HIOKI

Instruction Manual

8420-51
8421-51
8422-51

MEMORY HiLOGGER

HIOKI E. E. CORPORATION

January 2009 Revised edition 5 8420E981-05 09-01H

To users of the 9334 LOGGER COMMUNICATOR

The 9334 LOGGER COMMUNICATOR Ver. 1.20 or later supports models 8420-51, 8421-51, and 8422-51.
Note that 9334 models of Ver. 1.11 or earlier require upgrading. Please contact your vendor (agent) or nearest Hioki office.

Contents

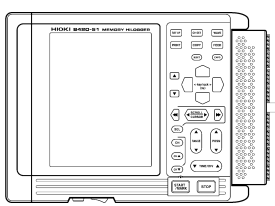
Introduction

Thank you for purchasing the HIOKI “8420-51, 8421-51, 8422-51 MEMORY HiLOGGER”. To obtain maximum performance from the instrument, please read this manual first, and keep it handy for future reference.
Refer to the Communications/ Wave Viewer Instruction Manual and Quick Start Manual provided with this instrument.

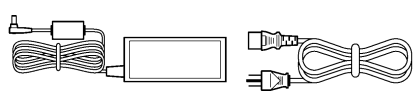
Inspection

Checking the Contents of the Package

When you receive the instrument, inspect it carefully to ensure that no damage occurred during shipping. In particular, check the accessories, panel switches, and terminals. If damage is evident, or if it fails to operate according to the specifications, contact your dealer or Hioki representative.



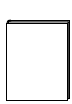
8420-51, 8421-51, 8422-51 MEMORY HiLOGGER (1)



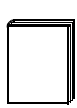
9418-15 AC ADAPTER
(SA145A-1240V-6,SINO AMERICAN) (1)

Flatblade screwdriver
(for terminal block) (1)

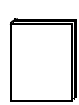
Application Disk (CD) (1)



Quick Start Manual (1)



Instruction Manual (1)



Communications/
Wave Viewer Instruction
Manual (1)

Options

8992 PRINTER UNIT (printing width 100 mm)
8993 DIGITAL I/O UNIT
9234 RECORDING PAPER (112 mm wide, 18 m long roll)
9334 LOGGER COMMUNICATOR (data collection program)
9418-15 AC ADAPTER (SA145A-1240V-6, SINO AMERICAN)
9447 BATTERY PACK (7.2 V, 2400 mAh)
9641 CONNECTION CABLE (for pulse input)
9642 LAN CABLE
9643 CHARGE STAND (for the 9447 BATTERY PACK)
9648 CARRYING CASE
9652-01 FIXED STAND
9653 HUMIDITY SENSOR (for the 8420-51 and 8421-51)
9681 HUMIDITY SENSOR (for the 8420-51 and 8421-51)
9701 HUMIDITY SENSOR (for the 8420-51 and 8421-51)
9612 RS-232C CABLE (9-pin mini DIN to 9-pin Dsub, cross cable, for PC)
9721 RS-232C CABLE (9-pin mini DIN to 9-pin Dsub, straight cable, for modem)
9329 TERMINAL UNIT (M3 screw)
9626 PC CARD 32M
9627 PC CARD 64M
9726 PC CARD 128M
9727 PC CARD 256M
9728 PC CARD 512M
9729 PC CARD 1G

Shipping Precautions

When transporting the instrument, use the original packing materials in which it was shipped, and pack in a double carton. Damage occurring during transportation is not covered by warranty.

Safety Notes

DANGER

This instrument is designed to comply with IEC 61010 Safety Standards, and has been thoroughly tested for safety prior to shipment. However, mishandling during use could result in injury or death, as well as damage to the instrument. Be certain that you understand the instructions and precautions in the manual before use. We disclaim any responsibility for accidents or injuries not resulting directly from instrument defects.

Safety Symbols

This manual contains information and warnings essential for safe operation of the instrument and for maintaining it in safe operating condition. Before using it, be sure to carefully read the following safety precautions.

	In the manual, the ⚠ symbol indicates particularly important information that the user should read before using the instrument.
⚠	The ⚠ symbol printed on the instrument indicates that the user should refer to a corresponding topic in the manual (marked with the ⚠ symbol) before using the relevant function.
⎓	Indicates DC (Direct Current).
~	Indicates AC (Alternating Current).
|	Indicates the ON side of the power switch.
○	Indicates the OFF side of the power switch.

The following symbols in this manual indicate the relative importance of cautions and warnings.

DANGER	Indicates that incorrect operation presents an extreme hazard that could result in serious injury or death to the user.
WARNING	Indicates that incorrect operation presents a significant hazard that could result in serious injury or death to the user.
CAUTION	Indicates that incorrect operation presents a possibility of injury to the user or damage to the instrument.
NOTE	Advisory items related to performance or correct operation of the instrument.

Other Symbols

	Indicates the prohibited action.
❖	Indicates the reference.

Accuracy

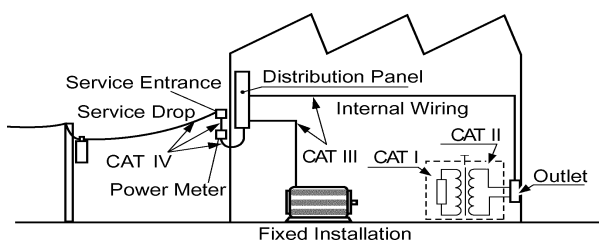
We define measurement tolerances in terms of f.s. (full scale) value, with the following meanings:

f.s. (maximum display value or scale length)
The maximum displayable value or scale length. This is usually the name of the currently selected range.

Measurement Categories (Overvoltage categories)

This instrument complies with CAT I safety requirements.
To ensure safe operation of measurement instruments, IEC 61010 establishes safety standards for various electrical environments, categorized as CAT I to CAT IV, and called measurement categories. These are defined as follows.

CAT I	Secondary electrical circuits connected to an AC electrical outlet through a transformer or similar device.
CAT II	Primary electrical circuits in equipment connected to an AC electrical outlet by a power cord (portable tools, household appliances, etc.)
CAT III	Primary electrical circuits of heavy equipment (fixed installations) connected directly to the distribution panel, and feeders from the distribution panel to outlets.
CAT IV	The circuit from the service drop to the service entrance, and to the power meter and primary overcurrent protection device (distribution panel).



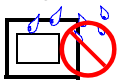
Higher-numbered categories correspond to electrical environments with greater momentary energy. So a measurement device designed for CAT III environments can endure greater momentary energy than a device designed for CAT II.
Using a measurement instrument in an environment designated with a higher-numbered category than that for which the instrument is rated could result in a severe accident, and must be carefully avoided.
Never use a CAT I measuring instrument in CAT II, III, or IV environments.
The measurement categories comply with the Overvoltage Categories of the IEC60664 Standards.

Usage Notes

Follow these precautions to ensure safe operation and to obtain the full benefits of the various functions.

WARNING

Do not get wet.



Corrosive or explosive gas-

To avoid electric shock

- **Do not allow the instrument to get wet, and do not take measurements with wet hands. This may cause an electric shock.**
- **Do not use the instrument where it may be exposed to corrosive or combustible gases. The instrument may be damaged or cause an explosion.**
- **Never apply more than 30 Vrms or 60 VDC between analog input terminal, or between analog input terminal and chassis ground.**
- **Never exceed the limits in the following table.**

Terminals	Maximum Input Voltage
Analog Inputs	30 Vrms or 60 VDC
Pulse Inputs	15 VDC
External Trigger Terminal	-5 to +10 V
Trigger Output Terminal	-20 to +30 V, 500 mA max., 200 mW max.

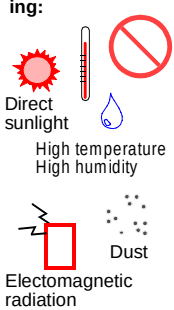
NOTE

- After use, always turn OFF the power.
- This instrument will not run erratically under a momentary power outage lasting less than 40 ms. However, if a momentary outage of 40 ms or more occurs, the instrument turns off temporarily, so the power condition at the installation location should be considered beforehand. Therefore, consider the power supply conditions at your installation site before installing the instrument.

Setting Up the Instrument

⚠CAUTION

Avoid the following:



- This instrument is designed for use indoors. It can be operated at temperatures between 0 and 40°C, 30 to 80%RH without degrading safety.
- Do not store or use the instrument where it could be exposed to direct sunlight, high temperature or humidity, or condensation. Under such conditions, the instrument may be damaged and insulation may deteriorate so that it no longer meets specifications.
- This instrument is not designed to be entirely water- or dust-proof. Do not use it in an especially dusty environment, nor where it might be splashed with liquid. This may cause damage.
- Do not use the instrument near a source of strong electromagnetic radiation, or near a highly electrically charged object. These may cause a malfunction.

Handling This Instrument

⚠CAUTION

To avoid damage to the instrument, protect it from physical shock when transporting and handling. Be especially careful to avoid physical shock from dropping.

Handling the AC Adapter and the Battery Pack

⚠WARNING

- **Turn the instrument off before connecting the AC adapter to the instrument and to AC power.**
- **Use only the supplied the 9418-15 AC ADAPTER (SA145A-1240V-6, SINO AMERICAN). AC adapter input voltage range is 100 to 240 VAC (with ±10% stability) at 50/60 Hz. To avoid electrical hazards and damage to the instrument, do not apply voltage outside of this range.**
- **For battery operation, use only the 9447 BATTERY PACK. We cannot accept responsibility for accidents or damage related to the use of any other batteries.**

Handling the CD

⚠CAUTION

- Always hold the disc by the edges, so as not to make fingerprints on the disc or scratch the printing.
- Never touch the recorded side of the disc. Do not place the disc directly on anything hard.
- Do not wet the disc with volatile alcohol or water, as there is a possibility of the label printing disappearing.
- To write on the disc label surface, use a spirit-based felt pen. Do not use a ball-point pen or hard-tipped pen, because there is a danger of scratching the surface and corrupting the data. Do not use adhesive labels.
- Do not expose the disc directly to the sun's rays, or keep it in conditions of high temperature or humidity, as there is a danger of warping, with consequent loss of data.
- To remove dirt, dust, or fingerprints from the disc, wipe with a dry cloth, or use a CD cleaner. Always wipe radially from the inside to the outside, and do no wipe with circular movements. Never use abrasives or solvent cleaners.
- Hioki shall not be held liable for any problems with a computer system that arises from the use of this CD, or for any problem related to the purchase of a Hioki product.

Preliminary Checks

Before using the instrument the first time, verify that it operates normally to ensure that the no damage occurred during storage or shipping. If you find any damage, contact your dealer or Hioki representative.

Registered Trademarks

The names of instruments that appear in this manual are the registered trademarks or trademarks of their respective manufacturers.

Overview 1

1.1 Product Overview

The 8420-51, 8421-51, 8422-51 MEMORY HiLOGGERs are data collection instruments designed to replace hybrid recorders and data loggers. Both analog and pulse inputs are supported, and logic inputs and alarm outputs can be added with the optional 8993 DIGITAL I/O UNIT. A wide variety of measurements, including simultaneous totalization of power and rotation rate are supported. Data can be acquired not only within the instrument, but also to a PC for external analysis, or for storage on a PC Card or by transfer via LAN cable.

1.2 Features

Compact & Lightweight
The lightweight, B5-size (182 x 257 mm/ 7.17" x 10.12") portability of these instruments makes them ideal for use where space is limited, and the dual-power (AC adapter or battery) capability makes them ideal for mobile applications as well.

Isolated Input Circuits (Analog & Pulse)
Analog and pulse channels can be recorded in combination. The input circuits are fully isolated, so they can be safely connected to points of independent potential.

Digital Filter
This instrument has a built-in delta-sigma AD converter, which offers a high level of noise reduction. The longer the recording interval is, the larger the noise reduction effect becomes; this ensures highly accurate measurement with little scatter.

High-Resolution (16-bit) Analog Inputs
The eight analog channels in the 8420-51 (16 in the 8421-51, 32 in the 8422-51) measure up to 60 VDC, temperature with nine types of thermocouples and two types of resistance temperature detectors*, and humidity* with an optional sensor. Both three- and four-wire resistance temperature detectors are supported. The input terminal block can be easily removed to facilitate connections in difficult conditions.
* 8420-51, 8421-51 only

100 ms Recording Intervals*
The shortest recording interval is 100 ms, during which data at all input channels can be scanned. The recording interval can be set in 16 steps from 100 ms to one hour.
* 8420-51, 8421-51: The recording interval is five seconds or longer when one or more channels are set to humidity measurement.
  8422-51: The recording interval is 200 ms or longer when the channels between CH17 and CH32 are used.

Four (16-bit) Pulse Input Channels
Four pulse-input channels are provided for totalization and rotation rate measurements. Rotations are measured by counting pulses from an encoder. Flow and power can be measured simultaneously with temperature by flowmeter and wattmeter pulse measurements.

10BASE-T LAN Interface
Waveform display and data acquisition can be controlled in real time by a PC running the optional 9334 LOGGER COMMUNICATOR program. Up to 16 instruments can be controlled from a single PC.

PC Card Slot
Measurement data and settings can be saved on ATA Flash cards. Measurement data can be saved to a card in real time. The file system is designed to protect against power failure, so that even if power is cut, data acquired prior to power loss is not lost.

Scaling Function
Data acquired as voltage levels or pulse counts can be converted into any units by setting the physical value or instrument name per input signal volt or pulse.

A Variety of Measurement Display Functions
Calculated numerical average and maximum values can be displayed, as well as times and numerical values at display cursors.

Easy-To-See Display
The built-in 5.7-inch STN Color LCD (320 x 240 dots) displays either waveforms only, or waveforms along with numerical values or gauges, so measured values can be easily verified on the screen.

The Optional 8992 PRINTER UNIT
The high-resolution (10 mm/division) thermal printer provides hard copy of important measurements. Waveforms or measurement values can be printed in real time, simultaneously with data acquisition. The screen image can be printed at any time simply with the push of a button.

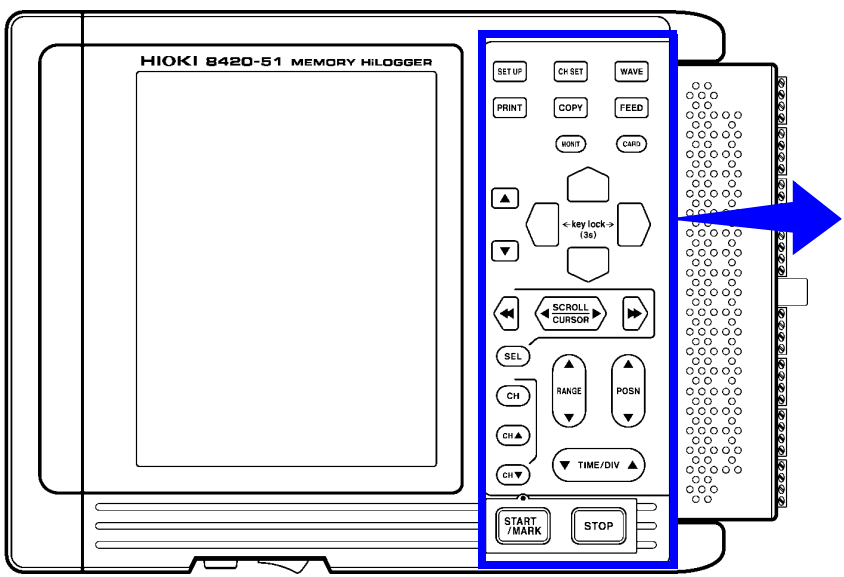
Logic Inputs, Alarm Outputs and External Control with the Optional 8993 DIGITAL I/O UNIT
The Digital I/O unit provides 16 logic input channels and 16 alarm output channels (open collector outputs) for controlling external devices.

Simple Help Function
Help information displayed at the bottom of the screen eliminates the need for the operator to refer to the manual to perform most basic operations.

Dual (Japanese/English) Language Support

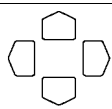
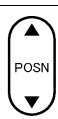
1.3 Identification of Controls and Indicators

Front Panel

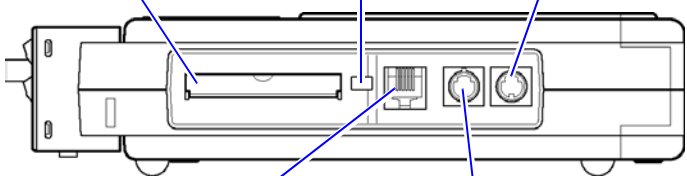


This is the 8420-51.

Buttons Operations

SET UP	Displays the Status Screen.
CH SET	Displays the Channel Screen.
WAVE	Displays the Waveform Screen, and selects the display format of the Waveform Screen.
PRINT	Prints measurement data stored in memory; while measuring, starts and stops real-time printing.
COPY	Prints the screen (or creates a screen image file); while measuring, prints the most recently logged data value.
FEED	Feeds recording paper while pressed.
MONIT	Displays the Monitor Screen.
CARD	Displays the File Screen (for loading and saving measurement data).
▲ ▼	Select and accept settings.
	Move the blinking cursor up, down, left and right.
◀◀ SCROLL ◀ CURSOR ▶ ▶▶	Scroll waveforms, move A-B cursors and search for event markers.
SEL	Switches between scrolling waveforms, moving A-B cursors and searching for event markers.
CH	Displays the Channel Setup Window on the Waveform Screen, for entering settings.
CH▲	Changes the setting channel to the previous channel.
CH▼	Changes the setting channel to the next channel.
	Selects the range for each channel.
	Selects the zero position for each channel.
▼ TIME/DIV ▲	Sets the time per division on the horizontal axis.
START /MARK	Starts measurement; while measuring, the LED above the button is lit.
STOP	Pressing this button twice stops measurement.

Upper Panel



PC Card Slot
A PC Card can be inserted here.

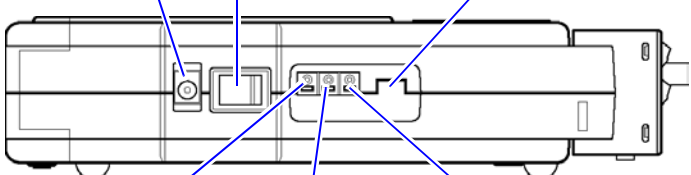
Eject button
Pressing this button ejects the PC Card.

Pulse Probe Connector (PULSE)
These are the pulse input terminals, for connecting the 9641CONNECTION CABLE.

10BASE-T Ethernet Connector
The 9642 LAN CABLE can be connected here.

RS-232C Connector
The 9612 RS-232C CABLE or 9721 RS-232C CABLE can be connected here.

Lower Panel



AC Adapter Connector
The AC adapter can be connected here.

Power Switch (POWER)
Turns the power on and off.

Contrast Adjustment Knob (CONTRAST)
Adjusts display contrast.

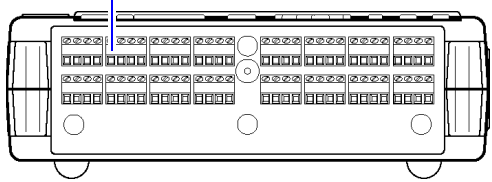
External Trigger Terminal (EXT TRIG)
External trigger source input.

Trigger Output Terminal (TRIG OUT)
Trigger signals are output at these terminals.

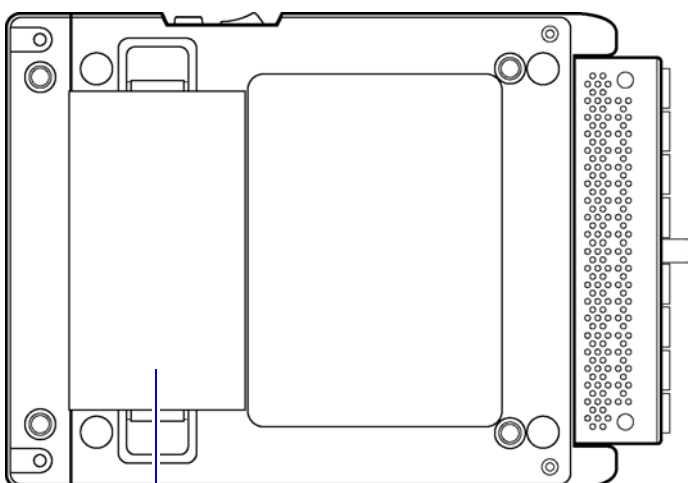
GND Terminal
This is the signal ground for use with the trigger terminal.

Right Panel

Analog Input Terminal Block
These are the analog input terminals.
The 8420-51 has 8 input channels, the 8421-51 has 16 input channels, and the 8422-51 has 32 input channels.



Bottom Panel

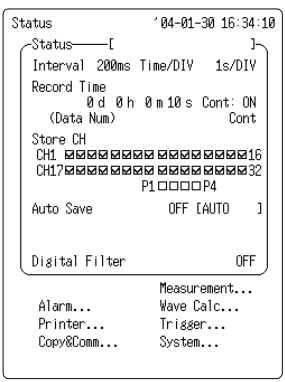


Battery Compartment
Contains the 9447 BATTERY PACK.

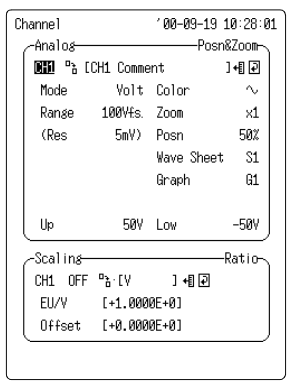
1.4 Screen Organization

Five screens can be selected for display. The Waveform Screen and the Monitor Screen show measurement data, the Status Screen and the Channel Screen provide access to instrument settings, and the File Screen supports measurement data storage functions.

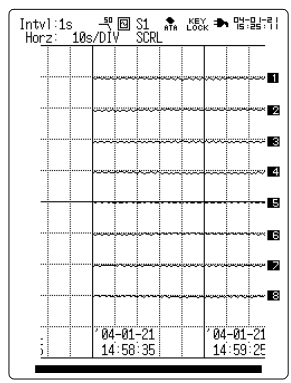
SET UP Status Screen



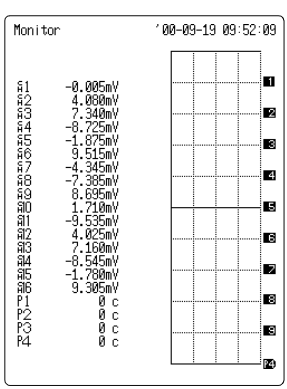
CH SET Channel Screen



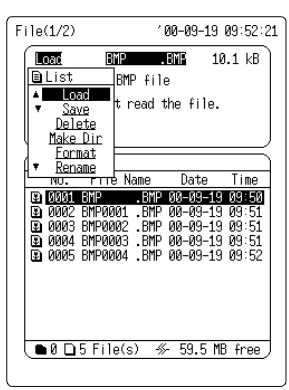
WAVE Waveform Screen

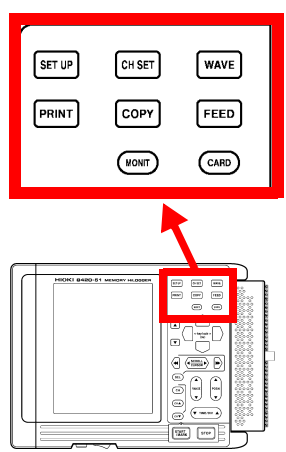


MONIT Monitor Screen



CARD File Screen





- Move from the Status Screen to a screen for the setting of communications, system, trigger, or calculation.
- The Waveform Screen layout can be selected from six configurations by the WAVE button (seven configurations when numerical calculation is enabled).

❖See Chapter 6.2 "Switching the Waveform Screen Layout" (page 101.)

1.5 Measurement Flowchart

Measurement Preparations

When the Analog Channel is used

- Connecting Power (Use the AC adapter or the Battery pack) — ❖ See Section 2.1 (page 21.)
- Connecting Measurement Cables — ❖ See Section 2.2 (page 25.)
- Powering On — ❖ See Section 2.3 (page 31.)

Settings of the Instrument (Status Screen)

- Entering the Title Comment*1 — ❖ See Section 4.1 (page 40.)
- Setting the Recording Interval — ❖ See Section 4.2 (page 41.)
- Setting the Time Axis*1, 2 — ❖ See Section 4.3 (page 42.)
- Setting the Recording Period — ❖ See Section 4.4 (page 44.)
- Setting the Measurement Channels — ❖ See Section 4.5 (page 46.)
- Setting the Auto Save — ❖ See Section 4.6 (page 47.)
- Setting the Digital Filter — ❖ See Section 4.7 (page 48.)

Settings of the Instrument (Analog Channel Screen)

Entering the Analog Channel Comments*1	❖ See Section 5.1 (page 52.)
Setting the Mode (Input Type)	
Setting the Range	
Setting the Thermocouple Type, Appropriate Compensation, Burn Out Detection (Measuring Temperature via Thermocouple)	❖ See Section 5.1.2 (page 57.)
Setting about Resistance Temperature Detector Type and Connection Type (Measuring Temperature via Resistance Temperature) Detector)	❖ See Section 5.1.3 (page 62.)
Setting the Waveform Screen Color*1, 2	❖ See Section 5.1.6 (page 68.)
Setting the Magnification*1, 2	❖ See Section 5.1.7 (page 69.)
Setting the Display Position*1, 2	❖ See Section 5.1.8 (page 70.)
Setting the Waveform Sheet*1	❖ See Section 5.1.9 (page 72.)
Setting the Display Layout*1	❖ See Section 5.1.10 (page 73.)
Setting the Scaling	❖ See Section 5.4 (page 86.)

*1 Even if the setting is not made, measurement will be unaffected.
*2 The setting can be changed during measurement.

Starting Measurement

Press START /MARK button to start measurement.

❖ See Section 3.1 (page 35.)

To stop measurement,
press the STOP button twice.

Ending Measurement

Recording stops when the specified recording period has elapsed.
(When the recording period is set to an arbitrary number)

❖ See Section 3.2 (page 38.)

Press STOP button twice to stop measurement.

NOTE

Applied Measurement

Saving measurement data
❖ See Chapter 7 "Saving Measurement Data" (page 113.)

Analyzing measurement data in detail
❖ See Chapter 8 "Calculation Functions" (page 145.)

Printing out measurement data
❖ See Chapter 11 "Printing Measurement Data" (page 181.)

Measurement Preparations 2

NOTE For the procedure of attaching the 8992 PRINTER UNIT and the 8993 DIGITAL I/O UNIT, see Section 11.1.1 "Connecting the 8992 PRINTER UNIT" (page 181) and Section 12.1 "Connecting the 8993 DIGITAL I/O UNIT" (page 198).

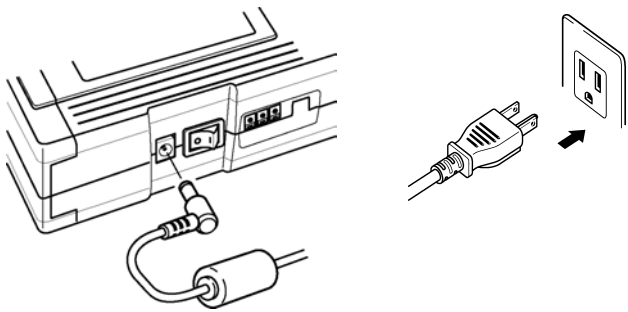
2.1 Connecting Power

2.1.1 Connecting the AC Adapter

⚠WARNING

- **Turn the instrument off before connecting the AC adapter to the instrument and to AC power.**
- **Use only the supplied 9418-15 AC ADAPTER (SA145A-1240V-6, SINO AMERICAN). AC adapter input voltage range is 100 to 240 VAC (with ±10% stability) at 50/60 Hz. To avoid electrical hazards and damage to the instrument, do not apply voltage outside of this range.**

1. Make sure the instrument is OFF.
2. Connect the AC adapter to the instrument.
3. Plug the AC adapter into the power outlet.



NOTE

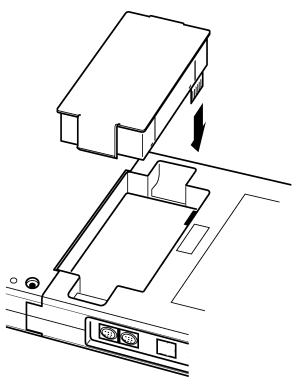
- Make sure the power is turned off before connecting or disconnecting the AC adapter.
- Data can be retained for about ten minutes after power is interrupted. Operation after power interruption depends on the setting for Resume Recording After Power Loss.
  ❖ See Section 13.1.2 "Setting the Start Backup After Power Loss" (page 205.)
  ❖ See Section 7.3.6 "PC Card Initialization" (page 128.)
- Having the 9447 BATTERY PACK installed can help protect against power interruption. When the AC adapter and a battery pack are both installed, the AC adapter takes priority.
- This instrument will not run erratically under a momentary power outage lasting less than 40 ms. However, if a momentary outage of 40 ms or more occurs, the instrument turns off temporarily, so the power condition at the installation location should be considered beforehand. Therefore, consider the power supply conditions at your installation site before installing the instrument.

2.1.2 Installing the Battery Pack

WARNING

For battery operation, use only the 9447 BATTERY PACK. We cannot accept responsibility for accidents or damage related to the use of any other batteries.

The battery pack is subject to self-discharge. Be sure to charge the battery before initial use. If the battery capacity remains very low after correct recharging, the useful battery life is at an end.
❖ See Section 16.6 "9447 BATTERY PACK Charging" (page 256.)



1. Turn off the power switch.
2. Remove the battery compartment.
3. Insert the 9447 BATTERY PACK until it clicks.

Continuous Operating Time with the 9447 BATTERY PACK (at 23°C and unused printer.)

• Voltage measurement • Backlight saver enabled (5 min) • After 10 h (approx.) charging	Approx. 5 hours
• Voltage measurement • Backlight brightness • After 2.5 h (approx.) charging	Approx. 2.5 hours

The times in this table depend on ambient temperature.

NOTE

- Continuous operating time is about doubled when a second battery pack is installed in the 8993 DIGITAL I/O UNIT.
- When operating from a battery pack, the instrument automatically turns off as the battery becomes discharged. If the instrument is allowed to remain in this state for a long time, the battery pack can become overdischarged, so the power switch should always be turned off.
- The battery pack is subject to self-discharge. If stored or otherwise not used for a long time, the battery pack should be discharged and then recharged at least once every two months. Battery capacity may be degraded if stored for a long time without charging.
- For long-term storage, remove the battery pack from the instrument.
- The battery pack is a consumable. If the battery capacity remains very low after correct recharging, the useful battery life is at an end.
- The life of the battery pack is 500 charges or one year, whichever comes first.
- Printing with the battery pack may result in light printouts. We therefore recommend that the AC adapter be used when printing.

2.2 Connecting Measurement Cables

2.2.1 Removing the Terminal Block

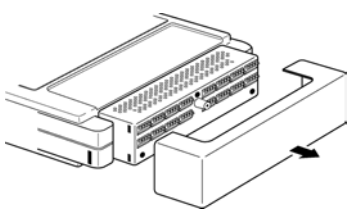
⚠WARNING

To avoid electric shock

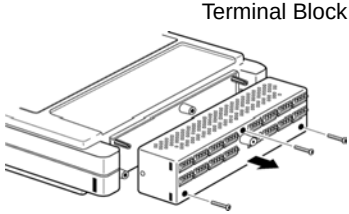
- **Make sure the instrument is turned off when connecting or removing the terminal block.**
- **Never connect or remove the terminal block from the instrument while power is applied to a circuit to which an input lead or a connection cable is connected.**

If the terminal block is removed, the input lead can be easily connected. (However, you can also connect the input lead with the terminal block attached.)

Removal



Terminal Block Cover



Terminal Block

1. Turn the instrument off.
2. Remove the terminal block cover.
3. Loosen the three Phillips screws on the front of the terminal block.
4. Remove the terminal block by pulling it forward.
5. Connect the input leads.
   ❖See Section 2.2.2 "Connecting the Input Leads" (page 26.)

Replacement

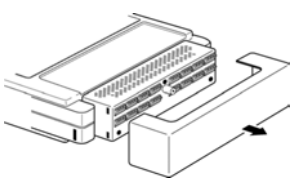
Press it until it clicks and affix with the three screws.

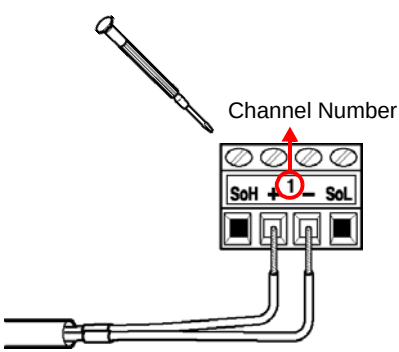
2.2.2 Connecting the Input Leads

WARNING **To avoid electric shock, never connect the input lead from the instrument while power is applied to a circuit to which an input lead is connected.**

CAUTION When disconnecting input leads, always loosen the terminal block screws before pulling out the wires. The input lead can be damaged if the lead is pulled without first loosening the screws.

After making a connection, always replace the terminal block cover before starting measurement.



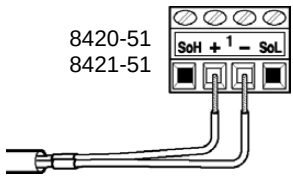


1. Turn the instrument off.
2. Remove the terminal block cover.
3. Loosen the screw on the terminal using the screwdriver (supplied with the instrument).
4. Insert the input lead into the terminal, and tighten the screw.
   ❖See "Connection Positions" (page 27.)
5. Replace the terminal block cover.

Connection Positions

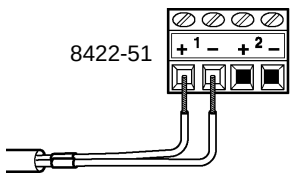
Voltage Measurement

8420-51
8421-51



SoH	+	-	SoL
No connection	Meas. terminal	Ground terminal	No connection

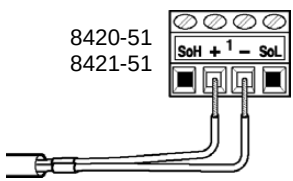
8422-51



1 (CH1)		2 (CH2)	
+	-	+	-
Meas. terminal	Ground terminal	Meas. terminal	Ground terminal

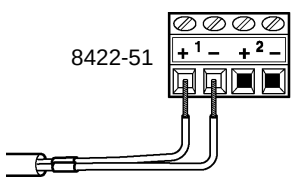
Temperature Measurement via Thermocouple

8420-51
8421-51



SoH	+	-	SoL
No connection	Meas. Terminal (+)	Meas. Terminal (-)	No connection

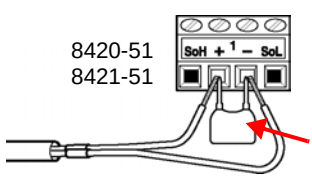
8422-51



1 (CH1)		2 (CH2)	
+	-	+	-
Meas. Terminal (+)	Meas. Terminal (-)	Meas. Terminal (+)	Meas. Terminal (-)

4-20 mA Input

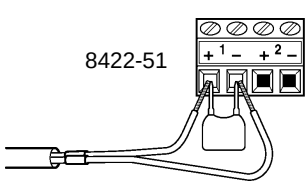
8420-51
8421-51



250 Ω Shunt Resistance

SoH	+	-	SoL
No connection	Meas. terminal	Ground terminal	No connection

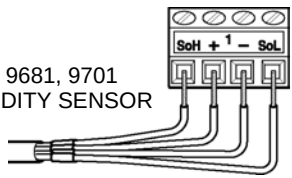
8422-51



1 (CH1)		2 (CH2)	
+	-	+	-
Meas. terminal	Ground terminal	Meas. terminal	Ground terminal

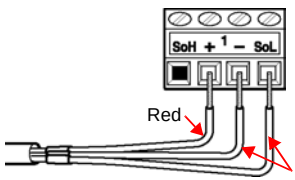
Humidity Measurement*

9653, 9681, 9701
HUMIDITY SENSOR



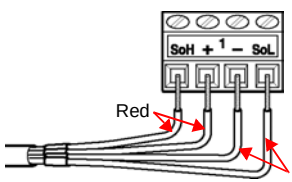
SoH	+	-	SoL
Meas. Terminal (red)	Meas. Terminal (Yellow)	Meas. Terminal (Green)	Meas. Terminal (Black)

Temperature Measurement via Resistance Temperature Detector (3-wire)*



SoH	+	-	SoL
No con-nection	Meas. Terminal (A)	Meas. Terminal (B)	Meas. Terminal (B)

Temperature Measurement via Resistance Temperature Detector (4-wire)*

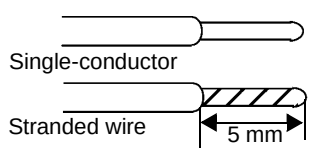


SoH	+	-	SoL
Meas. Terminal (A)	Meas. Terminal (A)	Meas. Terminal (B)	Meas. Terminal (B)

* 8420-51, 8421-51 only

Recommended Lead Wire

Single-conductor : 0.14 to 1.5 mm^2
Stranded wire : 0.14 to 1 mm^2
AWG : AWG26-AWG16
Wire stripping length: 5 mm



NOTE

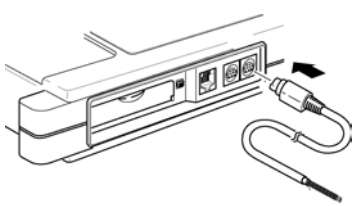
- Measurements may be affected by noise or other electromagnetic ingress if the input lead is longer than about three meters.
- The general guidelines for resistance temperature detector terminations are provided in JIS Z 8704, in which A and B signals are designated by red and white wires, respectively. However, the three-wire IEC guidelines define the connections differently (red and white are reversed), so special attention is required.
- The measure current for resistance temperature detector are 1 mA.

2.2.3 Connecting the 9641 CONNECTION CABLE (for pulse input)

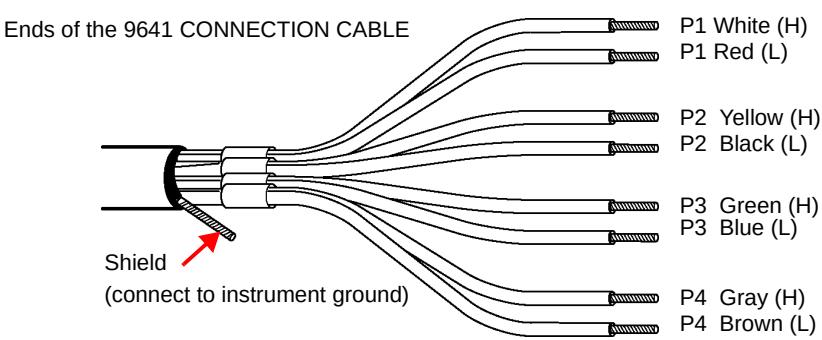
WARNING **To avoid electric shock, never connect the connection cable from the instrument while power is applied to a circuit to which an connection cable is connected.**

NOTE Use only the optional 9641 CONNECTION CABLE for pulse inputs.

Up to four pulse totalizer or rotation rate channels can be recorded using the 9641 cable.
If the 9641 cable is not connected, the pulse waveform is displayed as a zero level.



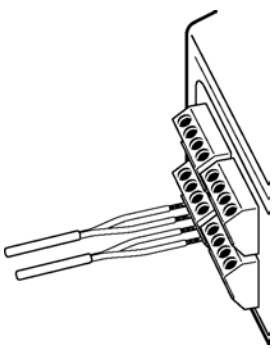
1. Connect the 9641 CONNECTION CABLE to the pulse input terminal (PULSE) on the upper side of the instrument.
2. Connect the terminals of the connection cable to the item to be measured.



2.2.4 Connecting Leads to Terminal Block of Digital I/O Unit

❖ See Section 12.1 "Connecting the 8993 DIGITAL I/O UNIT" (page 198.)

Connection to Logic Inputs

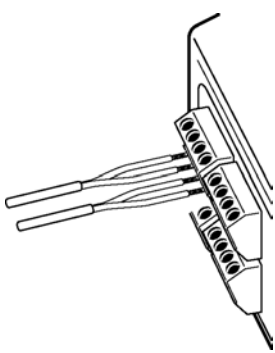


The logic inputs are on the lower half of the terminal block. Sixteen logic input channels are provided.

1. Loosen the screw on the terminal using the screwdriver supplied with the instrument.
2. Insert the leads in each + and - terminal, and tighten the screws.

❖See Section 5.3 "Input Settings on the Logic Channel" (page 83.)

Connection to Alarm Outputs



The alarm outputs are on the upper half of the terminal block. Sixteen alarm output (active-low) channels are provided.

1. Loosen the screw on the terminal using the screwdriver supplied with the instrument.
2. Insert the leads in each + and - terminal, and tighten the screws.

❖See Chapter 12 "Alarm Function" (page 197.)

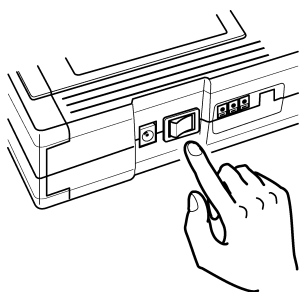
2.3 Powering On/Off

⚠WARNING

Check the following before turning the power switch on:

- **Make sure the supply voltage is between 100 and 240 VAC (including allowance for ±10% voltage tolerance), and 50 or 60 Hz.**
- **Make sure the instrument is correctly installed.**
  ❖ See "Setting Up the Instrument" (page 7.)

Power On



1. Turns on (❙) the POWER switch.
2. Depending on the type and condition of the power supplied to the instrument, one of the following messages appears on the Waveform Screen.

	Operating with the AC adapter.
	Operating with the 9447 BATTERY PACK.
LOW	Battery capacity is low. Replace the batteries.

Power Off

Turns off (◯) the power switch.

NOTE

- After power is turned off, the last waveform data is retained for about 10 minutes.
- When power is turned on, the instrument restores the settings used immediately before power was turned off last (backup function).

2.4 Measuring Precautions

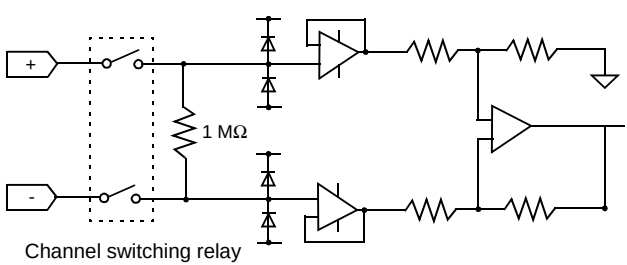
WARNING

To avoid electric shock

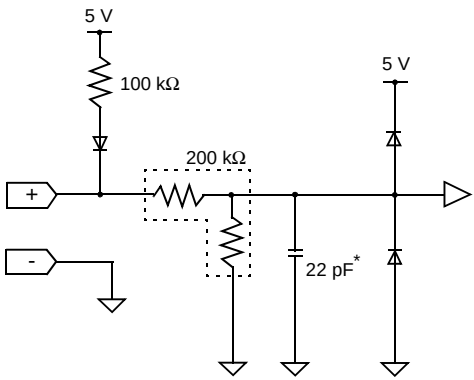
- **Use only the supplied 9418-15 AC ADAPTER (SA145A-1240V-6, SINO AMERICAN). AC adapter input voltage range is 100 to 240 VAC (with ±10% stability) at 50/60 Hz. To avoid electrical hazards and damage to the instrument, do not apply voltage outside of this range.**
- **Never apply more than 30 Vrms or 60 VDC between analog input terminal, or between analog input terminal and chassis ground.**
- **Never exceed the limits in the following table.**

Terminals	Maximum Input Voltage
Analog Inputs	30 Vrms or 60 VDC
Pulse Inputs	15 VDC
External Trigger Terminal	-5 to +10 V
Trigger Output Terminal	-20 to +30 V, 500 mA max., 200 mW max.

Circuit Diagram of Analog Input (Voltage/Thermocouple input)

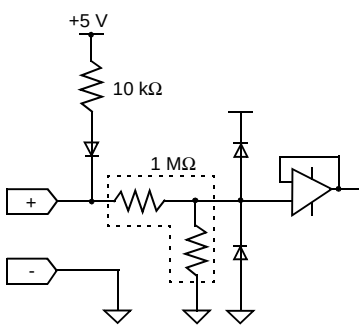


Circuit Diagram of Pulse Input

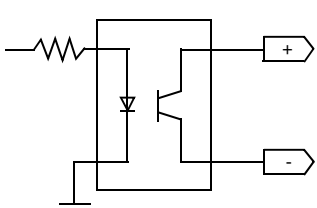


* 0.22 µF when the chatter filter is used.

Logic Circuit Diagram of 8993 DIGITAL I/O UNIT



Alarm Output Circuit Diagram of the 8993 DIGITAL I/O UNIT

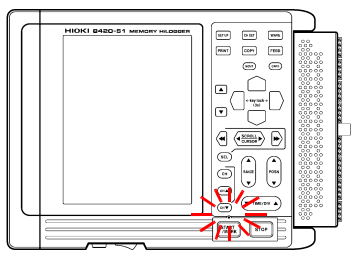


Starting and Ending Measurement 3

3.1 Starting Measurement

Start measurement.

LED of the instrument lights green.



- When Binary (real-time) automatic saving is enabled, data is saved to the PC Card as it is acquired.
  ❖ See Section 7.5 "Automatic Data Saving" (page 133.)
- The display can be switched between waveforms and numerical values.
  ❖ See Chapter 6 "Waveform Screen" (page 99.)
- The waveform can be scrolled left and right.
  ❖ See Section 6.4 "Scrolling the Waveform" (page 104.)
- A-B cursor measurements can be made on the waveform during data acquisition.
  ❖ See Section 6.5 "A-B Cursor Measurement" (page 106.)
- Event markers can be applied, for search operations.
  ❖ See Section 6.6 "Event Markers (Recall Function)" (page 108.)

When the 8992 PRINTER UNIT is used

- When real-time printing is enabled, data is printed and displayed simultaneously.
  ❖ See Section 11.2.2 "Printing Continuously in Real Time (Real Time Printing)" (page 185.)

When the 8993 DIGITAL I/O UNIT is used

- An alarm signal can be output when an anomality is detected during measurement.
  ❖ See Chapter 12 "Alarm Function" (page 197.)

Measurement can be started and ended either manually, or by the trigger functions, described below.

Manual Starting

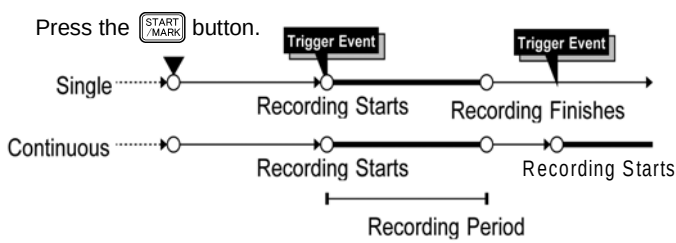
Press the START /MARK button to start measurement.
All trigger conditions are disabled (OFF, free-running mode).

Trigger Starting

"Trigger" is a function that transmits a signal to start or stop measurement with certain timings. The following trigger functions are available.

(1) Trigger Mode
Sets whether trigger events continue to be accepted after each measurement is completed.

Single	Only one trigger event is accepted (one-shot trigger recording).
Continuous	Subsequent trigger events start the recorder after the first event has been recorded. When Continuous mode is selected, measurement can be stopped by pressing the STOP button.



❖ See Section 9.1 "Setting the Trigger Mode" (page 158.)

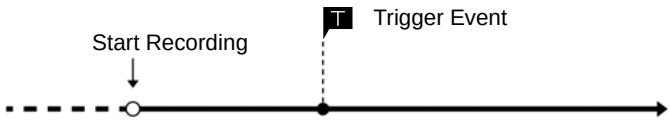
(2) Trigger Timing
Sets the timing to start recording waveforms, in accordance with the trigger application.

START	Recording starts as soon as the trigger is applied.
STOP	Recording starts only when the START /MARK button is pressed, and stops when the trigger is applied.
START& STOP	Recording starts when the trigger is applied, and stops when the trigger is applied next.

❖ See Section 9.2 "Setting the Trigger Timing" (page 159.)

(3) Pre-Trigger

When the trigger timing is set to "START" or "START & STOP," the waveforms occurring before the trigger is applied will be recorded, as well as those occurring after the trigger is applied.



❖ See Section 9.3 "Setting the Pre-Trigger" (page 161.)

