hh:mm:ss |
| Voltage (V): 1st through 13th order | V1(1) to V1(13) V2(1) to V2(13) V3(1) to V3(13) |
| Voltage content (%): 1st through 13th order | V1CONT(1) to V1CONT(13) V2CONT(1) to V2CONT(13) V3CONT(1) to V3CONT(13) |
| Voltage phase angle (°): 1st through 13th order | V1PA(1) to V1PA(13) V2PA(1) to V2PA(13) V3PA(1) to V3PA(13) |
| Total rms voltage value (V) [All-RMS] | TOTAL_V1 TOTAL_V2 TOTAL_V3 |
| Voltage THD (IEEE) (%) | THD(IEEE)_V1 THD(IEEE)_V2 THD(IEEE)_V3 |
| Voltage THD (CSA) (%) | THD(CSA)_V1 THD(CSA)_V2 THD(CSA)_V3 |
| Current (A): 1st through 13th order | 1(1) to 1(13) 2(1) to 2(13) 3(1) to 3(13) |
| Current content (%): 1st through 13th order | 1CONT(1) to 1CONT(13) 2CONT(1) to 2CONT(13) 3CONT(1) to 3CONT(13) |
| Current phase angle (°): 1st through 13th order | 1PA(1) to 1PA(13) 2PA(1) to 2PA(13) 3PA(1) to 3PA(13) |
| Total rms current value (A) [All-RMS] | TOTAL_ 1 TOTAL_ 2 TOTAL_ 3 |
| Current THD (IEEE) (%) | THD(IEEE)_ 1 THD(IEEE)_ 2 THD(IEEE)_ 3 |

Appendix 3. Explanation of Data Item to be Saved/Printed

| | |
|---|--|
| Current THD (CSA) (%) | THD(CSA)_1 THD(CSA)_2 THD(CSA)_3 |
| Active power (W): 1st through 13th order | P(1) to P(13) |
| Power content (%): 1st through 13th order | PCONT(1) to PCONT(13) |
| Power phase angle (°): 1st through 13th order | PPA(1) to PPA(13) |
| Total power (W) | TOTAL_P |
| Total power factor | TOTAL_PF |
| Event input | EVENT |

Appendix 4. Terminology

The following table lists terms and symbols shown on the CW140 screen.

| Symbol | Item | Description |
|---------|---------------------------|-------------------------------|
| V | Effective value | Vrms |
| A (I) | Effective value | Arms |
| W (P) | Active power | |
| Var (Q) | Reactive power 1 | With reactive power method |
| Var (Q) | Reactive power 2 | Without reactive power method |
| VA | Apparent power | |
| PF | Power factor | |
| PA | Phase angle | |
| +Wh | Active energy | |
| -Wh | Regenerative energy | |
| +Varh | Lagging reactive energy | |
| -Varh | Leading reactive energy | |
| UR | Unbalance factor | |
| THD | Total harmonic distortion | (IEEE/CSA) |
| F (f) | Frequency | |
| | Crest factor | |
| VT | Voltage transformer | (Same as PT) |
| CT | Current transformer | |

Appendix 5. Explanation of Reactive Power Method

Reactive Power Method

The CW140 can calculate reactive power either with or without the reactive power method (reactive power 1 or 2).

● Calculation Without Using Reactive Power Method Option (Reactive Power 2)

The CW140 calculates reactive power from apparent power VA (product of the effective voltage and current) and active power P using the following equation.

If the voltage and current have different frequency elements, their effective values are used for the calculation.

Even if this calculation option is selected, the CW140 makes calculations based on this method in the background, where the polarity (SQ) determined by the method is used.

If the current lags behind the voltage: no polarity is indicated

If the current leads the voltage: negative (-) polarity is indicated

$$Q = SQ \sqrt{(VA)^2 - P^2}$$

Q = Reactive power

SQ = Polarity determined by reactive power method

VA = Apparent power

P = Active power

With reactive power 2, the power factor, which is also determined by the apparent power and active power, is called effective power factor. This calculation method is commonly used. The CW140 uses the polarity determined by the reactive power method so that it can tell whether the power factor is leading or lagging.