(4) Trigger Settings

Sets the signals used to start trigger and stop trigger. Level or Window trigger modes can be set according to whether the measurement is on an analog and pulse channel.
For the logic channels, only the logic trigger can be set.

❖ See Section 9.5 "Setting the Trigger Function" (page 163.)

(5) AND/OR Trigger Conditions

Selects whether the trigger is applied when all the trigger conditions are met (AND) or when any one of the conditions is met (OR).

❖ See Section 9.6 "Trigger Source AND/OR Linking" (page 169.)

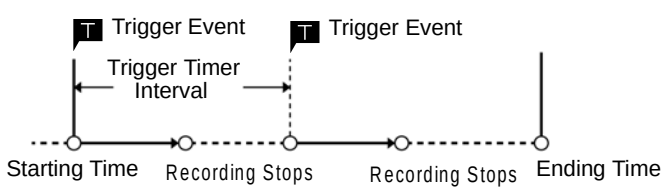
(6) External Trigger

Triggering can be initiated by external signal inputs.

❖ See Section 9.7 "Setting the External Trigger Function" (page 171.)

(7) Timer Trigger

This trigger mode is used for fixed-time recordings, so that trigger events are recognized only within a specific period between specified Start and Stop times.



❖ See Section 9.8 "Setting the Timer Trigger Function" (page 175.)

3.2 Ending Measurement

Stopping Measurement When Recording Period is "Continuous"

Stopping Measurement Before Recording Period Elapses

Press this button twice.

Stop measurement.

When the recording time is set to an arbitrary number, measurement stops after the set recording time has elapsed.
(If printing and numerical saving or automatic (text) saving are enabled, these operations are completed.)

Processing Measured Data

Analysis by numerical calculation
❖ See Section 8.1 "Applying Numerical Calculation to Measurement Data" (page 145.)

Printing
❖ See Chapter 11 "Printing Measurement Data" (page 181.)

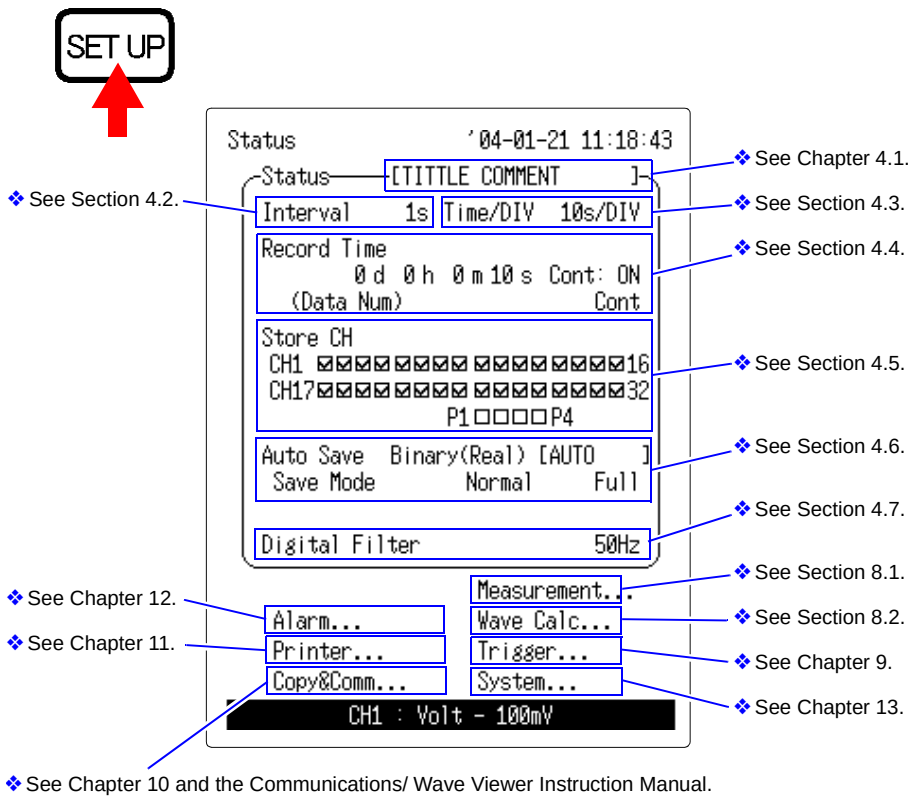
Storage on a PC card
❖ See Chapter 7 "Saving Measurement Data" (page 113.)

NOTE

- When the recording period is set to Continuous, the most recent 16 M Word/channel quantity of data is stored within the instrument. Subsequent additional measurement data overwrites the old data.
- When the measurement start and stop conditions are determined by the trigger function, measurement starts and stops automatically.
  ❖ See Chapter 9 "Trigger Functions" (page 157.)

Status Screen 4

The Status Screen provides access to items that affect all measurements.



4.1 Entering the Title Comment

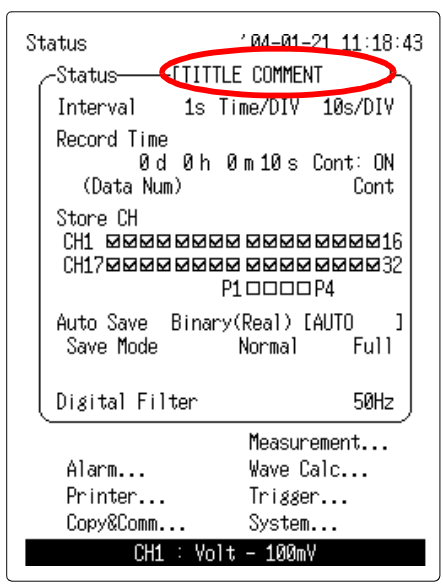
When a title comment has been entered,

- It is displayed when the Waveform Screen is set to display Numerical Values + Comments
  ❖ See Section 6.2 "Switching the Waveform Screen Layout" (page 101.)
- Title comments can be printed out
  ❖ See Section 11.5 "Comment Printing" (page 193.)
- Title comments are saved with measurement data
  ❖ See Section 7.6 "Text File Internal Format" (page 142.)

NOTE Enter a title comment when necessary; even if no title comment is entered, measurement will be unaffected.

SET UP Display the Status Screen.

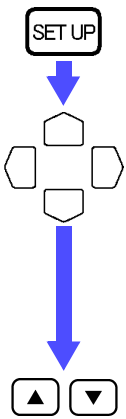
Move the blinking cursor to the position shown.



▲ ▼ Display the Comment Entry Window.
Enter the desired title comment.
❖ See Chapter 14 "Text Entry Procedure" (page 225.)

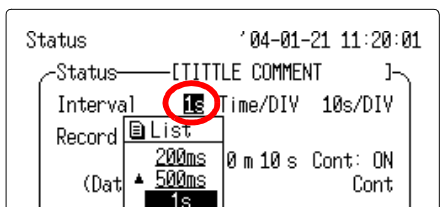
4.2 Setting the Recording Interval

Select the recording interval according to the type of measurement object. If the recording interval is set too small, the maximum recording period will be limited.



Display the Status Screen.

Move the blinking cursor to the position shown.



Set the Interval (recording interval.)

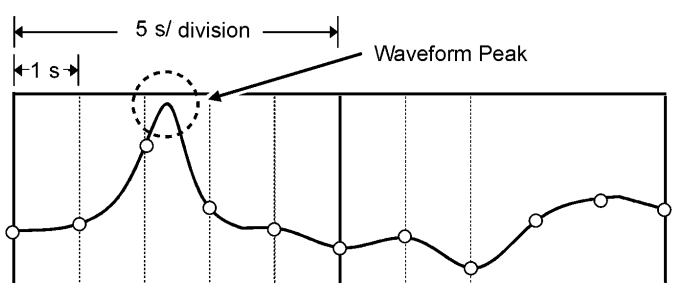
Selection

100ms, 200ms, 500ms,1s, 2s,5s,10s, 20s, 30s, 1min, 2min, 5min, 10min, 20min, 30min, or 1h

Example

Waveform peaks may not be recorded, depending on the recording interval setting.

Recording interval: 1 s, Time axis: 5 s/division



NOTE

- The recording interval is 200 ms or longer when the channels between CH17 and CH32 are used.
- The selectable recording intervals range from 5 sec. to 1 hr. when one or more channels are set to humidity measurement (8420-51 and 8421-51 only).

4.3 Setting the Time Axis (Time Per Division)

The waveform can be magnified or reduced in the time axis direction by changing the time axis while measuring, or after finishing measurement.

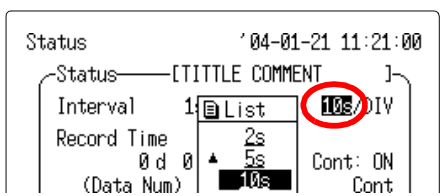
Method 1: Configure on Status Screen.

SET UP

Display the Status Screen.

Move the blinking cursor to the position shown.

To move the blinking cursor to the "Time Axis" position automatically for setting, press the ▼ TIME/DIV ▲ button.



Set the Time/DIV (time axis.)

Selection

1s, 2s, 5s, 10s, 20s, 30s, 1min, 2min, 5min, 10min, 20min, 30min, 1h, 2h, 5h, 10h, 12h, or 1d

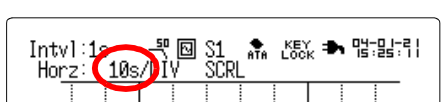
Method 2: Configure on Waveform Screen.

WAVE

Display the Waveform Screen.

Move the blinking cursor to the position shown.

Press the ▼ TIME/DIV ▲ button to make the setting regardless of the blinking cursor position.



Set the time axis.

NOTE The range of available time axis settings depends on the recording interval.

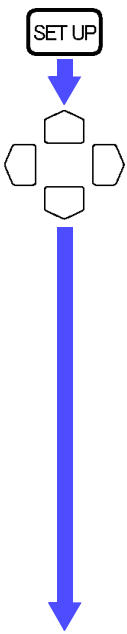
Recording Interval and Time Axis

The following table shows the combinations of recording interval and time axis settings that can be selected and displayed.

Time Axis	Recording Interval															
	100 ms	200 ms	500 ms	1 s	2 s	5 s	10 s	20 s	30 s	1 min	2 min	5 min	10 min	20 min	30 min	1 h
1 s	Yes	Yes	Yes	No	No	No	No	No	No	No	No	No	No	No	No	No
2 s	Yes	Yes	Yes	Yes	No	No	No	No	No	No	No	No	No	No	No	No
5 s	Yes	Yes	Yes	Yes	No	No	No	No	No	No	No	No	No	No	No	No
10 s	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No	No	No	No	No	No	No
20 s	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No	No	No	No	No	No
30 s	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No	No	No	No	No	No
1 min	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No	No	No	No
2 min	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No	No	No
5 min	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No	No	No
10 min	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No
20 min	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No
30 min	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No
1 h	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
2 h	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
5 h	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
10 h	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
12 h	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
1 d	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

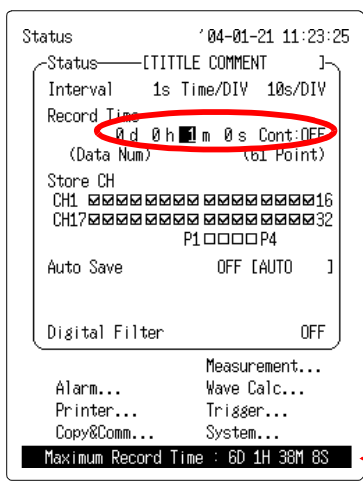
4.4 Setting the Recording Period (Measurement Duration)

The duration of each recording period is set as follows.
The maximum recording period indicates the time it takes to record data in internal memory. Note that the recording interval and number of measurement channels limit this recording period.



Display the Status Screen.

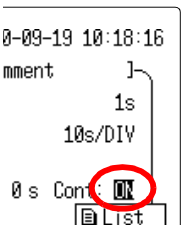
Move the blinking cursor to the position shown.



Set the Record Time (recording period.)
The data values per channel is displayed.

NOTE To set an arbitrary recording period, choose "**OFF**" for "**Continuous**" and then set the desired time.

Recording Period: Continuous Case



Measurement can be performed continuously from the starting time of the measurement. In this case, any recording period setting value is ignored. When the amount of data stored in internal memory exceeds 16 MB per channel, the stored data is overwritten.

To stop measuring, press the STOP button twice.
If the maximum recording period is likely to be exceeded when recording data on a PC card in real time, select "**Continuous**."

Relationship between Data Storage Interval, Number of Measurement Channels, and Maximum Recording Time

The maximum recording period is calculated as follows:

$$\text{Maximum Recording Period (s)} = \frac{16777216 \times \text{Data Storage Interval (s)}}{\text{Number of the Measurement Channels}}$$

When the Digital I/O Unit is used, all Logic channels (LI) count collectively as one channel, and all alarm output channels (ALM) count collectively as one channel.
For example, four analog channels and two pulse channels with alarm output enabled is equivalent to seven data channels for storage purposes.

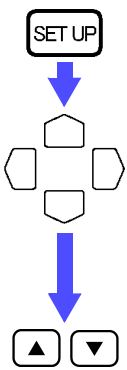
Example ▶▶ **Recording Interval: 1 s**

1 CH	2 CH	3 CH	4 CH	5 CH
194d,4h,20m,16s	97d,2h,10m,8s	64d,17h,26m,45s	48d,13h,5m,4s	38d,20h,4m,3s
6 CH	7 CH	8 CH	9 CH	10 CH
32d,8h,43m,22s	27d,17h,45m,45s	24d,6h,32m,32s	21d,13h,48m,55s	19d,10h,2m,1s
11 CH	12 CH	13 CH	14 CH	15 CH
17d,15h,40m,1s	16d,4h,21m,41s	14d,22h,29m,15s	13d,20h,52m,52s	12d,22h,41m,21s
16 CH	17 CH	18 CH	19 CH	20 CH
12d,3h,16m,16s	11d,10h,8m,15s	10d,18h,54m,27s	10d,5h,16m,51s	9d,17h,1m,0s
21 CH	22 CH	23 CH	24 CH	25 CH
9d,5h,55m,15s	8d,19h,50m,0s	8d,10h,37m,24s	8d,2h,10m,50s	7d,18h,24m,48s
26 CH	27 CH	28 CH	29 CH	30 CH
7d,11h,14m,37s	7d,4h,36m,18s	6d,22h,26m,26s	6d,16h,42m,4s	6d,11h,20m,40s
31 CH	32 CH	33 CH	34 CH	35 CH
6d,6h,20m,0s	6d,1h,38m,8s	5d,21h,13m,20s	5d,17h,4m,7s	5d,13h,9m,9s
36 CH	37 CH	38 CH		
5d,9h,27m,13s	5d,5h,57m,18s	5d,2h,38m,25s		

(d: day, h: hour, m: minute, and s: second)

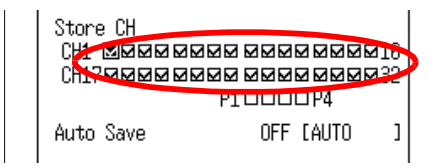
4.5 Setting the Measurement Channels On/Off

The display and measurement functions of each input channel are enabled and disabled as follows.
The 8420-51 supports up to 8 analog channels, the 8421-51 supports up to 16 analog channels, and the 8422-51 supports up to 32 analog channels.
Four pulse channels and logic channels are also available.



Display the Status Screen.

Move the blinking cursor to the position shown.



Set the measurement channel On or Off.
(P and LI indicate pulse and logic channels, respectively.)

Selection

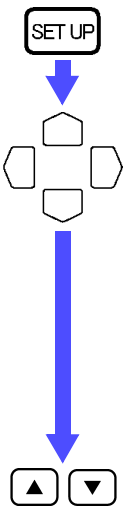
☑ (ON)	Measurement is enabled.
☐ (OFF)	Measurement is disabled.

NOTE

- Channels that are turned off are not displayed on the Channel or Waveform Screens.
- LI (logic channel) settings require that the optional 8993 DIGITAL I/O UNIT be installed.
- The maximum recording period is limited by the number of channels enabled.
  ❖ See Section 4.4 "Setting the Recording Period (Measurement Duration)" (page 44.)
- Colors serve to distinguish input types (with screen color schemes 1 to 6)
  Analog: red = voltage, green = thermocouple,
  yellow = resistance temperature detector*, blue = humidity*,
  Pulse: red = totalized count, green = rotation rate
  * 8420-51, 8421-51 only

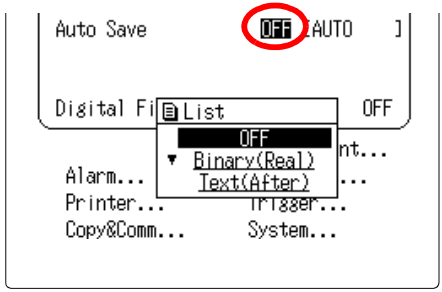
4.6 Setting the Auto Save

Measurement data can be saved to a PC Card automatically.
❖ See Section 7.5 "Automatic Data Saving" (page 133.)



Display the Status Screen.

Move the blinking cursor to the position shown.



Set the Auto Save (automatic saving.)

Selection

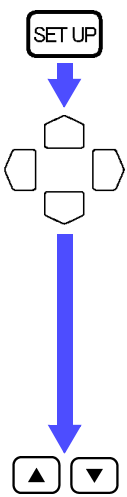
OFF	Automatic saving is disabled.
Binary (Real)	Data is automatically saved in binary format (readable only by the instrument) to the PC Card in real time.
Text (After the measurement)	Data recorded for the set recording time is automatically saved onto a PC card in text format (for Excel). When Continuous recording is selected, all data stored in the instrument is automatically saved. Data saved in text (Excel) format cannot be read back into the instrument. The saving interval and type of text header can be set.

4.7 Setting the Digital Filter

A digital filter can be used on analog channels to remove noise in the input signals.
The longer the recording interval is, the larger the noise reduction effect becomes; this ensures highly accurate measurement with little scatter.
❖ See "Recording Interval and Cutoff Frequency table" (page 238.)

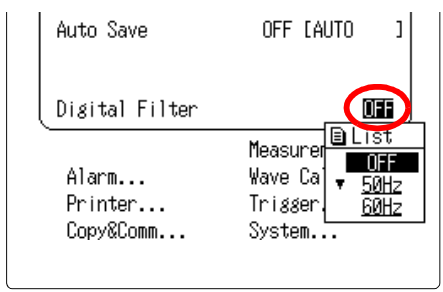
For example, assuming that channels CH1 to CH16 are used, and the digital filter is set to 60Hz, noise reduction in the supply frequency is maximized at a recording interval from 2 sec. to 1 hr.

Method 1: Configure on Status Screen.



Display the Status Screen.

Move the blinking cursor to the position shown.



Set the Digital Filter.

Selection

OFF	Filter is not used.
50 Hz	The optimum noise reduction effect is achieved where the supply frequency is 50 Hz.
60 Hz	The optimum noise reduction effect is achieved where the supply frequency is 60 Hz.

NOTE

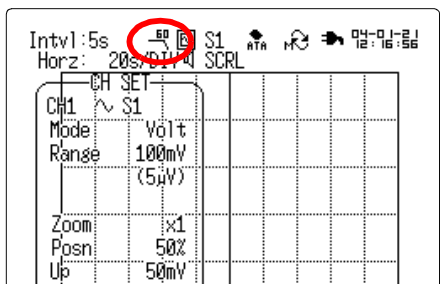
- When the digital filter is set to 50 Hz or 60 Hz, the scanning time of each channel becomes longer close to the minimum time for which the data of all channels is recorded within the recording interval. When the digital filter is OFF, each channel is scanned for 5 ms.
- The digital filter is only available for analog channels.

Method 2: Configure on Waveform Screen.

WAVE

Display the Waveform Screen.

Move the blinking cursor to the position shown.



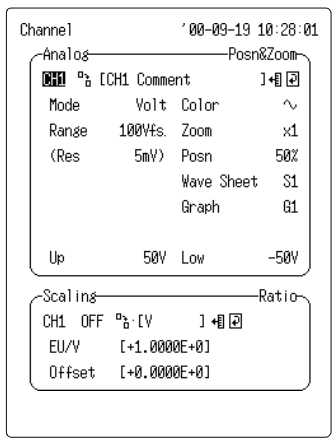
Set the digital filter.

Selection

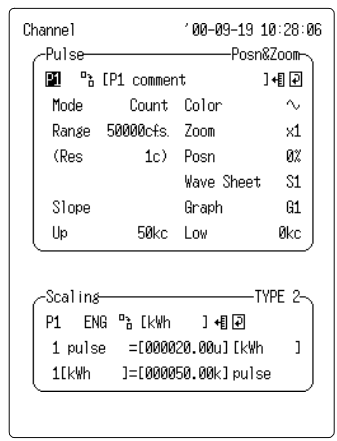
OFF	Filter is not used.
50	The optimum noise reduction effect is achieved where the supply frequency is 50 Hz.
60	The optimum noise reduction effect is achieved where the supply frequency is 60 Hz.

Channel Screen 5

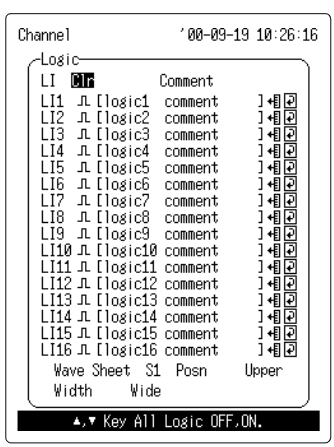
The Channel Screen allows you to set the input conditions and the display conditions for analog, pulse, and logic channels.



Analog Channel Screen
❖ See Section 5.1.



Pulse Channel Screen
❖ See Section 5.2.



Logic Channel Screen
❖ See Section 5.3.

Logic channel settings are applicable only when the 8993 DIGITAL I/O UNIT is installed.

5.1 Input Settings on the Analog Channel

Settings for voltage, thermocouples, resistance temperature detector*, and humidity* used on analog input channels are described below.
* 8420-51, 8421-51 only
Settings can be made only on those analog channels which have a checkmark (☑) in the Measurement CH settings on the Status Screen.

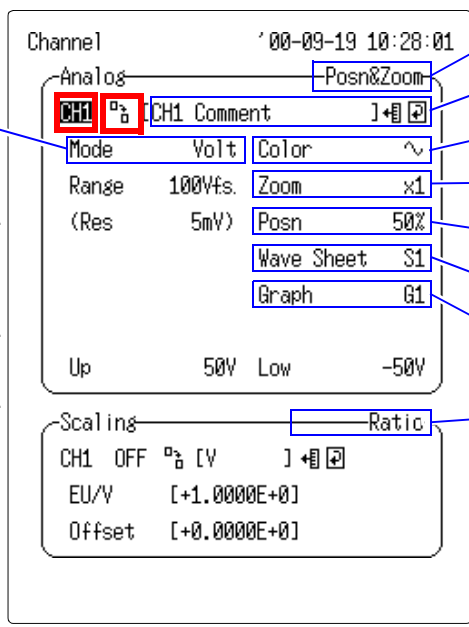
❖ Scaling settings:
See Section 5.4 "Setting Scaling" (page 86.)

Voltage
❖ See Section 5.1.1

Temperature
(via Thermocouple)
❖ See Section 5.1.2.

Temperature
(via Resistance temperature detector)
❖ See Section 5.1.3.

Humidity
❖ See Section 5.1.4.



❖ See Section 5.1.5.

❖ See Chapter 14.

❖ See Section 5.1.6.

❖ See Section 5.1.7.

❖ See Section 5.1.8.

❖ See Section 5.1.9.

❖ See Section 5.1.10.

❖ See Section 5.4.

Channel Selection

Move the blinking cursor to channel No. (CH1) and move up or down the channel Nos. one by one by pressing the ▲/▼ buttons. You can also move up the channel Nos. one by one using the CH SET or CH▲ buttons. You can move down the channel Nos. one by one using the CH▼ button.

8420-51

CH1 ..... → CH8 → P1 → P2 → P3 → P4 → LI1 ..... → LI16

Press to increase the channel No.

8421-51

CH1 ..... → CH16 → P1 → P2 → P3 → P4 → LI1 ..... → LI16

Press to decrease the channel No.

8422-51

CH1 ..... → CH32 → P1 → P2 → P3 → P4 → LI1 ..... → LI16

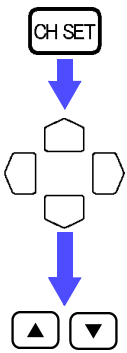
- By pressing the CH button when you are in the Analog Channel, the Pulse Channel, or the Logic Channel Screen, you can go to another channel setting screen.
- You can edit the settings for logic channels when the 8993 DIGITAL I/O UNIT is connected to the instrument.

Channel Copying

Move the blinking cursor to the channel copy icon ( ) to copy and paste the settings of a channel (input type, range, magnification, display position, and upper and lower limits) using the ▲/▼ buttons. The channel to be copied is shown at the bottom of the screen.

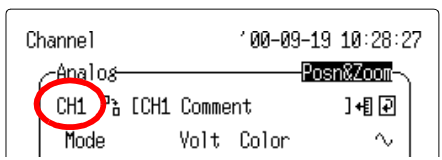
5.1.1 Measuring Voltage

(1) Display the Channel Screen to be set up.



Display the Analog Channel Screen.

Move the blinking cursor to the position shown.



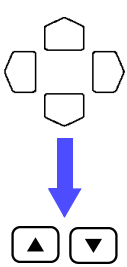
Select the channel to be set.

❖ Channel Selection: See "Channel Selection" (page 53.)

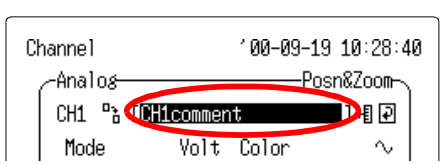
(2) Enter the Analog Channel comments.

Enter a title comment when necessary; even if no title comment is entered, measurement will be unaffected.

- The comment is displayed when the Waveform Screen is set to display Numerical Value + Comments.
  ❖ See Section 6.2 "Switching the Waveform Screen Layout" (page 101.)
- The comments are included when printing.
  ❖ See Section 11.5 "Comment Printing" (page 193.)

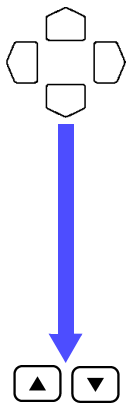


Move the blinking cursor to the position shown.

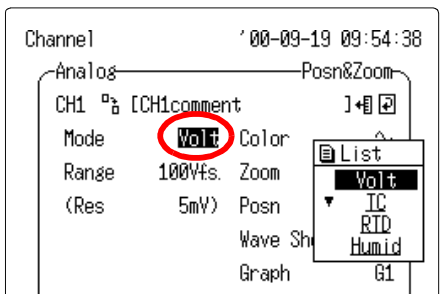


Display the Comment Entry Window.
Enter the desired analog comment.
❖ See Chapter 14 "Text Entry Procedure" (page 225.)

(3) Set the Mode (input type) to "Voltage."



Move the blinking cursor to the position shown.

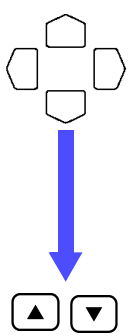


Select "**Voltage**."

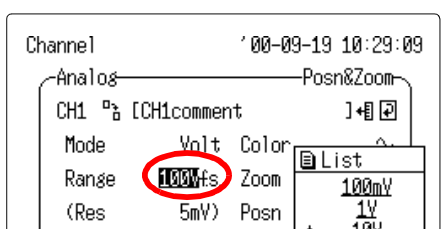
(4) Set the range.

No range selection is available when upper and lower limits have been enabled.

❖See Section 5.1.5 "Setting the Display Area" (page 67.)



Move the blinking cursor to the position shown.



Set the Range.

Selection

100 mV, 1 V, 10 V, 100 V, or 1-5 V*

The measurable range varies depending on selected range. With a high-sensitivity range, data will be measured in high resolution. The display resolution varies depending on the set range.

Measurement Objects	Range	Measurable Range	Maximum Resolution
Voltage	100 mVf.s.	-100 mV to +100 mV	5 µV
	1 Vf.s.	-1 V to +1 V	50 µV
	10 Vf.s.	-10 V to +10 V	500 µV
	100 Vf.s.	-60 V to +60 V	5 mV
	1-5 Vf.s.	1 V to 5 V	500 µV

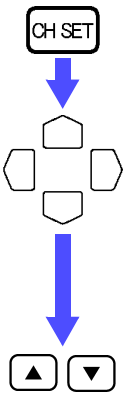
* 1-5 Vf.s. Range

The 1-5 Vf.s. range is intended for use with measurement devices that provide an output of one to five volts at four to 20 mA. It automatically sets the range to 10 Vf.s., the lower limit to one-volt, and the upper limit to five volt.
The accuracy in the range from 1 to 5 V is the same as for 10 Vf.s.
When the measurement signal is a 4-20 mA electric current, connect a 250 Ω shunt resistance across the positive and negative analog input terminals.
❖ See Section 2.2.2 "Connecting the Input Leads" (page 26.)

Also, for operator convenience, set the scaling to allow direct reading of values.
❖ See Section 5.4 "Setting Scaling" (page 86.)

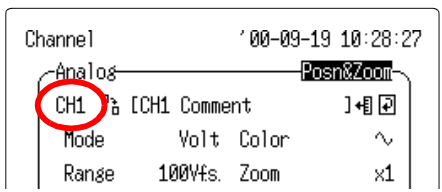
5.1.2 Measuring Temperature via Thermocouple

(1) Display the Channel Screen to be set up.



Display the Analog Channel Screen.

Move the blinking cursor to the position shown.



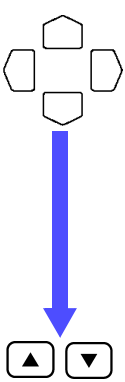
Select the channel to be set.

❖ Channel Selection: See "Channel Selection" (page 53.)

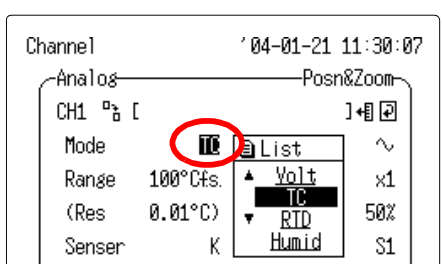
(2) Enter the Analog Channel comments.

❖ See Section 5.1.1 "Measuring Voltage" (page 54.)

(3) Set the Mode (input type) to "TC (thermocouple)."



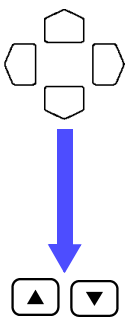
Move the blinking cursor to the position shown.



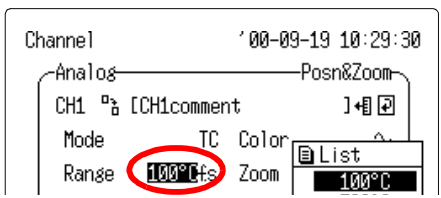
Select "**TC** (thermocouple)."

(4) Set the range.

No range selection is available when upper and lower limits have been enabled.
❖See Section 5.1.5 "Setting the Display Area" (page 67.)



Move the blinking cursor to the position shown.



Set the Range.

Selection

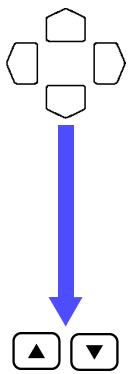
100°C, 500°C, or 2000°C

The measurable range varies depending on selected range. With a high-sensitivity range, data will be measured in high resolution. The display resolution varies depending on the set range.

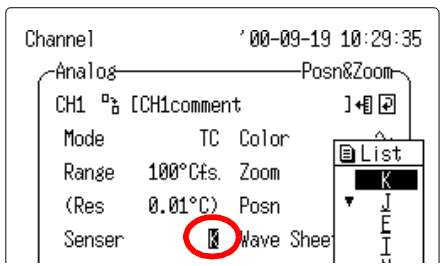
Measurement Objects	Range	Measurable Range	Maximum Resolution
Temperature (Thermocouple)	100°Cf.s.	-100°C to 100°C	0.01°C
	500°Cf.s.	-200°C to 500°C	0.1°C
	2000°Cf.s.	-200°C to 2000°C	0.5°C

Upper and lower temperature measurement limits depend on the measurement range of the sensor used.

(5) Set the thermocouple type.



Move the blinking cursor to the position shown.



Set the Sensor (thermocouple type.)

Selection

K, J, E, T, N, R, S, B, or W

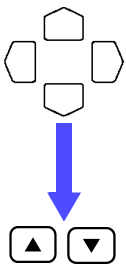
5

Temperature Measurement Range of Thermocouples

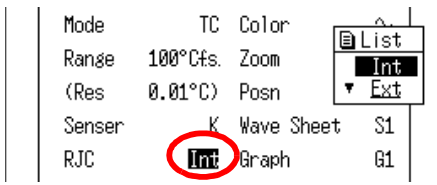
K	-200°C to 1350°C*1	J	-200°C to 1200°C*1
E	-200°C to 1000°C*1	N	-200°C to 1300°C*1
T	-200°C to 400°C*1	R	400°C to 1700°C*1
S	400°C to 1700°C*1	B	400°C to 1800°C*1
W (WRe5-26)	400°C to 2000°C*2		

*1: JIS C 1602-1995
*2: ASTM E-988-96
R, S, B, W display 0 to 400°C, but accuracy is not guaranteed.

(6) Set the appropriate compensation.



Move the blinking cursor to the position shown.

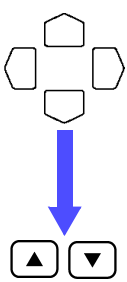


Set the RJC (appropriate compensation for the thermocouple.)

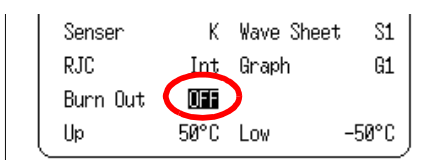
Selection

Int	Reference junction compensations are performed within the instrument. Measurement accuracy is the sum of the temperature measurement accuracy and the reference junction compensation accuracy.
Ext	Reference junction compensations are not performed within the instrument. Use this setting when reference junction compensations are performed by an external device. Measurement accuracy is equivalent to the measurement temperature accuracy.

(7) Set the burn out detection.



Move the blinking cursor to the position shown.

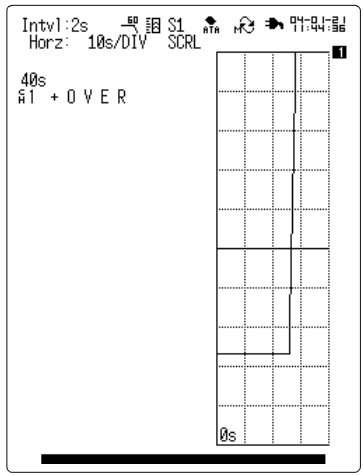


Set the Burn Out detection ON or OFF.

Selection

OFF	Burn out detection is disabled.
ON	Burn out detection is enabled. If a wire is broken, the waveform stays at the top edge of the Waveform Screen, and +OVER appears on the numerical display. Disconnection or broken wire is detected by applying infinitesimal current of about 200 nA to the thermocouple. If the thermocouple is long or manufactured using a large-resistance thermocouple wire material, a measurement error may occur. In such case, turn broken-wire detection off during measurement.

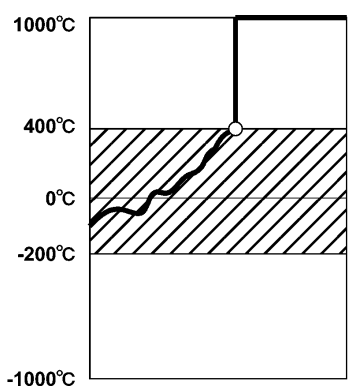
Available Selections



When the measurement exceeds the limits of the thermocouple.

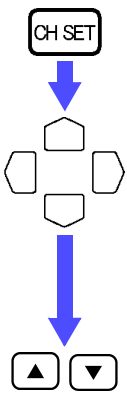
Thermocouple type: T
Temperature input range: -200 to 400°C
Measurement range: 2000°Cf.s.

When the measured temperature exceeds the limits of the thermocouple, the waveform saturates and stays at the top edge of the screen.
When numerical display is selected, over-range values are indicated by +OVER, and cursor measurement, calculation and data saving functions treat such values as full scale in the A/D converter (16 bits).



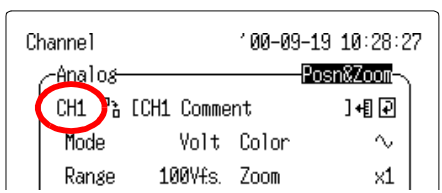
5.1.3 Measuring Temperature via Resistance Temperature Detector (8420-51, 8421-51 only)

(1) Display the Channel Screen to be set up.



Display the Analog Channel Screen.

Move the blinking cursor to the position shown.



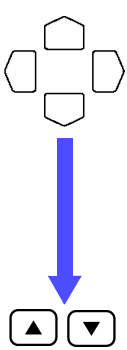
Select the channel to be set.

❖ Channel Selection: See "Channel Selection" (page 53.)

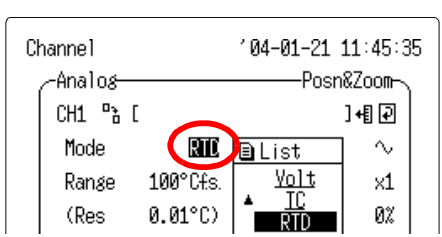
(2) Enter the Analog Channel comments.

❖ See Section 5.1.1 "Measuring Voltage" (page 54.)

(3) Set the Mode (input type) to "RTD (resistance temperature detector)."



Move the blinking cursor to the position shown.

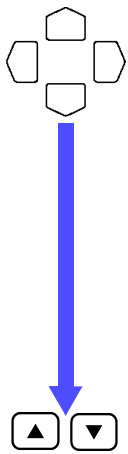


Select "**RTD** (resistance temperature detector)."

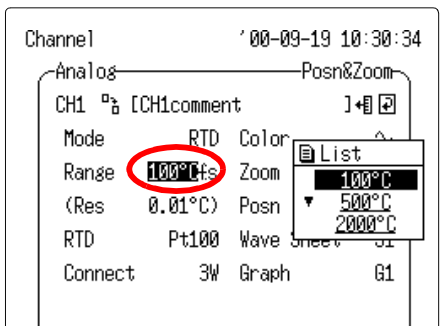
(4) Set the range.

No range selection is available when upper and lower limits have been enabled.

❖See Section 5.1.5 "Setting the Display Area" (page 67.)



Move the blinking cursor to the position shown.



Set the Range.

Selection

100°C, 500°C, or 2000°C

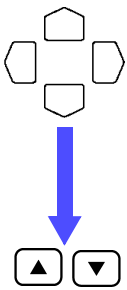
The measurable range varies depending on selected range. With a high-sensitivity range, data will be measured in high resolution. The display resolution varies depending on the set range.

Measurement Objects	Range	Measurable Range	Maximum Resolution
Temperature (Resistance Temp. Detector)	100°Cf.s.	-100°C to 100°C	0.01°C
	500°Cf.s.	-200°C to 500°C	0.1°C
	2000°Cf.s.	-200°C to 2000°C	0.5°C

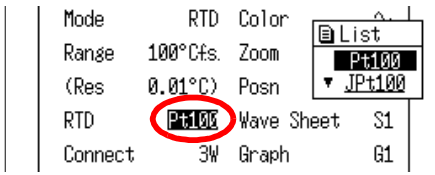
Upper and lower temperature measurement limits depend on the measurement range of the sensor used.

5

(5) Set the resistance type.



Move the blinking cursor to the position shown.



Set the RTD (resistance type.)

Selection

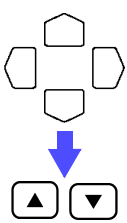
Pt100 or JPt100

Temperature Measurement Range of Resistance Temperature Detectors

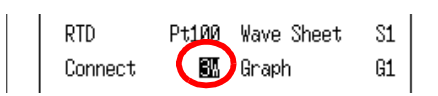
Pt100	-200°C to 800°C*1	JPt100	-200°C to 500°C*2

*1: JIS C 1604-1997
*2: JIS C 1604-1989

(6) Set the connection type.



Move the blinking cursor to the position shown.



Set the Connect (connection type.)

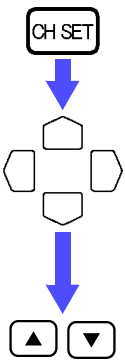
Selection

3W	For a resistance temperature detector with 3-wire connection
4W	For a resistance temperature detector with 4-wire connection

When the measured temperature exceeds the limits of the resistance temperature detector, the waveform saturates and stays at the top edge of the screen.
When numerical display is selected, over-range values are indicated by +OVER, and cursor measurement, calculation and data saving functions treat such values as full scale in the A/D converter (16 bits).

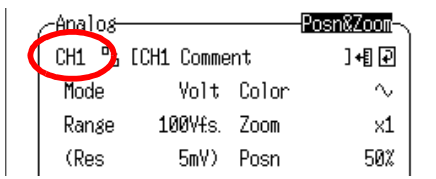
5.1.4 Measuring Humidity (8420-51, 8421-51 only)

(1) Display the Channel Screen to be set up.



Display the Analog Channel Screen.

Move the blinking cursor to the position shown.



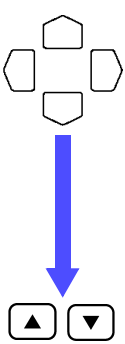
Select the channel to be set.

❖ Channel Selection: See "Channel Selection" (page 53.)

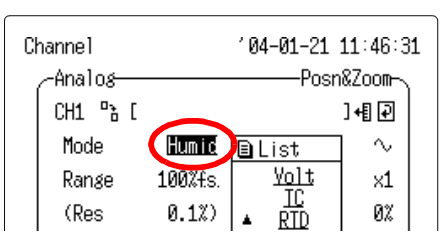
(2) Enter the Analog Channel comments.

❖ See Section 5.1.1 "Measuring Voltage" (page 54.)

(3) Set the Mode (input type) to "Humid."



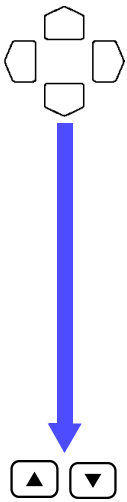
Move the blinking cursor to the position shown.



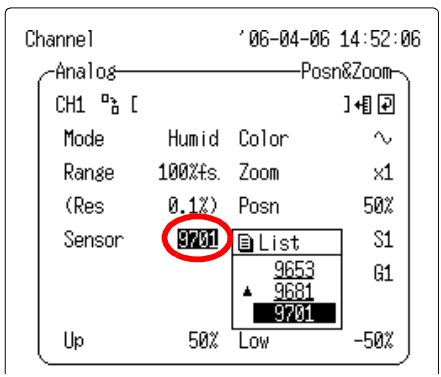
Select "**Humid**."

NOTE The range is fixed to 100%f.s.

(4) Set the sensor type.



Move the blinking cursor to the position shown.



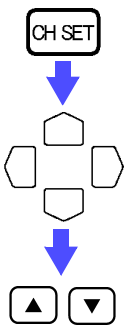
Set the Sensor (sensor type.)

Selection

9653	Connects the 9653 HUMIDITY SENSOR.
9681	Connects the 9681 HUMIDITY SENSOR.
9701	Connects the 9701 HUMIDITY SENSOR.

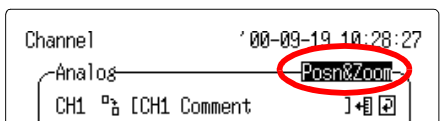
5.1.5 Setting the Display Area

The waveform display area can be specified by enabling Specify Upper and Lower Limits for an analog channel or a pulse channel.



Display the Analog Channel Screen.

Move the blinking cursor to the position shown.



Set the display area.

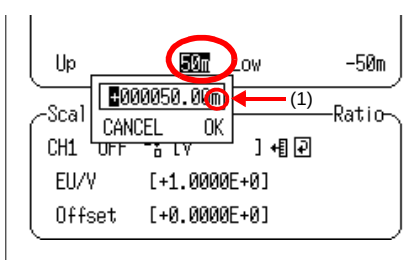
Selection

Posn&Zoom	The upper and lower limits are determined according to the specified range.
Upper-Lower	Regardless of any previously set range, the range is set automatically according to the specified upper and lower limits.

When Upper-Lower is selected

The appropriate range is automatically set according to the specified limits, so the range setting does not need to be specified. Also, magnification and display position settings are ignored.

Move the blinking cursor to the position shown.

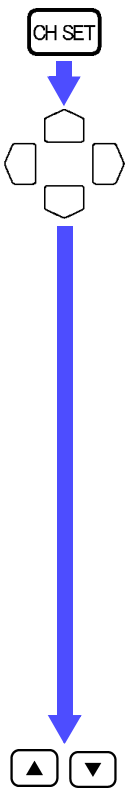


The rightmost character location (1) is for a unit symbol indicator: E, P, T, G, M, k, ☐ (blank), m, u, n, p, f or a. If no unit symbol is needed, move the cursor to location (1) and press the the ▲/▼ buttons to select the blank (no symbol).

Display the Numerical Entry Window.

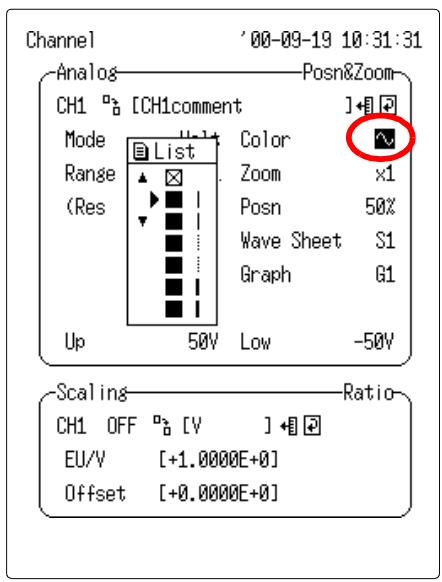
1. Move the blinking cursor to the digit you want to change using the Cursor buttons.
2. Increase or decrease the number using the ▲/▼ buttons.
3. Move the cursor to "OK" using the Cursor buttons and press the ▲/▼ buttons.

5.1.6 Setting the Waveform Screen Color



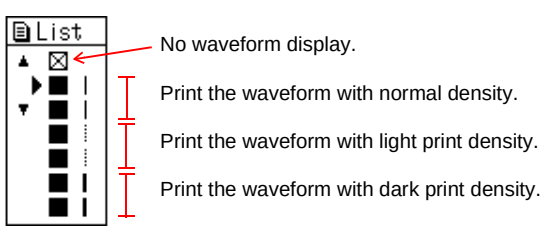
Display the Analog Channel Screen.

Move the blinking cursor to the position shown.



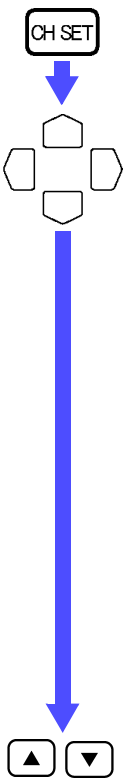
Set the Color (waveform display color.)

The 8992 PRINTER UNIT supports three print densities corresponding to the six waveform display colors.



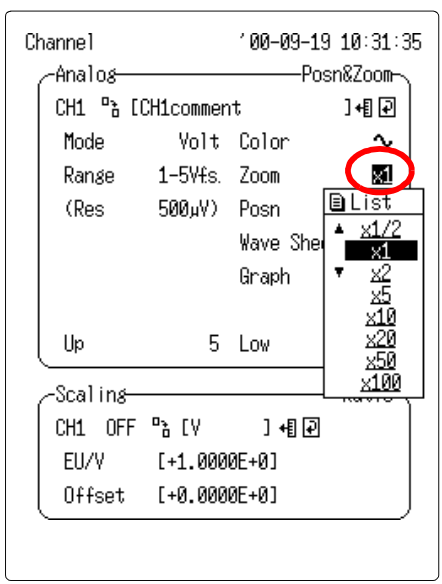
5.1.7 Setting the Magnification

Each channel waveform can be magnified in the voltage axis direction for display and recording. Magnification is normalized to the center of the screen.
This setting has no affect on the Waveform Screen when the display area has been restricted by setting upper and lower limits.



Display the Analog Channel Screen.

Move the blinking cursor to the position shown.



Set the Zoom (magnification.)