● Calculation Using Reactive Power Method (Reactive Power 1)

The CW140 directly calculates reactive power by shifting current phases by 90 degrees, as with common reactive power meters. This method can eliminate the effects of the unbalanced element and harmonic content on the measured object, gaining measurement values for the voltage and current with the same frequency element.

$$Q = \frac{1}{T} \int_0^T v(t) \times i(t + \frac{T}{4}) dt$$

Q = Reactive power

v(t) i(t) = Input signals

T = One period input signal

With reactive power 1, the power factor is calculated as the ratio of the active power to the reactive power, and is called a power-ratio power factor.

Reactive power values calculated by the two methods above are the same if both the voltage and current are sine waves (excluding harmonic content) and balanced. However, if either the voltage or current is unbalanced or includes the harmonic content, the reactive power values are different. Therefore, select the method best suited to the state of the measured object and analysis details.

In addition, if you want to compare the reactive power values with those of another instrument, be sure to understand the measurement principles before selecting the instrument.

Appendix 6. Settings Check Sheet

Settings Check Sheet

The settings check sheet is attached to facilitate efficient and accurate on-site settings. Fill in your desired settings on the settings check sheet and use it for reference in the field.

Description

- A settings check sheet is provided for each measurement mode (total of 4 types).
- The A RANGE setting depends on the clamp setting.
Relationship between the two items is marked with an asterisk (*).
- The D/A output setting is only valid when the optional D/A output is installed.
- Highlighted characters such as **1** and **V1** represent factory settings or default settings for system reset.
- Setting options for items that depend on wiring including the voltage and current, are not listed.
The voltage and current entry screen depends on the wiring settings. See page 7-1, or 14-2 to 14-4.

Appendix 6. Settings Check Sheet

| | |
|----------------------|--|
| Place of Application | |
| Prepared by | |
| Date | |

Settings Check Sheet - Instant Measure Mode

| Item | | User Setting | CW140 Setting Options | | | | |
|--------------------------------------|-----------------------------------|----------------------------------|---|------------------|-------------------|------------------------|------------------|
| Wiring | | | <1> 1φ2W | <2> 1φ3W | 3 3φ3W | <4> 3φ3W3i | |
| | | | <5> 3φ4W | <6> 1φ2W×2 | <7> 1φ3W×2 | <8> 3φ3W× 2 | |
| V Range (Voltage) | | | <1> 150V | <2> 300V | <3> 600V | 4 AUTO | |
| *A RANGE (Current) | 20 – 200A | | <1> 20A | <2> 50A | <3> 100A | <4> 200A 5 AUTO | |
| | 200 – 1000A | | <1> 200A | <2> 500A | <3> 1000A | 4 AUTO | |
| | 50 – 500A | | <1> 50A | <2> 100A | <3> 200A | <4> 500A 5 AUTO | |
| Expanded View Field | Upper V1 | | <Voltage, Current, (Depends on the wiring type)> | | P, Q, or VA | | |
| | Middle I1 | | | | P, PF, or PA | | |
| | Lower P | | | | P, F, or UR | | |
| Logging | | | <1> ON | 2 OFF | | | |
| When logging is set to ON | Start | | <1> Time | <2> Trigger | 3 Manual | | |
| | Stop | | <1> Time | <2> Timer | <3> Trigger | 4 Manual | |
| | Time | | Start: | Stop: | | | |
| | Timer | | hour | minute | second from Start | | |
| | Output Interval | hour minute | 2 minutes to 1000 hours | | | | 30minutes |
| | Output Destination (Media) | | | Internal Memory: | | 1 ON | <2> OFF |
| | | | | FD: | | <1> ON | 2 OFF |
| | | | Printer: | | <1> ON | 2 OFF | |
| File Name | | (AINS□□□.CSV when not specified) | | | | | |
| Items to Be Saved and Printed | | | Voltage: | | 1 ON | <2> OFF | |
| | | | Current: | | 1 ON | <2> OFF | |
| | | | Electric Power: | | 1 ON | <2> OFF | |
| | | | Event: | | 1 ON | <2> OFF | |
| D/A Output Settings | CH1 OFF | | Voltage, Current (Depends on the wiring type) P, Q, VA, PF, PA, UR, F, OFF | | | | |
| | CH2 OFF | | | | | | |
| | CH3 OFF | | | | | | |
| | CH4 OFF | | | | | | |
| Reactive Power Method | | | <1> ON | 2 OFF | | | |
| Frequency Source | | | Voltage or Current (Depends on the wiring type) | | | V1 | |
| Low-pass Filter | | | <1> ON | 2 OFF | | | |
| VT Ratio | | | 1 to 10000 | | | 1 | |
| CT Ratio | | | 0.01 to 10000 | | | 1 | |
| *Clamp Setting | | | 1 20–200A | <2> 200–1000A | <3> 50–500A | | |
| Number of Averaging Cycles | | | 2, 3, 4, 5, 6, 7, 8, 9, 10 (cycles), or OFF | | | OFF | |