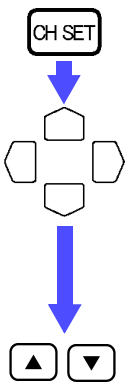
Selection

X1/2, X1, X2, X5, X10, X20, X50, or X100

5.1.8 Setting the Display Position

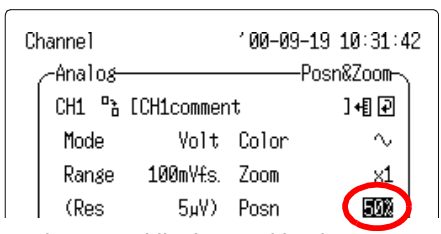
The waveform display position (zero position) is set as follows. This setting has no affect on the Waveform Screen when the display area has been restricted by specified upper and lower limits.

Method 1: Configure on Status Screen.



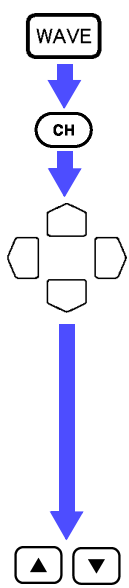
Display the Analog Channel Screen.

Move the blinking cursor to the position shown.



Set the Posn (display position.)

Method 2: Configure on Waveform Screen.

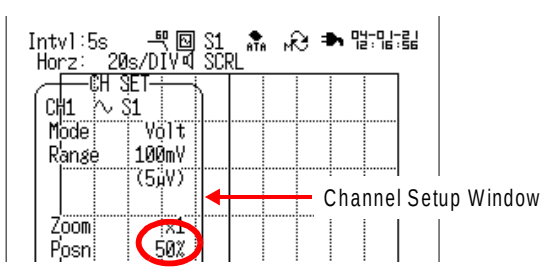


Display the Waveform Screen.

Display the Channel Setup Window.

Move the blinking cursor to the position shown.

By pressing this button, the setting can also be performed without regard to the blinking cursor.

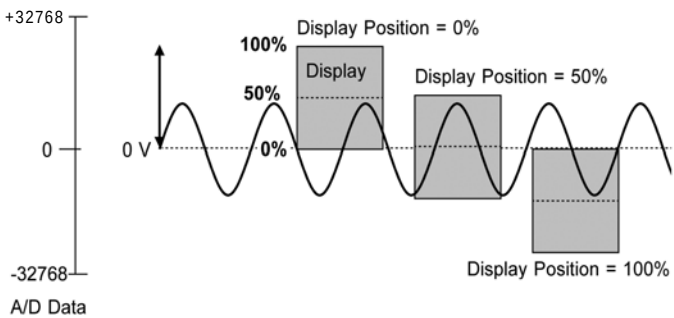


Set the Posn (display position.)

The settable display position depends on the selected magnification.

X1/2	X1	X2	X5	X10	X20	X50	X100
0 to 100	-50 to 150	-150 to 250	-450 to 550	-950 to 1050	-1950 to 2050	-4950 to 5050	-9950 to 10050

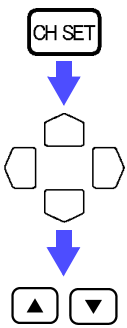
By changing the display position, hidden parts of the waveform can be displayed.
The following example presumes x 1 magnification.



NOTE Although the display area of the Waveform Screen is affected by the display position and magnification settings, the actual measurement range of the instrument is unaffected.

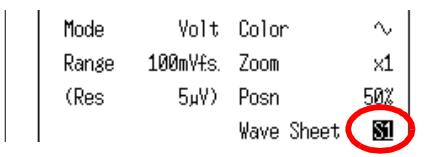
5.1.9 Setting the Waveform Sheet

Multiple waveform recordings can be easily viewed by dividing, recording and displaying waveforms into Waveform Sheets S1 to S4.



Display the Analog Channel Screen.

Move the blinking cursor to the position shown.

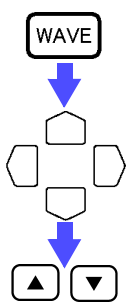


Set the waveform sheet.

Selection

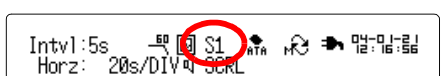
S1, S2, S3, or S4

Waveform Sheet Selection



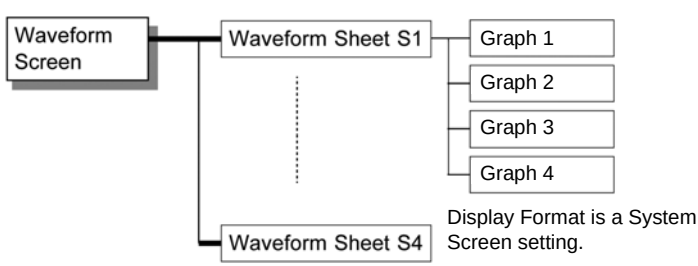
Display the Waveform Screen.

Move the blinking cursor to the position shown.



Set the waveform sheet for display.
Select "**ALL**" to simultaneously display all of S1 through S4.

Relationship between waveform sheets and graphs

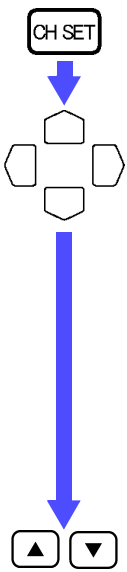


Display Format is a System Screen setting.

5.1.10 Setting the Display Layout

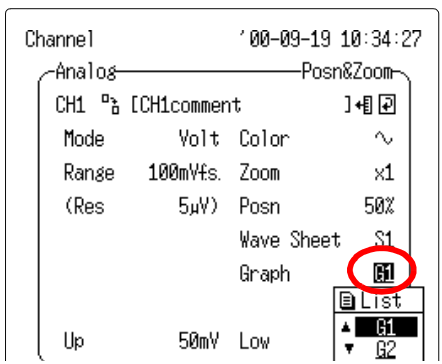
When Dual or Quad screens are selected for the Display Format on the System Screen, the position of the graph to be displayed can be set.

❖ See Section 13.1.3 "Setting the Display Format" (page 206.)



Display the Analog Channel Screen.

Move the blinking cursor to the position shown.

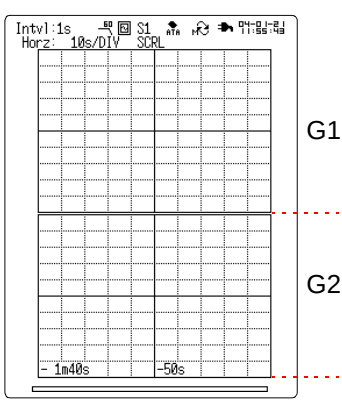


Set the Graph (desired graph position.)

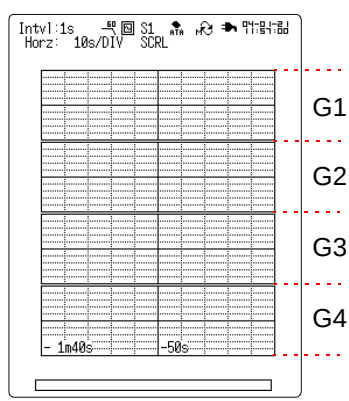
Selection

G1, G2, G3, or G4 (G3 and G4: when Quad is selected)

Dual



Quad

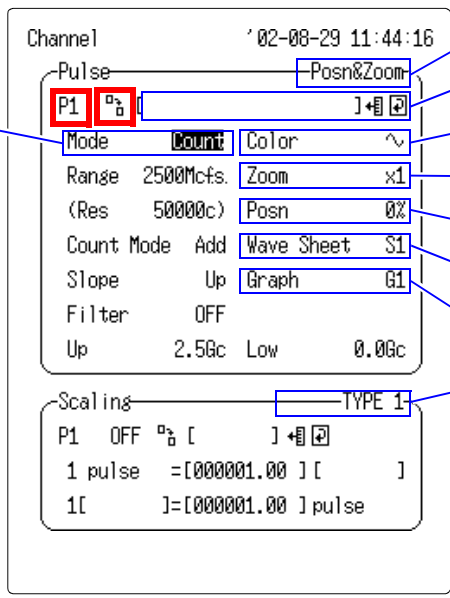


5.2 Input Settings on the Pulse Channel

Settings for totalization and rotation rate measurement on pulse input channels are described below.
Settings can be made only on those pulse channels (P1 to P4) which have a checkmark (☑) in the Measurement CH settings on the Status Screen.

Measuring Pulse Accumulation (Totalization)
❖See Section 5.2.1.

Measuring Rotation Rate
❖See Section 5.2.2.



❖See Section 5.1.5.
❖See Chapter 14.
❖See Section 5.1.6.
❖See Section 5.1.7.
❖See Section 5.1.8.
❖See Section 5.1.9.
❖See Section 5.1.10.
❖See Section 5.4.

Channel Selection

Move the blinking cursor to channel No. (P1) and move up or down the channel Nos. one by one by pressing the ▲/▼ buttons. You can also move up the channel Nos. one by one using the CH SET or CH▲ buttons. You can move down the channel Nos. one by one using the CH▼ button.

Channel Copying

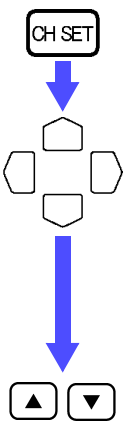
Move the blinking cursor to the channel copy icon ( ) to copy and paste the settings of a channel (input type, range, magnification, display position, and upper and lower limits) using the ▲/▼ buttons. The channel to be copied is shown at the bottom of the screen.

5.2.1 Measuring Pulse Accumulation (Totalization)

Pulses output from an accumulating wattmeter or flowmeter are totalized and measured. The totalized pulse scaling function can be used to convert totalized pulse measurements to physical units (Wh, VA, etc.).

❖ See Section 5.4.2 "Pulse Channel (Totalization) Scaling" (page 90.)

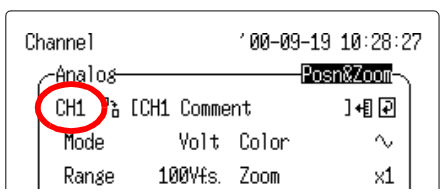
(1) Display the Channel Screen to be set up.



Display the Pulse Channel Screen.

Move the blinking cursor to the position shown.

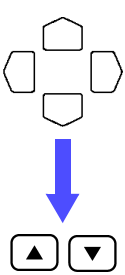
By pressing the CH button when you are in the Analog Channel or the Pulse Channel, you can go to the other channel setting screen.



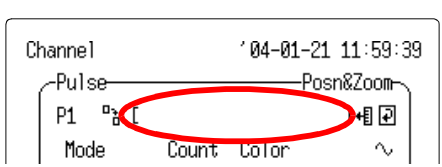
Select the channel (P1 to P4) to be set.

(2) Enter the Pulse Channel comments.

- The comment is displayed when the Waveform Screen is set to display Numerical Value + Comments.
  ❖ See Section 6.2 "Switching the Waveform Screen Layout" (page 101.)
- The comments are included when printing.
  ❖ See Section 11.5 "Comment Printing" (page 193.)



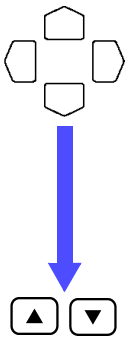
Move the blinking cursor to the position shown.



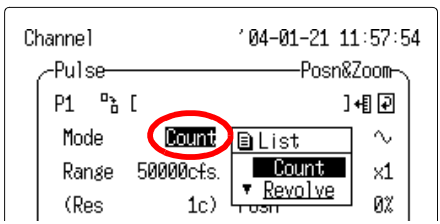
Display the Comment Entry Window.
Enter the desired pulse comment.

❖ See Chapter 14 "Text Entry Procedure" (page 225.)

(3) Set the Mode (input type) to "Count."



Move the blinking cursor to the position shown.

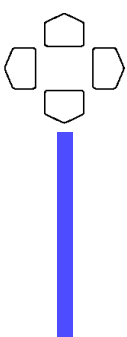


Select "**Count**."

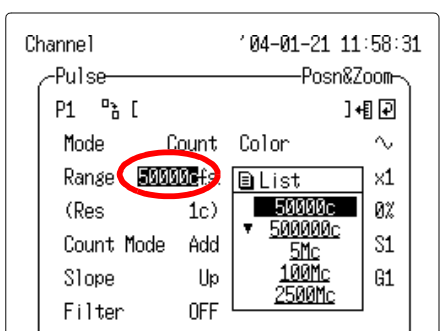
(4) Set the range.

No range selection is available when upper and lower limits have been enabled.

❖ See Section 5.1.5 "Setting the Display Area" (page 67.)



Move the blinking cursor to the position shown.



Set the Range.

Selection

50000c, 500000c, 5Mc, 100Mc, or 2500Mc

The measurable range varies depending on selected range. With a high-sensitivity range, data will be measured in high resolution. The display resolution varies depending on the set range.

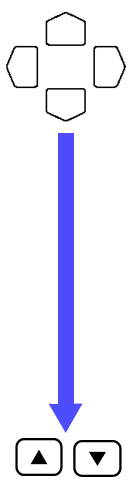
Measurement Objects	Range	Measurable Range	Maximum Resolution
Pulse Totalization	50,000 pulses f.s.	0 to 50,000 pulses	1 pulse
	500,000 pulses f.s.	0 to 500,000 pulses	10 pulses
	5 Mpulses f.s.	0 to 5 Mpulses	100 pulses
	100 Mpulses f.s.	0 to 100 Mpulses	2,000 pulses
	2,500 Mpulses f.s.	0 to 2,500 Mpulses	50,000 pulses

NOTE

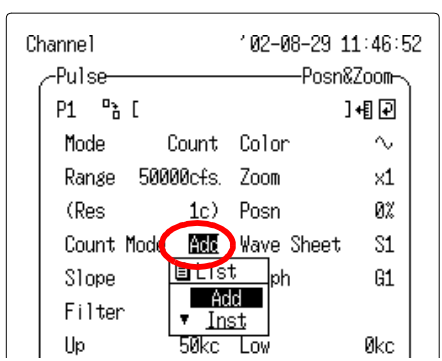
Data below the maximum resolution is ignored, so be careful when setting the measurement range.
Pulse counts of less than the maximum resolution will be dropped.

5

(5) Set the count mode.



Move the blinking cursor to the position shown.

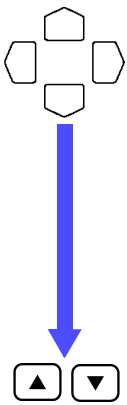


Set the Count Mode.

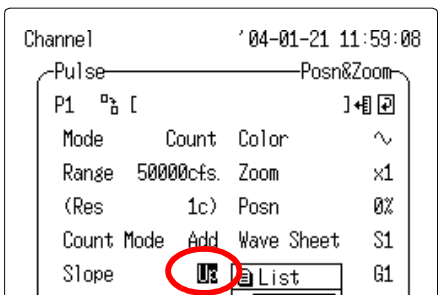
Selection

Add	Adds up the total values measured from the start of measurement.
Inst	Measures instantaneous values at each recording interval. An integrated value is reset for each recording interval.

(6) Set the slope type.



Move the blinking cursor to the position shown.

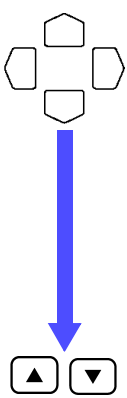


Set the Slope type.

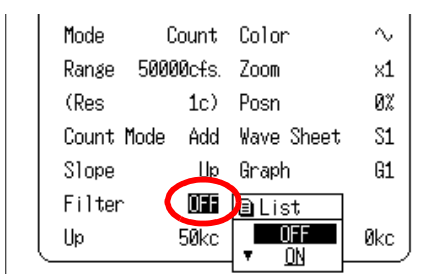
Selection

Up	The totalized pulse count is the sum of L → H transitions.
Down	The totalized pulse count is the sum of H → L transitions.

(7) Set the filter On or Off.



Move the blinking cursor to the position shown.



Set the Filter ON or OFF.

Selection

OFF	Without chatter filter
ON	With chatter filter Use when connecting to a device with mechanical contact output.

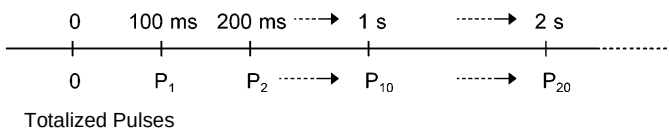
5.2.2 Measuring Rotation Rate

Rotation is measured by counting pulses output from a device such as a rotary encoder or rotor. Input pulses are totalized over a one-second period to determine the rotation rate.

The rotation rate scaling function can be used to convert totalized rotation pulse counts to physical units.
❖ See Section 5.4.3 "Pulse Channel (Rotation) Scaling" (page 94.)

Rotation Rate Measurement Theory

When rotation rate measurement is selected, pulses are internally totalized every 100 ms.



The rotation rate at time t[s] is calculated by dividing the number of pulses from (t-1) to t[s] by the number of pulses per rotation:

$$r\ [rps] = \frac{\text{t[s] totalized pulses - (t-1) [s] totalized pulses}}{\text{Pulses per rotation}}$$

Example: Pulses per rotation = 4
After 1s, totalized pulses P10 = 1000 counts
After 2s, totalized pulses P20 = 2000 counts
In this case, the rotation rate $r_{t=2}$ for t = 2s is calculated as follows:

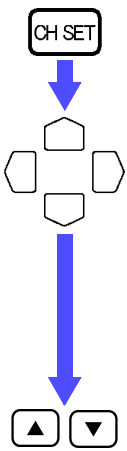
$$r_{t=2} = \frac{2000 - 1000}{4} = 250\ [rps]$$

If time t[s] < 1 second

The totalized pulse value of t-1[s] is not measurable, so the value that is ten times the totalized pulses between t-0.1[s] and t[s] is calculated as the totalized pulse value between 1s, so the rotation rate can be calculated. For this reason, the rotation rate when t is less than one second may vary.

$$r\ [rps] = \frac{\text{(t[s] totalized pulses - (t-0.1) [s] totalized pulses)}}{\text{Pulses per rotation}} \times 10$$

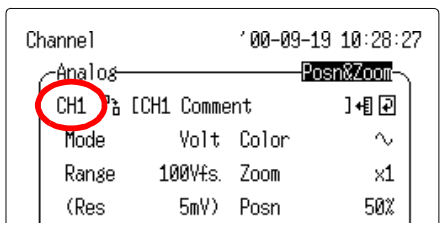
(1) Display the Channel Screen to be set up.



Display the Pulse Channel Screen.

Move the blinking cursor to the position shown.

By pressing the (CH) button when you are in the Analog Channel or the Pulse Channel, you can go to the other channel setting screen.

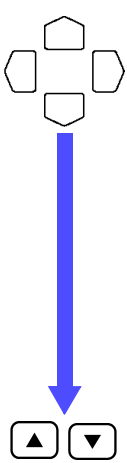


Select the channel (P1 to P4) to be set.

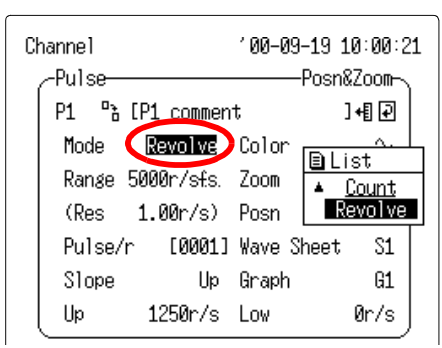
(2) Enter the Pulse Channel comments.

❖ See Section 5.2.1 "Measuring Pulse Accumulation (Totalization)" (page 75.)

(3) Set the Mode (input type) to "Revolve."



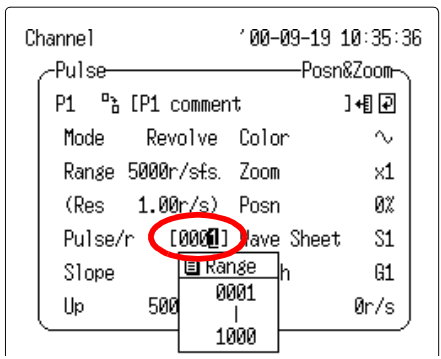
Move the blinking cursor to the position shown.



Select "**Revolve**."

(4) Set the pulse counts.

Move the blinking cursor to the position shown.

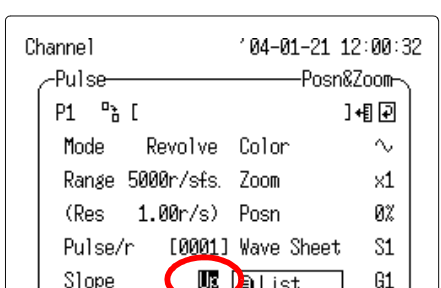


Set the Pulse/r (pulse counts per encoder period.)

The range is automatically selected depending on the pulse count setting. The measurable range is from 0 to 5000/n [r/s] and the maximum resolution is 1/n [r/s]. ("n" represents the number of pulses per rotation and ranges between 1 and 1000.)

(5) Set the slope type

Move the blinking cursor to the position shown.

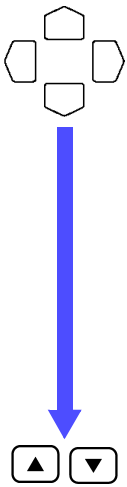


Set the Slope (slope type.)

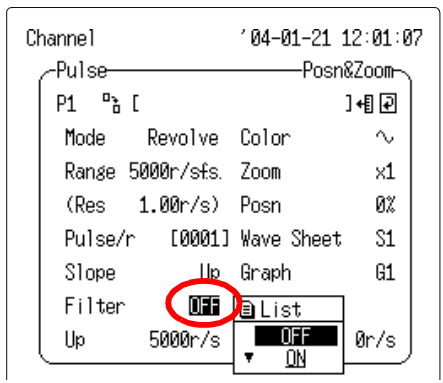
Selection

Up	The totalized pulse count is the sum of L → H transitions.
Down	The totalized pulse count is the sum of H → L transitions.

(6) Set the Filter On or Off.



Move the blinking cursor to the position shown.



Set the Filter ON or OFF.

Selection

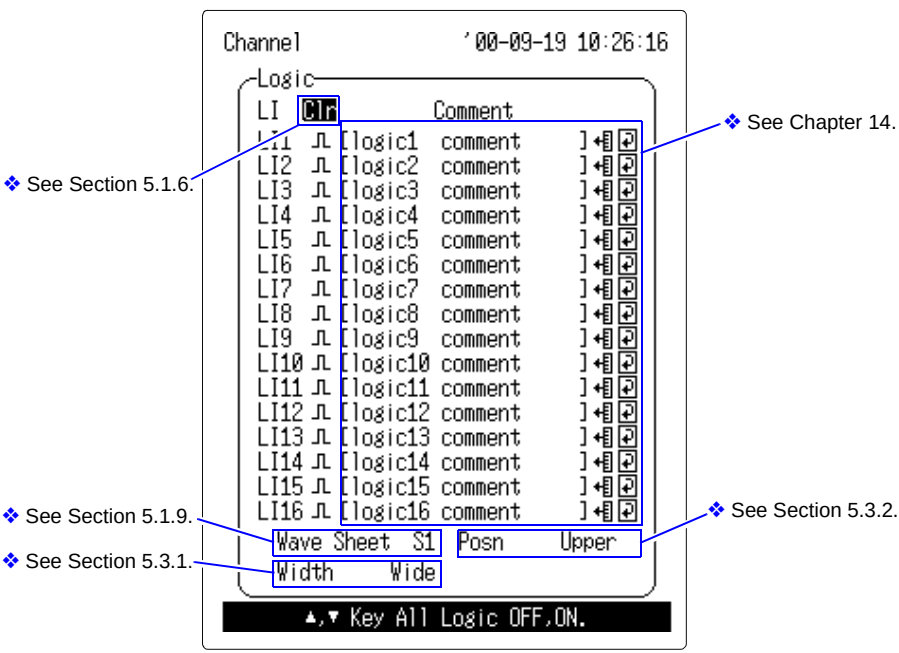
OFF	Without chatter filter
ON	With chatter filter Use when connecting to a device with mechanical contact output.

5.3 Input Settings on the Logic Channel

Logic channel settings require the 8993 DIGITAL I/O UNIT to be installed.

However, settings cannot be made unless the LI item is checked (☑) for the Measurement CH on the Status Screen.

Fix the setting of 16 logic channels (LI).



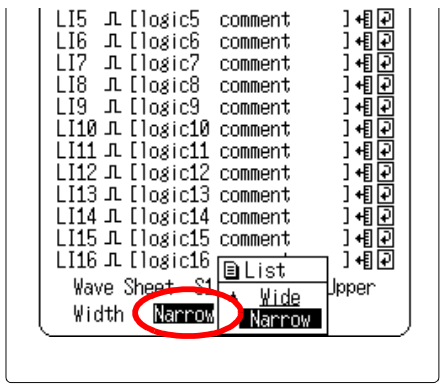
5.3.1 Setting the Logic Recording Width

The vertical space for logic waveform display can be set as follows.

CH SET

Display the Logic Channel Screen.

Move the blinking cursor to the position shown.



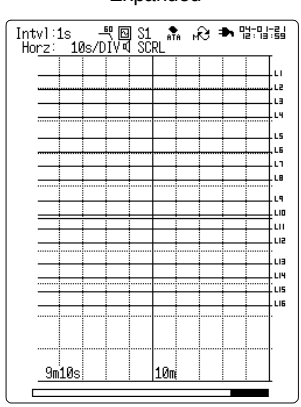
▲ ▼

Set the Width (logic recording width.)

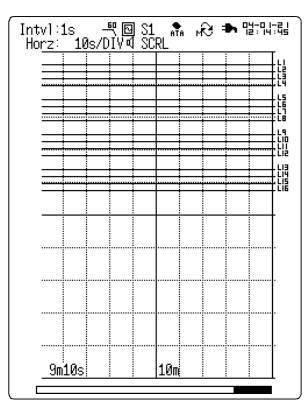
Selection

Wide	Expanded logic recording width setting.
Narrow	Condensed logic recording width setting.

Expanded

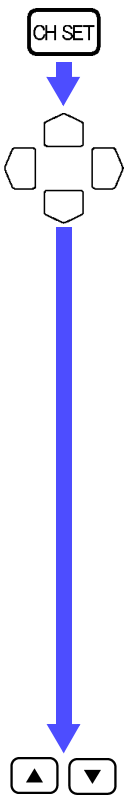


Condensed



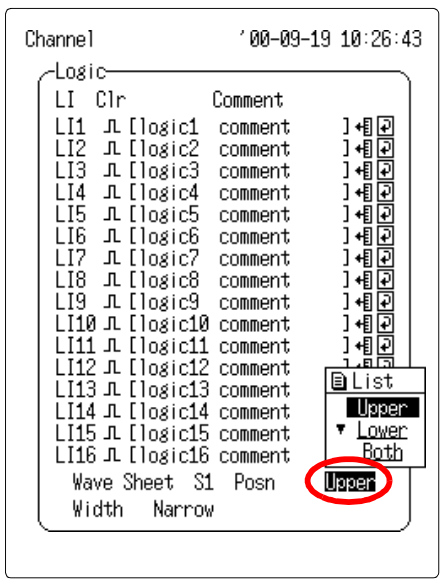
5.3.2 Setting the Logic Display Position

The logic display position can be set when the Logic Recording Width is set to Narrow, or when Display Format is Single.



Display the Logic Channel Screen.

Move the blinking cursor to the position shown.



Set the Posn (logic display position.)

Selection

Upper	The logic channel is at the upper half of the display.
Lower	The logic channel is at the lower half of the display.
Both	Logic channels are displayed with LI1-8 at the top, and LI9-16 at the bottom.

5

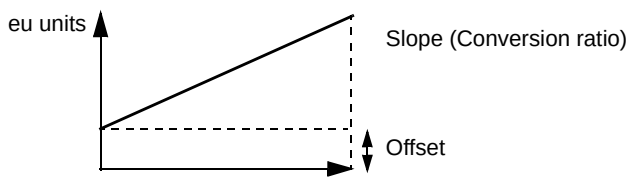
5.4 Setting Scaling

5.4.1 Analog Channel Scaling

- The scaling function converts the voltage from a sensor to physical units that correspond to the measured quantity.
- The gauge, vertical axis limits and A-B cursor values can be displayed as scaled values and units.

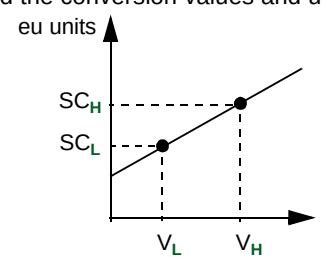
Setting by Conversion Ratio

Scaling can be set by entering the physical quantity per volt (conversion ratio = eu/V) of input signal, and the offset and name of units (eu = engineering units).



Setting by Two-Point Method

Scaling can also be set by entering the input voltage at two points, and the conversion values and units (eu) of the two points.



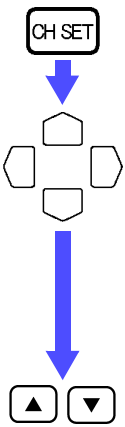
V_H : High voltage point
V_L : Low voltage point
SC_H : Conversion value for the high voltage point
SC_L : Conversion value for the low voltage point

Combined Scaling and Display Position (upper and lower limit) Settings

When setting both scaling and upper and lower display position limits, set the scaling before setting the limits. The available ranges for setting the upper and lower limits after scaling has been set are as follows.

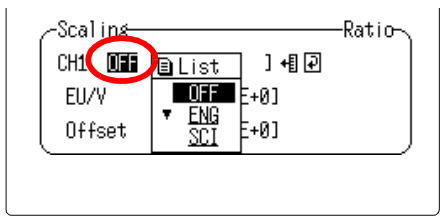
-9.9999E+19 ≦ Setting value ≦ -1.0000E-19
Setting value = 0
+1.0000E-19 ≦ Setting value ≦ +9.9999E+19

(1) Set the display format of scaling.



Display the Analog Channel Screen to be set.

Move the blinking cursor to the position shown.

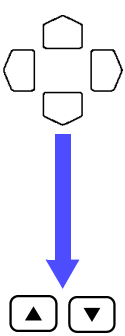


Set the display format of scalling.

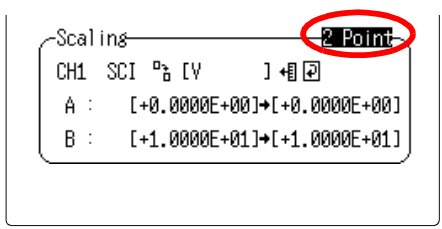
Selection

OFF	Scaling is disabled.
ENG	Scaling is enabled (decimal portion)
SCI	Scaling is enabled (exponential portion)

(2) Set the scaling method.



Move the blinking cursor to the position shown.

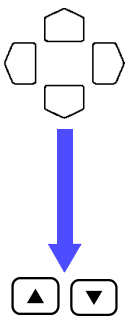


Set the scaling method.

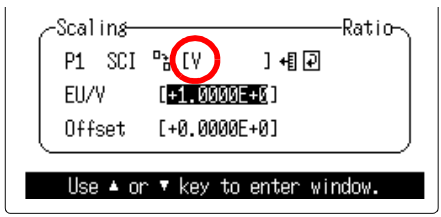
Selection

Ratio	Set by conversion ratio.
2 Point	Set by two-point entry.

(3) Set the scaling units.



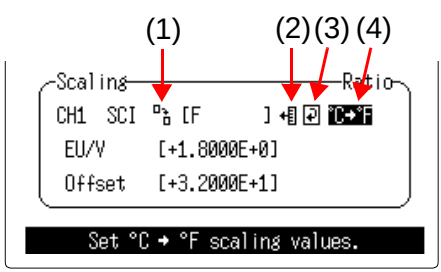
Move the blinking cursor to the position shown.



Display the Comment Entry Window and enter the scalling units.
❖ See Chapter 14 "Text Entry Procedure" (page 225.)

The following three methods are also available for setting scaling units.

- Copy from another channel.
  Move the blinking cursor to position (1) below and paste the unit and the settings of a channel using the ▲/▼ buttons. The channel to be copied is shown at the bottom of the screen.
- Choose from common units.
  Move the blinking cursor to position (2) and select from the common units shown using the ▲/▼ buttons.
- Recall the units from the input history.
  Move the blinking cursor to position (3) and select the units from the input history using the ▲/▼ buttons.

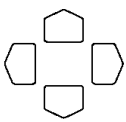


NOTE

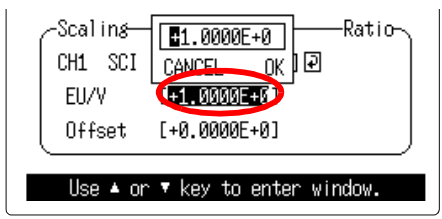
When the input type is set to "**Thermocouple**" or "**Resistance temperature detector**", you can convert data from Celsius to Fahrenheit. The conversion rate and the offset will be set automatically. Move the cursor to position (4) and confirm the setting using the ▼ button.

(4) Enter the scaling value.

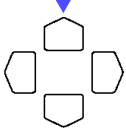
To set scaling by entering a conversion ratio, enter the conversion ratio and offset.
To set scaling by the two-point method, enter the values of the two points (A, B) before and after conversion.



Move the blinking cursor to the position shown.

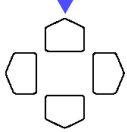


Display the Numerical Entry Window.



Move the cursor to the number to be entered.

Enter the scalling value.



When finished setting, move the blinking cursor to the "**OK**" position, and press the ▲/▼ buttons or press the START/MARK button to accept the entry.

To cancel an entry, move the blinking cursor to the "**CANCEL**" position or press the ▲/▼ buttons or the STOP button.

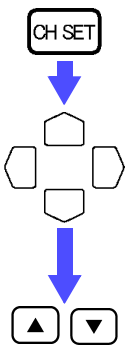
You can copy the settings of another channel.
Move the blinking cursor to the channel copy icon ( ) and paste the unit and the settings of a channel using the ▲/▼ buttons.
The channel to be copied is shown at the bottom of the screen.

5

5.4.2 Pulse Channel (Totalization) Scaling

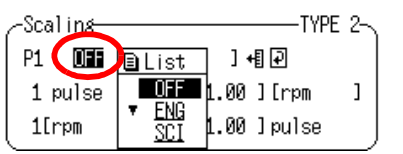
The scaling function converts totalized pulses into physical units (Wh, VA, etc.) that correspond to the measured quantity.
Pulse output devices typically have a specific physical quantity per pulse or number of pulses per fundamental unit (e.g., kWh, liters or m^3). Either of the following setting methods may be used for scaling.

(1) Set the display format of scaling.



Display the Pulse Channel Screen (Mode: Count) to be set.

Move the blinking cursor to the position shown.

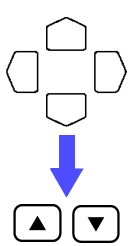


Set the display format of scaling.

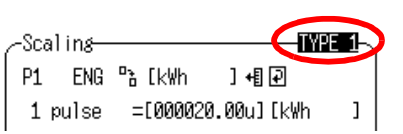
Selection

OFF	Scaling is disabled.
ENG	Scaling is enabled (decimal portion) Display supplemental units.
SCI	Scaling is enabled (exponential portion)

(2) Set the scaling method.



Move the blinking cursor to the position shown.

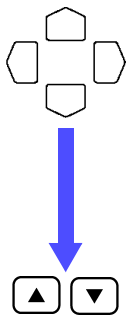


Set the scaling method.

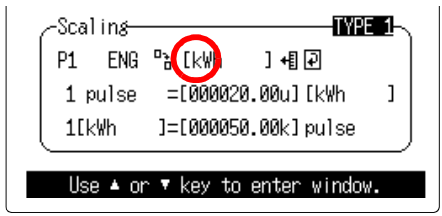
Selection

TYPE 1	Set scaling by the physical quantity per pulse.
TYPE 2	Set scaling by the number of pulses per fundamental unit.

(3) Set the scaling units.



Move the blinking cursor to the position shown.



Display the Comment Entry Window and enter the scalling units.
❖See Chapter 14 "Text Entry Procedure" (page 225.)

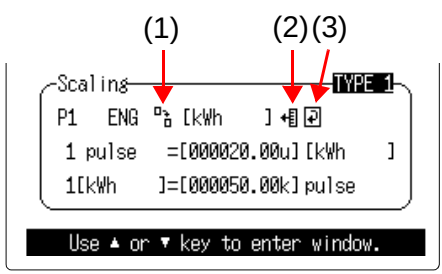
5

The following three methods are also available for setting scaling units.

- Copy from another channel.
  Move the blinking cursor to position (1) below and paste the unit and the settings of a channel using the ▲/▼ buttons. The channel to be copied is shown at the bottom of the screen.

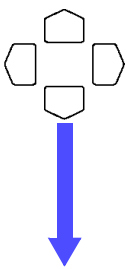
- Choose from common units.
  Move the blinking cursor to position (2) and select from the common units shown using the ▲/▼ buttons.

- Recall the units from the input history.
  Move the blinking cursor to position (3) and select the units from the input history using the ▲/▼ buttons.

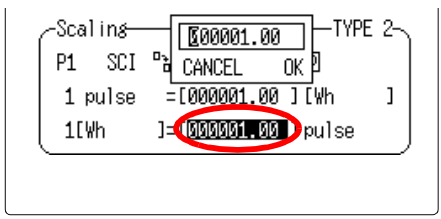


(4) Enter the scaling value.

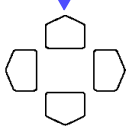
- For setting method 1 (TYPE 1), enter the scaling quantity per pulse. For setting method 2 (TYPE 2), enter the pulse conversion ratio.
- The parameters set by Procedure 1 and Procedure 2 are interlocked and represent the same scaling ratio.



Move the blinking cursor to the position shown.

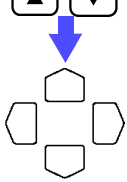


Display the Numerical Entry Window.



Move the cursor to the number to be entered.

Enter the scalling value.



When finished setting, move the blinking cursor to the "**OK**" position, and press the ▲/▼ buttons or press the START/MARK button to accept the entry.

To cancel an entry, move the blinking cursor to the "**CANCEL**" position or press the ▲/▼ buttons or the STOP button.

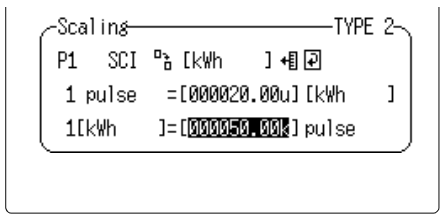
You can copy the settings of another channel.
Move the blinking cursor to the channel copy icon ( ) and paste the unit and the settings of a channel using the ▲/▼ buttons.
The channel to be copied is shown at the bottom of the screen.

Example

Scalling Settings

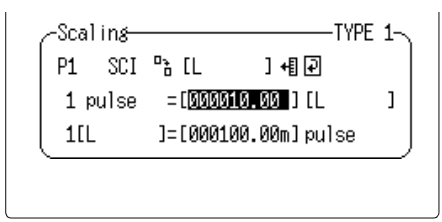
When connected to a power consumption measurement device providing 50,000 pulses/kWh (totalization):

Use setup method 2.
Set units to kWh, and set 1 kWh = 050000.00 pulses



When connected to a flow measurement device that indicates 10 liters/pulse (totalization):

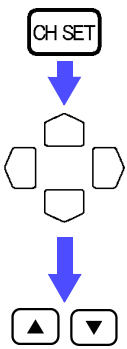
Use setup method 1.
Set units to L, and set 1 pulse = 000010.00



5.4.3 Pulse Channel (Rotation) Scaling

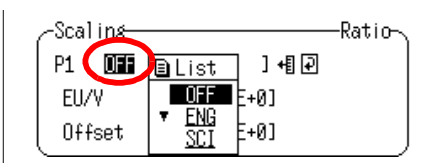
The scaling function can be used to convert input pulse counts from rotations per second to rotations per minute (rpm).

(1) Set the display format of scaling.



Display the Pulse Channel Screen (Mode: Revolve) to be set.

Move the blinking cursor to the position shown.

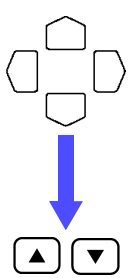


Set the display format of scaling.

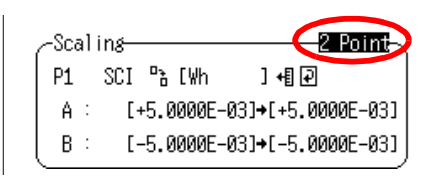
Selection

OFF	Scaling is disabled.
ENG	Scaling is enabled (decimal portion) Display supplemental units.
SCI	Scaling is enabled (exponential portion)

(2) Set the scaling method.



Move the blinking cursor to the position shown.

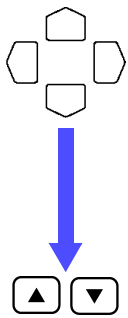


Set the scaling method.

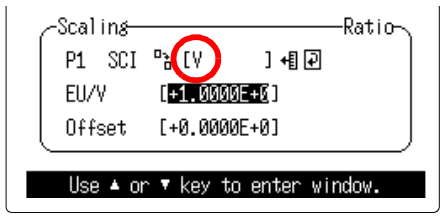
Selection

Ratio	Set by conversion ratio.
2 Point	Set by two-point entry.

(3) Set the scaling units.



Move the blinking cursor to the position shown.



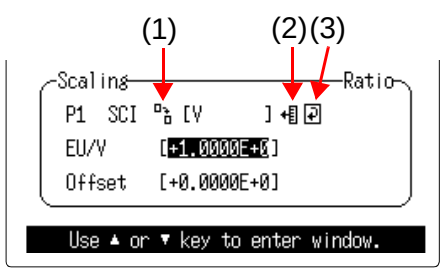
Display the Comment Entry Window and enter the scalling units.
❖ See Chapter 14 "Text Entry Procedure" (page 225.)

The following three methods are also available for setting scaling units.

- Copy from another channel.
  Move the blinking cursor to position (1) below and paste the unit and the settings of a channel using the ▲/▼ buttons. The channel to be copied is shown at the bottom of the screen.

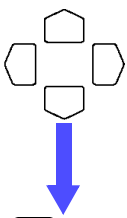
- Choose from common units.
  Move the blinking cursor to position (2) and select from the common units shown using the ▲/▼ buttons.

- Recall the units from the input history.
  Move the blinking cursor to position (3) and select the units from the input history using the ▲/▼ buttons.

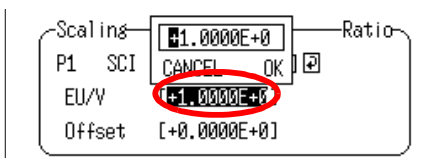


(4) Enter the scaling value.

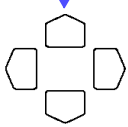
To set scaling by entering a conversion ratio, enter the conversion ratio and offset.
To set scaling by the two-point method, enter the values of the two points (A, B) before and after conversion.



Move the blinking cursor to the position shown.

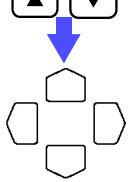


Display the Numerical Entry Window.



Move the cursor to the number to be entered.

Enter the scalling value.



When finished setting, move the blinking cursor to the "**OK**" position, and press the ▲/▼ buttons or press the START/MARK button to accept the entry.

To cancel an entry, move the blinking cursor to the "**CANCEL**" position or press the ▲/▼ buttons or the STOP button.

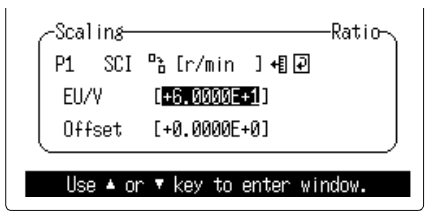
You can copy the settings of another channel.
Move the blinking cursor to the channel copy icon ( ) and paste the unit and the settings of a channel using the ▲/▼ buttons.
The channel to be copied is shown at the bottom of the screen.

Example

Scalling Settings

To measure rotations as rpm:

Set the conversion ratio (pulses/unit) to 60,
Set units to r/min.
(The conversion ratio could be set to 3600 to measure rotations per hour.)



Waveform Screen 6

This chapter describes the parameters to be set on the Waveform Screen and how to read the screen.

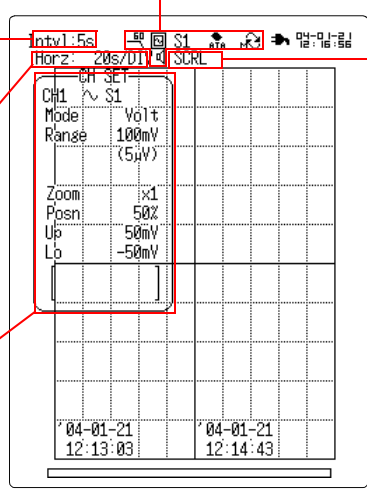
Display Marks

60	Digital Filter Setting	Sets the digital filter.	❖ See Section 4.7.
	Display Layout Selection	Select from six display layouts.	❖ See Section 6.2.
S1	Waveform Sheet	Select a waveform sheet for display.	❖ See Section 5.1.9.
	Selection of Method of Changing Numeric Display Channels	Set the method of changing numeric display channels.	❖ See Section 6.3.
	Speaker Indicator	Enable or disable the alarm for audible alarm output.	❖ See Section 12.2.

Period (Recording Interval)
Sets the interval for acquired data.
❖ See Section 4.2.

Horizontal Axis (Time Axis)
Sets the time per division in the time axis direction.
❖ See Section 4.3.

Channel Setup Window
Make input channel settings.
❖ See Section 6.1.



Scroll Mode
Waveform scrolling
❖ See Section 6.4.
A-B cursor measurement
❖ See Section 6.5.
Event markers
❖ See Section 6.6.

Measurements may be viewed without saving to memory.

Monitor Function	Measurements are displayed numerically without being saved to memory.	❖ See Section 6.7.

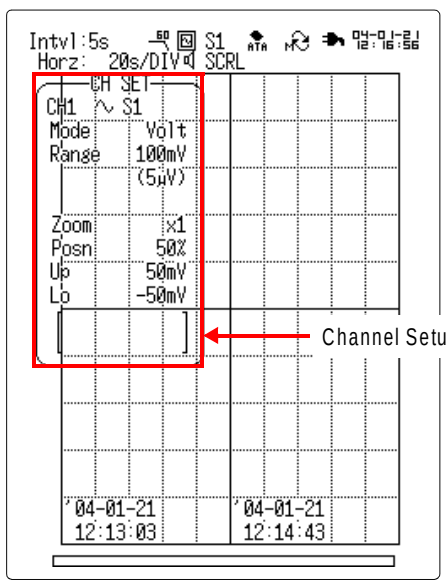
6.1 Input Settings on the Waveform Screen

The Channel Setup Window allows input channel settings while monitoring waveforms.

The Channel Setup Window is toggled on and off with the CH button. The input channel is selected with the CH▲ / CH▼ buttons.

❖ Settings in Detail:

See Section 5.1 "Input Settings on the Analog Channel" (page 52.)
See Section 5.2 "Input Settings on the Pulse Channel" (page 74.)

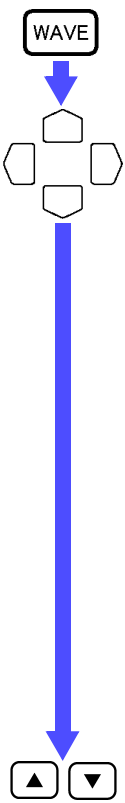


6.2 Switching the Waveform Screen Layout

Method 1

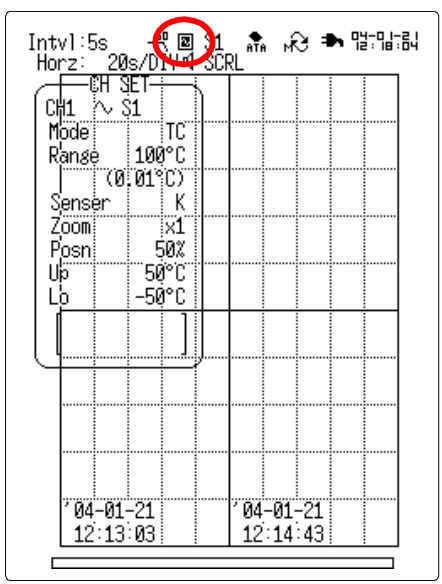
Display the Waveform Screen.
Every time the button is pressed, a different layout of the Waveform Screen appears.

Method 2



Display the Waveform Screen.

Move the blinking cursor to the position shown.

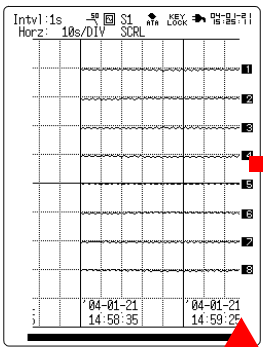


Switch the Waveform Screen layout.

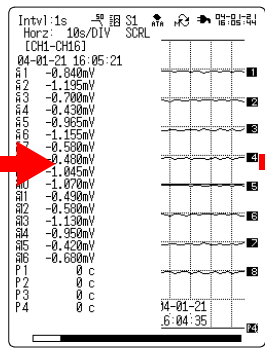
WAVE

The Waveform Screen changes from one layout to another as shown below.

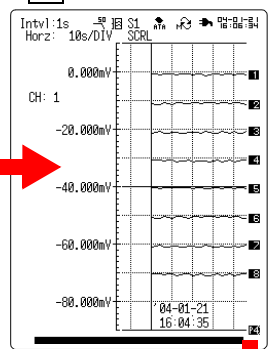
Whole Screen Waveform



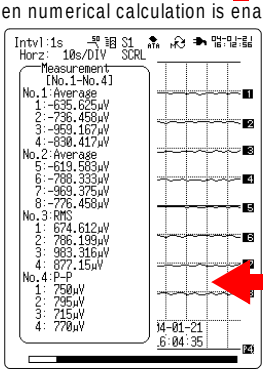
Numerical Value + Waveform



Gauge + Waveform

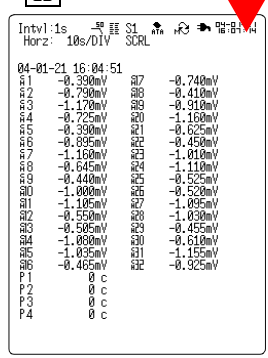


Calculation Results + Waveform
(When numerical calculation is enabled)

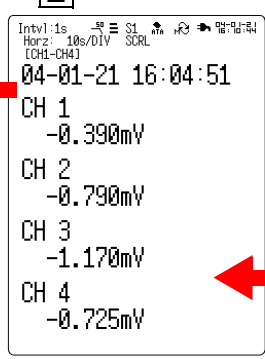


Calculation Results + Waveform

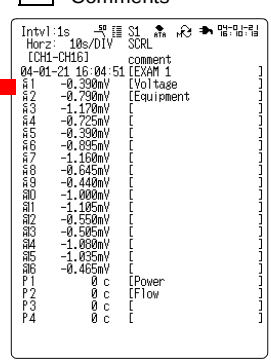
Numerical Value



Expanded Numerical Value



Numerical Value + Comments

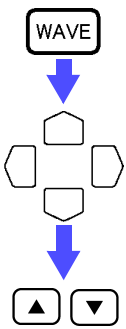


NOTE

The channel to be displayed with the gauge in the Gauge + Waveform Screen can be changed with the CH▲/CH▼ buttons.

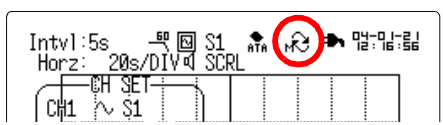
6.3 Switching the Numeric Display Channels

Select the method of changing numeric display channels on the Expanded Numerical Value Screen (common to the 8420-51, 8421-51, and 8422-51).
Select the method of changing display channels between "**CH1-CH16**" and "**CH17-CH32**" on the Numerical Value + Waveform Screen and Numerical Value + Comment Screen (for the 8422-51 only).



Display the Waveform Screen.

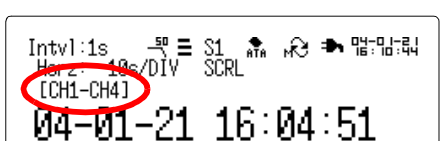
Move the blinking cursor to the position shown.



Set the method for numeric display channel switching.

Selection

	Channels are automatically switched between "**CH1-CH16**" and "**CH17-CH32**" about once every second. (8422-51 only) The channel in the expanded numerical value display changes about once every two seconds.
	The display channel is fixed to "**CH1-CH16**" or "**CH17-CH32**." (This applies to the Numerical Value + Waveform Screen and the Numerical Value + Comment Screen when the 8422-51 is used.) The channel in the expanded numerical value display does not change automatically. Move the blinking cursor to the position shown in the diagram below and use the ▲/▼ buttons to change the display channels. This is possible even during measurement.



NOTE If you want only certain channels to appear in the expanded numerical value display, assign those channels on the corresponding Waveform sheet.

6.4 Scrolling the Waveform

Waveforms on the Waveform Screen can be scrolled horizontally.

WAVE

Display the Waveform Screen.

Move the blinking cursor to the position shown.

You can also select **Scroll** using the SEL button.

Select "**SCRL**."

SCROLL CURSOR

Scroll the waveform.

Scroll the waveform fast.

SCROLL CURSOR

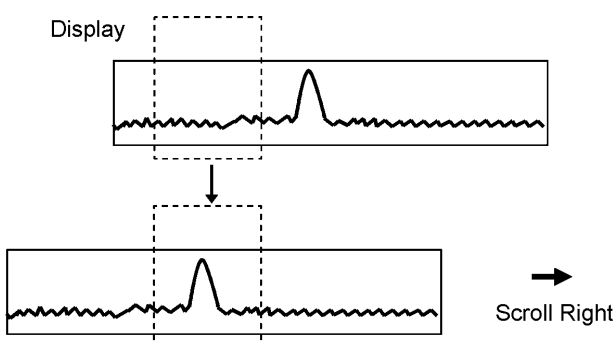
Move to the head of the data stored in instrument memory.

Hold them down together

SCROLL CURSOR

Move back to the current waveform.

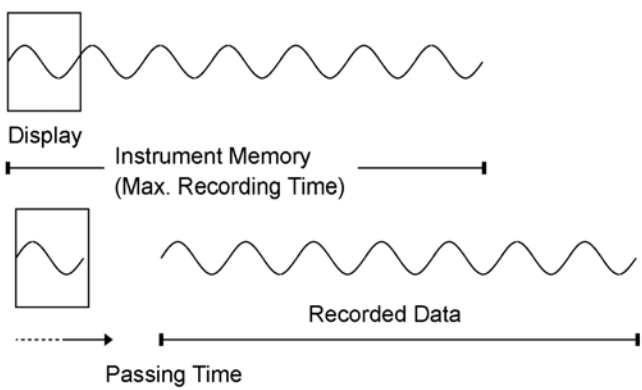
Hold them down together



Auto Scrolling

Holding the SCROLL CURSOR button for five seconds activates automatic waveform scrolling ("**Auto Scroll**" is displayed). Press any button to cancel auto scrolling.

NOTE When the recording period is set to continuous, data in internal memory is overwritten when the memory becomes full. Therefore, if the waveform is scrolled to display earlier data while measuring, the displayed data will be overwritten when the maximum recording period has passed. In this case, although data of the displayed waveform is displayed, it may no longer be present in memory, and when the display is switched, it may not be possible to be restored.



6.5 A-B Cursor Measurement

Measurement data at a particular position on a waveform can be read using the A-B cursors. The A-B cursor operations are available while measuring.

WAVE

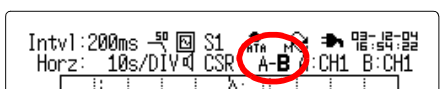
Display the Waveform Screen.

Move the blinking cursor to the position shown.

You can also select **CSR** using the SEL button.

Select "**CSR**."

Move the blinking cursor to the position shown.

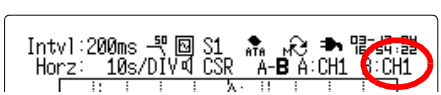


Set the cursor to be moved (A or B).

Selection

A	Use cursor A only.
A-B	Use cursors A and B, and move cursor A.
A-**B**	Use cursors A and B, and move cursor B.
A-B	Use cursor A and B, and move both cursors together.

Move the blinking cursor to the position shown.



Set the channel for cursor measurement.

Selection

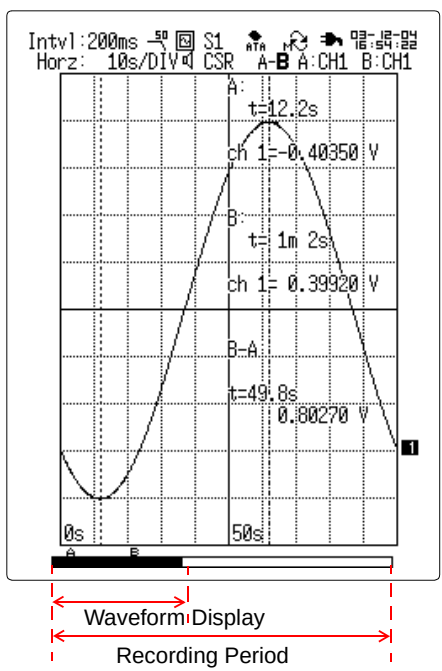
CH1...CH32	The value on the specified analog channel is displayed.
P1...P4	The value on the specified pulse channel is displayed.
ALL or CH1-CH16 CH17-CH32	Selectable only for cursor A. The values on analog channels (CH1-CH16 or CH17-CH32) in the current waveform sheet are shown.

SCROLL CURSOR

Scroll the cursor.

Value to be Shown by Cursor

	Display Examples	Display Contents
A	t = 12.2 s	Time from starting measurement to cursor A
	v1 = -0.40350 V	Amplitude at cursor A
B	t = 1 m 2 s	Time from starting measurement to cursor B
	v1 = 0.39920 V	Amplitude at cursor B
B-A	t = 49.8 s	Time difference between B and A cursors
	v1 = 0.80270 V	Amplitude difference between B and A cursors



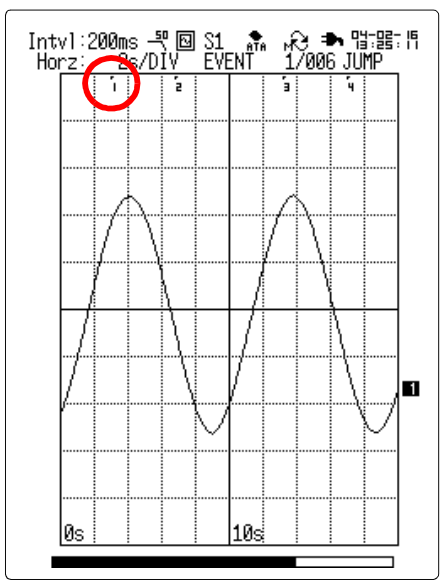
NOTE +OVER and -OVER are displayed for the values at the A-B cursor when at the full scale limits of the measurement range.

6.6 Event Markers (Recall Function)

The Event Marker function allows applying up to 100 event markers to any data as it is acquired, for later recall.

6.6.1 Manually Positioning the Event Marker

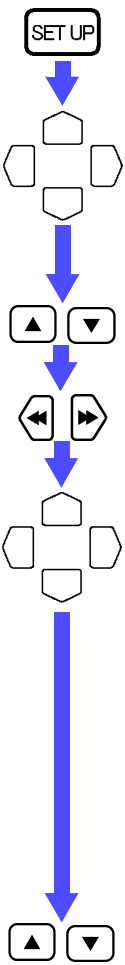
Apply an event marker while measuring.
Event markers are numbered serially as they are applied.



6.6.2 Placing Event Marker by External Signal

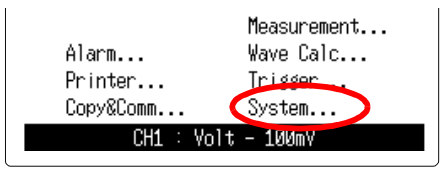
Event markers can be applied using an external signal.

❖Specification of the input signals: See Section 9.7 "Setting the External Trigger Function" (page 171.)



Display the Status Screen.

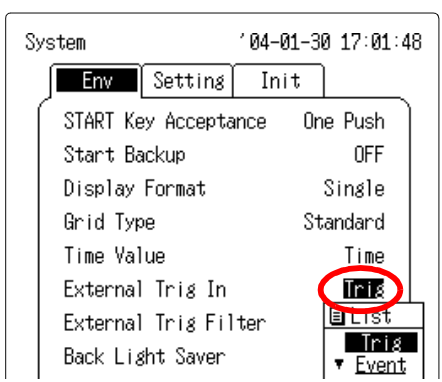
Move the blinking cursor to the position shown.



Display the System Screen.

Display the Env Window.

Move the blinking cursor to the position shown.



Select "**Event**."

If the input voltage of an external trigger terminal is changed from HIGH level (2.5 to 5.0 V) to LOW level (0 to 1.0 V) during measurement (falling edge), an event marker will be inserted.

6.6.3 Recalling an Event Marker

Event markers are numbered serially as they are applied, and any marker can be recalled.

WAVE

Display the Waveform Screen.

Move the blinking cursor to the position shown.

Select "**Event**."

You can also select **Event** using the SEL button.

Move the blinking cursor to the position shown.

Set the event number to be recalled.

Move the blinking cursor to the position shown.

Recall the specified event marker.

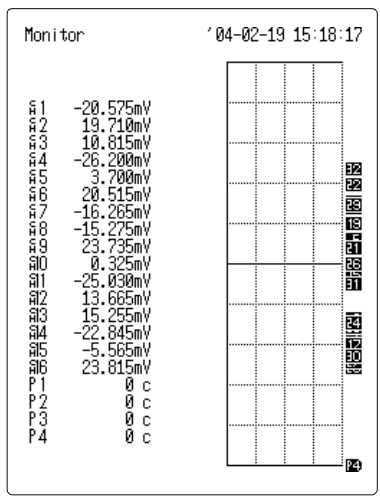
You can also search for an event marker by increasing or decreasing the event No. using the buttons below.

- Pressing the SCROLL CURSOR button, the cursor is scrolled right or left by a notch, which increases or decreases the event No. by one event.
- Pressing the ◀◀ button decreases the event No. by five events.
- Pressing the ▶▶ button increases the event No. by five events.

6.7 Monitor Function

The monitor function displays measurements numerically without saving them to memory. Use this function, for example, when you wish to check measurements before starting real-time saving to the PC card. The display is refreshed every second.

MONIT Display the Monitor Screen.

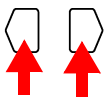


NOTE

- Measurements are not stored in memory while the Monitor Screen is displayed. To display instantaneous values while storing measurements in memory, switch the Waveform Display to the Waveform + Numerical Value mode before starting measurement.
  ❖ See Section 6.2 "Switching the Waveform Screen Layout" (page 101.)
- The range will be that which is already set.
- Regardless of the set recording interval, the data refresh period is:
  One second when the digital filter is OFF; and
  Two seconds when the digital filter is set to 50 or 60 Hz. (This applies when up to 16 channels are used; when 17 or more channels are used, double the above periods.)
- The monitor function is disabled during measurement.

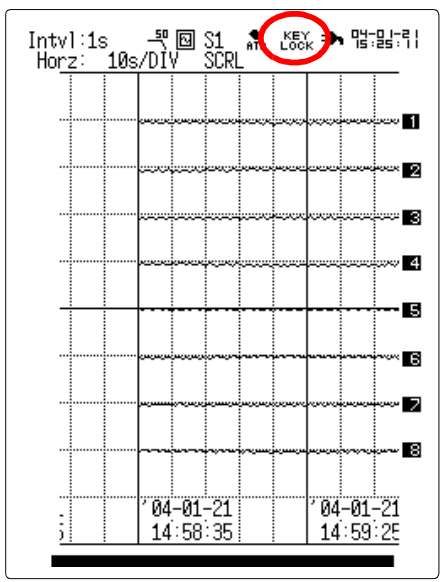
6.8 Key Lock Function

This function disables all front-panel button controls on the instrument, to prevent unintended changes to settings while measuring.



Hold them down together for three seconds or longer.

Turn the key lock On or Off.
When the key lock function is active, "**KEY LOCK**" appears on the display.



To turn off the key lock, hold down the keys for three seconds or longer again.

NOTE

- The key lock function is not canceled by turning the power off and on.
- If the backlight saver function is enabled and the display backlight turns off, it can be turned on again by touching any button. The function assigned to the button will not be activated.

Saving Measurement Data 7

7.1 PC Card Selection

⚠WARNING

- **Use only PC Cards sold by Hioki.**
  Compatibility and performance are not guaranteed for PC cards made by other manufacturers. You may be unable to read from or save data to such cards.
- **Hioki options**
  PC cards (includes adapter)
  9626 PC CARD 32M
  9627 PC CARD 64M
  9726 PC CARD 128M
  9727 PC CARD 256M
  9728 PC CARD 512M
  9729 PC CARD 1G

⚠CAUTION

When using a PC card with the instrument, be sure to format the card before its initial use using the instrument. When formatting in "FAT 16" using a PC (personal computer), please note that the Power Fault Protection function will be ineffective. Furthermore, do not use the "FAT 32" format, as doing so will result in error.
When recording for long durations, format the card before measurement, and make a backup copy of the resulting waveform files on your PC or other storage media. When re-using a PC card, it is recommended that you re-format the card before measurement in order to obtain maximum performance.

Saving and Loading Measurement Data

- Binary Format (proprietary for the instruments)
  Measurement data saved in binary format can be loaded, analyzed and printed as desired.
- Text Format (for Excel)
  Measurement data saved in text format can be thinned and can be processed directly by Excel, but cannot be loaded back into the instrument.

Saving Selected Measurement Data

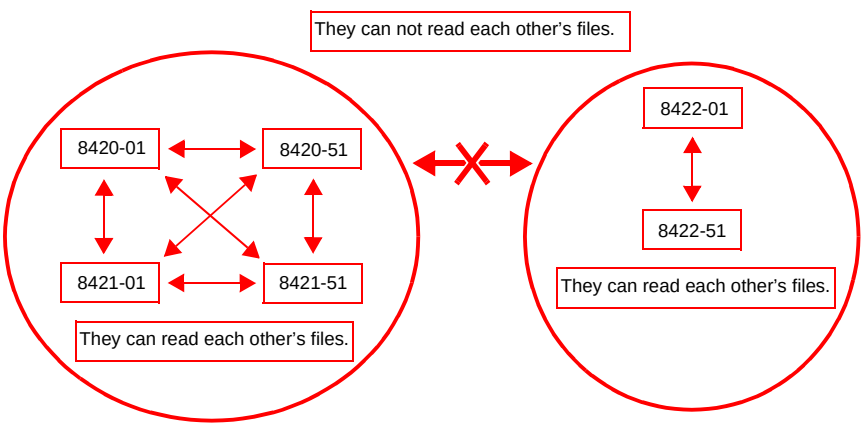
Only the measurement data between the A-B cursors can be specified for saving to the PC Card.

Saving and Loading Settings

Settings such as the time axis and voltage axis range can be saved and reloaded when needed to allow duplicating measurement conditions.

NOTE Although the PC card on this instrument can be accessed from outside using FTP, do not access the card from FTP or the main instrument, or simultaneously manipulate files from telnet, etc. Such operation may lead to unexpected results.

- The setting files and waveform files of the 8420-01, 8421-01, 8420-51, and 8421-51 are interchangeable, so these instruments can read each other's files.
- The setting files and waveform files of the 8422-01 and 8422-51 are interchangeable, so these instruments can read each other's files.
- The files of the 8420-51/8421-51 and the 8422-51 are not interchangeable, so these instruments cannot read each other's files.



NOTE The internal memory capacities of the 8420-01, 8421-01, and 8422-01 are different from those of the 8420-51, 8421-51, and 8422-51, as is the quantity of waveform data that can be read at a time.

7.2 Using the PC Card Slot

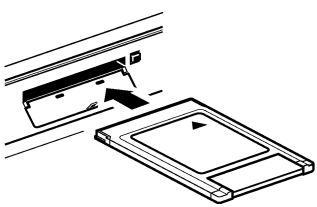
⚠CAUTION

- Inserting a PC card upside down, backwards or in the wrong direction may damage the instrument.
- To prevent PC Card failure, avoid pulling the PC Card out during a saving operation (including real-time, automatic, calculation result and text saving).
- To avoid damage to the PC Card and the instrument, remove the PC Card and close the door when transporting the instrument.

Before using a new PC Card, it must be initialized.

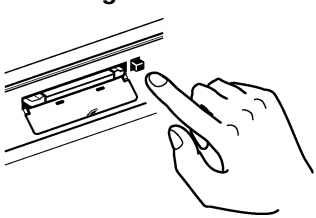
❖ See Section 7.3.6 "PC Card Initialization" (page 128.)

PC Card Insertion



Open the cover and insert the PC card with the arrow facing up and in the direction of the PC card slot, as far as it will go.

Removing the PC Card



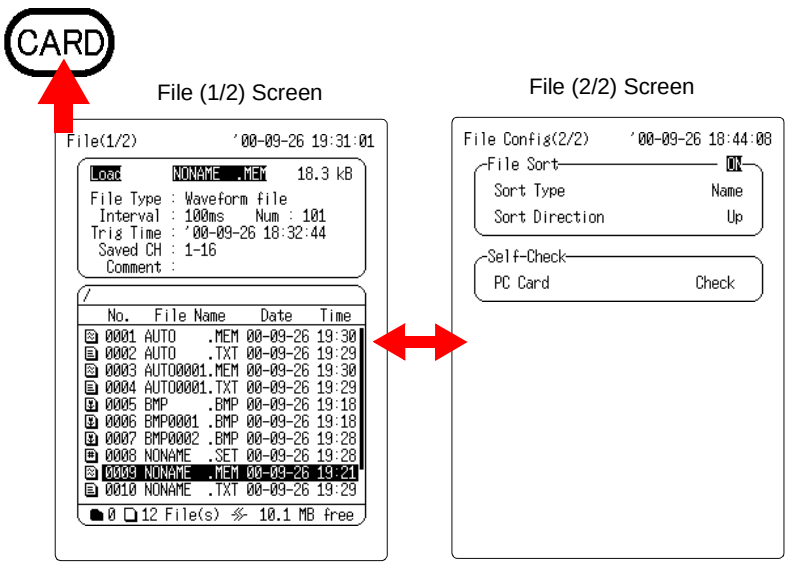
Press the eject button and pull out the PC card.

NOTE Always close the cover when no PC Card is installed.

7.3 File (1/2) Screen

Measurement data can be saved, and saved data or settings can be loaded from a PC Card.

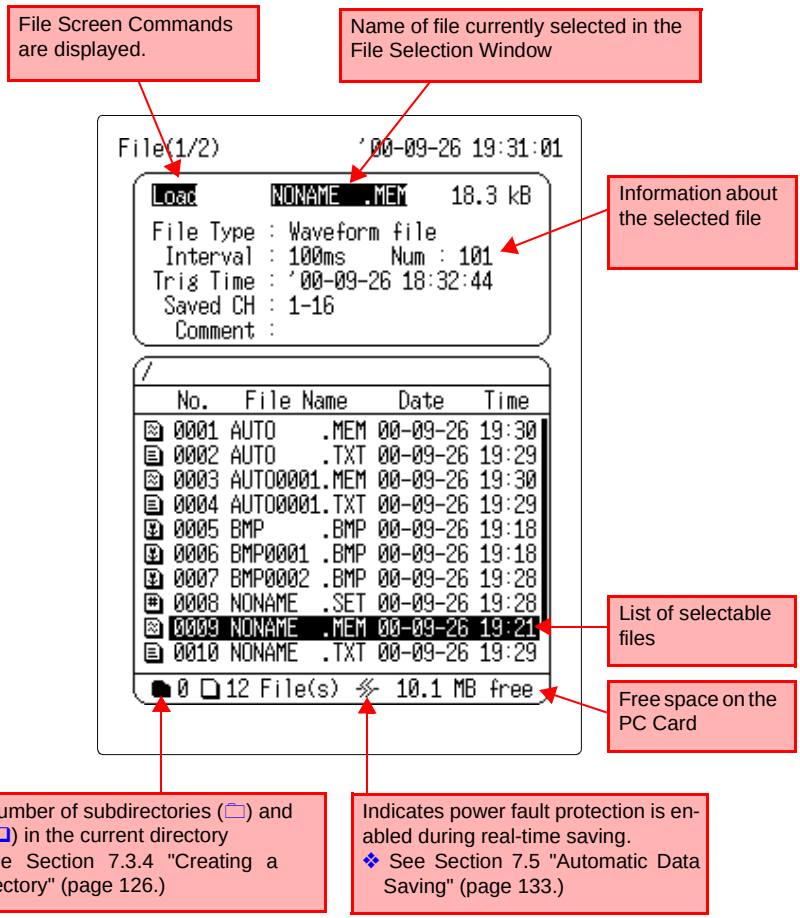
Press the CARD button to display the settings on the File Screen.



Load	Setting conditions and measurement data are transferred from the PC Card to the internal memory of the instrument.	❖ See Section 7.3.1.
Save	Saves measurement data and settings to the PC Card.	❖ See Section 7.3.2.
Delete	Deletes a file or directory.	❖ See Section 7.3.3.
Make Dir	Creates a subdirectory.	❖ See Section 7.3.4.
Format	Initializes a PC Card.	❖ See Section 7.3.6.
Rename	Changes a file or directory name.	❖ See Section 7.3.7.

File Sort	Changes the order of files listed.	❖ See Section 7.4.1.
Self-check	Tests the PC Card.	❖ See Section 7.4.2.

The File (1/2) Screen is described simply below.



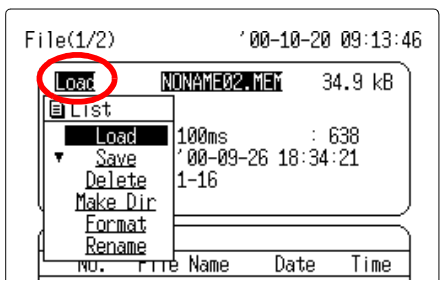
7.3.1 Loading from a PC Card

The setting conditions of the instrument and measurement data can be transferred from a PC Card to internal memory.
Data saved in text format (for Excel) cannot be loaded back into the instrument.

(1) Select the "Load" command.

CARD

Display the File (1/2) Screen.



▲ ▼

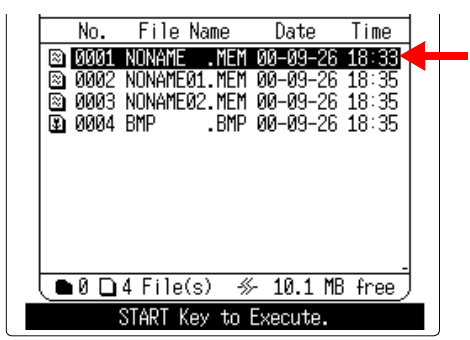
Select "**Load**."

(2) Select the file to load.

Select the file to load from the file.

By pressing the ◀◀/▶▶ buttons, you can skip 10 files while searching for a file.

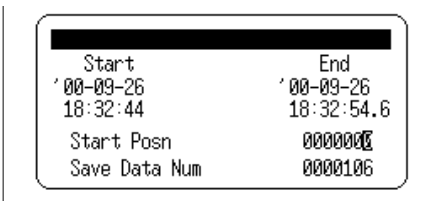
By pressing the SCROLL CURSOR button, you can skip 100 files while searching for a file.



(3) Specify the area to load.

START /MARK

The waveform file Starting time and Ending time are displayed.



Set the load starting position and save data number.

START /MARK

Begin a loading.

To cancel a loading, press the STOP button.

NOTE

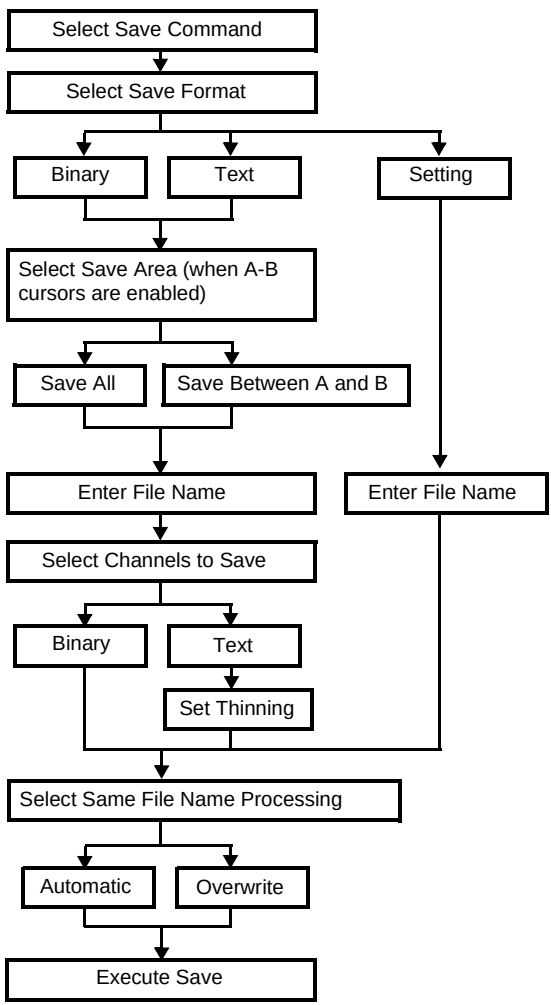
- Saved data is loaded in sequential order from analog channel one to 32. Load time is determined by the length of the recording and the number of channels.
- The amount of data that can be loaded may be limited by the internal memory capacity.

7.3.2 Saving Measurement Data and Settings

Measurement data and settings can be saved to a PC Card. The data to be saved must first be stored in internal memory.
If the A-B cursors are used, they can be set to specify part of the waveform to be saved.

❖ Saving data during measurement:
See Section 7.5 "Automatic Data Saving" (page 133.)

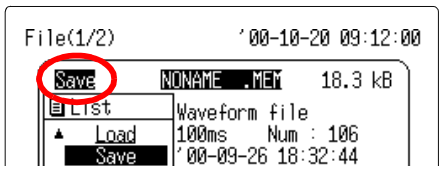
Settings of the Saving Flowchart



(1) Select the "Save" command.

CARD

Display the File (1/2) Screen.



▲ ▼

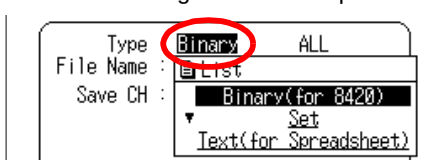
Select "**Save**."

(2) Set the storage format.

START /MARK

Display the Storage Format Screen.

Move the blinking cursor to the position shown.



▲ ▼

Set the Type (storage format.)

Selection

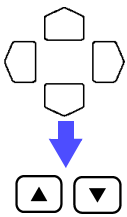
Binary	The waveform data is saved in binary format (readable only by the instruments.)
Set	The settings are saved.
Text	The waveform data is saved in text format (for Excel). Data stored in text format is not readable by the instrument.

NOTE

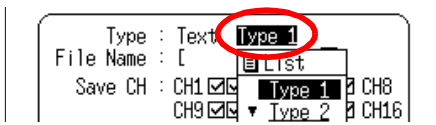
To view data saved in a binary format on a PC, use the Wave Viewer supplied with the instrument. With this application you can view simplified waveforms or convert data to a CSV file and analyze it in a spreadsheet program.

- Communications/ Wave Viewer Instruction Manual
  See Chapter 2 "Waveform Viewer (Wv)" (page 103.)
- Binary File Size:
  See Section 7.7 "Calculating Binary File Sizes" (page 144.)

(3) Set the text header format (for text format)



Move the blinking cursor to the position shown.



Set the Type (text header format.)

Selection

TYPE 1	DaDisp compatible (Extension: TXT)
TYPE 2	Excel compatible (Extension: CSV)

NOTE

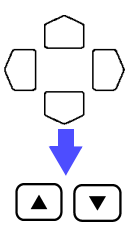
The format of time data in text files is determined by the "Time Value" setting on the System Screen.

Time : Stored as seconds from the start of measurement (in units of seconds)

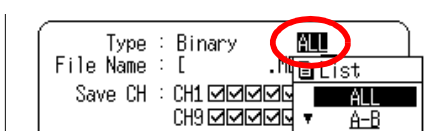
Date : Stored as day and time

Point : Stored as the number (count) of data points from the start of measurement.

(4) Specify the area to save (If using the A-B cursors)



Move the blinking cursor to the position shown.

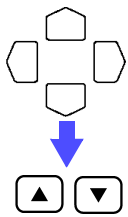


Set the Type (area to save.)

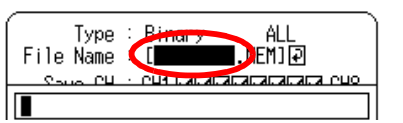
Selection

ALL	Saves data for all captured waveforms.
A-B (partial saving)	If only the A cursor is enabled, data from the cursor to the end of input is saved. If both A and B cursors are enabled, only data between the cursors is saved.

(5) Enter the file name.

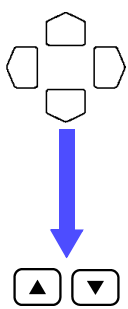


Move the blinking cursor to the position shown.

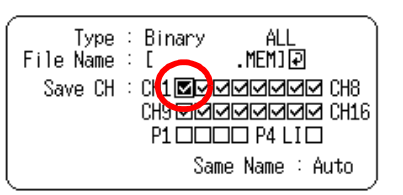


Enter the file name.
When a file is saved with filename ([.]) left blank, the filename is automatically set as shown below.
[NONAME] → [NONAME01] ....→ [NONAME10]...
❖ See Chapter 14 "Text Entry Procedure" (page 225.)

(6) Specify the channels to save (for measurement data).

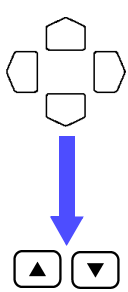


Move the blinking cursor to the position shown.

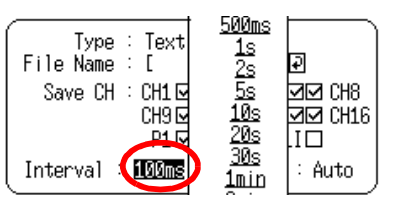


Select (place a checkmark on ☑) the channels to be saved.

(7) Set the saving interval (for text format).

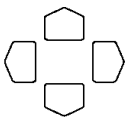


Move the blinking cursor to the position shown.

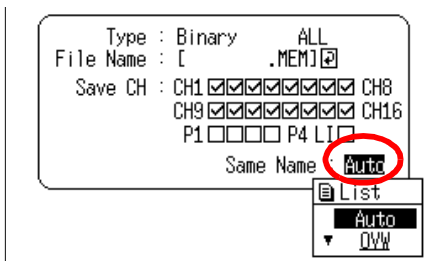


Set the Interval (saving interval.)
The data can be thinned by setting the save interval larger than the recording interval.

(8) Select the same file name handling setting (if desired).



Move the blinking cursor to the position shown.



Set the Same Name (same file name handling setting.)

Selection

Auto	This mode saves files with the same name by automatically appending a number after the file name. If the last file was saved with a number appended, the next file is saved with the number incremented. Example: TEST0001, TEST0002....
OVW (Overwrite)	This mode saves files with the same name, overwriting the previous the same namefile.

Execute a saving.

To cancel a saving, press the STOP button.

File Name Extension

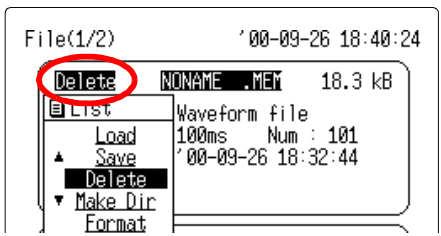
The following extensions are automatically assigned, according to the selected storage format.

Extensions	Meanings	Loading
MEM	Binary memory recorder data file (readable only by the instruments.)	Yes
TXT, CSV	Text data file (for Excel)	No
SET	Settings file (readable only by the instruments.)	Yes

7.3.3 Deleting Files and Directories

CARD

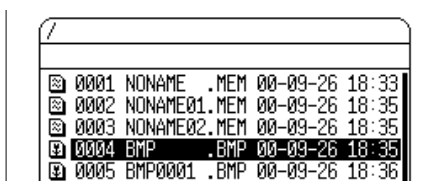
Display the File (1/2) Screen.



▲ ▼

Select "**Delete**."

Select the file or directory to be deleted.



START /MARK

Display a Confirmation Window.

START /MARK

Excute a deletion.

To cancel a deletion, press the STOP button.

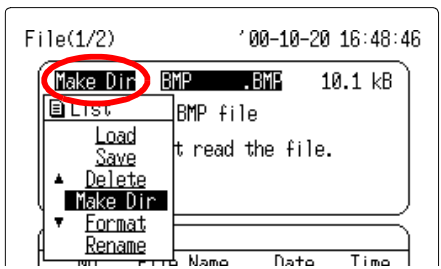
NOTE

The instrument does not support Windows long file names (LFN).
When a file created on a Windows PC is deleted on the instrument, the file is not completely deleted and an error will occur when drive check is performed on the PC.

7.3.4 Creating a Directory

CARD

Display the File (1/2) Screen.

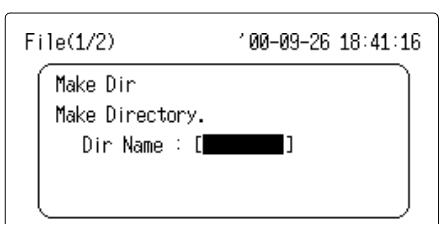


▲ ▼

Select "**Make Dir**."

START /MARK

Display the Dir Name Entry Window.



▲ ▼

Enter the directory name.
❖ See Chapter 14 "Text Entry Procedure" (page 225.)

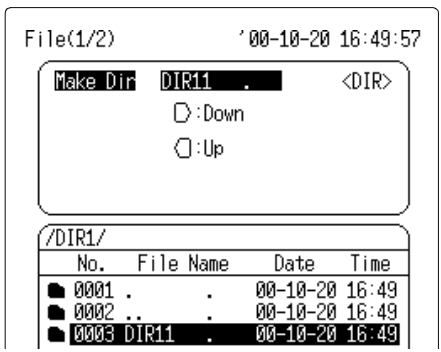
START /MARK

Create the directory.

7.3.5 Changing Directories

CARD

Display the File (1/2) Screen.



Select the directory to move.

Move the upper directory.

Move the lower directory.

NOTE

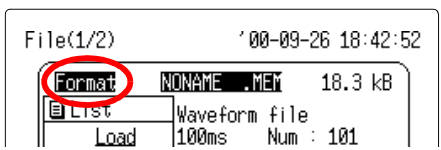
- Files cannot be moved from one directory to another with the instrument.
- The maximum number of files that can be saved in the root directory of a Flash ATA Card is 512 files (depending on the manufacturer). The power fault protection function requires at least 16 system files to be created in the root directory, reducing the total number of files (512 or less) that can be created in the root directory respectively.
- Always make sure that multiple files reside in subdirectories. For a memory card formatted by the instrument, automatic saving of a file to the root directory moves automatically to the /LOGGER/ directory where the file will be saved.

7.3.6 PC Card Initialization

Initializing (formatting) a PC Card deletes all files and creates the system files required by the power fault protection function.

CARD

Display the File (1/2) Screen.

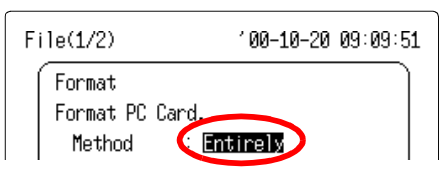


▲ ▼

Select "**Format**."

START /MARK

Set the Method (initialization method.)
Select "**Entirely**" when using a new PC Card



▲ ▼

Selection

Quick	The PC Card is not tested for bad sectors.
Entirely	The PC Card is tested for bad sectors, which are removed from use if possible.

START /MARK

Excute an initialization.

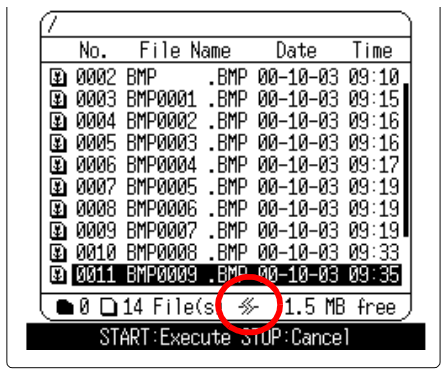
To cancel an initialization, press the STOP button.

NOTE

- If a memory card is formatted by the instrument, a /LOGGER/ directory will be created, and when you attempt to save a file into the root directory automatically it will be saved to this directory instead. When the saving operation begins, you will automatically be moved to the /LOGGER/ directory.
- You cannot change the name of the /LOGGER/ directory or delete the directory.

Power Fault Protection While Recording to a PC Card

System files are automatically created for the power fault protection function during initialization (formatting). These files are not displayed in the File Selection Window, but the ⚡ symbol is displayed at the bottom of the File Screen.
The system files for the power fault protection function occupy about 1.5 MB of file space on the PC Card.



If power is interrupted while a real-time data file is being recorded to a PC Card, the data file is recovered automatically. In this event, turn the power back on before removing the PC Card. If real-time saving was interrupted, data recorded up to the point of the last file refresh can be read from the PC Card.

Precautions Regarding the System Files for Power Fault Protection

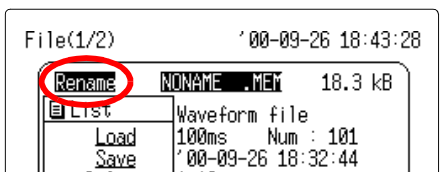
- During real-time saving, files are refreshed at regular intervals. The refresh interval is 1 min. for a recording interval set from 100 ms to 1 min., and is equal to the recording interval for a recording interval set from 2 min. to 1 hr.
- If power is interrupted before the first data refresh, no data is stored, and a file is created with zero bytes.
- The system files occupy a particular area on the PC Card. When a PC Card is used the first time, or when a Card that has been used in another device for a long time, we recommend performing an "Entirely" initialization to check for bad sectors on the PC Card.
- If a PC Card is written to by a device other than a instrument, the power fault protection system files may become corrupted. We therefore recommend that after using a PC Card in another device, it be reformatted before use in the instrument.
- Do not remove a PC Card while recording a file, as the PC Card electronics could be damaged. In such a case, the power fault protection file system may be unable to recover data.

7.3.7 Renaming Files and Directories

The names of directories and saved files can be changed as follows.

CARD

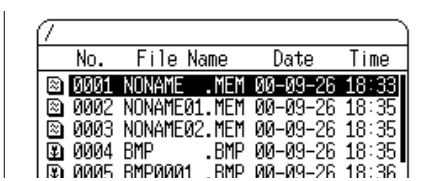
Display the File (1/2) Screen.



▲ ▼

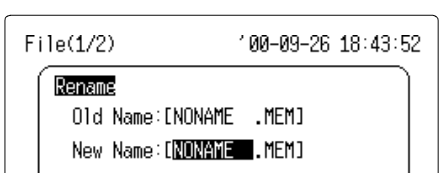
Select "**Rename**."

Select the file or directory to rename.



START /MARK

Displays the old file name and the new file name (when renaming a file).



▲ ▼

Enter the new file name.

❖ See Chapter 14 "Text Entry Procedure" (page 225.)

START /MARK

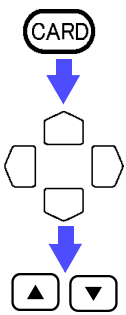
Execute a renaming.

7.4 File (2/2) Screen

7.4.1 Sorting Files

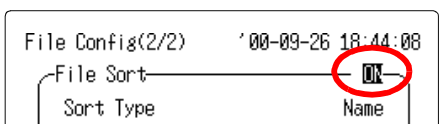
Sorts the files on the PC Card.

(1) Enable or disable the Sorting.



Display the File (2/2) Screen.

Move the blinking cursor to the position shown.

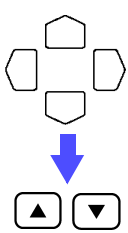


Set the Sorting ON or OFF.

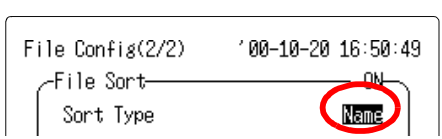
Selection

OFF	Sorting is disabled.
ON	Sorting is enabled.

(2) Set the item to base the sort on.



Move the blinking cursor to the position shown.

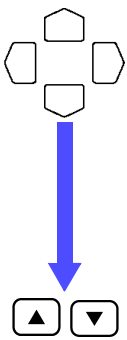


Set the Sort Type (item to base the sort on.)

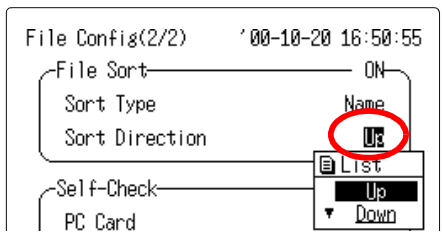
Selection

Name	Sort by file name
Type	Sort by file type (extension)
Date	Sort chronologically
Size	Sort by file size

(3) Set the sort direction.



Move the blinking cursor to the position shown.



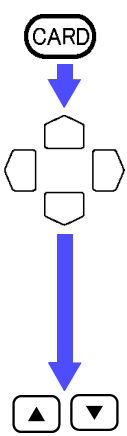
Set the Sort Direction.

Selection

Up	Sort in ascending order
Down	Sort in descending order

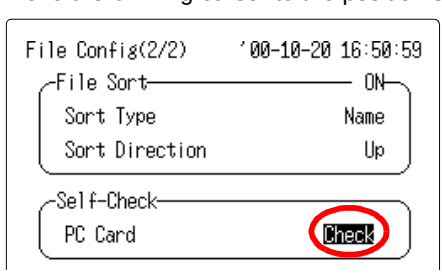
7.4.2 Self-Check

This function checks the PC Card. The operation is the same as the PC Card Check function in the Self-Check menu on the Init Window.
❖See Section 13.3.4 "Self-Check" (page 223.)



Display the File (2/2) Screen.

Move the blinking cursor to the position shown.



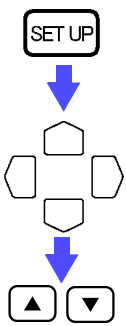
Set the Self-Check.

The PC Card check tests the following items:
PC Card Type : ATA card
RAM Size : Capacity of the installed card

7.5 Automatic Data Saving

Measurement data can be automatically saved to a PC Card. Data is saved from the start to the end of measurement.

(1) Set the automatic saving.



Display the Status Screen.

Move the blinking cursor to the position shown.

Set the Auto Save (automatic saving.)

Selection

OFF	Automatic saving is disabled.
Binary (Real)	Data is automatically saved in binary format (readable only by instruments) to the PC Card in real time. We recommend saving in binary format whenever practicable.
Text (After)	Data recorded for the set recording time is automatically saved onto a PC card in text format (for Excel). Data saved in text (Excel) format cannot be read back into the instrument.

NOTE

To view data saved in a binary format on a PC, use the Wave Viewer supplied with the instrument. With this application you can view simplified waveforms or convert data to a CSV file and analyze it in a spreadsheet program.

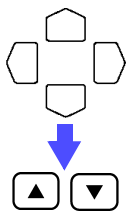
- Communications/ Wave Viewer Instruction Manual
  See Chapter 2 "Waveform Viewer (Wv)" (page 103.)
- Binary File Size:
  See Section 7.7 "Calculating Binary File Sizes" (page 144.)

NOTE

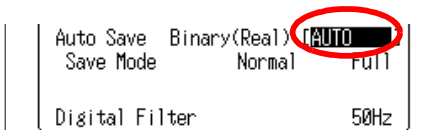
- Only data from those channels enabled for measurement is automatically saved.
- A warning message appears as the PC Card fills up while measuring. Stop measurement and remove the PC Card. Removing or inserting a PC Card during measurement may destroy data.
- During real-time saving, files are refreshed at regular intervals. The refresh interval is 1 min. for a recording interval set from 100 ms to 1 min., and is equal to the recording interval for a recording interval set from 2 min. to 1 hr.
- If power is interrupted before the first data refresh, no data is stored, and a file is created with zero bytes.
- When you attempt to save a file into the root directory automatically, if there is a /LOGGER/ directory then the file will be saved to this directory instead.
- When the recording period is set to "**Continuous**" and automatic saving is set to "**Text**", the data remaining on the internal memory will be saved automatically.
- If the STOP button is pressed while data is being saved in the text format, the save operation will be interrupted.
- When automatically saving in the text format, if the PC card does not have enough space, the save cannot be completed; in this case we recommend saving in the binary format.
- During automatic saving, if an abnormality occurs on the PC Card while recording, one of the following messages appears near the bottom of the screen.