Appendix 6. Settings Check Sheet

| | |
|----------------------|--|
| Place of Application | |
| Prepared by | |
| Date | |

Settings Check Sheet - Electric Energy Measure Mode

| Item | User Setting | CW140 Setting Options |
|--|-----------------------------------|---|
| Wiring | | <1> 1φ2W <2> 1φ3W 3 3φ3W <4> 3φ3W3i <5> 3φ4W <6> 1φ2W×2 <7> 1φ3W×2 <8> 3φ3W×2 |
| V Range (Voltage) | | <1> 150 V <2> 300 V <3> 600 V 4 AUTO |
| *A RANGE (Current) | 20 – 200A | <1> 20A <2> 50A <3> 100A <4> 200A 5 AUTO |
| | 200 – 1000A | <1> 200A <2> 500A <3> 1000A 4 AUTO |
| | 50 – 500A | <1> 50A <2> 100A <3> 200A <4> 500A 5 AUTO |
| Regenerative Energy Calculation | | <1> ON 2 OFF |
| Integration | Start | <1> Time <2> Trigger 3 Manual |
| | Stop | <1> Time <2> Timer <3> Trigger 4 Manual |
| | Time | Start: _____ Stop: _____ |
| | Timer | hour minute second from Start |
| Data Output | | <1> ON 2 OFF |
| When data output is set to ON | Output Interval | hour minute 2 minutes to 1000 hours 30minutes |
| | Output Destination (Media) | Internal Memory: 1 ON <2> OFF |
| | | FD: <1> ON 2 OFF |
| | | Printer: <1> ON 2 OFF |
| File Name | (AWTH□□□.CSV when not specified) | |
| Items to Be Saved and Printed | | Voltage: 1 ON <2> OFF |
| | | Current: 1 ON <2> OFF |
| | | Electric Power: 1 ON <2> OFF |
| | | Electric Energy: 1 ON <2> OFF |
| | | Event: 1 ON <2> OFF |
| D/A Output Settings | CH1 OFF | Voltage, Current (Depends on the wiring type) P, Q, VA, PF, PA, Wh, (–Wh), +Varh, –Varh, F, OFF |
| | CH2 OFF | |
| | CH3 OFF | |
| | CH4 OFF | |
| Integrated Value Output Rate | | 1 1 V/5 kWh <2> 1 V/10 kWh <3> 1 V/50 kWh <4> 1 V/100 kWh <5> 1 V/500 kWh <6> 1 V/1 MWh |
| Energy Display | Decimal point | STANDARD 000.000 0000.00 00000.0 000000 |
| | Unit | Wh kWh MWh GWh kWh |
| Reactive Power Method | | <1> ON 2 OFF V1 |
| Frequency Source | | Voltage or Current (Depends on the wiring type) |
| Low-pass Filter | | <1> ON 2 OFF 1 |
| VT Ratio | | 1 to 10000 1 |
| CT Ratio | | 0.01 to 10000 |
| *Clamp Setting | | 1 20–200A <2> 200–1000A <3> 50–500A OFF |
| Number of Averaging Cycles | | 2, 3, 4, 5, 6, 7, 8, 9, 10 (cycles), or OFF |

Appendix 6. Settings Check Sheet

| | |
|----------------------|--|
| Place of Application | |
| Prepared by | |
| Date | |