Messages	Descriptions
No PC Card	Appears when no PC Card is installed in the PC Card slot.
PC Card has error	Appears when a fault occurs on the PC Card, and when recording is not possible.
PC Card got weak	Appears after recovery from an error that occurs while reading or writing the PC Card. May be caused by aging of the PC Card.
PC Card is full	Appears when the available space on the PC Card reaches or falls below the specified amount. This message does not appear when deleting and saving files.

(1) Enter the file name for automatic saving.



Move the blinking cursor to the position shown.

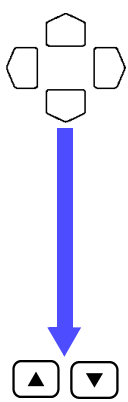


Display the File Name Entry Window.

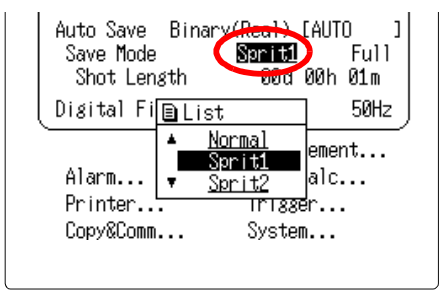
❖ See Chapter 14 "Text Entry Procedure" (page 225.)

If a file name has already been entered, the file is automatically saved with that name. For continuous saving, a number is appended to the file name. If no file name has been entered, default file naming is used ([AUTO, AUTO0001], etc.)

(2) Select the saving mode (binary data format.)



Move the blinking cursor to the position shown.



Set the Save Mode (sprit saving.)

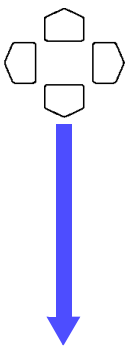
Selection

Normal	Creates one file for each measurement session.
Split 1	Divides data at regular intervals from the start of measurement and creates separate files.
Split 2	Sets a reference time every 24 hours, divides data at regular intervals from said reference time, and creates separate files.

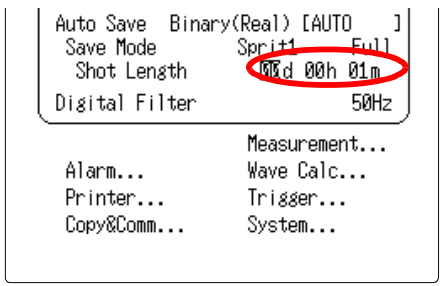
NOTE

- No files can be split-saved in text format.
- When a Split 2 is selected, "Sync fixed time" is displayed until the recording interval is synchronized with the reference time at the start of measurement.

Settings and instrument functioning for "Split 1"



Move the blinking cursor to the position shown.

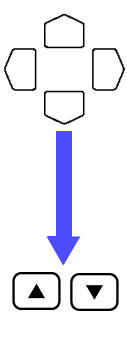


Set the Short Length (split interval.)

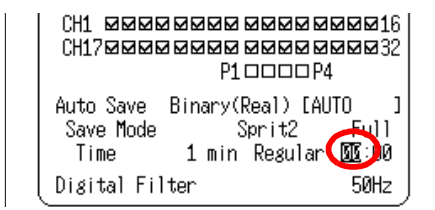
NOTE

- This interval must be an integral multiple of the sampling time.
- When a split interval of two hours is set, waveform files are created by separating data every two hours from the time when data was initially sampled.

Settings and instrument functioning for "Split 2"



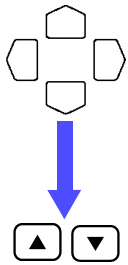
Move the blinking cursor to the position shown.



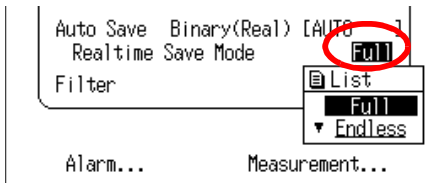
Set the Time (split interval and reference time.)

NOTE

- This interval must be an integral multiple of the sampling time.
- When a split interval of four hours and reference time of day of 9:30 are set, waveform files are created by separating data at 1:30, 5:30, 9:30, 13:30, 17:30, and 21:30 after the start of measurement. For "Split 2," the trigger time has no effect.



Move the blinking cursor to the position shown.



Set the Saving Mode.

Selection

Full	Saving stops when the PC Card becomes full.
Endless	When free space on the PC card becomes too low, oldest data in the currently recorded file is overwritten. A file containing the latest data will be saved.
Delete	If available PC Card space drops below a predetermined level when starting real-time saving or during saving, files in the currently recorded directory are deleted, beginning with the oldest. When no more files can be deleted, the instrument functions the same way as for endless saving.

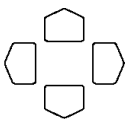
NOTE The maximum number of files that can be saved in the root directory is limited. Therefore, when saving multiple files, always make sure the files are saved in subdirectories.

7

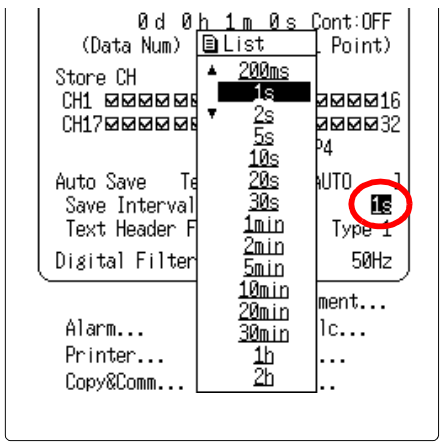
Delete Conditions

- Only those files that exist in the directory (where automatically saved files are created) can be deleted.
- Files with file extension .MEM are recognized as waveform files. Therefore, any files with file extension .MEM are recognized as waveform files, regardless of content.
- Whether files are new or old are determined by the timestamp (i.e., date and time when created).
- No files are deleted when there is only one file or no waveform files in the directory. If the size of a waveform file to be deleted is too large for the capacity of the PC card, it may not be deleted. We recommend that the size of a file should not exceed 1/4 of the free space on the PC card.
- Files in the directory are searched for up to 10,000 instances. If there are more files than that, the oldest file may not always be deleted.
- For "split saving," the instrument functions the same way as when files are automatically saved a number of times. In other words, one or more files separately created from one measurement session are deleted when regarded as old in terms of time.

(3) Set the interval at which to automatically save data (text format.)



Move the blinking cursor to the position shown.



Set the Save Interval.

If set shorter than the recording interval, the save interval is automatically increased to match it.
The data can be thinned by setting the save interval larger than the recording interval.

NOTE

- We recommend saving in binary format whenever practicable.
- Files saved in text format are relatively large: the amount of data that can be saved is less than one tenth that of binary format.
- Data acquired before a power outage is not saved when text format is selected. Also, if there is insufficient space for the file on the PC Card, no data is saved.
- Data saved in text format is not readable by this instrument.
- If the STOP button is pressed while data is being saved in the text format, the save operation will be interrupted.

Text Saving Intervals

The following table shows the available saving intervals for text data.
The available saving intervals for text saving depend on the selected recording interval.

Time Axis	Recording Intervals															
	100 ms	200 ms	500 ms	1 s	2 s	5 s	10 s	20 s	30 s	1 min	2 min	5 min	10 min	20 min	30 min	1 h
100 ms	Yes	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
200 ms	Yes	Yes	No	No	No	No	No	No	No	No	No	No	No	No	No	No
500 ms	Yes	No	Yes	No	No	No	No	No	No	No	No	No	No	No	No	No
1 s	Yes	Yes	Yes	Yes	No	No	No	No	No	No	No	No	No	No	No	No
2 s	Yes	Yes	Yes	Yes	Yes	No	No	No	No	No	No	No	No	No	No	No
5 s	Yes	Yes	Yes	Yes	No	Yes	No	No	No	No	No	No	No	No	No	No
10 s	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No	No	No	No	No	No
20 s	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No	No	No	No	No
30 s	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No	No	No	No	No	No
1 min	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No	No	No
2 min	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No	No
5 min	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No	No	No
10 min	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No
20 min	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No
30 min	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No
1 h	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2 h	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
5 h	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
10 h	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
12 h	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
1 d	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

(4) Set the text header format.

Move the blinking cursor to the position shown.

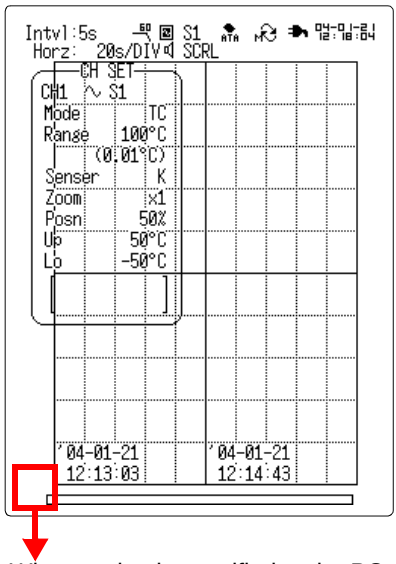
Set the Text Header Format.

Selection

Type 1	DaDisp compatible (Extension: TXT)
Type 2	Excel compatible (Extension: CSV)

❖ See Section 7.6 "Text File Internal Format" (page 142.)

Waveform Screen



When saving is specified to the PC card, the following icons appear.

Real-time Save Icon Summary

	Saving in real-time. (File full)
	Saving in real-time. (Endless)
	When text saving is specified
	When saving of numerical calculations is specified
	When real-time saving is impossible, such as when there is no free space on the memory card.
	When text saving is impossible, such as when there is no free space on the memory card.
	When the saving of the results of numerical calculations is impossible, such as when there is no free space on the memory card.
	During real-time saving (Split saving)

When either real-time saving or text saving is specified, the icon for saving numerical calculations is not displayed.

7.6 Text File Internal Format

Text files consist of a header and a data section.
The header consists of the following measurement-related information:

Type 1 Format (DaDisp compatible)

(1) COMMENT	Overall waveform comment
(2) DATE	Measurement month, day and year (in MM-DD-YYYY format)
(3) TIME	Trigger time (in HH:MM:SS format)
(4) NUM_SIGS	Number of data types (including time axis data)
(5) INTERVAL	Sampling rate (= time axis range / 80)
(6) HORZ_UNITS	Time axis units (S = seconds)
(7) VERT_UNITS	Vertical data units (including time axis data)
(8) SIGNAL	Data name
(9) EVENT	The Event No. will be added only when there is one or more event marks. (ver. 1.10 and later)
(10) DATA	Indicates the end of the header. Measurement data follows.

```
"COMMENT","8421 MEM DATA"  ...(1)
"DATE","10-05-2000"  ...(2)
"TIME","09:03:57"  ...(3)
"NUM_SIGS", 5  ...(4)
"INTERVAL",  1.000E-01  ...(5)
"HORZ_UNITS", "S"  ...(6)
"VERT_UNITS", "S", "C", "V", "c", "r/s"  ...(7)
"SIGNAL","TIME", "CH1", "CH2", "P1", "P2","EVENT"  ...(8), (9)
"DATA"  ...(10)
  +0.00000000E+00, +7.50000E-05, -4.82950E-02, -9.46250E-02, +1.32050E-02
  +1.00000000E+00, +6.50000E-05, -4.66650E-02, -9.32750E-02, +1.27750E-02
  +2.00000000E+00, +6.50000E-05, -4.50750E-02, -9.19300E-02, +1.23800E-02
  +3.00000000E+00, +1.05000E-04, -4.36150E-02, -9.05250E-02, +1.19500E-02
  +4.00000000E+00, +8.50000E-05, -4.21450E-02, -8.91550E-02, +1.15600E-02
  +5.00000000E+00, +8.50000E-05, -4.07550E-02, -8.77450E-02, +1.11850E-02
  +6.00000000E+00, +7.50000E-05, -3.93000E-02, -8.63750E-02, +1.08600E-02
  +7.00000000E+00, +7.50000E-05, -3.79900E-02, -8.49750E-02, +1.05100E-02
  +8.00000000E+00, +8.00000E-05, -3.67450E-02, -8.34950E-02, +1.01400E-02
  +9.00000000E+00, +5.50000E-05, -3.54700E-02, -8.20850E-02, +9.80500E-03
  +1.00000000E+01, +5.50000E-05, -3.42650E-02, -8.06600E-02, +9.48000E-03
```

Type 2 Format (Excel compatible)

(1) Overall comment about waveform
(2), (3) From left: number of data points, recording interval, trigger date, trigger time, model name
(4) From left: channel number, input type, range, comment, scaling type, scaling ratio, scaling offset, units
(5) Settings listed in (4) for each channel

```
"                "  ...(1)
"DATA NUM","INTERVAL","TRIG DATE","TRIG TIME","MODEL"  ...(2)
"11","  1.000E+00","2003-01-08","15:46:34","8421"  ...(3)

"CH","AMP","RANGE","COMMENT","SCALING","RATIO","OFFSET","UNIT"  ...(4)
"CH1","VOLT","100mV","                ","OFF","","","","  ...(5)
"CH2","VOLT","100mV","                ","OFF","","","","  ...(5)
"CH3","VOLT","100mV","                ","OFF","","","","  ...(5)
"CH4","VOLT","100mV","                ","OFF","","","","  ...(5)

"TIME","CH1[V]","CH2[V]","CH3[V]","CH4[V]","EVENT"
  +0.00000000E+00, +7.50000E-05, -4.82950E-02, -9.46250E-02, +1.32050E-02
  +1.00000000E+00, +6.50000E-05, -4.66650E-02, -9.32750E-02, +1.27750E-02
  +2.00000000E+00, +6.50000E-05, -4.50750E-02, -9.19300E-02, +1.23800E-02
  +3.00000000E+00, +1.05000E-04, -4.36150E-02, -9.05250E-02, +1.19500E-02
  +4.00000000E+00, +8.50000E-05, -4.21450E-02, -8.91550E-02, +1.15600E-02
  +5.00000000E+00, +8.50000E-05, -4.07550E-02, -8.77450E-02, +1.11850E-02
  +6.00000000E+00, +7.50000E-05, -3.93000E-02, -8.63750E-02, +1.08600E-02
  +7.00000000E+00, +7.50000E-05, -3.79900E-02, -8.49750E-02, +1.05100E-02
  +8.00000000E+00, +8.00000E-05, -3.67450E-02, -8.34950E-02, +1.01400E-02
  +9.00000000E+00, +5.50000E-05, -3.54700E-02, -8.20850E-02, +9.80500E-03
  +1.00000000E+01, +5.50000E-05, -3.42650E-02, -8.06600E-02, +9.48000E-03
```

7.7 Calculating Binary File Sizes

8420-51, 8421-51

(The unit is byte.)

File size = Header size + data size

Header Size = 512 x (18 + number of analog channels + number of pulse channels + number of logic channels)

Data Size = (Number of analog channels + number of pulse channels + number of logic channels + number of alarm channels) x number of data points x 2

* Number of logic channels is zero or one (it is one when a logic channel is used)
  Number of alarm channels is zero or one (it is one when an alarm channel is used)

8422-51

(The unit is byte.)

File size = Header size + data size

Header Size = 512 x (11 + number of analog channels x 2 + number of pulse channels x 2 + number of logic channels + A)

Data Size = (Number of analog channels + number of pulse channels + number of logic channels + number of alarm channels) x number of data points x 2

* Number of logic channels is zero or one (it is one when a logic channel is used)
  Number of alarm channels is zero or one (it is one when an alarm channel is used)
  "A" is 16 when a logic or alarm channel is used and zero when neither of them is used.

Calculation Functions 8

8.1 Applying Numerical Calculation to Measurement Data

Seven type of numerical calculation can be applied to data measured on analog channels. The results of the calculation are displayed (printed or saved) as numerical values. Numerical calculations can be applied during measurement.
Up to eight types of numerical calculations can be applied on up to four channels.
When finished measurement, calculations can be applied to selected data saved in internal memory using the A-B cursors.

Types of Numerical Calculation

Average value, Effective value, Peak-to-Peak value, Maximum value, Time to maximum value, Minimum value, Time to minimum value

Numerical Calculation Processing

Average
Calculates the average value of the waveform data.

$$AVE = \frac{\sum_{i=1}^{n} di}{n}$$

AVE: Average value
n: Numerical data source
di: The ith data item of the channel

Effective Value (RMS)
Calculates the effective value of the waveform data. If scaling is enabled, the calculation occurs after the data has been scaled.

$$RMS = \sqrt{\frac{\sum_{i=1}^{n} di^2}{n}}$$

RMS: Average value
n: Numerical data source
di: The ith data item of the channel

Peak-to-Peak Value

Calculates the peak-to-peak value (maximum minimum) of the waveform data.

Maximum

Calculates the maximum value of the waveform data.

Time to Maximum Value

- Calculates the time(s) from the start of measurement to the maximum value.
- If the maximum value occurs more than once, the calculated value is the time to the first occurrence.

Minimum

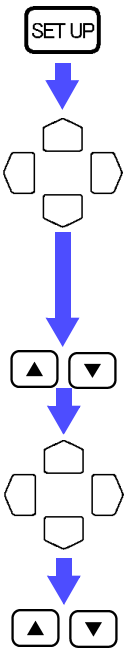
Calculates the minimum value (V) of the waveform data.

Time to Minimum Value

- Calculates the time(s) from the start of measurement to the minimum value.
- If the minimum value occurs more than once, the calculated value is the time to the first occurrence.

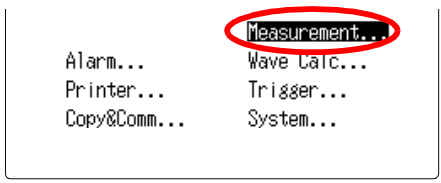
8.1.1 Calculating in Real Time During Measurement

(1) Enable or disable numerical calculations.



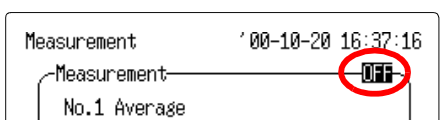
Display the Status Screen.

Move the blinking cursor to the position shown.



Display the Measurement Screen.

Move the blinking cursor to the position shown.



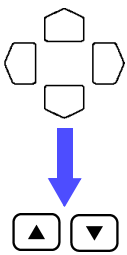
Turn On/Off the Measurement (numerical calculation.)

Selection

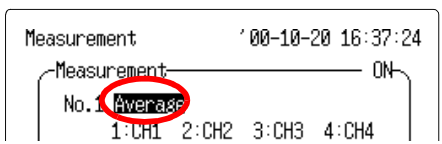
OFF	Numerical calculations are disabled.
ON	Numerical calculations are enabled.

(2) Select the numerical calculation to be performed.

Up to four calculations, No. 1 to No. 8, can be enabled simultaneously.
Set No.1 to No.4 on page (1/2) and No.5 to No.8 on page (2/2).



Move the blinking cursor to No. 1 to No. 8 position.



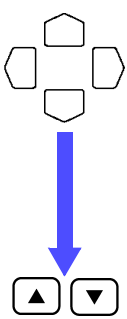
Select the desired calculation item.

Selection

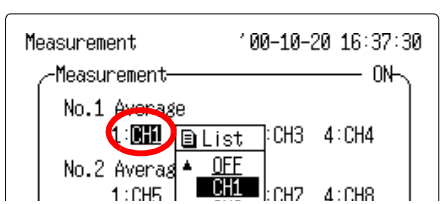
OFF, Average, RMS, P-P, MAX, MAX-TIME, MIN, or MIN-TIME

(3) Select the channels on which to apply the numerical calculations.

One calculation can be applied on up to four channels.



Move the blinking cursor to the position shown.

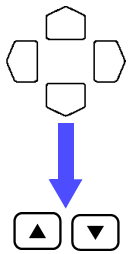


Set the channel for calculation.

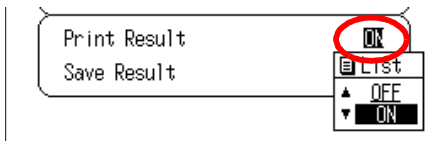
Selection

OFF	No calculations are performed.
CH1 to CH32	Calculations are performed on the selected channel.

(4) Once calculation results are displayed, select whether to print.



Move the blinking cursor to the position shown.



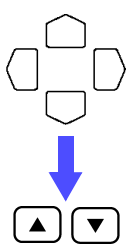
Select whether to print.

Selection

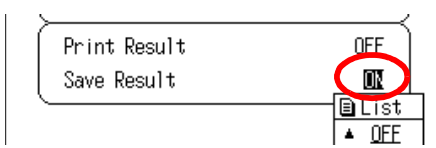
OFF	Calculation results are not printed.
ON	Calculation results are printed.

NOTE Printer settings are available when the 8992 PRINTER UNIT is installed.

(5) Once calculation results are displayed, select whether to save them to a PC card.



Move the blinking cursor to the position shown.



Select whether to save.

Selection

OFF	Calculation results are not saved.
ON	Calculation results are saved to a PC Card in text format (for Excel). (saved calculation results cannot be read back by the instrument.)

NOTE Out-of-range (+OVER and -OVER) measurement data is treated as full-scale values in the operating measurement range, so if such measurements are present, calculation results may be invalid.

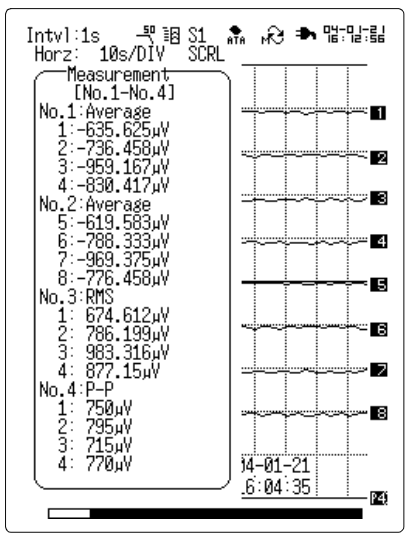
(6) Performing numerical calculations

START /MARK

Start measuring.
Numerical calculations are performed as data is acquired.

WAVE

To display calculation results while measuring, press this button to set the display to Numerical Calculations + Waveforms.
You can change the calculation results to display between "**No.1 - No.4**" and "**No.5 - No.8**."



NOTE

- The data is acquired, beginning from the start of measurement.
- The area for numerical calculation cannot be specified by the A-B cursors during measurement (although other measurements using the A-B cursors can be performed).
- When the pre-trigger feature is enabled with the trigger function, calculations are performed from the pre-trigger point.
- After data for the set recording period has been recorded, the calculation will be printed out and saved (when printing and saving of calculation result are set to ON).
- To stop the measurement, press the STOP button twice.
  When saving of the calculation result is set to ON, the calculation result will be saved.
  However, even if the printing of the calculation result is set to ON, the calculation result will not be printed out.
- When data acquisition is restarted, previous data is cleared.

8.1.2 Calculating Internal Memory Data upon Completion of Measurement

After recording is finished, calculations can be applied to data saved in internal memory or that read from a PC Card.
Various calculation results can be obtained by selecting different items and channels for calculation. Calculations can be applied to all waveforms, or to an area specified by the A-B cursors.

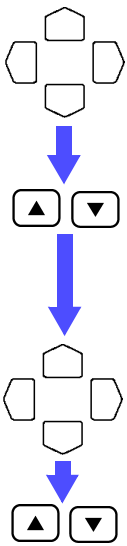
(1) Enable or disable numerical calculations.

(2) Select the numerical calculation to be performed.

(3) Select the channels on which to apply the numerical.

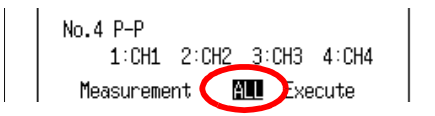
❖ See Section 8.1.1 "Calculating in Real Time During Measurement" (page 147.)

(4) Select the calculation area.



Selecting the item and channel(s) for calculation.

Move the blinking cursor to the position shown.

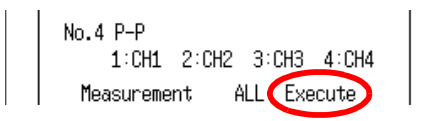


Set the calculation area.

Selection

ALL (All waveforms), A-B (Between A and B)

Move the blinking cursor to the position shown.



Perform the calculation.

When numerical calculations are finished, the Numeric Calculation + Waveforms Screen is displayed. Calculation will be printed out and saved when printing and saving of the calculation result are set to ON.

NOTE

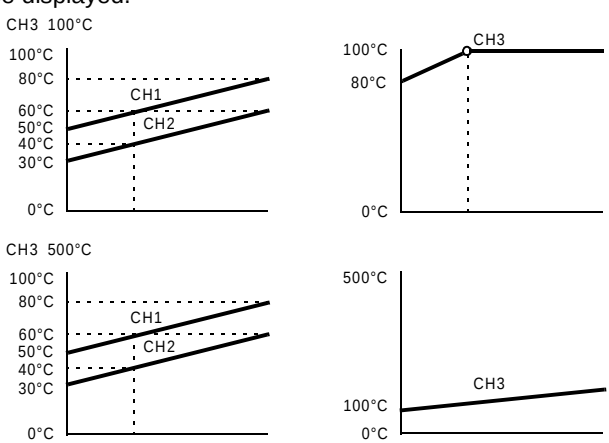
- When using the A-B cursors for calculation, the area must be specified on the Waveform Screen beforehand.
- Even if the A-B cursors are displayed on the Waveform Screen, unless calculation is specifically set to apply to the area between the cursors, it applies to all waveforms.

8.2 Performing Waveform Calculation of Measurement Data

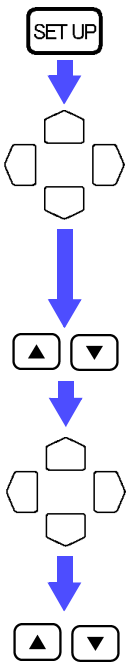
- The waveform calculation function performs addition (+) or subtraction (-) of two analog channel measurements (after scaling) and stores the results in a channel, in real time. This records differences in potential and temperature between two measuring points.
- The waveform calculation results are stored in accordance with the resolution of the recording channel.
  If a calculation result exceeds the full-scale value of the recording channel, the waveform will default to the full-scale value.
  The display will indicate "+OVER" and the cursor measurement result, calculation result, and stored data will be handled as the full-scale value of the range.

Example ▶▶ **Calculation equations CH3 = CH1 + CH2**

CH1: 100°Cf.s. (resolution = 0.01°C)
CH2: 100°Cf.s. (resolution = 0.01°C)
When the CH3 range is set to 100°Cf.s. (resolution = 0.01°C), the sum of the CH1 and CH2 measurements is stored in CH3, at a resolution of 0.01°C. If the sum of CH1 and CH2 exceeds 100°C, the waveform of CH3 will be saturated and it will be clipped at the top of the screen.
The display will indicate "+OVER" and the cursor measurement result, calculation result, and stored data will be handled as the full-scale value of the range.
When the CH3 range is set to 500°Cf.s. (resolution = 0.1°C), the sum of the CH1 and CH2 measurements is stored into CH3, at a resolution of 0.1°C. If the CH1 or CH2 measurement reaches its full-scale value, the waveform of CH3 will not be saturated and it will be displayed.

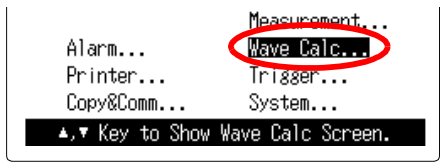


(1) Enable or disable waveform calculations.



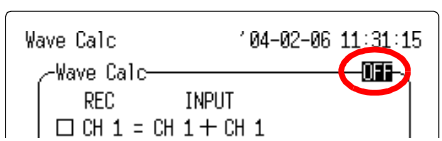
Display the Status Screen.

Move the blinking cursor to the position shown.



Display the Measurement Screen.

Move the blinking cursor to the position shown.

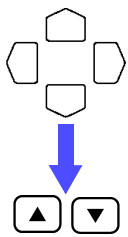


Set the waveform calculation ON or OFF.

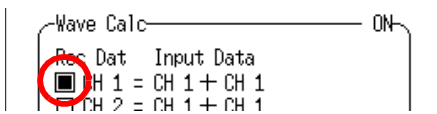
Selection

OFF	Waveform calculations are disabled.
ON	Waveform calculations are enabled.

(2) Select the channels on which to apply the waveform calculations.



Move the blinking cursor to the check box next to the channel in which you want to store the calculation result.



Select the channel.

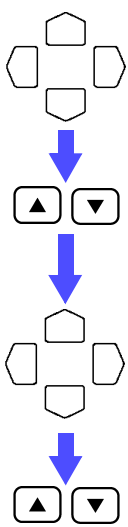
Selection

☐	A waveform calculation is disabled on this channels.
☑	A waveform calculation is enabled on this channels.

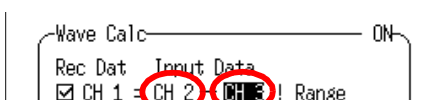
NOTE

Waveform calculations will be performed on (☑) channels enabled measurement on the Status Screen.

(4) Set the processing equation.



Move the blinking cursor to an input data channel.

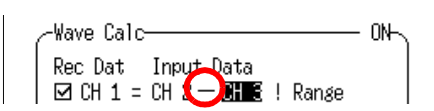


Set the input data channels.

Selection

CH1 to CH32

Move the blinking cursor to the position shown.



select + or -.

Selection

+	Adds two channel measurements.
-	Subtracts one channel measurement from the other channel measurement.

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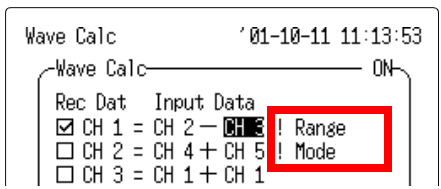
- The measurement data before calculation will be used for the channels on the right side of the equation.
  After all the calculations are completed, the calculation result will override the measurement data.
- If the input types or ranges of the recording channel and the input data channels are different, the following warnings will be shown on the right side of the equation.



! Range	The ranges of the input data channels are different. The lower resolution will be used for calculation.
! Mode	The input types of the input data channels are different. The calculation result may not be correct.

Example ▶▶ **When you set "CH3 = CH1 + CH2" and "CH4 = CH3 + CH4"**

The following data will be stored in CH1 to CH4.
(Data stored in CH1) = (CH1 input data)
(Data stored in CH2) = (CH2 input data)
(Data stored in CH3) = (CH1 input data + CH2 input data)
(Data stored in CH4) = (CH3 input data + CH4 input data)
The data stored in CH4 is NOT CH3 calculation result + CH4 input data (= CH1 input data + CH2 input data + CH4 input data).

(5) Performing waveform calculations.

START /MARK

Start measuring.
Waveform calculations are performed as data is acquired.

Data obtained after the waveform calculation will appear on the Waveform Screen.

Trigger Functions 9

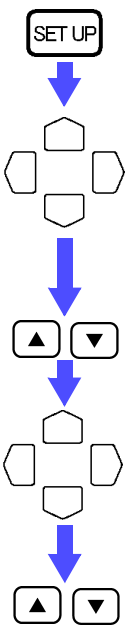
- The term "trigger" refers to a signal used to control recording start or stop times.
  The term "triggering has occurred" refers to the state when such a signal has caused recording to start or stop.
- Trigger parameters for the various functions are set using the Trigger Screen.

Analog Trigger	Level Trigger	A signal input to an analog channel serves as the trigger source.
	Window-In Trigger	
	Window-Out Trigger	
Logic Trigger		A signal input to a logic channel serves as the trigger source. Requires 8993 DIGITAL I/O UNIT.
External Trigger		A signal input to the External trigger terminal serves as the trigger source.
Timer Trigger		Triggering occurs at a preset start time and a preset stop time.

NOTE Trigger conditions can be applied by logical AND and OR operations between all trigger sources.

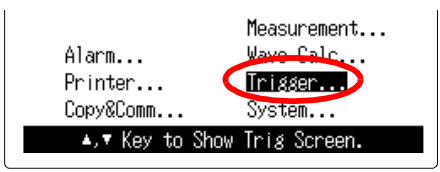
9.1 Setting the Trigger Mode

The trigger mode determines how triggering controls measurement. When all trigger sources are set to OFF, recording begins immediately (free-running).
If the Continuous trigger mode is enabled, data is acquired for the recording period, after which the trigger waiting condition occurs and previously measurement data is erased.



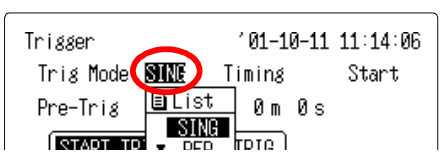
Display the Status Screen.

Move the blinking cursor to the position shown.



Display the Trigger Screen.

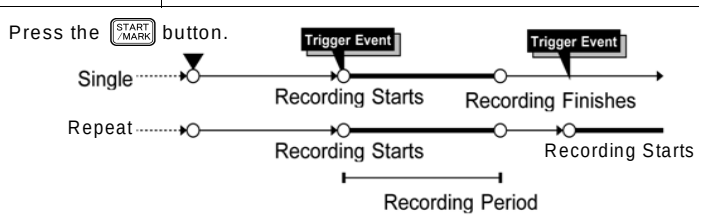
Move the blinking cursor to the position shown.



Set the Trig Mode (trigger mode.)

Selection

SING	A trigger can occur only once. After the START /MARK button is pressed, waveform recording starts when triggering occurs, and continues for the preset recording period. Measurement then stops automatically.
REP	Triggering is continuously enabled. The instrument waits in the trigger standby condition when trigger conditions are not met. Measurement stops when the STOP button is pressed.



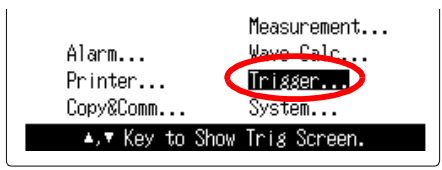
9.2 Setting the Trigger Timing

The moment the trigger occurs, the time related to the waveform being recorded can be set.

SET UP

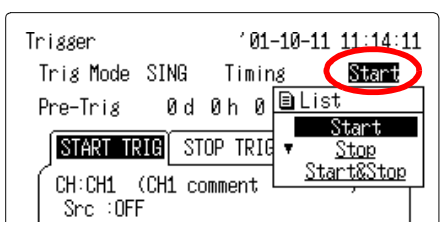
Display the Status Screen.

Move the blinking cursor to the position shown.



Display the Trigger Screen.

Move the blinking cursor to the position shown.



Set the Timing (trigger timing.)

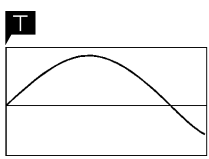
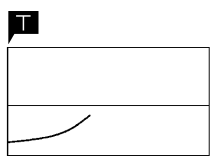
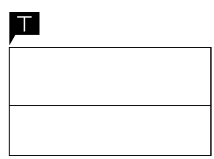
Selection

Start	Recording starts as soon as the trigger is applied.
Stop	Recording starts only when the START/MARK button is pressed, and stops when the trigger is applied.
Start & Stop	Recording starts when the trigger is applied, and stops when the trigger is applied next.

NOTE

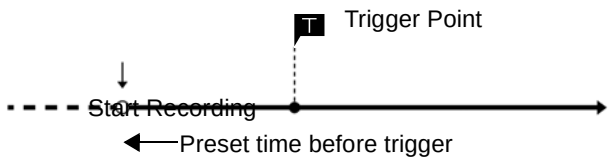
When the trigger timing is set to Stop or Start & Stop, measured waveform data equivalent to the recording length is saved if the stop triggering is not generated between the initiation of measurement and the end of the set time related.

- Trigger mode is set to "**SINGLE**": Stop measurement.
- Trigger mode is set to "**REPEAT**" and trigger timing is set to "**STOP**": Wait for trigger.
- Trigger mode is set to "**REPEAT**" and trigger timing is set to "**START & STOP**": Wait for start trigger.

Trigger Mode: SINGLE	Trigger Mode: REPEAT Trigger Timing: STOP	Trigger Mode: REPEAT Trigger Timing: START&STOP
Measurement ends. 	Measurement starts again. 	The system awaits the start trigger. (trigger wait status) 

9.3 Setting the Pre-Trigger

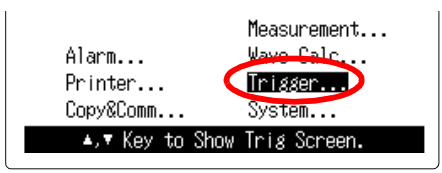
When the trigger timing is set to "START" or "START & STOP," the waveforms occurring before the trigger is applied will be recorded, as well as those occurring after the trigger is applied.



SET UP

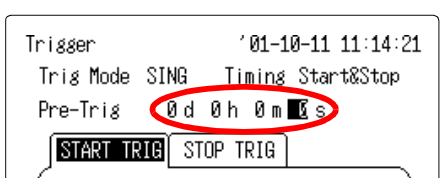
Display the Status Screen.

Move the blinking cursor to the position shown.



Display the Trigger Screen.

Move the blinking cursor to the position shown.



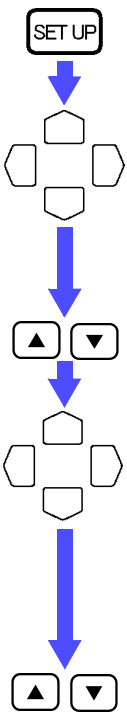
Set the Pre-Trigger.

The maximum pre-trigger period is 95% of the maximum recording period.

NOTE When pre-trigger is enabled and the START /MARK button is pressed, Pre-Trigger Waiting is displayed for a length of time equal to the pre-trigger period, during which triggers are disabled. Afterwards, Trigger Waiting is displayed while awaiting a trigger event.

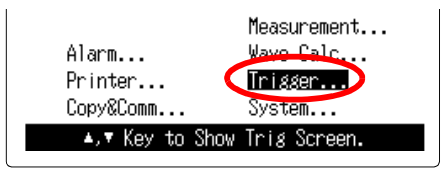
9.4 Setting the Start/Stop Trigger Condition

You can set start trigger conditions when the trigger timing is set to "START" and set the stop trigger conditions when the trigger timing is set to "STOP."
When the trigger timing is set to "START & STOP," you can set the start trigger conditions and the stop trigger conditions for individual channels separately.



Display the Status Screen.

Move the blinking cursor to the position shown.



Display the Trigger Screen.

Move the blinking cursor to the position shown.

Select using the ◀◀/▶▶ buttons.

Select "**START TRIG**" or "**STOP TRIG**."

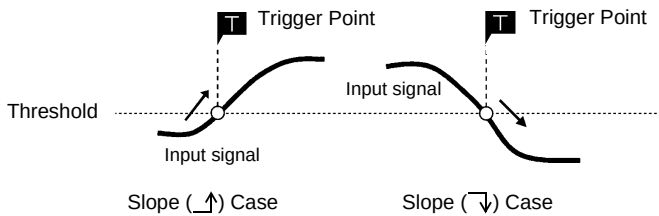
Selection

START TRIG	Sets the start trigger conditions.
STOP TRIG	Sets the stop trigger conditions.

9.5 Setting the Trigger Function

9.5.1 Level Triggers

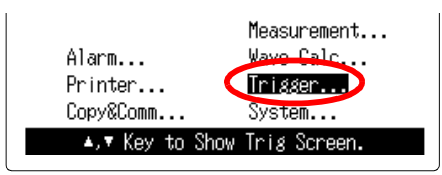
A trigger can be set to occur whenever the input signal crosses a preset threshold level with a rising(↑) or falling(↓) slope.



SET UP

Display the Status Screen.

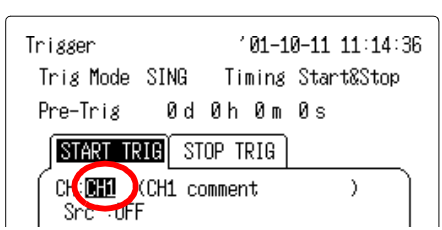
Move the blinking cursor to the position shown.



▲ ▼

Display the Trigger Screen.

Move the blinking cursor to the position shown.



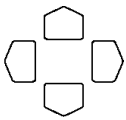
▲ ▼

Select the channels to be used for triggering.

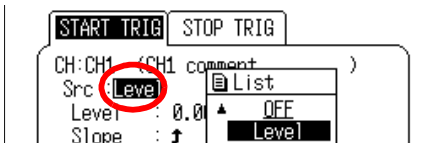
Selection

CH1 to CH32 or P1 to P4

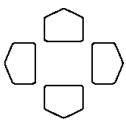
9



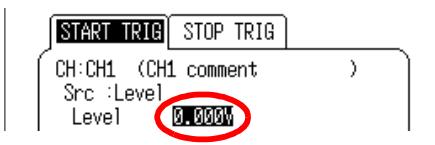
Move the blinking cursor to the position shown.



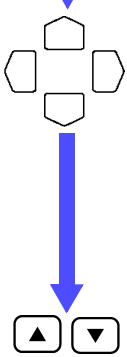
Select "**Level**."



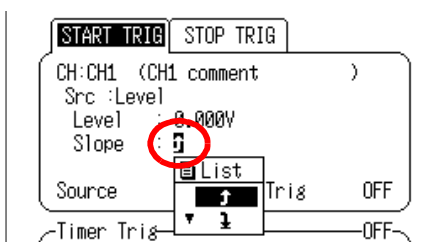
Move the blinking cursor to the position shown.



Set the Level (trigger level.)



Move the blinking cursor to the position shown.



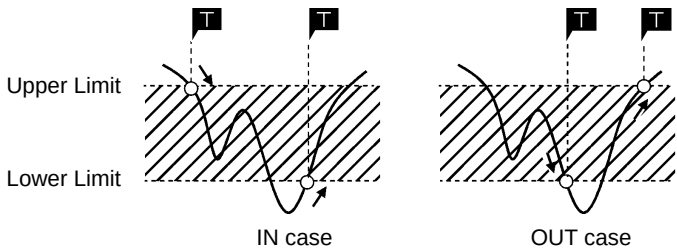
Set the Slope type.

Selection

↑	The trigger condition is met on a rising slope (↑).
↓	The trigger condition is met at the same level, but on a falling slope (↓).

9.5.2 Window Triggers

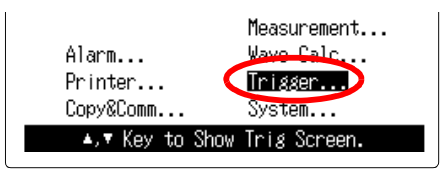
A trigger can be set to occur whenever the input signal enters (IN) or exits (OUT) a range of amplitudes specified by upper and lower limits.



SET UP

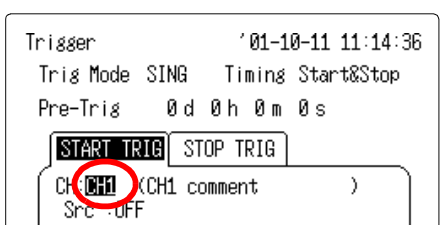
Display the Status Screen.

Move the blinking cursor to the position shown.



Display the Trigger Screen.

Move the blinking cursor to the position shown.



Select the channels to be used for triggering.

Selection

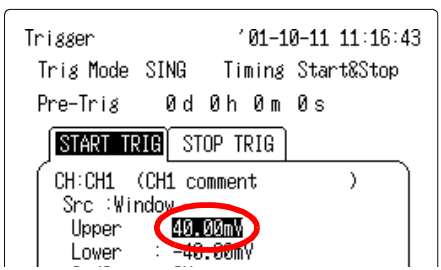
CH1 to CH32 or P1 to P4

9

Move the blinking cursor to the position shown.

Select "**Window**."

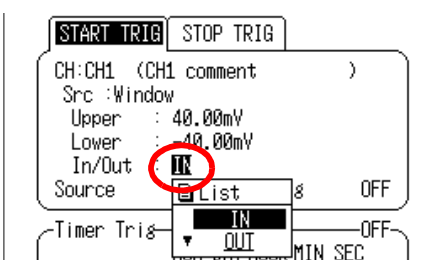
Move the blinking cursor to the position shown.



Set the upper limit of the trigger level.

Move the blinking cursor to the Lower position to set the lower limit. The lower limit can only be set to a value that is less than the upper limit (and vice versa).

Move the blinking cursor to the position shown.



Select "**IN**" or "**OUT**."

Selection

IN	The trigger is activated when the input signal appears in the window (upper and lower limits).
OUT	The trigger is activated when the input signal disappears from the window (upper and lower limits).

9.5.3 Logic Triggers

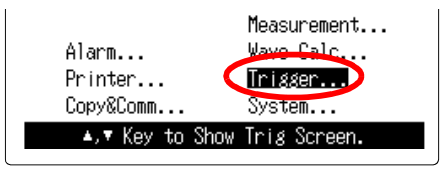
Logic Trigger requires the 8993 DIGITAL I/O UNIT.
A logic channel input signal serves as a trigger.
Trigger patterns (1/0/X) can be set and combined with logical AND and OR operators to specify a particular trigger logic condition.

1 = High level signal
0 = Low level signal
X = Ignore signal level

SET UP

Display the Status Screen.

Move the blinking cursor to the position shown.

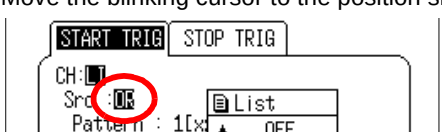


Display the Trigger Screen.

Move the blinking cursor to the position shown.

Set the channel to set a trigger to "LI."

Move the blinking cursor to the position shown.

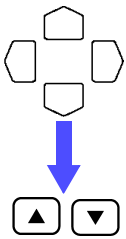


Set the Src (trigger conditions.)

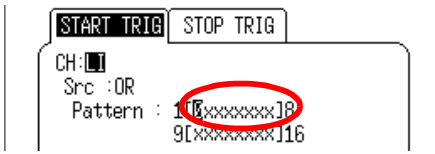
Selection

OR	Triggering is activated when any one of the trigger conditions is met.
AND	Triggering is activated when all of the trigger conditions are met.

9



Move the blinking cursor to the position shown.



Set the Pattern (trigger pattern.)

Selection

1, 0, or X

9.5.4 Trigger Level Resolution

The resolution of the level trigger and upper and lower limit settings for window triggering depend on the measurement object and range, as follows:

Measurement Objects	Range	Trigger Resolution	Maximum Resolution
Voltage	100 mV f.s.	500 µV	5 µV
	1 V f.s.	5 mV	50 µV
	10 V f.s.	50 mV	500 µV
	100 V f.s.	500 mV	5 mV
	1-5 V f.s.	50 mV	500 µV
Temperature	100°C f.s.	0.5°C	0.01°C
	500°C f.s.	2.5°C	0.1°C
	2000°C f.s.	10°C	0.5°C
Humidity	100 %RH	0.5 %RH	0.1 %RH
Pulse Totalization	50.000 pulses f.s.	250 pulses	1 pulse
	500.000 pulses f.s.	2,500 pulses	10 pulses
	5 M pulses f.s.	25,000 pulses	100 pulses
	100 M pulses f.s.	500,000 pulses	2,000 pulses
	2,500 M pulses f.s.	12,500,000 pulses	50,000 pulses
Pulse (Rotation)	5000 [r/s]	25/ (Rotation rate) [r/s]	1/ (Rotation rate) [r/s]

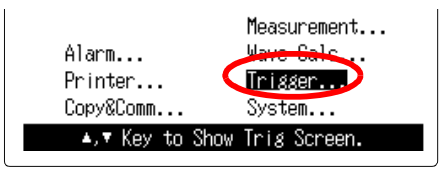
9.6 Trigger Source AND/OR Linking

- Analog trigger, logic trigger, external trigger, and timer trigger (only the start triger) modes can be linked with AND/OR logical operators.
- The start trigger and the stop trigger can be set to AND/OR separately.

SET UP

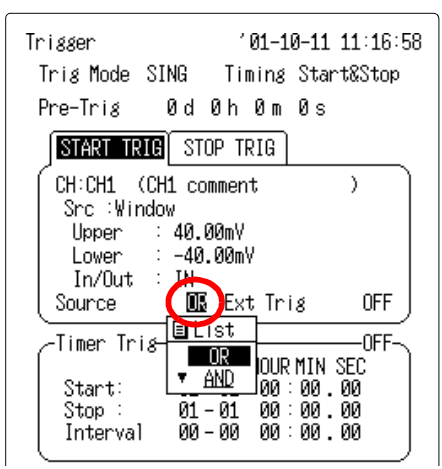
Display the Status Screen.