Settings Check Sheet - Demand Measure Mode 1/2

| Item | | User Setting | CW140 Setting Options | | | | | |
|--------------------------------------|-----------------------------------|----------------------------------|---|----------------|--------------------------------|------------------------|-----------------|---------------|
| Wiring | | | <1> 1φ2W | <2> 1φ3W | 3 3φ3W | <4> 3φ3W3i | | |
| | | | <5> 3φ4W | <6> 1φ2W×2 | <7> 1φ3W×2 | <8> 3φ3W× 2 | | |
| V Range (Voltage) | | | <1> 150 V | <2> 300 V | <3> 600 V | 4 AUTO | | |
| *A RANGE (Current) | 20 – 200A | | <1> 20A | <2> 50A | <3> 100A | <4> 200A 5 AUTO | | |
| | 200 – 1000A | | <1> 200A | <2> 500A | <3> 1000A | 4 AUTO | | |
| | 50 – 500A | | <1> 50A | <2> 100A | <3> 200A | <4> 500A 5 AUTO | | |
| Reference Electric Energy | | | 1 kW to 1000 kW | | | 100kW | | |
| Demand | Demand Period | hour minute | 1, 2, 3, 4, 6, 8, 10, or 12 hour | | 5, 10, 15, or 30 minute | | | |
| | Start | | <1> Time | <2> Trigger | 3 Manual | | | |
| | Stop | | <1> Time | <2> Timer | <3> Trigger 4 Manual | | | |
| | Time | Start: | Stop: | | | | | |
| | Timer | | hour | minute | second from Start | | | |
| Data Output | | | <1> ON 2 OFF | | | | | |
| When data output is set to ON | Output Interval | | Same as the demand period. | | | | | |
| | Output Destination (Media) | | Internal Memory: | 1 ON | <2> OFF | | | |
| | | | FD: | <1> ON | 2 OFF | | | |
| | | | Printer: | <1> ON | 2 OFF | | | |
| | File Name | (ADEM□□□.CSV when not specified) | | | | | | |
| Items to Be Saved and Printed | | | Voltage: | 1 ON | <2> OFF | | | |
| | | | Current: | 1 ON | <2> OFF | | | |
| | | | Electric Power: | 1 ON | <2> OFF | | | |
| | | | Electric Energy: | | ON | <2> OFF | | |
| | | | Demand: | 1 ON | <2> OFF | | | |
| | | | Event: | 1 ON | <2> OFF | | | |
| D/A Output Settings | CH1 | OFF | Voltage, Current (Depends on the wiring type) P, Q, VA, PF, PA, Wh, F, OFF | | | | | |
| | CH2 | OFF | | | | | | |
| | CH3 | OFF | | | | | | |
| | CH4 | OFF | | | | | | |
| Integrated Value Output Rate | | | 1 1 V/5 kWh | <2> 1 V/10 kWh | <3> 1 V/50 kWh | <4> 1 V/100 kWh | <5> 1 V/500 kWh | <6> 1 V/1 MWh |
| Total Energy | Decimal point | | STANDARD 000.000 0000.00 00000.0 000000 | | | | | |
| | Unit | | Wh kWh MWh GWh kWh | | | | | |
| Period Energy | Decimal point | | STANDARD 000.000 0000.00 00000.0 000000 | | | | | |
| | Unit | | Wh kWh MWh GWh kWh | | | | | |

Appendix 6. Settings Check Sheet

| | |
|----------------------|--|
| Place of Application | |
| Prepared by | |
| Date | |

Settings Check Sheet - Demand Measure Mode 2/2

| Item | User Setting | CW140 Setting Options |
|----------------------------|--------------|---|
| Reactive Power Method | | <1> ON 2 OFF |
| Frequency Source | | Voltage or Current (Depends on the wiring type) V1 |
| Low-pass Filter | | <1> ON 2 OFF |
| VT Ratio | | 1 to 10000 1 |
| CT Ratio | | 0.01 to 10000 1 |
| *Clamp Setting | | 1 20–200A <2> 200–1000A <3> 50–500A |
| Number of Averaging Cycles | | 2, 3, 4, 5, 6, 7, 8, 9, 10 (cycles), or OFF OFF |

Appendix 6. Settings Check Sheet

| | |
|----------------------|--|
| Place of Application | |
| Prepared by | |
| Date | |

Settings Check Sheet - Harmonics Measure Mode 1/2

| Item | | User Setting | CW140 Setting Options | | |
|--------------------------------------|-----------------------------------|---|--|--------------------------------------|--|
| WIRING | | | <1> 1φ2W <5> 3φ4W | <2> 1φ3W 3 3φ3W <4> 3φ3W3i | |
| V Range (Voltage) | | | <1> 150 V <2> 300 V <3> 600 V | 4 AUTO | |
| *A RANGE (Current) | 20 – 200A | | <1> 20A <2> 50A <3> 100A <4> 200A | 5 AUTO | |
| | 200 – 1000A | | <1> 200A <2> 500A <3> 1000A | 4 AUTO | |
| | 50 – 500A | | <1> 50A <2> 100A <3> 200A <4> 500A | 5 AUTO | |
| Logging | | | <1> ON 2 OFF | | |
| When logging is set to ON | Start | | <1> Time <2> Trigger | 3 Manual | |
| | Stop | | <1> Time <2> Timer <3> Trigger | 4 Manual | |
| | Time | Start: | Stop: | | |
| | Timer | hour minute | second | from Start | |
| | Output Interval | hour minute | 2 minutes to 1000 hours 30minutes | | |
| | Output Destination (Media) | | Internal Memory: 1 ON <2> OFF | | |
| | | | FD: <1> ON 2 OFF | | |
| | | | Printer: <1> ON 2 OFF | | |
| File Name | (AHRM□□□.CSV when not specified) | | | | |
| Items to Be Saved and Printed | Item Selection | Voltage | RMS value: | 1 ON <2> OFF | |
| | | | Contents: | 1 ON <2> OFF | |
| | | | Phase angle: | 1 ON <2> OFF | |
| | | Current | Total RMS value: | 1 ON <2> OFF | |
| | | | RMS value: | 1 ON <2> OFF | |
| | | | Contents: | 1 ON <2> OFF | |
| | | Electric Power | Phase angle: | 1 ON <2> OFF | |
| | | | Total RMS value: | 1 ON <2> OFF | |
| | | | Power value: | 1 ON <2> OFF | |
| | Contents: | | 1 ON <2> OFF | | |
| | Element Selection | Phase angle: | 1 ON <2> OFF | | |
| | | Total power: | 1 ON <2> OFF | | |
| | | V1 | 1 ON <2> OFF | | |
| | | V2 | 1 ON <2> OFF | | |
| | | V3 | 1 ON <2> OFF | | |
| | | I1 | 1 ON <2> OFF | | |
| | | I2 | 1 ON <2> OFF | | |
| | Order | I3 | 1 ON <2> OFF | | |
| | | P | 1 ON <2> OFF | | |
| | | | All orders: ON, Odd-numbered orders: ON | | |
| | | Select each order: <1> ON <2> OFF | | | |
| | | Total power factor: 1 ON <2> OFF | | | |
| | | Event: 1 ON <2> OFF | | | |
| | (IEEE) | Total harmonic distortion: 1 ON <2> OFF | | | |
| | (CSA) | Total harmonic distortion: 1 ON <2> OFF | | | |

Continued on "Harmonics Measure Mode 2/2"

Appendix 6. Settings Check Sheet

| | |
|----------------------|--|
| Place of Application | |
| Prepared by | |
| Date | |

Settings Check Sheet - Harmonics Measure Mode 2/2

| Item | | User Setting | CW140 Setting Options | |
|-----------------------|------------|--------------|---|---|
| D/A Output Settings | CH1 | | Element* | Voltage, Current, P, or OFF |
| | OFF | | Item | <1> RMS value (Power value) <2> Contents <3> Phase angle <4> Total RMS value (Total power) <5> THD/IEEE <6> THD/CSA |
| | | | Order | Selected from 1 to 13. |
| | CH2 | | Element* | Voltage, Current, P, or OFF |
| | OFF | | Item | <1> RMS value (Power value) <2> Contents <3> Phase angle <4> Total RMS value (Total power) <5> THD/IEEE <6> THD/CSA |
| | | | Order | Selected from 1 to 13. |
| | CH3 | | Element* | Voltage, Current, P, or OFF |
| | OFF | | Item | <1> RMS value (Power value) <2> Contents <3> Phase angle <4> Total RMS value (Total power) <5> THD/IEEE <6> THD/CSA |
| | | | Order | Selected from 1 to 13. |
| | CH4 | | Element* | Voltage, Current, P, or OFF |
| | OFF | | Item | <1> RMS value (Power value) <2> Contents <3> Phase angle <4> Total RMS value (Total power) <5> THD/IEEE <6> THD/CSA |
| | | | Order | Selected from 1 to 13. |
| Reactive Power Method | | | <1> ON 2 OFF | |
| Frequency Source | | | Voltage or Current (Depends on the wiring type) | V1 |
| Low-pass Filter | | | <1> ON 2 OFF | |
| VT Ratio | | | 1 to 10000 | 1 |
| CT Ratio | | | 0.01 to 10000 | 1 |
| *Clamp Setting | | | 1 20–200A <2> 200–1000A <3> 50–500A | |

*: Voltage or current may not be included in the Element menu depending on the wiring.