Move the blinking cursor to the position shown.



Display the Trigger Screen.

Move the blinking cursor to the position shown.

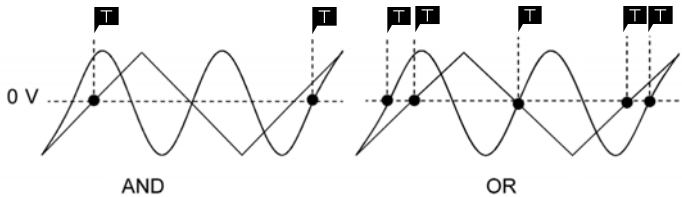


Select "**OR**" or "**AND**."

Selection

OR	Triggering is activated when any one of the trigger conditions is met.
AND	Triggering is activated when all of the trigger conditions are met.

When the trigger level setting is 0.00 V(_↑) for channels 1 and 2, the operational difference between AND/OR linking is as shown below.

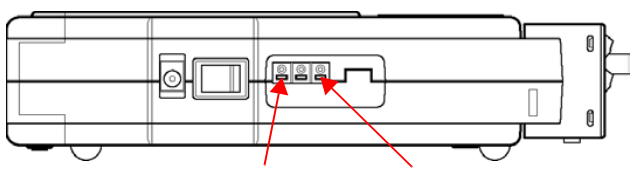


NOTE If trigger sources are ANDed, and the trigger conditions have already been met when the START /MARK button is pressed, triggering does not occur. Triggering occurs only when the conditions are again met after having cleared.

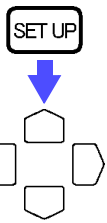
9.7 Setting the External Trigger Function

⚠CAUTION To avoid damaging the instrument, do not apply voltage outside the range -5 to +10 V to the external trigger terminal.

- When the external trigger input is set to "Trig," an external trigger terminal can be used as the trigger.
  ❖ See Section 13.1.6 "Setting Action for External Trigger Input" (page 209.)
- The start trigger and the stop trigger can be set to external trigger separately.
- The external trigger facility can be used to synchronize multiple instruments for parallel operation.

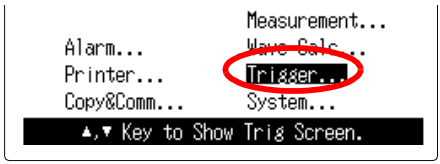


External trigger terminal (EXT TRIG) GND terminal



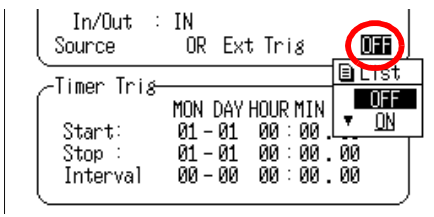
Display the Status Screen.

Move the blinking cursor to the position shown.



Display the Trigger Screen.

Move the blinking cursor to the position shown.



Set the Ext Trig (external trigger) ON or OFF.

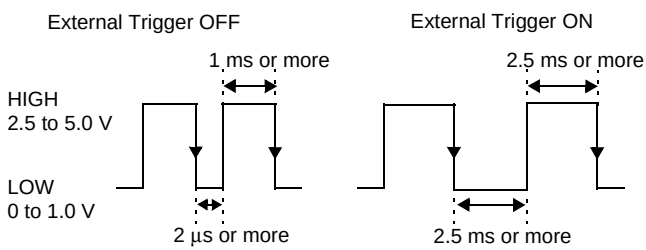
Selection

OFF	External trigger is disabled.
ON	External trigger is enabled.

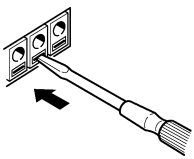
Trigger Signal Inputs

Triggering can be initiated by shorting the external trigger terminal to ground, or at the transition from a high logic level (2.5 to 5.0V) to low level (0 to 1.0V).

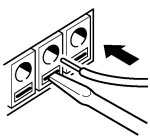
Voltage Range	High level: 2.5 to 5.0 V, Low level: 0 to 1.0 V
Pulse Width	External Trigger Filter OFF HIGH: 1 ms or more, LOW: 2 µs or more External Trigger Filter ON HIGH: 2.5 ms or more, LOW: 2.5 ms or more
Maximum Input Voltage	-5 to 10 V DC
Recommended Wire	Single-strand: ϕ1.0 mm (AWG18) Multi-strand: 0.75 mm^2
Usable Limits	Single-strand: ϕ0.3 to 1.0mm (AWG26 to 18) Multi-strand: 0.3 to 0.75 mm^2 (AWG22 to 20) Strand diameter: ϕ0.18 mm or more
Standard insulation stripping length	10 mm



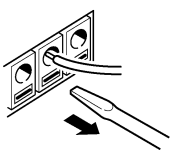
Connecting the wire.



1. Push the tab with a flat-blade screwdriver or similar implement.



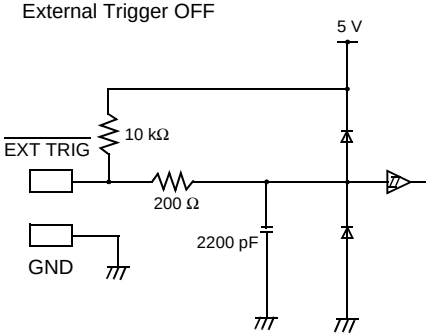
2. While keeping the tab depressed, insert a stripped wire into the connector opening.



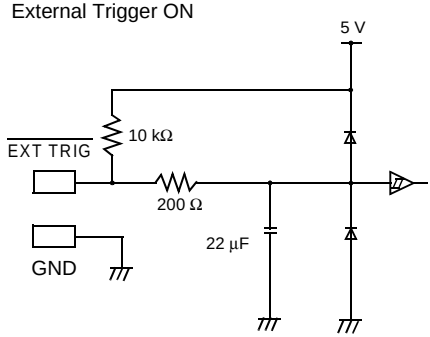
3. Release the tab to lock the wire.

External Trigger Input Circuit Diagram

External Trigger OFF



External Trigger ON

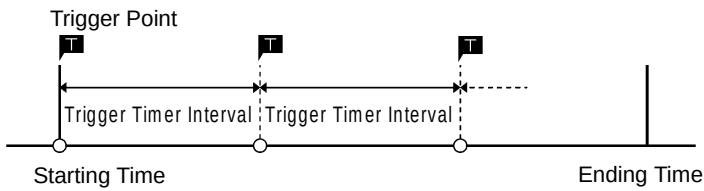


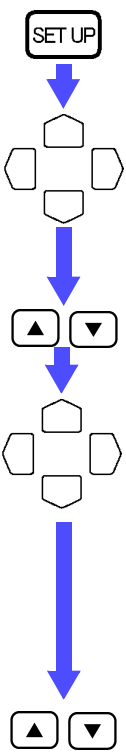
NOTE

- To use an external trigger, the external trigger input has to be set to "Trig" on the System Screen.
- External trigger filter is available for chattering prevention.
  ❖ See Section 13.1.7 "Turning On/Off External Trigger Filter" (page 210.)

9.8 Setting the Timer Trigger Function

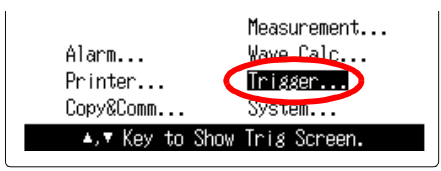
This function activates recording at preset times. Triggering can be performed at regular intervals between a preset start and end time.





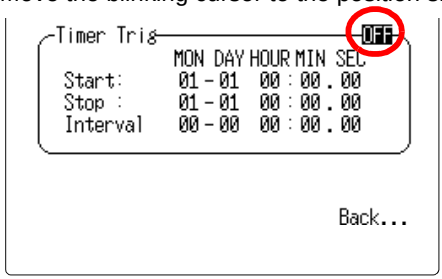
Display the Status Screen.

Move the blinking cursor to the position shown.



Display the Trigger Screen.

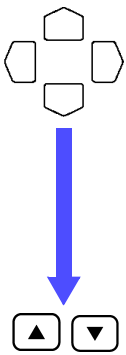
Move the blinking cursor to the position shown.



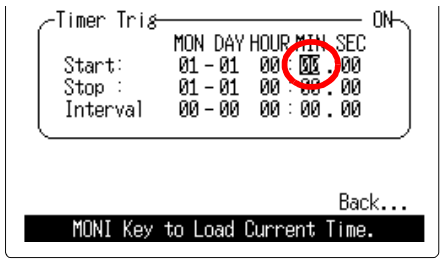
Set the Timer Trig (timer trigger) ON or OFF.

Selection

OFF	Timer trigger is disabled.
ON	Timer trigger is enabled.



Move the blinking cursor to the position shown.



Set the starting time.

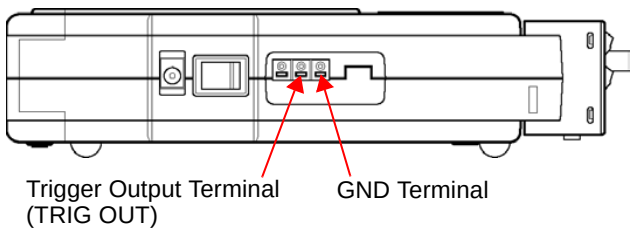
Press the (MONIT) button to set the current time.
Also set the Stop Time and Interval in the same way.

NOTE

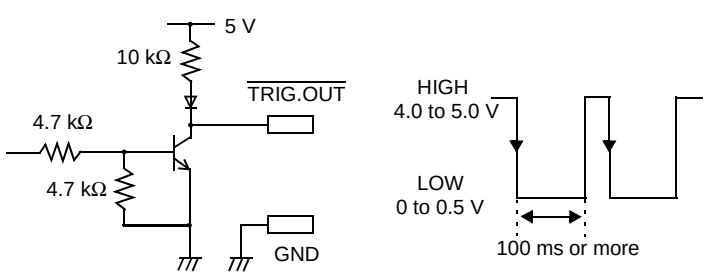
- The timer trigger functions as a start trigger only.
- Set the present time on the System Screen before setting the timer trigger.
- Set the start time and end time later than the time the (START/MARK) button is to be pressed.
- When the trigger mode is set to SINGLE, only one trigger event will be recognized after the start time.
- To record at regular intervals, make the following settings:
  Trigger mode: repeat,
  other trigger sources: all OFF
- When trigger sources are set to OR:
  All trigger sources are valid. If other trigger sources have been set, triggering can occur before the start time and after the end time.
- When trigger sources are set to AND:
  Measurement occurs between the start and end times. Triggering occurs once at the preset intervals if the conditions for the other trigger sources are also met at these times.
- If the interval has been set to 0 s, triggering occurs whenever the conditions for the other trigger sources are met between the start and end times.

9.9 Trigger Output Terminal

- When triggering occurs, a signal is output from the TRIG OUT terminal.
- This can be used to synchronize other instruments.

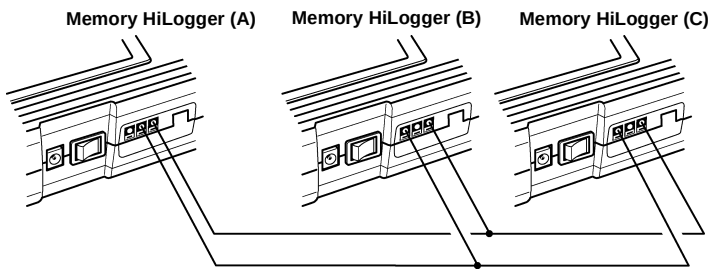


Output Voltage	Open-collector signal (with voltage output), active Low
Output Voltage Range	High level: 4.0 to 5.0 V Low level: 0 to 0.5 V
Pulse Width	Low level: 100 ms or more
Maximum Input Voltage	-20 V to +30 V, 500 mA max., 200 mW max.
Recommended Wire	Single-strand: ϕ1.0 mm (AWG18) Multi-strand: 0.75 mm^2
Usable Limits	Single-strand: ϕ0.3 to 1.0mm (AWG26 to 18) Multi-strand: 0.3 to 0.75 mm^2 (AWG22 to 20) Strand diameter: ϕ0.18 mm or more
Standard Insulation Stripping Length	10 mm



Example of Synchronous Measurements with Multiple Instruments

For parallel synchronous measurements, connect Memory HiLogger (A) trigger output to Memory HiLogger (B) and (C) external trigger inputs as shown in the figure. External triggering must be enabled (ON) in the Memory HiLogger (B) and (C) instruments to receive the external trigger.

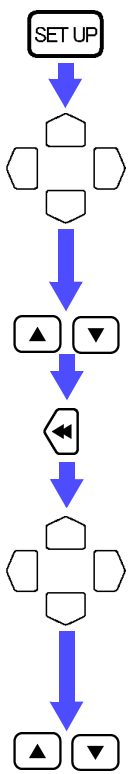


When the trigger condition is set and enabled on Memory HiLogger (A), trigger pulses are output from the TRIG OUT terminal. The Memory HiLogger (B) and (C) instruments are triggered by these pulses to start measurement.

Screen Copy Function 10

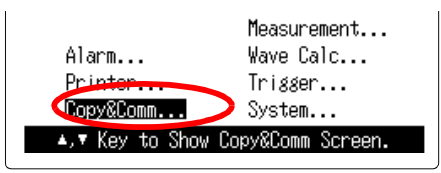
Copy the screen.
Select the output destination for data when this button is pressed.

(1) Enable or disable screen copy output.



Display the Status Screen.

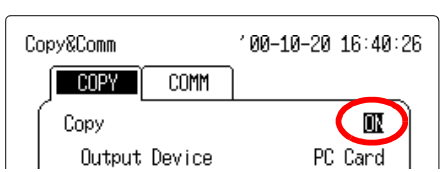
Move the blinking cursor to the position shown.



Display the Copy&Comm Screen.

Display the Copy Window.

Move the blinking cursor to the position shown.

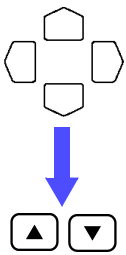


Set the Copy (screen copy output) ON or OFF.

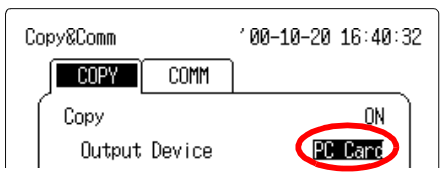
Selection

OFF	Screen copy is disabled.
ON	An image of the screen is sent to the preselected output device.

(2) Set the output device.



Move the blinking cursor to the position shown.

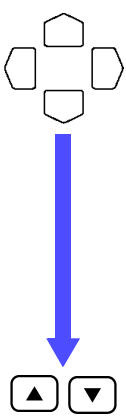


Set the Output Device.

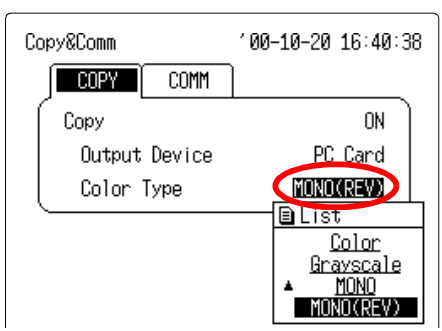
Selection

Printer	Print on the 8992 PRINTER UNIT.
PC Card	Store a BMP-format screen image on the PC Card. (You can select the output coloring.)

(3) Set the output coloring (output device: PC card)



Move the blinking cursor to the position shown.



Set the Color Type (output coloring.)

Selection

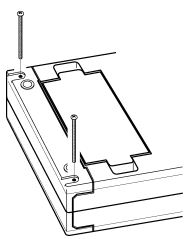
Color	Color output
Grayscale	Grayscale output
MONO	Monochrome output (black background)
MONO(REV)	Monochrome output (reversed) (white background)

Printing Measurement Data 11

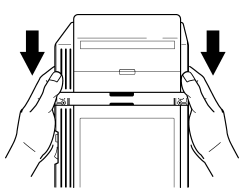
11.1 Preparation

11.1.1 Connecting the 8992 PRINTER UNIT

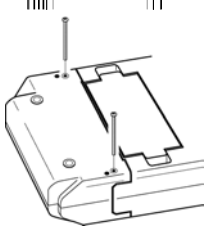
Before connecting or disconnecting the printer, make sure the power switch is off. When the printer is not connected, be sure the cover is installed.



1. Using a plastic-handled screwdriver, remove the two screws that secure the instrument's rear cover, and lift it off.

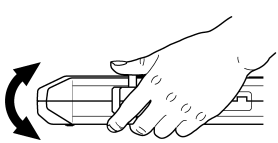


2. Insert the 8992 PRINTER UNIT.



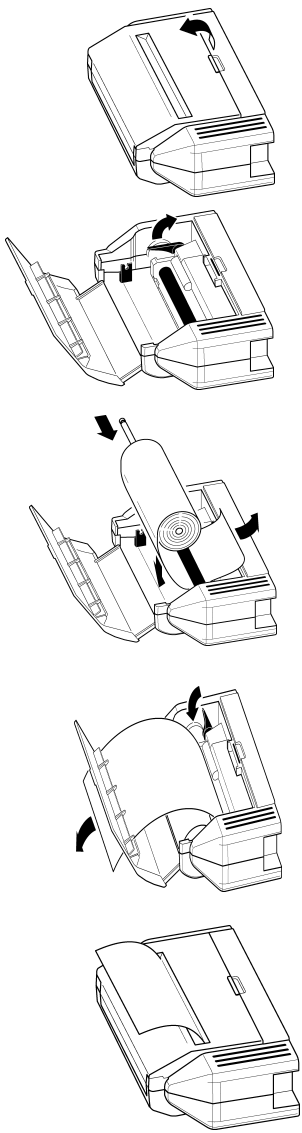
3. Secure with the two screws provided.

If the Printer Unit does not mate easily



Rock the printer slightly as shown while pressing the instruments together.

11.1.2 Loading Recording Paper



1. Lift the stock cover in the direction of the arrow.

2. Lift the head up/down lever. (Lift the printer head.)

3. Insert the leading edge of the recording paper from the back through the gap under the printer roller, and pull it out the front.

   Press the FEED button to feed paper as necessary.

4. Insert the shaft through the center of the paper roll, and set the paper in its holder.

5. Pull the end of the paper out at least 10 cm, and make sure that it is straight.

6. Lower the head up/down lever. (Lower the printer head.)

7. Pull the paper out through the paper exit slot in the stock cover.

8. Close the stock cover, and tear off the paper at the edge of the printer exit slot.

NOTE

- When the stock cover is fully open, attempting to force it open further may damage the cover.
- Please use only the specified recording paper. Using non-specified paper may not only result in faulty printing, but printing may become impossible.
- If the recording paper is skewed on the roller, paper jams may result.
- Always place the instrument in the head-up condition when it is to be transported or stored for an extended period of time. If the instrument is left idle for a long time with the head pressing on the roller, the roller may be deformed, resulting in uneven printing.
- Printing is not possible if the front and back of the recording paper are reversed.

11.2 Setting the Printing Methods

This chapter describes the methods for printing measurement data. Seven methods are available.

Manual Printing	Press the PRINT button to print waveforms when finished measurement.	❖See Section 11.2.1.
Real-Time Printing	Measurement data is printed continuously as it is acquired.	❖See Section 11.2.2.
Partial Printing	The portion of a waveform selected by the A-B cursors is printed.	❖See Section 11.2.3.
Numerical Value Printing	Measurement data is printed as numerical values.	❖See Section 11.2.4.
Hybrid Printing	Both graphical and numerical waveform data is printed.	❖See Section 11.2.4.
Screen Copy	Pressing the COPY button prints the currently displayed screen. During measurement, the instantaneous value is printed.	❖See Chapter 10.
List Printing	Pressing the PRINT button when the Waveform Screen is not displayed causes the setting conditions to be printed.	❖See Section 11.2.5.
Report Printing	Pressing the COPY button while holding the FEED button down prints the waveform shown on the Waveform Screen along with the setting conditions.	

NOTE

- As much as possible, avoid printing in hot and humid environments. Otherwise, printer life may be severely shortened.
- Printing is only possible when the optional 8992 PRINTER UNIT is connected to the instrument.
- The length of recording paper remaining (in cm) is printed at the end of each print job. This number is reset when a new roll of recording paper is loaded.
- For grid and time value setting, see the following pages.
  - ❖ Grid Setting:
    See Section 13.1.3 "Setting the Display Format" (page 206.)
  - ❖ Time Value Setting:
    See Section 13.1.5 "Setting the Format of the Time Data" (page 208.)

11.2.1 Printing Manually (Manual Printing)

WAVE

Display the Waveform Screen after measurement has been completed.

PRINT

Print the waveform.

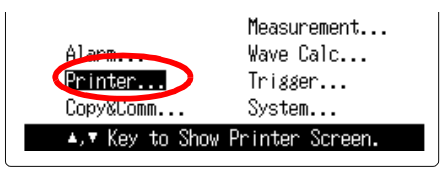
11.2.2 Printing Continuously in Real Time (Real Time Printing)

Measurement data is printed continuously in real time. Printing density can be darkened by setting the time axis.

SET UP

Display the Status Screen.

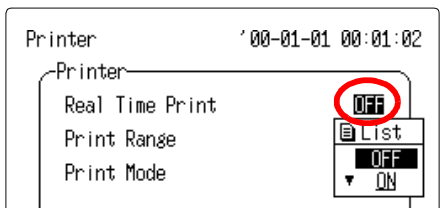
Move the blinking cursor to the position shown.



▲ ▼

Display the Printer Screen.

Move the blinking cursor to the position shown.



Set the Real Time Print ON or OFF.

Selection

OFF	Real-time printing is disabled.
ON	Real-time printing is enabled.

START /MARK

Start measurement.
The waveform prints simultaneously as it appears on the display.
During measurement, printing can be switched on and off by the PRINT button.

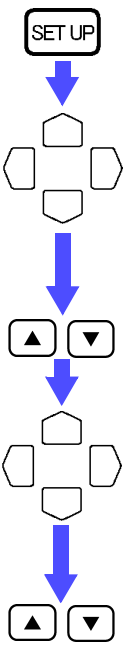
By pressing the COPY button, the current numeric measurement data (instantaneous value) will be printed out.

NOTE

- Real-time printing will not be performed with the print mode set to "**Wave**" or "**Hybrid**," and the time axis set to 1sec./division or 2sec./division. Moreover, real-time printing uses the time axis and waveform sheet selected at the start of measurement.
- Real-time printing is not possible when printing numerical values, or when the printing interval is between 0.1 s and 4.9 s.
- Real-time printing is disabled when partial printing between A-B cursors is enabled.
- During real-time printing, the " " icon appears at the bottom right of the screen.

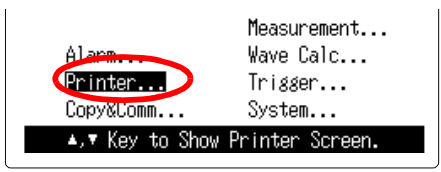
11.2.3 Printing a Specified Range of Data (Partial Printing)

The area to print (manually) can be selected from All Waveforms or A-B, using the PRINT button.
Setting A-B enables printing only the area selected between the A and B cursors on the Waveform Screen.



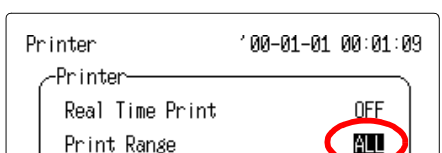
Display the Status Screen.

Move the blinking cursor to the position shown.



Display the Printer Screen.

Move the blinking cursor to the position shown.



Set the Print Range (printing area.)

Selection

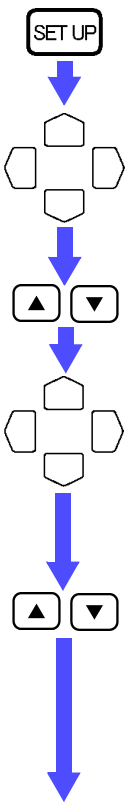
ALL	Print all data stored in internal memory.
A-B (partial printing)	Print only the data between A and B cursors. When only cursor A is displayed, the waveform prints from this cursor to the end of the waveform.

NOTE

- Regardless of whether the A-B cursors are displayed on the Waveform Screen, all of the waveform is printed unless the A-B printing function is enabled.
- See Section 6.5 "A-B Cursor Measurement" (page 106) for information on A-B cursor usage.
- Real-time printing starts when measurement starts, regardless of any specified print area.

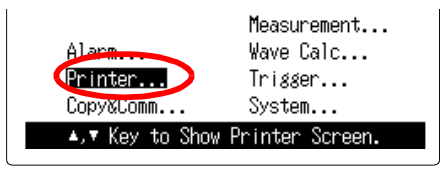
11.2.4 Setting the Print Mode (Numerical Value Printing/ Hybrid Printing)

The types of measurement data to be printed can be set as follows. Three selections are available: Waveforms, Numerical Values, and Waveforms + Numerical Values.
❖See Section 11.6 "Printing Examples" (page 194.)



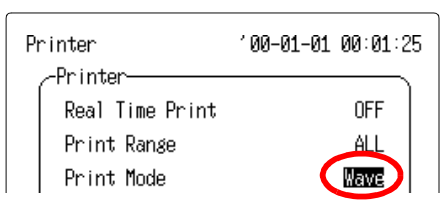
Display the Status Screen.

Move the blinking cursor to the position shown.



Display the Printer Screen.

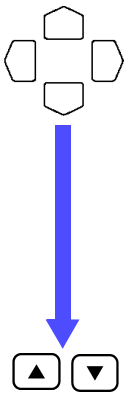
Move the blinking cursor to the position shown.



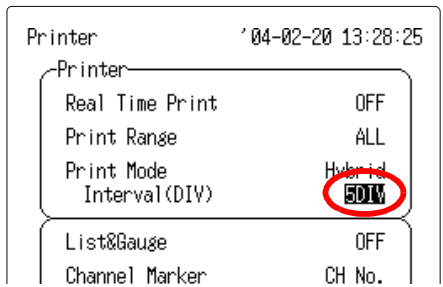
Set the Print Mode.

Selection

Wave	Prints waveforms
Logging	Prints numerical values. The printing interval can also be set.
Hybrid	Prints both waveforms and numerical values. The printing interval can also be set.



Move the blinking cursor to the position shown.



Set the Interval (printing interval.)

When the printing mode is set to "**Logging**" or "**Hybrid**", the printing interval can also be set.

- When "**Logging**" is selected, enter time.
- When "**Hybrid**" is selected, set the number of divisions at intervals at which the numeric values are printed.

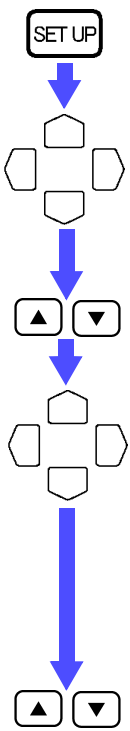
NOTE

- For Waveform printing, only the waveform on the Waveform Sheet (S1 to S4) that is displayed on the Waveform Screen can be printed. Numerical Value printing applies to the channel for which measurement is enabled, regardless of the Waveform Sheet.
- For Numerical Value printing, if the printing interval is set to be longer than the recording period, only the first data point is printed.

11.2.5 Printing Settings and Gauge (List Printing/ Gauge Printing)

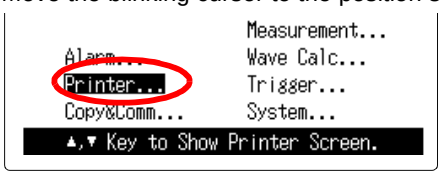
For Waveform or Waveforms + Numerical Values printing (other than by the Screen Copy function), the gauge is printed first, and the list is printed at the end, if enabled. The list of setting conditions can be printed by pressing the PRINT button beside the Waveform Screen (List Print).

❖See Section 11.6 "Printing Examples" (page 194.)



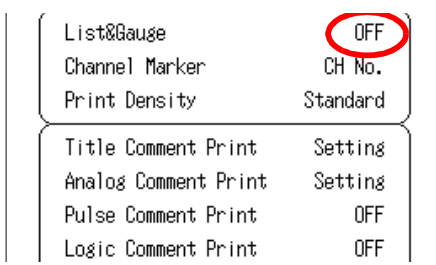
Display the Status Screen.

Move the blinking cursor to the position shown.



Display the Printer Screen.

Move the blinking cursor to the position shown.



Set the List&Gauge.

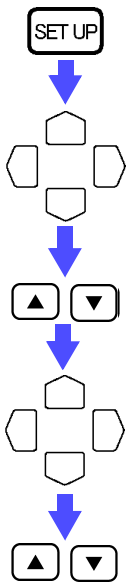
Selection

OFF	The list and gauge do not print.
List	The list is printed.
Gauge	The gauge is printed.
List&Gauge	Both list and gauge are printed.

NOTE The gauge prints only as shown on the Waveform Sheet (S1 to S4) displayed on the Waveform Screen.

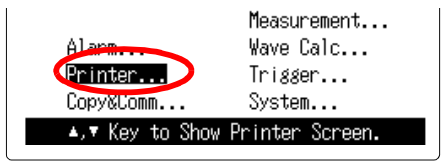
11.3 Printing Channel No. and Comment on Recording Paper (Channel Marker)

Channel numbers and comments can be printed along with waveforms.



Display the Status Screen.

Move the blinking cursor to the position shown.



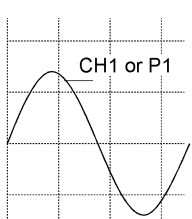
Display the Printer Screen.

Move the blinking cursor to the position shown.

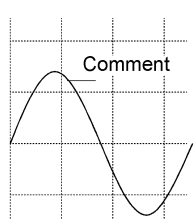
Set the Channel Marker.

Selection

OFF	Channel numbers and comments are not printed with waveforms.
CH No.	Channel numbers are printed with the waveforms.
Comment	The comments for each channel are printed with the waveforms. ❖ Channel Comments: See Chapter 14 "Text Entry Procedure" (page 225.)



Channel Number



Comment

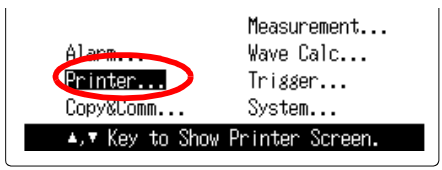
11.4 Setting the Printing Density

Printing density can be selected from three levels.

SET UP

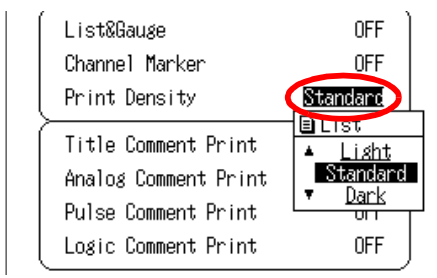
Display the Status Screen.

Move the blinking cursor to the position shown.



Display the Printer Screen.

Move the blinking cursor to the position shown.



Set the Print Density.

Selection

Light	Light printing (minimal power consumption)
Standard	Normal density printing.
Dark	Dark printing

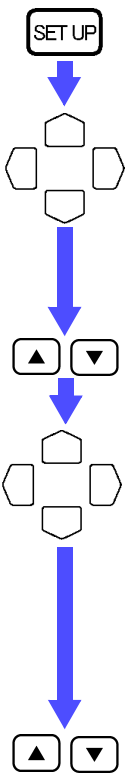
NOTE

Waveform printing density corresponds to the waveform display color.

❖See Section 5.1.6 "Setting the Waveform Screen Color" (page 68.)

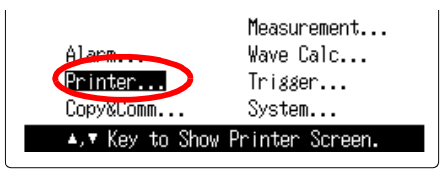
11.5 Comment Printing

Comments and settings can be printed along with waveforms. Even if comments have been entered, they are not printed unless comment printing has been specifically enabled.



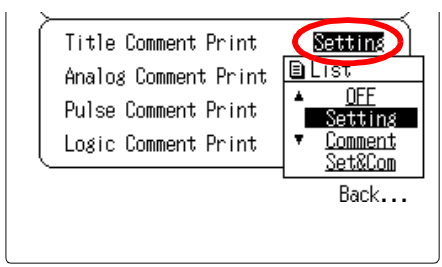
Display the Status Screen.

Move the blinking cursor to the position shown.



Display the Printer Screen.

Move the blinking cursor to the position shown.



Set the comment printing.

Selection

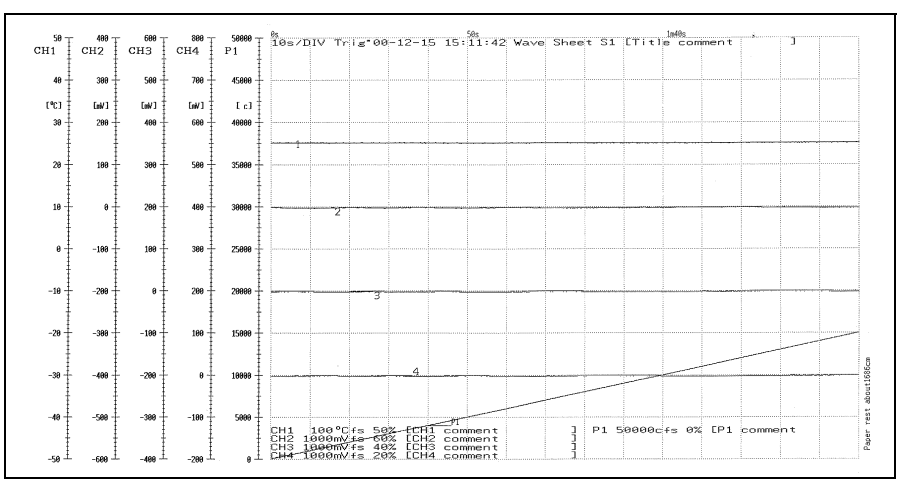
OFF	Settings and comments are not printed.
Setting	Settings are printed.
Comment	Comments are printed.
Set&Com	Both settings and comments are printed.

Printing Contents			Reference
Title Comment Print	Comments	Enter from Status Screen	❖See Section 4.1.
	Settings	Time axis, Measurement starting time	
Analog Comment Print	Comments	Enter from Channel Screen	❖See Section 5.1.
	Settings	Range, Display position (or upper and lower limits*)	
Pulse Comment Print	Comments	Enter from Channel Screen	❖See Section 5.2.
	Settings	Range, Display position (or upper and lower limits*)	
Logic Comment Print	Comments	Enter from Channel	❖See Section 5.3.

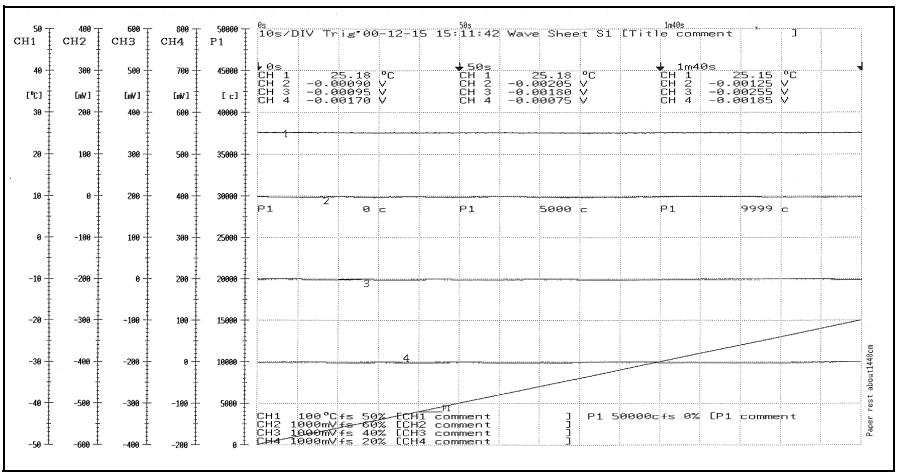
* When the display area is confined by upper and lower limits, or scaling is enabled.

11.6 Printing Examples

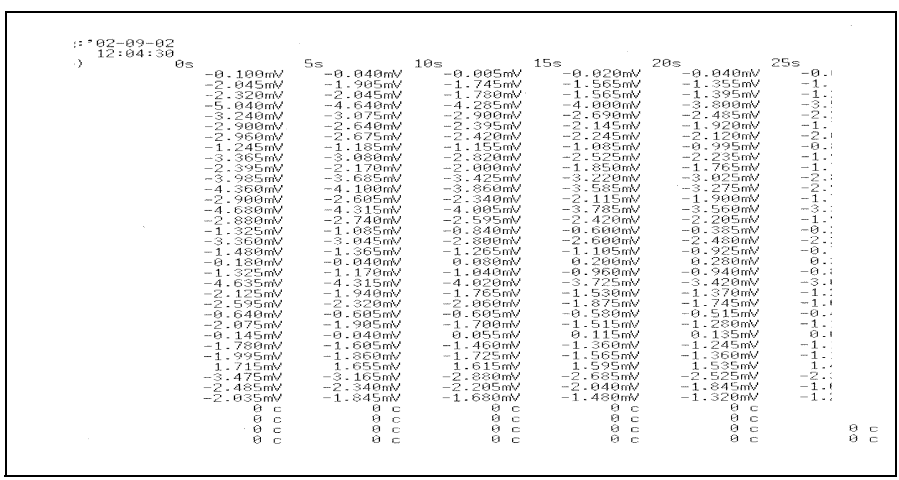
Printing mode: Waveforms



Printing mode: Waveforms + Numerical Values



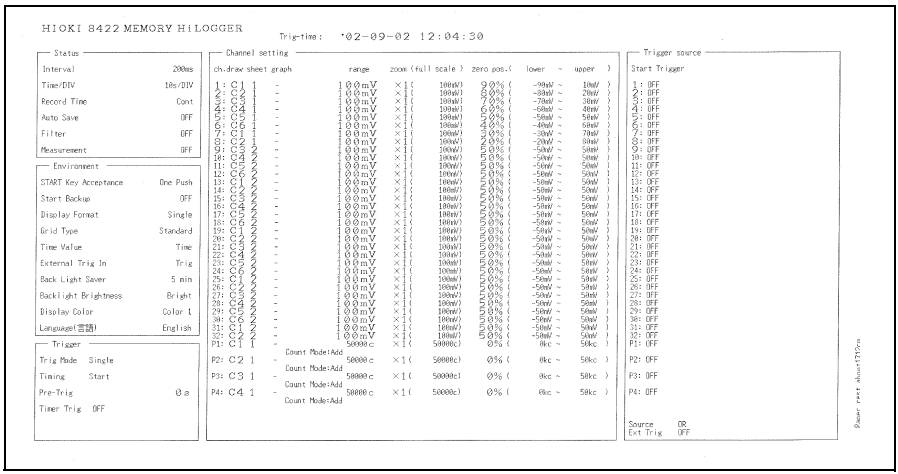
Printing mode: Numerical Values



::*02-09-02
) 12:04:30

0s	5s	10s	15s	20s	25s
-0.100mV	-0.040mV	-0.005mV	-0.020mV	-0.040mV	-0.
-2.045mV	-1.905mV	-1.745mV	-1.565mV	-1.355mV	-1.
-2.320mV	-2.045mV	-1.780mV	-1.565mV	-1.395mV	-1.
-5.040mV	-4.640mV	-4.285mV	-4.000mV	-3.800mV	-3.
-3.240mV	-3.075mV	-2.900mV	-2.690mV	-2.485mV	-2.
-2.900mV	-2.640mV	-2.395mV	-2.145mV	-1.920mV	-1.
-2.960mV	-2.675mV	-2.420mV	-2.245mV	-2.120mV	-2.
-1.245mV	-1.185mV	-1.155mV	-1.085mV	-0.995mV	-0.
-3.365mV	-3.080mV	-2.820mV	-2.525mV	-2.235mV	-1.
-2.395mV	-2.170mV	-2.000mV	-1.850mV	-1.765mV	-1.
-3.985mV	-3.685mV	-3.425mV	-3.220mV	-3.025mV	-2.
-4.360mV	-4.100mV	-3.860mV	-3.585mV	-3.275mV	-2.
-2.900mV	-2.605mV	-2.340mV	-2.115mV	-1.900mV	-1.
-4.680mV	-4.315mV	-4.005mV	-3.785mV	-3.560mV	-3.
-2.880mV	-2.740mV	-2.595mV	-2.420mV	-2.205mV	-1.
-1.325mV	-1.085mV	-0.840mV	-0.600mV	-0.385mV	-0.
-3.360mV	-3.045mV	-2.800mV	-2.600mV	-2.480mV	-2.
-1.480mV	-1.365mV	-1.265mV	-1.105mV	-0.925mV	-0.
-0.180mV	-0.040mV	0.080mV	0.200mV	0.280mV	0.
-1.325mV	-1.170mV	-1.040mV	-0.960mV	-0.940mV	-0.
-4.635mV	-4.315mV	-4.020mV	-3.725mV	-3.420mV	-3.
-2.125mV	-1.940mV	-1.755mV	-1.530mV	-1.370mV	-1.
-2.595mV	-2.320mV	-2.060mV	-1.875mV	-1.745mV	-1.
-0.640mV	-0.605mV	-0.605mV	-0.580mV	-0.515mV	-0.
-2.075mV	-1.905mV	-1.700mV	-1.515mV	-1.230mV	-1.
-0.145mV	-0.040mV	0.055mV	0.115mV	0.135mV	0.
-1.780mV	-1.605mV	-1.460mV	-1.360mV	-1.245mV	-1.
-1.995mV	-1.860mV	-1.725mV	-1.565mV	-1.360mV	-1.
1.715mV	1.655mV	1.615mV	1.595mV	1.535mV	1.
-3.475mV	-3.165mV	-2.830mV	-2.685mV	-2.525mV	-2.
-2.485mV	-2.340mV	-2.205mV	-2.040mV	-1.845mV	-1.
-2.035mV	-1.845mV	-1.680mV	-1.480mV	-1.320mV	-1.
0 c	0 c	0 c	0 c	0 c	
0 c	0 c	0 c	0 c	0 c	
0 c	0 c	0 c	0 c	0 c	0 c
0 c	0 c	0 c	0 c	0 c	0 c

List Printing



HIOKI 8422 MEMORY HiLOGGER

Trig-time: '02-09-02 12:04:30

Status

Interval	200ms
Time/DIV	10s/DIV
Record Time	Cont
Auto Save	OFF
Filter	OFF
Measurement	OFF

Environment

START Key Acceptance	One Push
Start Backup	OFF
Display Format	Single
Grid Type	Standard
Time Value	Time
External Trig In	Trig
Back Light Saver	5 min
Backlight Brightness	Bright
Display Color	Color 1
Language(言語)	English

Trigger

Trig Mode	Single
Timing	Start
Pre-Trig	0 s
Timer Trig	OFF

Channel setting

ch.draw sheet graph	range	zoom (full scale)	zero pos.	lower ~ upper
1: C1 1	100mV	×1 (100mV)	90%	-90mV ~ 10mV
2: C2 1	100mV	×1 (100mV)	80%	-80mV ~ 20mV
3: C3 1	100mV	×1 (100mV)	70%	-70mV ~ 30mV
4: C4 1	100mV	×1 (100mV)	60%	-60mV ~ 40mV
5: C5 1	100mV	×1 (100mV)	50%	-50mV ~ 50mV
6: C6 1	100mV	×1 (100mV)	40%	-40mV ~ 60mV
7: C1 2	100mV	×1 (100mV)	30%	-30mV ~ 70mV
8: C2 2	100mV	×1 (100mV)	20%	-20mV ~ 80mV
9: C3 2	100mV	×1 (100mV)	10%	-10mV ~ 90mV
10: C4 2	100mV	×1 (100mV)	50%	-50mV ~ 50mV
11: C5 2	100mV	×1 (100mV)	50%	-50mV ~ 50mV
12: C6 2	100mV	×1 (100mV)	50%	-50mV ~ 50mV
13: C1 2	100mV	×1 (100mV)	50%	-50mV ~ 50mV
14: C2 2	100mV	×1 (100mV)	50%	-50mV ~ 50mV
15: C3 2	100mV	×1 (100mV)	50%	-50mV ~ 50mV
16: C4 2	100mV	×1 (100mV)	50%	-50mV ~ 50mV
17: C5 2	100mV	×1 (100mV)	50%	-50mV ~ 50mV
18: C6 2	100mV	×1 (100mV)	50%	-50mV ~ 50mV
19: C1 2	100mV	×1 (100mV)	50%	-50mV ~ 50mV
20: C2 2	100mV	×1 (100mV)	50%	-50mV ~ 50mV
21: C3 2	100mV	×1 (100mV)	50%	-50mV ~ 50mV
22: C4 2	100mV	×1 (100mV)	50%	-50mV ~ 50mV
23: C5 2	100mV	×1 (100mV)	50%	-50mV ~ 50mV
24: C6 2	100mV	×1 (100mV)	50%	-50mV ~ 50mV
25: C1 2	100mV	×1 (100mV)	50%	-50mV ~ 50mV
26: C2 2	100mV	×1 (100mV)	50%	-50mV ~ 50mV
27: C3 2	100mV	×1 (100mV)	50%	-50mV ~ 50mV
28: C4 2	100mV	×1 (100mV)	50%	-50mV ~ 50mV
29: C5 2	100mV	×1 (100mV)	50%	-50mV ~ 50mV
30: C6 2	100mV	×1 (100mV)	50%	-50mV ~ 50mV
31: C1 2	100mV	×1 (100mV)	50%	-50mV ~ 50mV
32: C2 2	100mV	×1 (100mV)	50%	-50mV ~ 50mV
P1: C1 1	50000c	×1 (50000c)	0%	0kc ~ 50kc
Count Mode:Add				
P2: C2 1	50000c	×1 (50000c)	0%	0kc ~ 50kc
Count Mode:Add				
P3: C3 1	50000c	×1 (50000c)	0%	0kc ~ 50kc
Count Mode:Add				
P4: C4 1	50000c	×1 (50000c)	0%	0kc ~ 50kc
Count Mode:Add				

Trigger source

Start Trigger

1: OFF
2: OFF
3: OFF
4: OFF
5: OFF
6: OFF
7: OFF
8: OFF
9: OFF
10: OFF
11: OFF
12: OFF
13: OFF
14: OFF
15: OFF
16: OFF
17: OFF
18: OFF
19: OFF
20: OFF
21: OFF
22: OFF
23: OFF
24: OFF
25: OFF
26: OFF
27: OFF
28: OFF
29: OFF
30: OFF
31: OFF
32: OFF
P1: OFF

P2: OFF

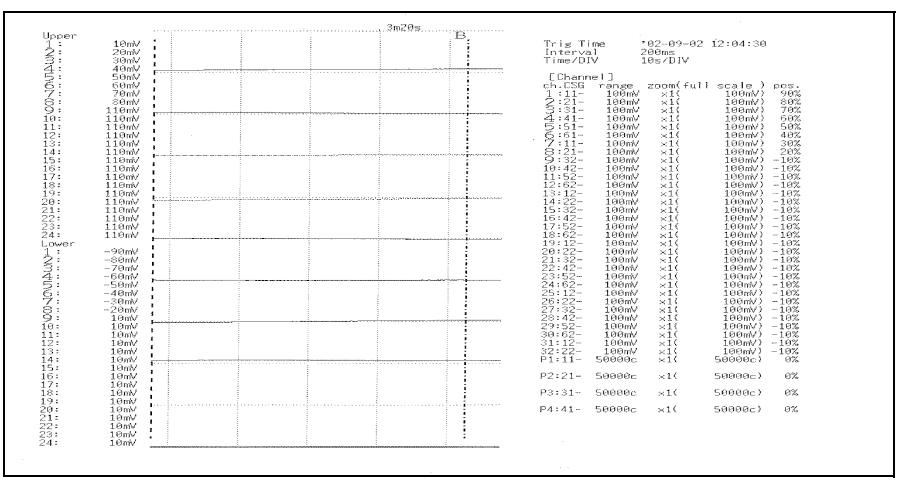
P3: OFF

P4: OFF

Source OR
Ext Trig OFF

Power rest about 1712hrs

Report Printing



Trig Time '02-09-02 12:04:30
Interval 200ms
Time/DIV 10s/DIV

[Channel]

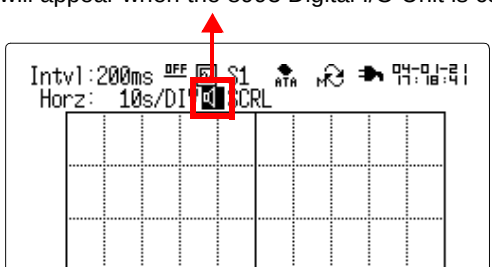
ch.CSG	range	zoom(full scale)	pos.
1:11-	100mV	×1(100mV)	90%
2:21-	100mV	×1(100mV)	80%
3:31-	100mV	×1(100mV)	70%
4:41-	100mV	×1(100mV)	60%
5:51-	100mV	×1(100mV)	50%
6:61-	100mV	×1(100mV)	40%
7:11-	100mV	×1(100mV)	30%
8:21-	100mV	×1(100mV)	20%
9:32-	100mV	×1(100mV)	-10%
10:42-	100mV	×1(100mV)	-10%
11:52-	100mV	×1(100mV)	-10%
12:62-	100mV	×1(100mV)	-10%
13:12-	100mV	×1(100mV)	-10%
14:22-	100mV	×1(100mV)	-10%
15:32-	100mV	×1(100mV)	-10%
16:42-	100mV	×1(100mV)	-10%
17:52-	100mV	×1(100mV)	-10%
18:62-	100mV	×1(100mV)	-10%
19:12-	100mV	×1(100mV)	-10%
20:22-	100mV	×1(100mV)	-10%
21:32-	100mV	×1(100mV)	-10%
22:42-	100mV	×1(100mV)	-10%
23:52-	100mV	×1(100mV)	-10%
24:62-	100mV	×1(100mV)	-10%
25:12-	100mV	×1(100mV)	-10%
26:22-	100mV	×1(100mV)	-10%
27:32-	100mV	×1(100mV)	-10%
28:42-	100mV	×1(100mV)	-10%
29:52-	100mV	×1(100mV)	-10%
30:62-	100mV	×1(100mV)	-10%
31:12-	100mV	×1(100mV)	-10%
32:22-	100mV	×1(100mV)	-10%
P1:11-	50000kc	×1(50000c)	0%
P2:21-	50000c	×1(50000c)	0%
P3:31-	50000c	×1(50000c)	0%
P4:41-	50000c	×1(50000c)	0%

Alarm Function 12

The alarm function is available only when the 8993 DIGITAL I/O UNIT is installed.