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IM CW140-S05E

- (1) Precautions for Safe Use of the Instrument (Page 4)



CAUTION, risk of electric shock

This symbol indicates caution and risk of electric shock.

- (2) The followings are added to “● Service Life of NiMH Battery Pack” on page 3-16.
Dispose under regional rules when unusable.
- (3) The followings are added to “(20) General specifications” on page 19-12.
Environment Indoor use, Altitude up to 2000m
- (4) The contents of “Ambient Temperature and Humidity” on page 3-3 and “Operating temperature and humidity ranges” on page 19-12 are changed to the followings.
Temperature 0 to 40 °C
Maximum relative humidity 80 % RH for temperature up to 31°C decreasing linearly to 50 % RH relative humidity at 40 °C.
- (5) The contents of “Safety standards” on page 19-13 are changed to the followings.
Safety standards: The safety standards depend on the suffix code (type of AC adapter) of CW140.
- When the suffix code of CW140 is F, R or S. (For example: CW140-S.)
Safety standards: EN61010-1, EN61010-2-031
 - Overvoltage category II (Max.input voltage: 600Vrms)
 - Overvoltage category III (Max.input voltage: 300Vrms)
 - Pollution degree 2
 - When the suffix code of CW140 is D. (When the meter is CW140-D.)
Safety standards: UL3111-1, First Edition, CAN C22.2 No.1010.1-92
 - Overvoltage category III Max. input voltage: 600Vrms)
 - Pollution degree 2
- (6) The contents of “Safety standards” on page 19-14 are changed to the followings.
Safety standards: The safety standards depend on the type of Current Clamps.
- When the Current Clamp is 960 30 or 960 31.
Safety standards: EN61010-1, EN61010-2-032
 - Overvoltage category II (Max.input voltage: 600Vrms)
 - Overvoltage category III (Max.input voltage: 300Vrms)
 - Pollution degree 2
 - When the Current Clamp is 960 30/D or 960 31/D.
(The following standards can be applied when the clamps are used with CW140-D.)
Safety standards: UL3111-1, First Edition, UL3111-2-032, First Edition, CAN C22.2 No.1010.1-92
 - Overvoltage category III (Max. input voltage: 600Vrms)
 - Pollution degree 2

IM CW140-S06E

This sheet supplements the 2nd and 3rd editions of User's Manual, CW140 Clamp on Power Meter. The content is that setting range of Reference power for Demand measure mode is changed from "1 to 1000kW" to "1W to 999.999TW." It is for the CW140 version 1.10 or higher.

Please change each item on the following pages.

(1) (User's Manual page 11-1)

● Reference Power

You can set a value of reference power between 0.001kW and 999.999TW.

(2) (User's Manual page 11-8)

Setting method of Reference power in Table 1 of Setup Data Items is changed to:

Table 1 of Setup Data Items

| Page | Setup Data Item | Items to Be Selected | See Also | Default |
|------|-----------------|---|--------------------------------|-----------|
| 1/3 | REFERENCE POWER | <p>Set a value between 0.001 and 999.999</p>  <p>Select the position of decimal point.</p> <p> (+) : Increment  (-) : Decrement</p> <p>Select the position of unit point. Press the  key. Option appears in the middle of screen.</p> <div style="border: 1px solid black; padding: 2px; display: inline-block;">kW MW GW TW</div>  <p>Selects the desired option.  Confirms the selection.</p> | "Reference Power" on page 11-1 | 100.000kW |

(3) (User's Manual: Page App 2-18)

Range of Communication commands: DEMAnd:REFERENCE is changed to:

:DEMAnd:REFERENCE

<NRf> = 1.00000E-03 to 9.99999E+11 kW

(4) (User's Manual: Page App 3-4)

Range of Demand reference power: Dem-StdW in "Explanation of Data Item to Be Saved/Printed" is changed to:

● Demand Measure Mode

| Output Item | Description | |
|-------------|------------------------|-------------------------------|
| Dem_StdW | Demand reference power | 1.00000E-03 to 9.99999E+11 kW |

(5) (User's Manual page App 6-4)

Setting range of Reference power (Reference electric energy) in Settings Check Sheet – Demand Measure Mode is changed to:

Settings Check Sheet - Demand Measure Mode 1/2

| Item | User Setting | CW140 Setting Option |
|---------------------------|--------------|---------------------------------------|
| Reference Electric Energy | | 0.001kW to 999.999TW 100.000kW |