When the measured value on any channel matches the pre-defined trigger condition, an alarm signal (active low) is indicated on the instrument display, and output from the loudspeaker and ALM channels of the DIGITAL I/O UNIT.
The alarm status of the output channels (ALM1 to 16) can be set to any input channel. When an alarm is output the LED of the corresponding output channel lights.

This will appear when the 8993 Digital I/O Unit is connected.

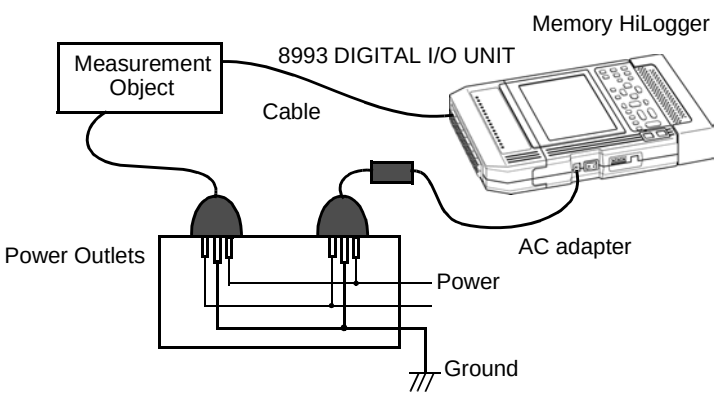


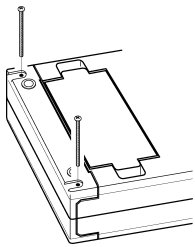
The loudspeaker can be enabled and disabled by the loudspeaker icon on the Waveform Screen.

12.1 Connecting the 8993 DIGITAL I/O UNIT

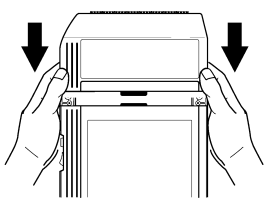
⚠WARNING

The logic inputs share common ground with the instrument. Therefore, electric shock or damage to the instrument could result if the source of power supplied to the instrument by the AC adapter is not the same as that supplied to the measurement object. Even if power is supplied from the same source, potential difference can result from wiring conditions, resulting in unintended current flow through the measurement lead and measurement object which could damage the instrument.
To avoid such hazards, use only power cords with two power conductors plus a ground conductor for both the measurement object and the instrument, and connect both cords to the same mains outlet before connecting the leads to the measurement object.

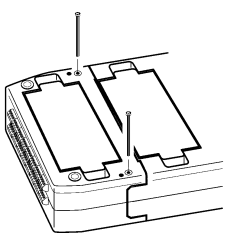




1. Using a plastic-handled screwdriver, remove the two screws that secure the instrument's rear cover, and lift it off.

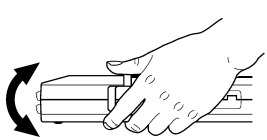


2. Insert the 8993 DIGITAL I/O UNIT.



3. Secure with the two screws provided.

If the Digital I/O Unit does not mate easily



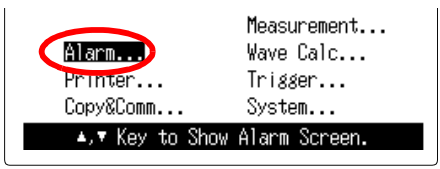
Rock the Digital I/O Unit slightly as shown while pressing the instruments together.

12.2 Setting the Alarm Function

SET UP

Display the Status Screen.

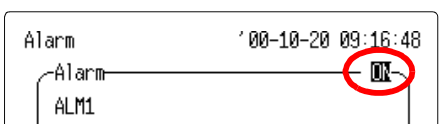
Move the blinking cursor to the position shown.



▲ ▼

Display the Alarm Screen.

Move the blinking cursor to the position shown.



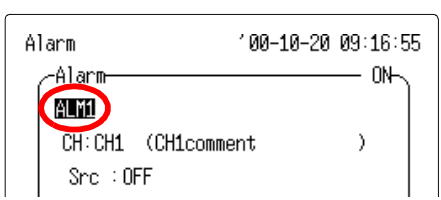
▲ ▼

Enable or disable alarm output.

Selection

OFF or ON

Move the blinking cursor to the position shown.

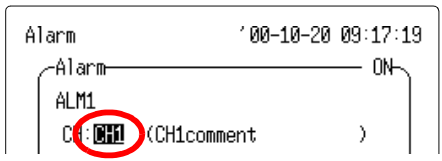


▲ ▼

Select the channel (ALM1 to 16) for alarm output (by setting the alarm status.)

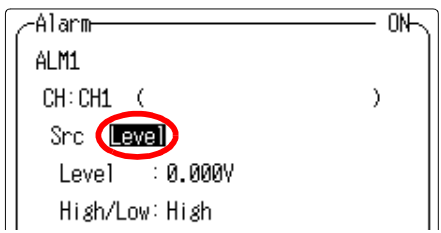
NOTE Channels that are not enabled for alarm conditions have no alarm output.

Move the blinking cursor to the position shown.



Select the input channel (CH 1 to 32, P1 to P4 or LI) to trigger the alarm.

Move the blinking cursor to the position shown.



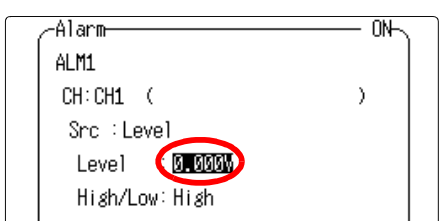
Select either Level or Window alarm triggering.

Selection

OFF	Alarm output is disabled.
Level	An alarm is output when the input signal is above (High/Low: High) or below (High/Low: Low) the specified level.
Window	An alarm is output when the input signal level enters (In/Out: IN) or exits (In/Out: Out) the amplitude range (window) defined by the specified upper and lower values.

Move the blinking cursor down.

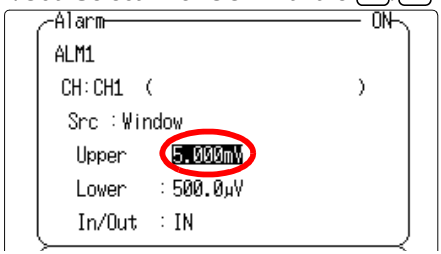
When the "Level" alarm type is selected.
Level: Set the Level value with the ▲/▼ buttons.
High/Low: Select High or Low with the ▲/▼ buttons.

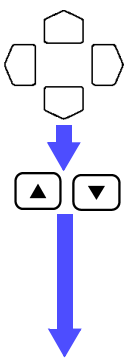


When the "Window" alarm status is selected.

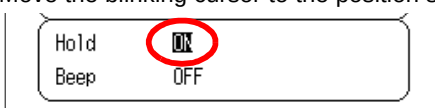
Upper, Lower: Set the upper or lower limit value with the ▲/▼ buttons.

In/Out: Select IN or OUT with the ▲/▼ buttons.





Move the blinking cursor to the position shown.

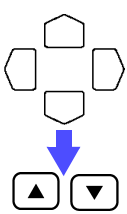


Turn On/Off the alarm hold function.

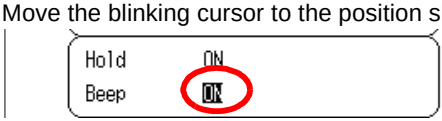
When the alarm condition of a particular alarm channel is satisfied and the alarm is output, specify whether the output condition is latched.

Selection

OFF	The alarm output is removed when the alarm condition disappears.
ON	The alarm output is retained until measurement is finished.



Move the blinking cursor to the position shown.



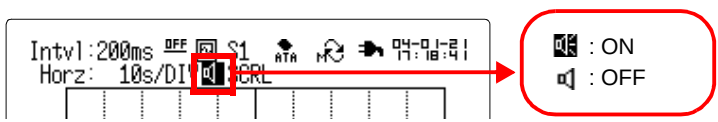
Turn On/Off the alarm sound.

When the alarm condition of a particular alarm channel is satisfied and the alarm is output, specify whether an alarm sound is emitted from the loudspeaker of the instrument.

Selection

OFF	No audible alarm is output when the alarm signal is output.
ON	An audible alarm sound is output from the loudspeaker while the alarm signal is output.

The loudspeaker can be enabled and disabled by the loudspeaker icon on the Waveform Screen.



System Screen 13

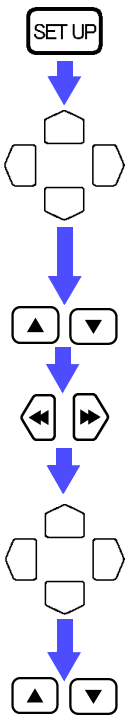
There are three System windows: the Env (Environment) Window, the Setting (Setup Status Window and the Int (Initialization)Window. Refer to the following sections on each of these windows for details.

Env Window (Settings pertaining to the environmental conditions of measurements.)	Start Button Activation Condition	❖ See Section 13.1.1.
	Start Backup After Power Loss	❖ See Section 13.1.2.
	Display Format	❖ See Section 13.1.3.
	Grid Types	❖ See Section 13.1.4.
	Format of the Time Data	❖ See Section 13.1.5.
	External Trigger Input	❖ See Section 13.1.6.
	External Trigger Filter	❖ See Section 13.1.7.
	Backlight Saver	❖ See Section 13.1.8.
	Backlight Brightness	❖ See Section 13.1.9.
	Screen Color	❖ See Section 13.1.10.
	Language	❖ See Section 13.1.11.
Setting Window (Settings pertaining to saving, loading, deleting and automatic settings of setup conditions.)		❖ See Section 13.2.1.
Init Window (Perform the system reset and self-check from here.)	Time Settings	❖ See Section 13.3.1.
	Delete Waveforms	❖ See Section 13.3.2.
	System Reset	❖ See Section 13.3.3.
	Self-Check	❖ See Section 13.3.4.

13.1 Env (Environment) Window

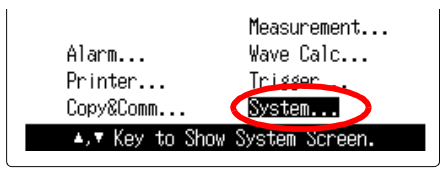
13.1.1 Setting the Start Button Activation Condition

Measurement is normally started by pressing the START/MARK button once, but to reduce the chance of inadvertent operation, the activation condition of the START/MARK button can be set to require multiple presses.



Display the Status Screen.

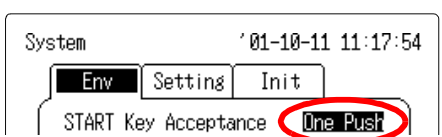
Move the blinking cursor to the position shown.



Display the System Screen.

Display the Env Window.

Move the blinking cursor to the position shown.



Set the START Key Acceptance.

Selection

One Push	Start measuring with one press of the START/MARK button.
Two Push	Start measuring with two presses of the START/MARK button.
2s Push	Start measuring with pressing START/MARK button for two seconds.

NOTE

When the START/MARK button activation condition is set to 2s Push, Waiting for 2s... is displayed when the START/MARK button is pressed. After holding the START/MARK button for two seconds, this message disappears and measurement begins.

13.1.2 Setting the Start Backup After Power Loss

Select whether recording automatically resumes when power is restored after it is cut off during recording (while the LED above the START /MARK button is lit green).

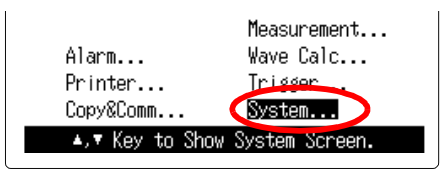
If Start Backup is On:
When the power supply is restored, the instrument erase previous measurement data, and recording is restored immediately.
If the trigger function is used, the instrument goes into trigger standby mode.

If Start Backup is Off:
The measurement stops when power fails, but data recorded up to that time is retained in memory. The data backup time is about 10 minutes.

SET UP

Display the Status Screen.

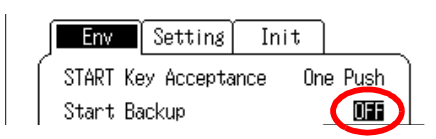
Move the blinking cursor to the position shown.



Display the System Screen.

Display the Env Window.

Move the blinking cursor to the position shown.



Set the Start Backup ON or OFF.

Selection

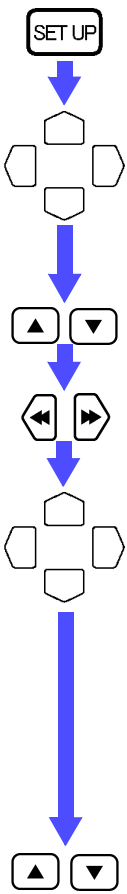
OFF	Start Backup function is disabled.
ON	Start Backup function is enabled.

NOTE

Having the 9447 BATTERY PACK installed can help protect against power interruption. When the AC adapter and a battery pack are both installed, the AC adapter takes priority.

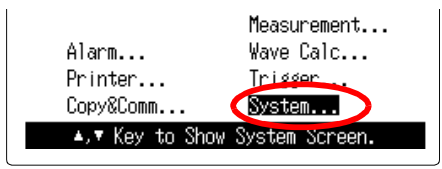
13.1.3 Setting the Display Format

The format of the waveform display for displaying and printing input waveforms can be set as follows. Available formats are single, dual and quad split screens.



Display the Status Screen.

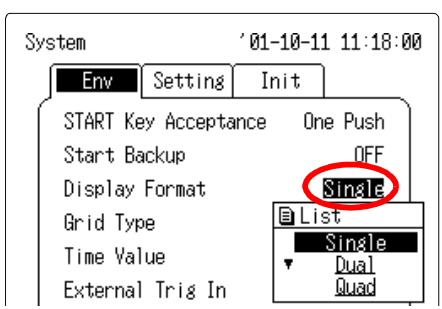
Move the blinking cursor to the position shown.



Display the System Screen.

Display the Env Window.

Move the blinking cursor to the position shown.



Set the Display Format.

Selection

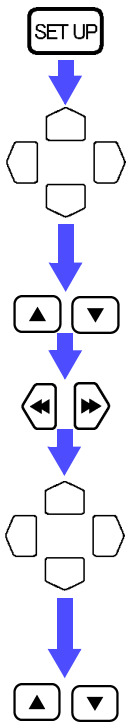
Single	Waveforms are displayed and recorded on a single screen.
Dual	Waveforms are displayed and recorded on a two-window split screen.
Quad	Waveforms are displayed and recorded on a four-window split screen.

When dual or quad split screens are enabled, each input channel can be set for display in a particular window.

❖See Section 5.1.10 "Setting the Display Layout" (page 73.)

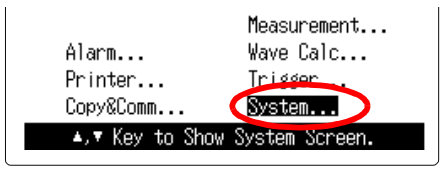
13.1.4 Setting the Grid Type

The grid on the Waveform Screen and recording paper can be set as follows.



Display the Status Screen.

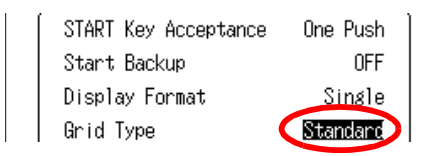
Move the blinking cursor to the position shown.



Display the System Screen.

Display the Env Window.

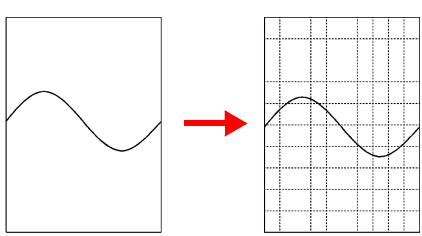
Move the blinking cursor to the position shown.



Set the Grid Type.

Selection

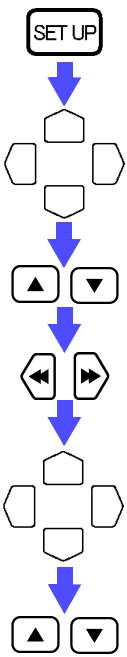
OFF	No grid is displayed on the screen or recording paper.
Standard Fine Standard (Dark) Fine (Dark)	The grid is shown on both the printout and screen. Select the grid type for printout. (There is no visible difference on the Screen between standard and precision selections.)



Grid: OFF Grid: ON

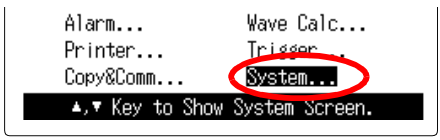
13.1.5 Setting the Format of the Time Data

Time and date or the number of data acquisitions since the start of measurement can be displayed on the Waveform Screen and recording paper.



Display the Status Screen.

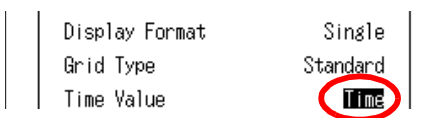
Move the blinking cursor to the position shown.



Display the System Screen.

Display the Env Window.

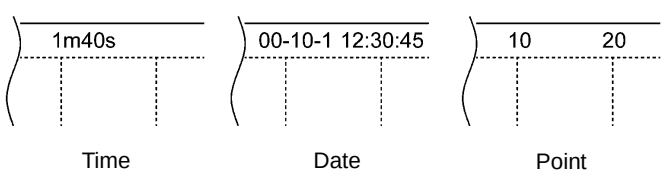
Move the blinking cursor to the position shown.



Set the Time Value.

Selection

Time	Time since the start of measurement (hours, minutes and seconds) is displayed. If a trigger is set, the time since the last trigger event can be displayed.
Date	Date and time of data acquisition is displayed.
Point	Number of data acquisitions since the start of measurement is displayed. If a trigger is set, the number of data since the last trigger event can be displayed.



NOTE

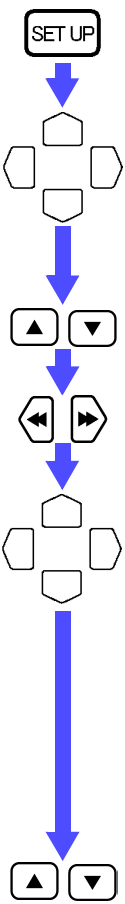
The format of the time data saved in the text format varies according to the setting of "**Time value display.**"

❖See "(3) Set the text header format (for text format)" (page 122.)

13.1.6 Setting Action for External Trigger Input

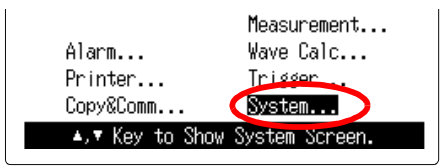
This sets the action to take when the signal input to the external trigger terminal changes from the HIGH level (2.5-5.0 V) to the LOW level (0-1.0 V).
The external trigger terminal can be set as an external trigger input signal or as an event marking signal.

❖Specification of the input signals: See Section 9.7 "Setting the External Trigger Function" (page 171.)



Display the Status Screen.

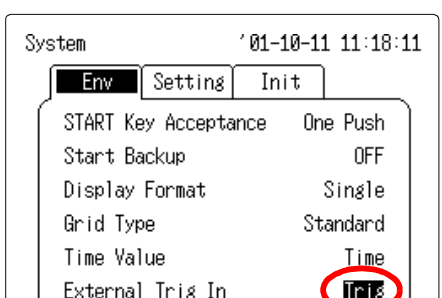
Move the blinking cursor to the position shown.



Display the System Screen.

Display the Env Window.

Move the blinking cursor to the position shown.



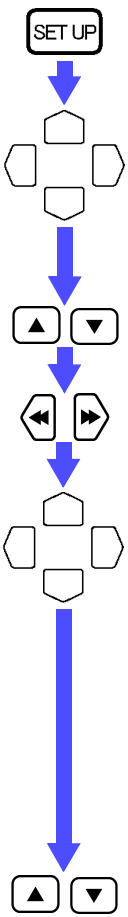
Set the External Trigger Input signal.

Selection

Trig	The external trigger terminal is used as the trigger.
Event	The external trigger terminal is used for event marking.

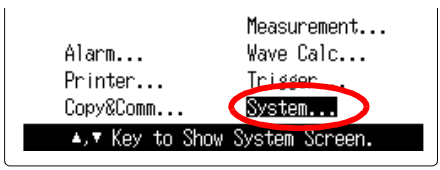
13.1.7 Turning On/Off External Trigger Filter

The external trigger filter is available to prevent chatter in the external trigger input.



Display the Status Screen.

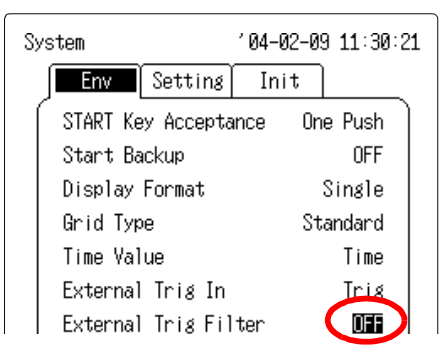
Move the blinking cursor to the position shown.



Display the System Screen.

Display the Env Window.

Move the blinking cursor to the position shown.



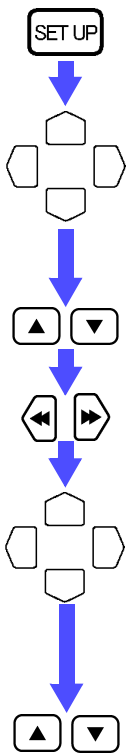
Turn On/Off the External Trigger Filter.

Selection

OFF	External trigger filter is not used.
ON	External trigger filter is used.

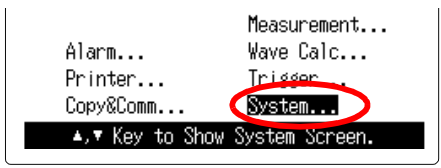
13.1.8 Setting the Backlight Saver

- When the backlight saver is enabled, the display backlight turns off automatically when no button is pressed for a specific time. The backlight turns on again when any button is pressed.
- Allowing the backlight to turn off when not needed increases the life of the backlight and operating time per battery charge.



Display the Status Screen.

Move the blinking cursor to the position shown.



Display the System Screen.

Display the Env Window.

Move the blinking cursor to the position shown.

Set the Back Light Saver.

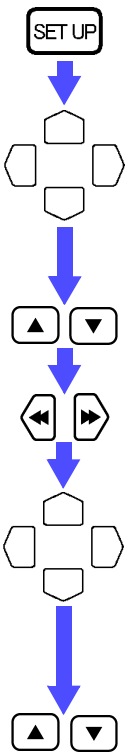
Selection

OFF	The backlight saver function is disabled.
1 to 30 min	The time after which the backlight turns off automatically (set to no more than five minutes when operating from the battery).

NOTE When the backlight saver activates during measurement, the green LED remains lit. When the backlight saver activates while making a setting, the LED blinks.

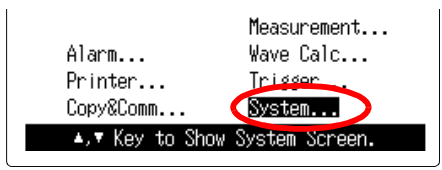
13.1.9 Setting the Backlight Brightness

- The brightness of the backlight can be adjusted as follows.
- The Dark backlight brightness setting can increase operating time from the battery by about 60 minutes.



Display the Status Screen.

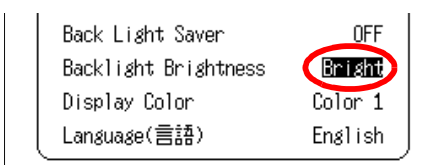
Move the blinking cursor to the position shown.



Display the System Screen.

Display the Env Window.

Move the blinking cursor to the position shown.



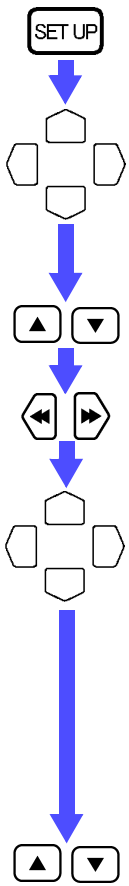
Set the Backlight Brightness.

Selection

Bright	Increases backlight brightness
Dark	Decreases backlight brightness

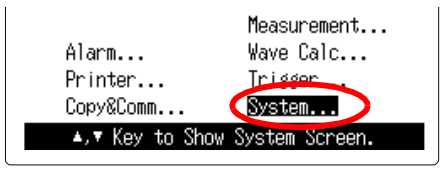
13.1.10Setting the Screen Color

The screen can be set to a choice of 16 colors.



Display the Status Screen.

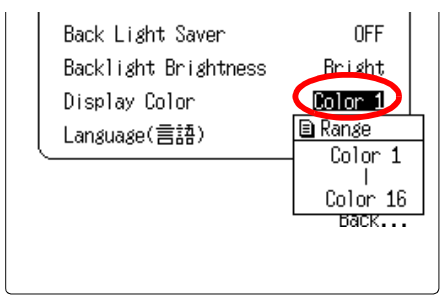
Move the blinking cursor to the position shown.



Display the System Screen.

Display the Env Window.

Move the blinking cursor to the position shown.



Set the Display Color.

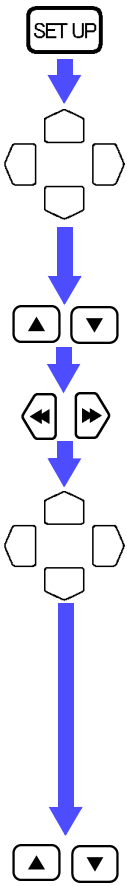
Selection

Color 1 to 16

NOTE

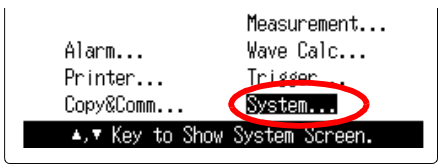
Screen colors 7 to 16 are not usable because the entire screen would appear as one color. Therefore, these selections are indicated by ===== to signify that they are unavailable.

13.1.11Setting the Language



Display the Status Screen.

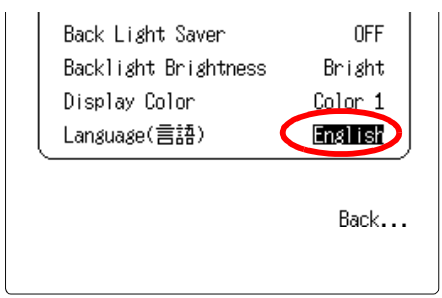
Move the blinking cursor to the position shown.



Display the System Screen.

Display the Env Window.

Move the blinking cursor to the position shown.



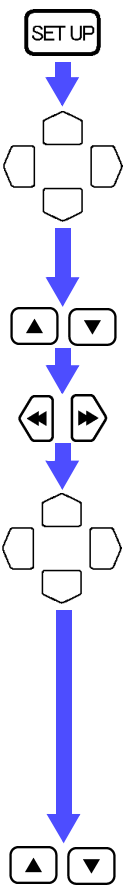
Set the display language.

Japanese	Displays Japanese
English	Displays English

13.2 Setting Window

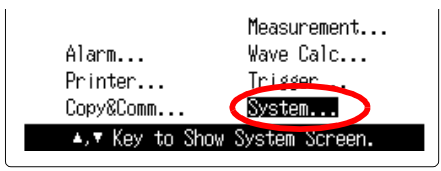
All current settings can be saved to internal memory. Up to four setting conditions can be saved and reloaded when needed.

13.2.1 Saving Settings



Display the Status Screen.

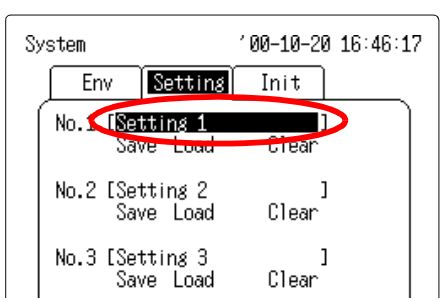
Move the blinking cursor to the position shown.



Display the System Screen.

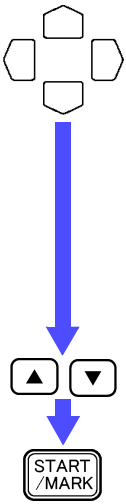
Display the Setting Screen.

Move the blinking cursor to the "**Comment**" position for the item (No.) to save.

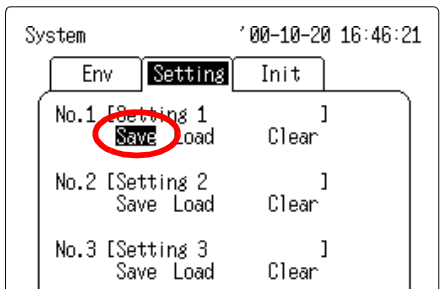


Display the Comment Entry Window, and enter a comment if desired. Settings can be saved even if no comment has been entered for the settings.

❖See Chapter 14 "Text Entry Procedure" (page 225.)



Move the blinking cursor to the position shown.



Displays a Confirmation Window.

Execute a saving.

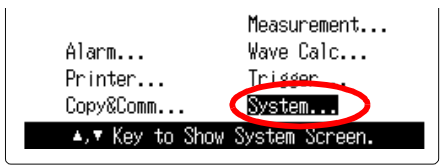
To cancel a saving, press the STOP button.

13.2.2 Loading Setting Conditions (previously saved settings)

SET UP

Display the Status Screen.

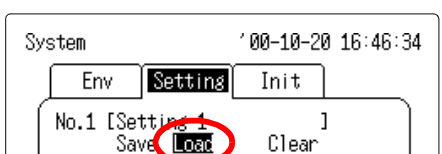
Move the blinking cursor to the position shown.



Display the System Screen.

Display the Setting Screen.

Move the blinking cursor to the "**Load**" position for the item (No.) to load.



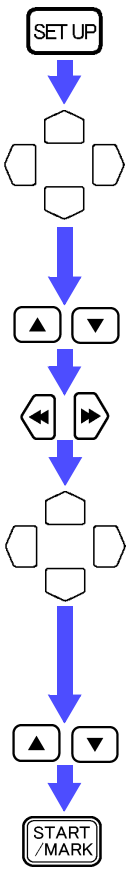
Displays a Confirmation Window.

START /MARK

Execute a loading.

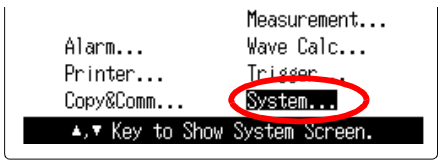
To cancel a loading, press the STOP button.

13.2.3 Deleting Setting Conditions (saved setting conditions are deleted)



Display the Status Screen.

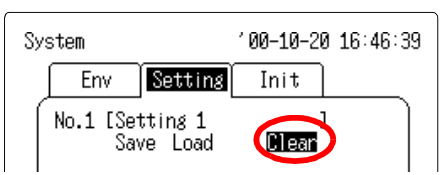
Move the blinking cursor to the position shown.



Display the System Screen.

Display the Setting Screen.

Move the blinking cursor to the "**Clear**" position for the item (No.) to delete.



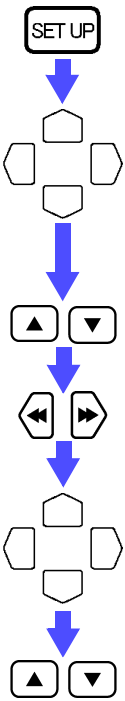
Displays a Confirmation Window.

Execute a deletion.

To cancel a deletion, press the STOP button.

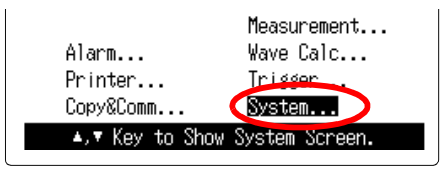
13.2.4 Automatically Loading Settings of a Specified No. (Automatic Setting)

Turning power on automatically loads the specified (No.) setting conditions.



Display the Status Screen.

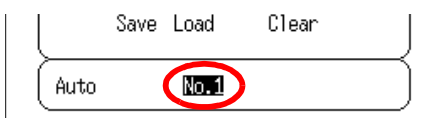
Move the blinking cursor to the position shown.



Display the System Screen.

Display the Setting Screen.

Move the blinking cursor to the position shown.



Select the setting conditions (No.) to be loaded automatically. Selecting a No. for which no settings have been saved is equivalent to setting this feature to OFF.

NOTE

The setting conditions can be saved to a PC Card.
❖See Section 7.3.2 "Saving Measurement Data and Settings" (page 120.)

13.2.5 Auto Setup

Settings can be loaded automatically when power is turned on by creating a file named STARTUP.SET in the root directory on the PC card.

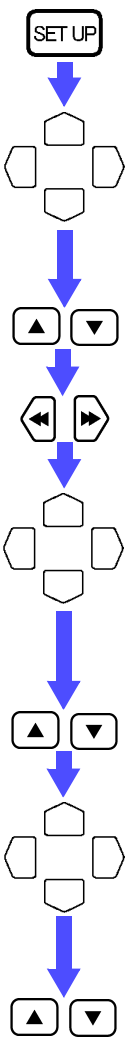
NOTE

If Auto Setup and the Autosetting on this screen are enabled at the same time, Auto Setup has priority.

13.3 Init (Initialization) Window

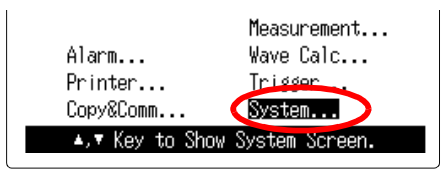
13.3.1 Setting the Time

The instruments includes an automatic calendar with leap year detection and 24-hour clock.



Display the Status Screen.

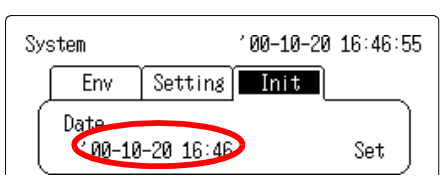
Move the blinking cursor to the position shown.



Display the System Screen.

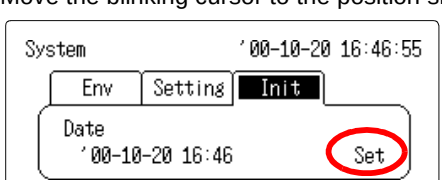
Display the Int Window.

Move the blinking cursor to the item to be set.



Set the time.

Move the blinking cursor to the position shown.



Accept the time setting.

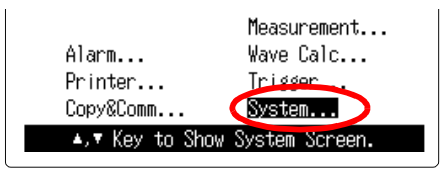
13.3.2 Deleting the Waveforms

Delete the waveform data stored in memory and initialized.

SET UP

Display the Status Screen.

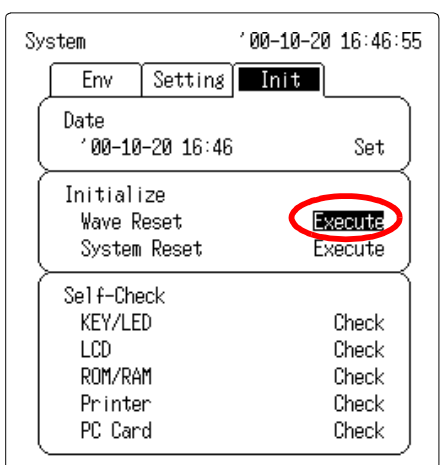
Move the blinking cursor to the position shown.



Display the System Screen.

Display the Int Window.

Move the blinking cursor to the position shown.



Displays a Confirmation Window.

START /MARK

Execute a Wave Reset.

To cancel a Wave Reset, press the STOP button.

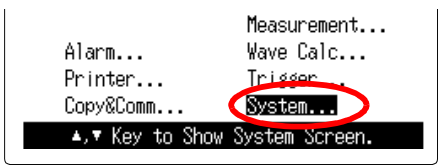
13.3.3 Restoring Default Settings (System Reset)

All settings return to the defaults except those relating to communications (RS-232C, 10BASE-T LAN, and PPP).

SET UP

Display the Status Screen.

Move the blinking cursor to the position shown.



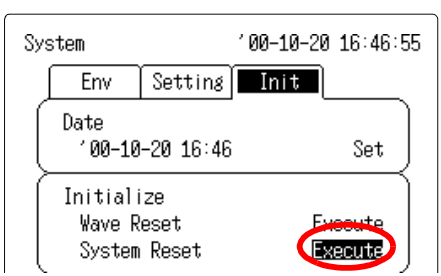
▲ ▼

Display the System Screen.

◀◀ ▶▶

Display the Int Window.

Move the blinking cursor to the position shown.



▲ ▼

Displays a Confirmation Window.

START /MARK

Perform a System Reset.

To cancel a System Reset, press the STOP button.

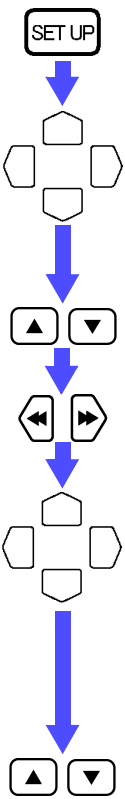
NOTE

System reset is performed by turning power on while holding the STOP button.

To return all the settings, including those for communications, to their defaults, turn on the power while holding down the STOP button and the START /MARK button at the same time.

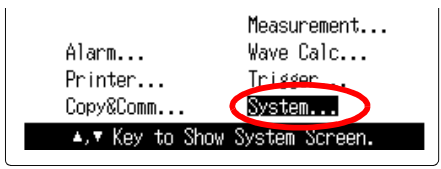
13.3.4 Self-Check

If you run a self-check and the message "NG" appears or there otherwise seems to be a problem, please have the instrument serviced.



Display the Status Screen.

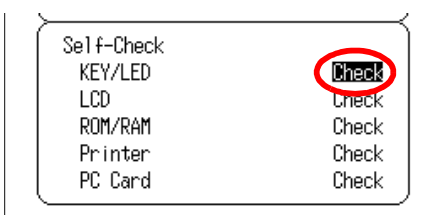
Move the blinking cursor to the position shown.



Display the System Screen.

Display the Int Window.

Move the blinking cursor to the Self-Check item to be checked.



Execute a Self-Check.

KEY/LED Check

The Key check requires pressing each button. If a malfunction is found, press the START /MARK and STOP buttons simultaneously to abort checking.
To check LED operation, confirm that the LED lights green when the START /MARK button is pressed.

LCD Check

The LCD check tests display of characters and solid patterns. Press any button to change screens.

ROM/RAM Check

The following items can be checked:

ROM	: OK/NG
Storage RAM	: OK/NG
Backup RAM	: OK/NG
Work RAM	: OK/NG
Video RAM	: OK/NG
Address bus	: OK/NG

Printer Check

This function is available when the 8992 PRINTER UNIT is installed. The printer check tests solid printing and character printing.

Pressing the STOP button aborts. When the blinking cursor is in the printer position, Holding the MONIT button cleans the print head by solid printing.

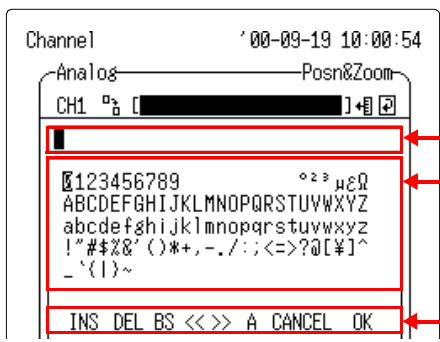
PC Card Check

The PC Card check tests the following items, which are the same as the PC Card self check on the File Screen.

PC Card Type : ATA card
RAM Size : Capacity of the installed card

Text Entry Procedure 14

This chapter describes how to enter a comment in the Comment Entry Window.
Select a character in the character selection field.



Confirm the selected character.

Confirm the entered comment and return to the previous screen.

Comment Entry Field Procedures

	Moves the cursor to the front of the Text Entry Field
	Moves the cursor to the end of the Text Entry Field
SCROLL CURSOR	Moves the cursor left or right one character

(in the Comment Entry Window)

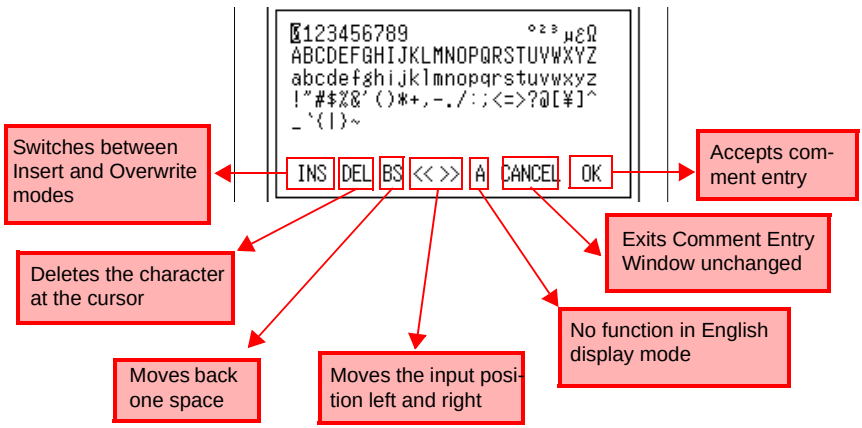
Character Selection Field Procedures

MONIT	Back Space
	Accepts character entry
	Cursor movement
START /MARK	Accepts character entry
STOP	Cancels comment entry

(in the Comment Entry Window)

Virtual Function Keys

The virtual function keys provide shortcuts by duplicating the process of moving the cursor to a particular location and pressing the ▲/▼ buttons to accept the selection.



Adding (Inserting) Characters

1. Using the SCROLL CURSOR button, move the character input cursor to the insertion location.
2. Use the cursor buttons to move the character selection cursor to the writing mode, and press the ▲/▼ buttons to select INS(insert) mode.
3. Use the cursor buttons to select the character to be inserted, then press the ▲/▼ buttons to accept the new character and insert it to the left of the cursor location.

Changing (Overwriting) Characters

1. Using the SCROLL CURSOR button, move the character input cursor to the change location.
2. Use the cursor buttons to move the character selection cursor to the writing mode, and press the ▲/▼ buttons to select OVER(overwritten) mode.
3. Use the cursor buttons to select the character to be overwritten, then press the ▲/▼ buttons to accept the new character and overwrite the character at the cursor location.

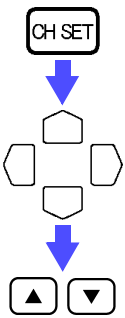
Deleting Characters

Characters can be deleted in two ways:
BS (Backspace) : deletes the character to the left of the cursor.
DEL (Delete) : deletes the character at the cursor location.

1. Using the SCROLL CURSOR button, move the character input cursor to the deletion location.
2. Use the cursor buttons to move the character selection cursor to BS or DEL, then press the ▲/▼ buttons to delete the character. character and insert it to the left of the cursor location.

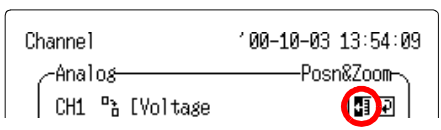
14.1 Standard Comment Entry

A comment can be selected from a set of standard preset comments.



Display the Channel Screen.

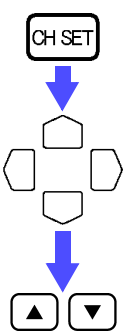
Move the blinking cursor to the position shown.



Select a comment from the list.

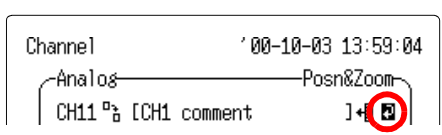
14.2 Recalling Comment History

The ten most recently entered comments can be recalled and selected for reuse.



Display the Channel Screen.

Move the blinking cursor to the position shown.



Recall an earlier comment.

Specifications 15

15.1 General Specifications

Internal Memory Capacity	16 M Words (total)
External Terminals	External Trigger Inputs, Trigger Output, Ground
Time Functions	Auto calendar with automatic leap year, 24-hour clock
Clock Accuracy	Power ON : ± 0.2 s/ day Power OFF : ± 3 s/ day (at 23°C)
Time Axis Accuracy	During measurement: ± 0.2 s/ day (at 23°C)
Backup Battery and Life	Time and Settings : Approx. 10 years (at 23°C) Measurement Data : After power off, Approx. 10 minutes (beginning at least 2 minutes after power on, 23°C)
Continuous Operating Time	With the 9447 BATTERY PACK (at 23°C) • About 5 hours (when measuring voltage, Backlight Saver enabled (5 min.), After about 10 hours charge) • About 2.5 hours (when measuring voltage, bright backlight, After about 2.5 hours charge) With the 8993 DIGITAL I/O UNIT and the 9447 BATTERY PACK • About 10 hours (when measuring voltage, Backlight Saver enabled (5 min.), After about 10 hours charge) • About 5 hours (when measuring voltage, bright backlight, After about 2.5 hours charge)
Charging	The 9447 BATTERY PACK rapid charges with the 9418-15 AC ADAPTER (SA145A-1240V-6,SINO AMERICAN). Rapid charging time: Approx. 2.5 hours (at 23°C) After rapid charging has been completed, carry out trickle charging (to prevent discharge of the battery). Rapid charging and printer operation cannot be carried out simultaneously (when the printer is running, rapid charging will be interrupted).

Environmental and Safety Specifications

Operating Environment	Indoors, <2000 m (6562 feet) ASL
Operating Temperature & Humidity	0 to 40°C (32 to 104°F) at 30 to 80%RH (non-condensating) (Chargeable temperature range is from 10 to 30°C.)
Storage Temperature & Humidity	-10 to 50°C (14 to 122°F) at 30 to 80%RH (non-condensating)
Operating temperature & humidity for guaranteed accuracy	23 ± 5°C (73 ± 9°F) at 30 to 80%RH (non-condensating)
Period of guaranteed accuracy	For one year
Dielectric Strength	350 VAC for 5 sec. (Between each analog input channel and the instrument and between analog input channels)
Power Supply	• Using the 9418-15 AC ADAPTER (SA145A-1240V-6, SINO AMERICAN) (driving at DC12 V ± 5%) AC adapter rated supply voltage: AC100 to 240 V (Voltage fluctuations of ±10% from the rated supply voltage are taken into account.) AC adapter rated supply frequency: 50/60 Hz • The 9447 BATTERY PACK (AC adapter takes priority) • 12V Automotive Battery (Fluctuations of +30% and -20% in supply voltage are allowed. However, chargeable voltage is DC12 V ± 5%.)
Maximum Rated Power	20 VA (using the AC adapter and with the maximum load) 16 VA (using the battery and with the maximum load)
Size	Approx. 234W x 170H x 52D mm (9.21"W x 6.69"H x 2.05"D)(without protrusions) Approx. 310W x 170H x 52D mm (12.2"W x 6.69"H x 2.05"D) (with printer installed) Approx. 302W x 170H x 52D mm (11.89"W x 6.69"H x 2.05"D) (with Digital I/O Unit installed)
Weight	Approx. 1.4 kg (49.38 oz.) (without battery) Approx. 1.7 kg (59.96 oz.) (when the printer is installed, without battery) Approx. 1.7 kg (59.96 oz.) (when the Digital I/O Unit is installed, without battery)
Applying Standards	Safety EN61010 Measurement Category I, Pollution Degree 2 (anticipated transient overvoltage 330 V) EMC EN61326, ClassA EN61000-3-2 EN61000-3-3

Accessories and Options

Accessories	Instruction Manual Quick Start Manual Communications/ Wave Viewer Instruction Manual 9418-15 AC ADAPTER (SA145A-1240V-6,SINO AMERICAN) Flatblade screwdriver (Terminal block) Application Disk (CD)
Options	8992 PRINTER UNIT (printing width 100 mm) 8993 DIGITAL I/O UNIT 9234 RECORDING PAPER (112 mm wide, 18 m long roll) 9334 LOGGER COMMUNICATOR (data collection program) 9418-15 AC ADAPTER (SA145A-1240V-6,SINO AMERICAN) 9447 BATTERY PACK (7.2 V, 2400 mAh) 9641 CONNECTION CABLE (for pulse input) 9642 LAN CABLE 9643 CHARGE STAND (for the 9447 BATTERY PACK) 9648 CARRYING CASE 9652-01 FIXED STAND 9653 HUMIDITY SENSOR (for the 8420-51 and 8421-51) 9681 HUMIDITY SENSOR (for the 8420-51 and 8421-51) 9701 HUMIDITY SENSOR (for the 8420-51 and 8421-51) 9612 RS-232C CABLE (9-pin mini DIN to 9-pin Dsub, cross cable, for PC) 9721 RS-232C CABLE (9-pin mini DIN to 9-pin Dsub, straight cable, for modem) 9329 TERMINAL UNIT (M3 screw) 9626 PC CARD 32 M 9627 PC CARD 64 M 9726 PC CARD 128 M 9727 PC CARD 256 M 9728 PC CARD 512 M 9729 PC CARD 1G

External Memory (PC Card)

PC Card Slot	One 68-pin PC Card standard compliant slot (Type I and II cards supported)
Card Type	Flash ATA Card (up to 1 GB)
File System	MS-DOS (MS-DOS is a registered trademark of Microsoft Corp., USA)
Memory Contents	Settings, measurement data (binary or text), screen data, waveform parameter calculation results. Partial measurement data can be selected between A-B cursors for saving.

Communications

External Interfaces	• RS-232C Interface EIA RS-232C compliant Mini DIN round 9-pin connector (Connect using the 9612 or the 9721 RS-232C CABLE.) • LAN Interface IEEE802.3 Ethernet 10BASE-T, Supprt for DHCP and DNS.
PPP	Communications via public telephone line, or cell phone is possible by connecting a modem to the RS-232C terminal using the 9721 RS-232C CABLE.
PC Control	• Data can be acquired by a data collection program. • Data can be acquired from internal memory or the PC card used by the FTP server. • Remote control is supported by commands • Remote operation by HTTP server is possible.
Transmission to PC	• Mail can be sent via e-mail. • Data can be automatically transferred using a FTP client.

Display

Display Type	5.7-inch STN Color LCD (320 x 240 dots)
Resolution	Waveform Display: 10 x 10 divisions 1 Division = 20 dots horizontal x 28 dots vertical
Display Characters	Japanese/English selectable
Dot Pitch	0.36 (H) x 0.36 (V) mm
Backlight Life	Approx. 25,000 hours (at 23°C)
Backlight Switching	Manual or automatic off selectable

STN color LCDs characteristically have a few defective pixels that do not always light, or that remain lit. We do not consider the presence of three or fewer such defects to indicate a damaged or faulty display. Please be aware of this in advance.

Printer (requires the 8992 PRINTER UNIT option)

Model	8992 PRINTER UNIT (removable option)
Printing Width	Overall width: 104 mm (832 dots) Waveform area: 100 mm f.s. (10 mm/div., 10 div./f.s.) Recording paper: 9234 RECORDING PAPER (112 mm x 18 m/roll)
Recording Speed	Maximum 2 mm/s (when either the AC adapter or the battery pack is used)
Partial Printing	Print only between A and B cursors
Logging Function	Measurement data prints as digital values
Hybrid Printing	When printing waveforms, several data values print together periodically. The printing interval for numerical values can be specified.
Real-Time Printing	ON/OFF: Available Automatic printing along with measurement Wave: Available when the time axis is between 5s and 1d. Logging: Available when the printing interval is 5 sec. or more.
Manual Printing	ON/OFF switchable while measuring
Screen Copy Function	Included
List Print	Setting conditions can be printed automatically after waveform data is printed (ON/OFF selectable), or by pressing the **Print** button beside the Waveform Screen
Report Print	Upper and lower limits, waveforms and setting conditions are all printed
List/Gauge	ON/OFF selectable
Comment Printing	Active channels, input range, display positioning, trigger times, etc.

Alarm Output (requires the 8993 DIGITAL I/O UNIT option)

Alarm Types	• Level An alarm is output by input rising above or falling below a preset level • Window An alarm is output by input crossing into or out of a window defined by preset upper and lower trigger levels • Logic Pattern
Latch Setting	Alarms can be set to latch on
Alarm Sound	ON/OFFselectable

15.2 Input Specifications

Accuracy is specified at 23 ± 5°C (73 ± 9°F) and 30 to 80%RH, with zero position calibration after 30 minutes warm-up. Accuracy is guaranteed for one year.

Number of Input Channels	• Analog Inputs 8 channels (8420-51) or 16 channels (8421-51) independently selectable for voltage, thermocouple, resistance temperature detectors or humidity measurement 32 channels (8422-51) independently selectable for voltage or thermocouple • Pulse Inputs 4 channels requires the optional 9641 CONNECTION CABLE connected to the pulse input terminal • Logic Inputs 16 ch requires the optional 8993 DIGITAL I/O UNIT
Input Terminals	Screw-type terminal block (8420-51, 8421-51: 4 terminals per channel, 2 terminals per channel) The terminal block is removable and includes a cover. Pulse inputs use a custom connector
Measurement Types	• Voltage • Thermocouples (types K, E, J, T, N, W, R, S, and B) • Resistance temperature detectors (Pt100, JPt100, 3- and 4-wire connections) 8420-51 and 8421-51 only • Humidity (requires the optional 9653, 9681 and 9701 HUMIDITY SENSOR) 8420-51 and 8421-51 only • Pulse Totalization (add, instant), Rotation Rate
Maximum Sampling Rate	100 ms (all channels) 5 s or more, when one or some channels are measured by humidity sensors. (8420-51 or 8421-51) 200 ms or more, when any one of CH 17 to 32 is selected. (8422-51)

Measurement Ranges and Resolutions

Measurement Objects	Range	Measurable Range	Maximum Resolution
Voltage	100 mVf.s.	-100 mV to +100 mV	5 μV
	1 Vf.s.	-1 V to +1 V	50 μV
	10 Vf.s.	-10 V to +10 V	500 μV
	100 Vf.s.	-60 V to +60 V	5 mV
	1-5 Vf.s.	1 V to 5 V	500 μV
Temperature (Thermocouple) (Resistance Temp. Detector)	100°Cf.s.	-100°C to 100°C	0.01°C
	500°Cf.s.	-200°C to 500°C	0.1°C
	2000°Cf.s.	-200°C to 2000°C	0.5°C
Humidity	100%RH	5.0 to 95.0%RH	0.1%RH
Pulse Totalization	50,000 pulses f.s.	0 to 50,000 pulses	1 pulse
	500,000 pulses f.s.	0 to 500,000 pulses	10 pulses
	5 Mpulses f.s.	0 to 5 Mpulses	100 pulses
	100 Mpulses f.s.	0 to 100 Mpulses	2,000 pulses
	2,500 Mpulses f.s.	0 to 2,500 Mpulses	50,000 pulses
Rotation Rate	5,000/n r/s f.s.	0 to 5,000/n r/s	1/n r/s

- n = pulses per rotation (1 to 1000)
- Upper and lower temperature measurement limits depend on the measurement range of the sensor used.

Temperature Measurement Range of Thermocouples and Resistance Temperature Detectors

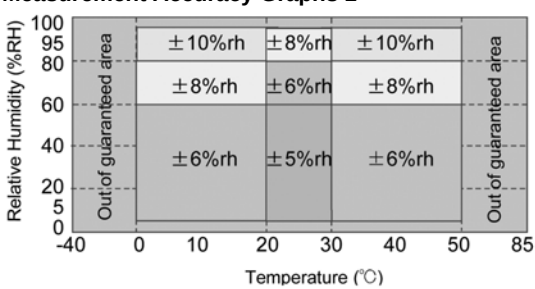
K	-200°C to 1350°C*1	J	-200°C to 1200°C*1
E	-200°C to 1000°C*1	N	-200°C to 1300°C*1
T	-200°C to 400°C*1	R	400°C to 1700°C*1
S	400°C to 1700°C*1	B	400°C to 1800°C*1
W (WRe5-26)	400°C to 2000°C*2		
Pt100	-200°C to 800°C*3	JPt100	-200°C to 500°C*4

*1: JIS C 1602-1995
*2: ASTM E-988-96
*3: JIS C 1604-1997
*4: JIS C 1604-1989

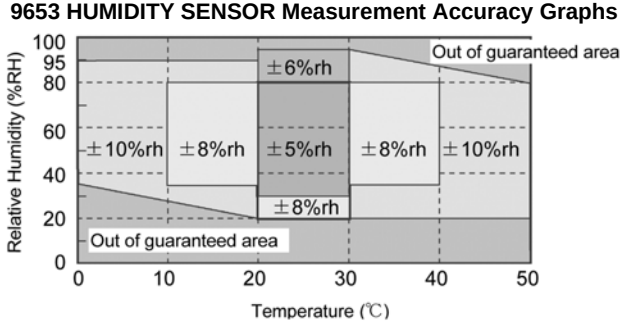
Measurement Accuracy

Voltage	± 0.1%f.s. (The accuracy in the range from 1 to 5 V is the same as for 10 Vf.s.)
Thermocouples (K,E,J,T,N) (R,S,B,W)	± 0.05%f.s. ± 1°C (± 0.05%f.s. ± 1.8°F) ± 0.05%f.s. ± 2°C (± 0.05%f.s. ± 3.6°F) (limited to 400°C (752°F) or more)
Resistance Temp. Detector (Pt100, JPt100)	± 0.05%f.s. ± 0.5°C
Reference Junction Compensation Accuracy	± 1°C (± 1.8°F) Add to thermal measurement accuracy when measuring with a thermocouple and internal reference junction compensation
Humidity	See Humidity Measurement Accuracy Graphs 1 and 2. (includes accuracy of optional 9653 HUMIDITY SENSOR, 9681 HUMIDITY SENSOR and 9701 HUMIDITY SENSOR)

9681 HUMIDITY SENSOR and 9701 HUMIDITY SENSOR Measurement Accuracy Graphs 1



9653 HUMIDITY SENSOR Measurement Accuracy Graphs 2



Thermal Characteristic	Add (meas. Accuracy X 0.1) per °C to the measurement accuracy (except humidity)
Reference Junction Compensation	Internal/external selectable (when measuring with thermocouple)
Digital Filter	OFF/50 Hz/60 Hz (When set to 50 Hz or 60 Hz, the appropriate digital filter is automatically set according to the recording interval.) ❖See "Recording Interval and Cutoff Frequency table" (page 238.)
Input Resistance	• 1 MΩ ± 5% (Burn out detection is OFF during temperature measurement with thermocouple.) • 2 MΩ± 5% (Temperature measurement with resistance temperature detector) • 850 kΩ± 5% (Burn out detection is ON during temperature measurement with thermocouple.)
Normal Mode Rejection	• 50 dB or better (Input is 50 Hz, 1 to 16 channels are used, recording interval is five seconds, and digital filter is set to 50 Hz.) (Input is 60 Hz, 1 to 16 channels are used, recording interval is two seconds, and digital filter is set to 60 Hz.)
Common Mode Rejection	• 100 dB or better (Input is 50/60 Hz, signal source resistance is 100 Ω or less, and digital filter is OFF) • 140 dB or better (Input is 50 Hz, signal source resistance is 100 Ω or less, 1 to 16 channels are used, recording interval is five seconds, and digital filter is set to 50 Hz.) (Input is 60 Hz, signal source resistance is 100 Ω or less, 1 to 16 channels are used, recording interval is two seconds, and digital filter is set to 60 Hz.)
Maximum Input Voltage	30 Vrms AC or 60 VDC (analog input channels)
Maximum Rated Voltage to Ground	30 Vrms AC or 60 VDC (between each channel and the chassis, and between input channels)
Effect of conducted radio-frequency electromagnetic field	± 2%f.s. at 3 V
Pulse Input	No-voltage contact points (always open connection), open collector, or voltage input Maximum input voltage: 15 VDC Detection levels: HIGH 1.0 V or more, LOW 0-0.5 V Pulse input period: at least 200 µs (high and low periods must be at least 100 µs) When the chattering prevention filter is turned on, at least 100 ms (high and low periods must be at least 50 ms) Slope: Rising or falling edge can be set for each channel Functions: Totalization, Rotation Rate The chattering prevention filter can be turned on or off.

Recording Interval and Cutoff Frequency table

Digital Filter: Set to 50 Hz

Recording Interval		100 ms	200 ms	500 ms	1 s	2 s	5 s	10 s	20 s	30 s or more
Cutoff Frequency	1 to 16 channels are used.	2030 Hz	568 Hz	225 Hz	110 Hz	60 Hz	50 Hz	50 Hz	10 Hz	10 Hz
	17 or more channels are used. (8422-51)	--	2030 Hz	568 Hz	225 Hz	110 Hz	60 Hz	50 Hz	50 Hz	10 Hz
	One or more channels are set to humidity measurement. (8420-51, 8421-51)	--	--	--	--	--	50 Hz	50 Hz	10 Hz	10 Hz

Digital Filter: Set to 60 Hz

Recording Interval		100 ms	200 ms	500 ms	1 s	2 s	5 s	10 s	20 s	30 s or more
Cutoff Frequency	1 to 16 channels are used.	2030 Hz	568 Hz	225 Hz	110 Hz	60 Hz	60 Hz	60 Hz	10 Hz	10 Hz
	17 or more channels are used. (8422-51)	--	2030 Hz	568 Hz	225 Hz	110 Hz	60 Hz	60 Hz	60 Hz	10 Hz
	One or more channels are set to humidity measurement. (8420-51, 8421-51)	--	--	--	--	--	60 Hz	60 Hz	10 Hz	10 Hz

Digital Filter: Set to OFF

Recording Interval		100 ms	200 ms	500 ms	1 s	2 s	5 s	10 s	20 s	30 s or more
Cutoff Frequency	1 to 16 channels are used.	2030 Hz	2030 Hz	2030 Hz	2030 Hz	2030 Hz	2030 Hz	2030 Hz	2030 Hz	2030 Hz
	17 or more channels are used. (8422-51)	--	2030 Hz	2030 Hz	2030 Hz	2030 Hz	2030 Hz	2030 Hz	2030 Hz	2030 Hz
	One or more channels are set to humidity measurement. (8420-51, 8421-51)	--	--	--	--	--	110 Hz	110 Hz	110 Hz	110 Hz

15.3 Functional Specifications

Screen/Printing Selections	1, 2 or 4 screens
Waveform Sheet Selection	Select sheets S1 to S4
Hybrid Display	• Waveform • Waveform and numerical data • Waveform and gauge • Numerical data • Numerical data and comment • Magnified numerical data • Calculated numerical data (calculated result and waveform)
Monitor Function	Indicates instantaneous value without saving data to the memory.
Recording Interval	100 m, 200 m, 500 m, 1 s, 2 s, 5 s, 10 s, 20 s, 30 s, 1 min, 2 min, 5 min, 10 min, 20 min, 30 min, 1 h 5 s or more, when one or some channels are measured by humidity sensors. (8420-51 or 8421-51) 200 ms or more, when any one of CH 17 to 32 is selected. (8422-51)
Recording Length	Recording period can be set specifically, or for continuous recording
Recording Data Quantity	Analog n channel recording period (16 M/n) data Analog, pulse, logic input,* alarm output*, recording all channels (8420-51: 16 M/ 14, 8421-51: 16 M/ 22, 8422-51: 16 M/ 38) data (* with the optional 8993)
Waveform Magnification/ Compression	• Time Axis (per division) 1 s, 2 s, 5 s, 10 s, 20 s, 30 s 1 min, 2 min, 5 min, 10 min, 20 min, 30 min 1 h, 2 h, 5 h, 10 h, 12 h, 1 d • Voltage Axis X 100, X 50, X 20, X 10, X 5, X 2, X 1, X 1/2 Upper/lower limit settings can be selected
Waveform Memory	The last 16 M of data (for single-channel recording) is saved to internal memory (for n channels, 16 M/n data). Data in memory can be scrolled for review, and printed (with optional printer installed)
Waveform Scrolling	Scroll left and right

Cursor Measurements	Time difference between A-B cursors, amplitude difference, amplitude at each cursor, time
Scaling Function	Settable for each channel
Automatic Saving Function	Select binary (real time) or text (after measurement)
Real-Time Saving Function	Waveforms are saved in real time to a PC Card in binary format. Data may be saved into different files at regular intervals. Selectable Until Full, Endless, or Delete Once saved, up to 16 M of data can be loaded from a specified position (for one channel; for n-channel recording, 16 M/n data per channel)
Start Status Hold Function	Provided
Setting Condition Saving Function	Provided (up to four sets of conditions)
Auto Setup Function	When power is turned on, settings can be automatically loaded from within the instrument, or from a PC Card.
Waveform Parameter Calculations	Up to eight of the following calculations can be performed at the same time: Average, peak, maximum, minimum and effective values, time to maximum or minimum values
Waveform Calculation	Performs addition or subtraction of measurements involving two channels.
Comment Entry Function	Provided
Event Markers Function	Events can be marked by pressing **START/MARK** button while measuring An external trigger terminal can be used for event-marking input.
Search Function	Event marks can be searched

15.4 Triggering

Trigger System	Digital comparison
Trigger Modes	Single, Repeat
Trigger Timing	Start, Stop, Start & Stop
Trigger Sources	• Analog Input Channels CH1 to CH8 (8420-51) CH1 to CH16 (8421-51) CH1 to CH32 (8422-51) • Pulse Totalization Inputs P1 to P4 • Logic Inputs LI1 to LI16 (requires the optional 8993) • External trigger The trigger is activated when the external trigger terminal is shorted with the GND terminal or when a falling signal from HIGH (2.5 to 5.0 V) to LOW (0 to 1.0 V) is detected. Maximum input voltage: DC-5 to 10 V External trigger filter: Can be turned On/Off. Response pulse width: External trigger filter is Off; HIGH level : Min. 1 ms LOW level : Min. 2 µs External trigger filter is ON; HIGH level : Min. 2.5 ms LOW level : Min. 2.5 ms • Timer Trigger
Trigger States	Each trigger source OR and AND condition setting Trigger conditions can be set separately for each channel.
Trigger Types	• Analog and Pulse Level trigger: The trigger is activated as the signal rises (falls) across the set threshold. Window trigger: Upper and lower trigger-level limits are set. The trigger is activated when the signal enters or leaves the designated range. • Logic (requires the optional 8993) 1, 0 and x patterns (x = any state)
Trigger Level Resolution	0.5% f.s. (f.s. = 10 divisions)
Pre-Trigger Recording	Time setting (any), for real-time saving operation
Trigger Output	Open collector output (with 5 V output, active low) Pulse width: 100 ms or greater
Trigger Input/ Output Terminals	Push-button type terminal block

15.5 Option Specifications

15.5.1 8993 DIGITAL I/O UNIT

Input Specifications

Input type	No-voltage contact (normally open), open collector or voltage input
Input Channels	16 channels (Each input channel and the main instrument chassis share common ground)
Maximum Input Voltage	0 to 50 VDC
Detection Levels	High = 2.5 V or more, Low = 0 to 1.5 V
Input Resistance	1.1 MΩ ± 5%
Transfer Rate	Once per recording interval

Output Specifications

Output Channels	16 channels Outputs can be set to correspond to any of the 32 analog input channels, 4 pulse input channels, or one 16-bit digital channel. (Each output channel is isolated from the others and from the main instrument chassis ground.)
Maximum Voltage to Ground (Output Only)	30 Vrms AC, 60 VDC (between each output channel and the main instrument, and between each output channel)
Withstand Voltage	350 VAC for 1 minute (between each output channel and the main instrument, and between each output channel)
Output Circuit	Open collector output (active low)
Maximum Switching Capacity	5 to 60 VDC, 10 mA
Output Refresh	Once each recording interval

General Specifications

Compatible Models	8420-01(-51), 8421-01(-51), 8422-01(-51) MEMORY HiLOGGERs
Operating Environment	Indoors, <2000 m (6562 feet) ASL
Operating Temperature & Humidity	0 to 40°C (32 to 104°F) at 30 to 80%RH (non-condensating)
Storage Temperature & Humidity	-10 to 50°C (14 to 122°F) at 30 to 80%RH (non-condensating)
Size (without protrusions)	Approx. 92W x 170H x 52D mm (3.62"W x 6.69"H x 2.05"D)
Weight	Approx. 0.3 kg (1.1 oz.) (without battery) Approx. 0.55 kg (1.9 oz.) (within battery)
Accessories	Instruction Manual
Options	9447 BATTERY PACK (7.2 V, 2400 mAh) The main instrument can be powered by installing a supplemental the 9447 BATTERY PACK (which must be charged in the main instrument or the 9643 CHARGE STAND).
Applying Standards	Determined by specification of the connected the main instrument

15.5.2 9334 LOGGER COMMUNICATOR

Ver. 1.20 or later supports this instrument.

Media	One CD
Operating Environment	PC running Windows95, 98, Me, NT, 2000, or XP with 133-MHz or faster Pentium CPU and at least 64 MB of RAM
Operating Systems	Windows95, 98, Me, NT4.0 SP3 or later, 2000, or XP
Supported Instruments	8420-01(-51), 8421-01(-51), 8422-01(-51) MEMORY HiLOGGERs
Interface	Ethernet
Controllable Instruments	16 instruments
Real-Time Transfer	Data can be acquired in real time (up to 200 MB per file) Remote control settings for real-time acquisition by the main instrument
Waveform Display	Acquired data can be displayed graphically as waveform images
Real-Time Display	Acquired data can be transferred for graphical display in real time. Split time-axis display is possible.
Digital Value Display	Waveform data as digital values can be displayed. Also, the image and digital values can be displayed simultaneously.
Cursor Functions	A-B cursor time and voltage difference, amplitude difference, and amplitude and time at each cursor Absolute and relative time displays are selectable
Scroll Functions	Provided
Maximum Channels	512 Analog, 256 Logic and 64 Pulse
Data Input Modes	Real-Time and Memory
Memory Contents	Settings, Measurement data (binary or text)
Data Conversion Objects	All data, or data between A-B cursors
Data Thinning	Simple thinning
Data Conversion	Analog waveform data is converted to voltage levels Logic data is converted to 1 s and 0 s
Data Conversion Formats	CSV format, text (separated by space), or text (separated by tab)
Conversion Channels	Selectable when saving (Default: displayed channels)
Print Data Selection	All data, or only data between A and B cursors
Print Data Contents	Waveform images, numerical values

Waveform Data Preview	Provided
Print Paper Size	A4 (default)
Parameter Calculation Object Data	All data, or only data between A-B cursors
Calculation Types	Average, peak, maximum and minimum values, time to maximum or minimum values, ON time, OFF time, times ON, times OFF, Standard deviation, Integral, Area value
Event Marking	Events can be marked during operation
Search Functions	Search for event markers, dates (absolute or relative time), triggers, maximum, minimum, extreme maximum, extreme minimum, alarm events

15.5.3 9643 CHARGE STAND

Charging Function	Charges an installed the 9447 BATTERY PACK by connecting the 9418-15 AC ADAPTER (SA145A-1240V-6, SINO AMERICAN). Charging time: approximately 2 h (± 23°C)
Supported Battery Type	9447 BATTERY PACK
Operating Environment	Indoors, <2000 m (6562 feet) ASL
Operating Temperature & Humidity	0 to 40°C (32 to 104°F) at 30 to 80%RH (non-condensating)
Storage Temperature & Humidity	-10 to 50°C (14 to 122°F) at 30 to 80%RH (non-condensating)
Size (without protrusions)	Approx. 96.5W x 171.5H x 53D mm (3.8"W x 6.75"H x 2.09"D)
Weight	Approx. 0.3 kg (1.1 oz.) (without battery) Approx. 0.55 kg (1.9 oz.) (within battery)
Applying Standards	Safety EN61010, Pollution Degree 2 EMC EN61326, Class A EN61000-3-2 EN61000-3-3

15.5.4 9329 TERMINAL UNIT

Compatible Models	8420-01(-51), 8421-01(-51), 8422-01(-51) MEMORY HiLOGGERs
InputTerminals	M3 Screw Terminal Block (4 terminals per channel when connected to the 8420-51 and 8421-51, 2 terminals per channel when connected to the 8422-51) Terminal Block Cover (accessory) Terminal Pitch: 8.89 mm Crimp-Type Terminal Width: 7.2 mm max.
Measurement Accuracy	Determined by specification of the connected the main instrument (with reference junction temperature detection element installed)
Size	Approx. 171.2W X 126.2H X 48.3D mm (6.74"W X 4.97"H X 1.90"D mm)
Weight	Approx. 750 g (26.5 oz.)
Accessories	CH labels (for the 8420/21-51 or 8422-51) Wiring diagram labels (for the 8420/21-51 or 8422-51) Instruction manual
Operating Environment	Indoors, <2000 m (6562 feet) ASL
Operating Temperature & Humidity	0 to 40°C (32 to 104°F) at 30 to 80%RH (non-condensating)
Storage Temperature & Humidity	-10 to 50°C (14 to 122°F) at 30 to 80%RH (non-condensating)
Applying Standards	Determined by specification of the connected the main instrument.

Maintenance and Service 16

16.1 Repair and Servicing

- If damage is suspected, check the "Troubleshooting" section before contacting your dealer or Hioki representative.
- When transporting the instrument, use the original packing materials in which it was shipped, and pack in a double carton. Damage occurring during transportation is not covered by warranty.
- Pack the instrument so that it will not sustain damage during shipping, and include a description of existing damage. We cannot accept responsibility for damage incurred during shipping.

Troubleshooting

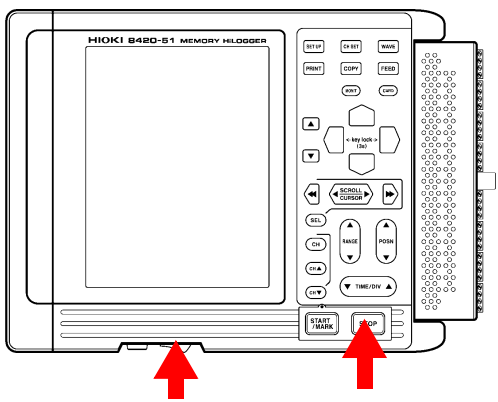
If problems are encountered with operation, check the appropriate items below.

Symptom	Check Items
The screen and indicators do not light when powered on.	• Is the AC Adapter correctly connected? • Are the batteries correctly inserted? • Are the batteries weak? • Is the contrast set too dark?
The normal screen does not appear when power is turned on.	• Are the batteries weak?
No waveform appears on the screen when the START /MARK button is pressed.	• Is the "Pre-Trig wait." message displayed? If so, no waveform trigger is accepted while recording before the trigger, until the preset interval has elapsed. • Has the "Wait for trigger" message appeared? Check the trigger settings. • Are all waveform display colors for every channel switched off? • Isn't the waveform color set to ☒?
There is absolutely no variation in the recorded waveform.	• Is the measurement range setting appropriate? • Is the input cable correctly connected?
The printed recording is very faint or non-existent.	• Is the recording paper installed backwards? • Is the correct recording paper installed? • Is there enough power left in the battery pack?
The LED lights but the screen does not appear.	• The backlight has been switched off by the backlight saver function. Press any button to switch on the backlight.

If none of the above conditions apply, and the cause of the problem is not evident, try performing a system reset. All settings will revert to the factory defaults.
Also refer to the Error Messages in the Appendix and Index for more information.

System Reset

To perform a system reset, hold the STOP button while turning the instrument on.
All settings return to the defaults except those relating to communications (RS-232C, 10BASE-T LAN, and PPP).



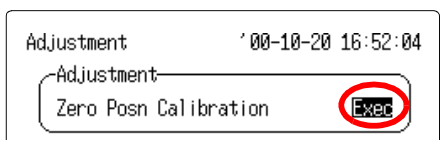
NOTE To return all the settings, including those for communications, to their defaults, turn on the power while holding down the STOP button and the START /MARK button at the same time.

16.2 Zero-Position Calibration

The zero position may drift over time.
The zero position is adjustable. The zero position of all analog channels can be set by the following procedure.
The measurement circuit is common to all channels. Correcting the zero position of channel 1 makes the correction effective for all the channels.

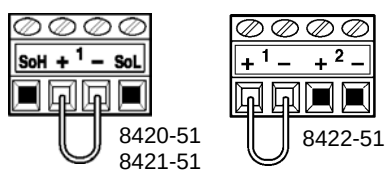
SEL

Turn the power on while pressing the **SEL** button.
An Adjustment..., item is added to the application settings of the Status Screen for zero adjustment.



Short the + and - terminals of channel 1.

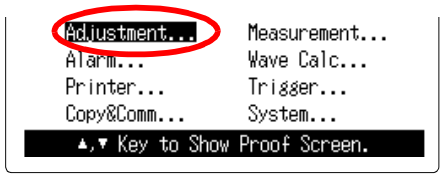
Short-circuit the + and - terminals of CH1 using a wire as shown below.

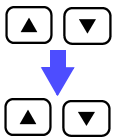


SET UP

Display the Status Screen.

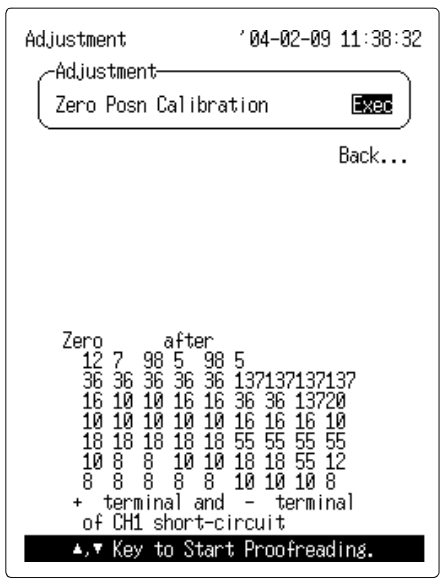
Move the blinking cursor to the position shown.





Display the Adjustment Screen.

Execute a zero-position calibration.



NOTE When carrying out a temperature measurement with a thermocouple (RJC: Internal), you cannot adjust the channels to a certain temperature or correct differences between measurements of the channels.

16.3 Cleaning

To clean the instrument, wipe it gently with a soft cloth moistened with water or mild detergent. Never use solvents such as benzene, alcohol, acetone, ether, ketones, thinners or gasoline, as they can deform and discolor the case.
Wipe the LCD gently with a soft, dry cloth.

16.3.1 Cleaning the Printer Head

The optional 8992 PRINTER UNIT requires no particular maintenance. However, depending upon usage, and especially if the printer is used for a long time, dirt or paper dust may adhere to the printer thermal head, causing faint or otherwise degraded printing. If this occurs, use one of the following procedures to clean the printer head.

Method 1: Cleaning the Printer Head

1. Press the SET UP button to display the Status Screen.
2. Move the blinking cursor to System on the Status Screen, and press the ▲/▼ buttons to display the System Screen.
3. From the System Screen, press the ◀◀/▶▶ buttons to display the Initialization (Init) Screen.
4. Move the blinking cursor to the Printer item in the Self-Check section of the Initialization Screen.
5. While pressing the MONIT button, clean the print head by solid-pattern printing. If print quality is not sufficiently improved, continue with Method 2.

Method 2: Cleaning the Printer Head

1. Moisten the back side of a strip of printer paper with alcohol, and set the paper in the printer. (If the front side of the paper is moistened, discoloring will occur.)
2. Lower the head up/down lever and slide the paper back and forth to clean the head.

NOTE

- Do not use organic solvents such as thinner or benzene, which could discolor or deform the instrument.
- After applying a solvent, be certain that the printer is completely dry before use to avoid discoloring or deforming the instrument.
- After prolonged use, white paper dust may build up on the surface of the paper roller. Small amounts of paper dust will not affect printer operation. However, you may remove it using a blower brush, such as those used for cameras.
- Cut the recording paper with the cutter attached to the printer's cover. If you cut the recording paper against the side of the printer head, large amounts of paper dust will stick to the paper roll.

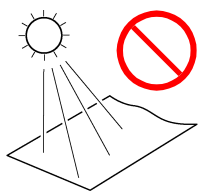
16.4 Storing Recording Paper

Storing Recording Paper

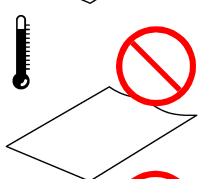
Store thermal paper where its temperature will not exceed 40°C.
The paper will deteriorate if exposed to light for a long time, so do not remove rolls from their wrappers until ready to use.
Make photocopies of recording printouts that are to be handled or stored for legal purposes.

Storing Data Recordings

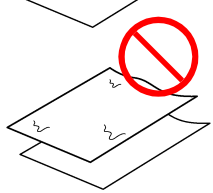
As the recording paper is thermally sensitive, be aware of the following points:



Avoid exposure to direct sunlight



Avoid 40°C, 90%RH



Avoid stacking with wet Diazo copy paper.

Avoid exposure to volatile organic solvents like alcohol, ethers and ketones

Avoid contact with adhesive tapes like soft vinyl chloride and masking tape.

16.5 Battery Pack Replacement

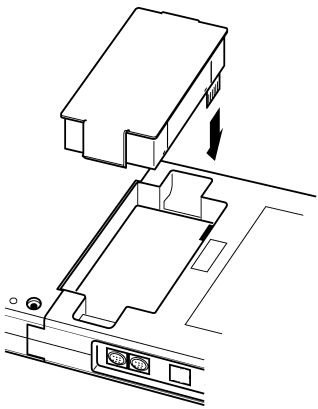
WARNING

- **To avoid electric shock, turn off the power switch and disconnect the measurement cables before replacing the battery pack.**
- **For battery operation, use only the 9447 BATTERY PACK. We cannot accept responsibility for accidents or damage related to the use of any other batteries.**
- **To avoid the possibility of explosion, do not short circuit, disassemble or incinerate battery pack. Handle and dispose of batteries in accordance with local regulations.**

While power is being drawn from the battery, the state of the battery charge mark "LOW" is displayed on the Waveform Screen. Also, a warning message (Warning 620: Battery low.) is displayed to indicate when the battery pack should be recharged.

NOTE

- To avoid corrosion from battery leakage, remove the battery pack from the instrument if it is to be stored for a long time (several months or more).
- The instrument continues to consume a small amount of power even after it shuts down automatically as a result of battery undervoltage (discharge). Therefore, the power should always be switched off even after automatic shutdown.
- The battery pack is a consumable. If the battery capacity remains very low after correct recharging, the useful battery life is at an end.
- The life of the battery pack is 500 charges or one year, whichever comes first.



1. Turn off the power switch.
2. Remove the battery pack.
3. Install a new battery pack.

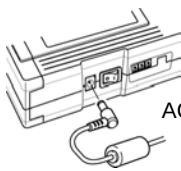
NOTE

- Before using a new battery pack the first time, be sure to charge it.
  ❖ See Section 16.6.1 "Battery Charging with the Instrument" (page 256.)
- When operating from a battery pack, the instrument automatically turns off as the battery becomes discharged. If the instrument is allowed to remain in this state for a long time, the battery pack can become overdischarged, so the power switch should always be turned off.
- The battery pack is subject to self-discharge. If stored or otherwise not used for a long time, the battery pack should be discharged and then recharged at least once every two months. Battery capacity may be degraded if stored for a long time without charging.
- For long-term storage, remove the battery pack from the instrument.
- Printing with the battery pack may result in light printouts. We therefore recommend that the AC adapter be used when printing.

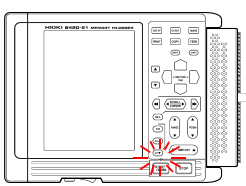
16.6 9447 BATTERY PACK Charging

16.6.1 Battery Charging with the Instrument

The 9447 BATTERY PACK can be charged using the instrument whether the power switch of the instrument is either Off or On (during or after measurement).



AC adapter

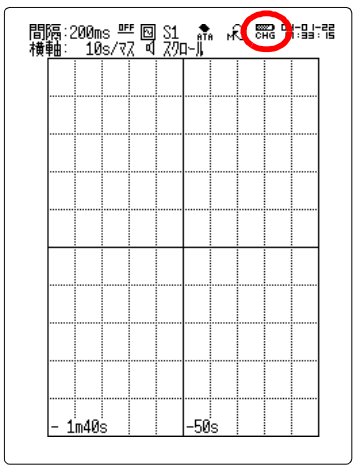


1. Install the battery pack and connect the 9418-15 AC Adapter (SA145A-1240V-6,SINO AMERICAN).

When power is OFF:

2. The LED on the START /MARK button will light up in red and rapid charging will begin.

3. Rapid charging will be completed in about 2.5 hours and LED will disappear.



When power is ON:

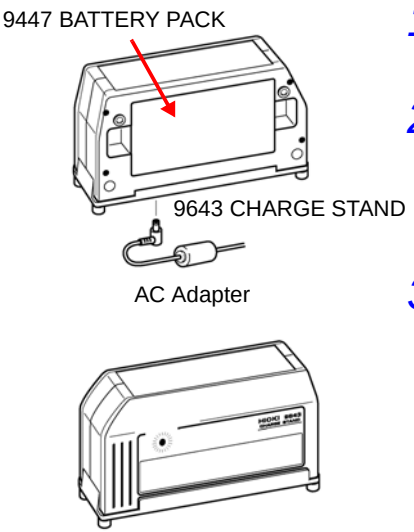
4. The indicator CHG will appear on the Waveform Screen and rapid charging will begin.
5. Rapid charging will be completed in about 2.5 hours and will appear.
6. After rapid charging is completed, supplemental charging will be performed for about 10 hours. With supplementary charging, the battery pack will be fully charged.
   After the battery pack is brought to full charge by supplementary charging, to prevent any discharge of the battery the instrument continues supplemental charging.
   (With rapid charging alone, the operating time of the battery will be about 70% of that of a full charge.)

NOTE

- Charge at an ambient temperature of 10 to 40°C. Charging outside this range may not only prevent full charging, but lead to reduced battery performance and electrolyte leaks.
- Charging outside the temperature range from 10 to 40°C will cause battery deterioration and shorter battery life.
- Do not use chargers made by other companies.
- If the operating time is found to be very short even after proper charging, the battery pack has reached the end of its useful life.
- When the 8992 PRINTER UNIT is used, you cannot charge the battery pack during printing.
- Make sure that the battery pack is fully charged when installing it in the 8993 DIGITAL I/O UNIT as you cannot charge the battery pack with this instrument.
- The 9418-15 AC ADAPTER (SA145A-1240V-6,SINO AMERICAN) is needed to charge the 9447 BATTERY PACK.

16.6.2 Battery Charging with the 9643 CHARGE STAND

The 9418-15 AC ADAPTER (SA145A-1240V-6,SINO AMERICAN) is required to charge the 9447 BATTERY PACK with the 9643 CHARGE STAND.



1. Install the battery pack in the charging stand.
2. Connect the 9418-15 AC adapter (SA145A-1240V-6,SINO AMERICAN) to the 9643 CHARGE STAND.
   The LED blinks red and then stays on as rapid charging begins.
3. After about two hours, rapid charging finishes and the LED turns green as supplemental charging begins.

Continuous Operating Time with the 9447 BATTERY PACK (at 23°C and unused printer.)

• Voltage measurement • Backlight saver enabled (5 min) • After 10 h (approx.) charging	Approx. 5 hours
• Voltage measurement • Backlight brightness • After 2.5 h (approx.) charging	Approx. 2.5 hours

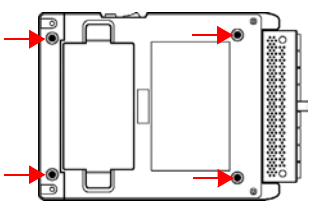
- The times in this table depend on ambient temperature.
- Continuous operating time is about doubled when a second battery pack is installed in the 8993 DIGITAL I/O UNIT.

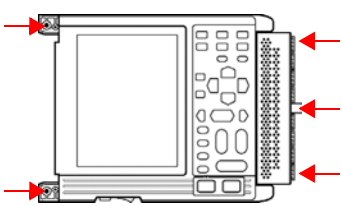
16.7 Removing the Battery Before Discarding the Instrument

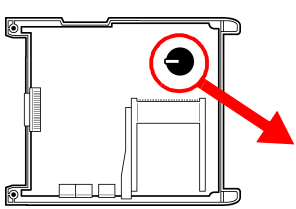
This instrument incorporates a lithium battery for memory backup. When disposing of this instrument, remove the lithium battery and dispose of battery and instrument in accordance with local regulations.

WARNING **To avoid electric shock, turn off the power switch and disconnect the power cord and measurement cables before removing the lithium battery.**

Removing the Lithium Battery

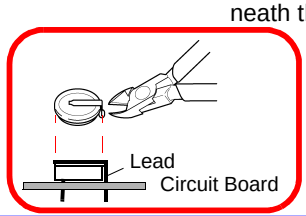






Required tools:
- Phillips screwdriver 2 (M3, M2.6)
- Wire cutter 1

1. Verify that the instrument is turned OFF.
2. Remove the four screws on the rear, and remove the cover (or printer or I/O Unit).
3. Remove the printer attachment compartment cover.
   Remove the two hidden screws in the cover using a Phillips screwdriver.
4. Remove the upper case (front).
5. Pry the battery upwards, and cut the positive (+) connection with wire cutters.
6. Pry the battery up further.
   Cut the negative (-) connection underneath the battery.



CALIFORNIA, USA ONLY
This product contains a CR Coin Lithium Battery which contains Perchlorate Material - special handling may apply.
See www.dtsc.ca.gov/hazardouswaste/perchlorate

Appendix

Error Messages and Troubleshooting

Error Messages

In the following conditions, an error message is displayed until the cause of the error is remedied or the STOP button is pressed.

1	Paper End.	Printer paper has run out. Reload.
2	Set printer lever.	Lower the head up/down lever.
12	Printer is not connect-ed.	The 8992 PRINTER UNIT is not connected.
14	Printer Error.	Check the built-in printer.
21	Battery low. (Printer)	Battery voltage is low.

Warning Messages

When an error occurs, the accompanying warning message is displayed only once (and disappears after a few seconds). Warning messages can be cleared by pressing any button.

51	System files are damaged.	The power fault protection system files are damage. Perform a complete format.
52	File cannot be repaired.	The power fault protection system files are damage. Perform a complete format.
53	Cannot change to initial directory.	The directory stored when power was turned off could not be found.
54	Card is not logger formatted.	Format the PC card using this instrument.
55	File is locked.	Protected files or directories cannot be manipulated on this instrument.
71	Cannot load.	Data cannot be loaded, either because it is text data, or was not created by the instrument.
72	Illegal format.	The media does not have the correct MS-DOS format.
73	Write Protected.	The media is write-protected. Release the write protection.
75	File is read only.	File cannot be written or deleted because it is read-only.
76	General failure.	The media is not accessible due to an error such as a bad format or corrupt file.
80	Insert PC card.	No card is present in the PC Card slot.
90	File already exists.	Rename the file.
91	Directory full.	Only a limited number of files (including directories) can be created in the root directory.
93	Disk full.	There is no more disk space available. Delete files or replace the media.
94	Path name error.	Path names are limited to 127 characters.
95	Empty directory name.	Name the directory.
96	Directory already exists.	Another directory exists with the same name. Saving cannot be performed with this directory name.
99	Conditions for OVERWRITE are not satisfied.	The instrument conditions and file data conditions (function and time-axis) must be set to be the same.
201	Set printer paper.	Printer paper has run out. Reload.
202	Set printer lever.	The head up/down lever has been left in the up position.
205	Invalid. (START)	The button pressed is not valid during measurement operation.
206	Invalid. (Copy OFF)	Turn ON Screen Copy.

210	Cannot Save (File Lock)	Do not write, edit, or delete a file in the PC card using the FTP during automatic text save or at the start of the real-time save operation.
300	Cannot START.	Measurement cannot be started from a screen displayed by pressing the **CARD** button.
360	Interval has been changed. (humid)	Humidity measurement cannot be performed unless the recording interval is from 5 sec. to 1 hr. Therefore, the recording interval is automatically adjusted.
361	Cannot be faster than 5s. (humid)	When humidity is measured on any channel, a recording interval less than 5 sec. cannot be set.
362	Measurement range was changed.	When upper and lower limits have been set, the range is automatically changed to the optimum range that corresponds with the upper and lower limits.
364	Saving was interrupted.	Operation was forcibly interrupted while saving text.
370	Cannot change while measuring.	Press the **STOP** button twice to stop measurement, then change the setting.
375	Invalid event marker.	You have attempted to go to an event marker that is no longer in memory.
382	No waveform data.	There is no waveform data to display on the Waveform Screen. Data must be acquired before processing can start.
396	Out of range. (variable)	The settable area for upper and lower limits has been exceeded. Enter an appropriate value for the upper or lower limit. (variable)
397	Out of range. (scaling)	Input the appropriate signal level. (scaling)
398	A-B cursor positions invalid.	Move the cursors to valid positions.
520	Bad MAC address.	The MAC address is illegally rewritten. Contact us.
521	Bad IP address.	Check the IP address.
522	Bad server IP address.	Check the server's IP settings.
523	Can not connect to server.	Check the settings and connection.
524	Can not connect to 9334.	Check the settings and connection of the 9334 LOGGERCOMMUNICATOR.
525	Connection timed out.	Check the connected device.
526	Transfer was aborted.	Check the connected device.
527	Network error.	Check the instrument and connected device.
528	Server not found or DNS failed.	Check the DNS IP address or the line connection.
529	DHCP failed.	Check the connected device.
530	Password error.	Check the password. Password recognition is case-sensitive.
531	Can not change while server is working.	Stop the monitor server and edit the setting.

532	Bad FTP server IP address.	Check IP settings for automatic transfer of FTP data.
533	Can not connect to FTP server.	Check settings and connections for automatic transfer of FTP data.
534	Can not find FTP server / DNS failed.	Check settings, DNS IP address, and connections for automatic transfer of FTP data.
535	Bad Mail server IP address.	Check IP settings of the mail server.
536	Can not connect to Mail server.	Check mail server settings and connections.
537	Can not find Mail server / DNS failed.	Check settings, DNS IP address, and connections for the mail server.
538	PPP: Connection failed.	Check the telephone number, AT command, etc.
539	PPP: Bad Telephone number.	Set the correct telephone number.
540	PPP: Connection was aborted.	PPP settings were modified or the **STOP** button was pressed.
541	PPP: MODEM error.	Check the power supply for the modem, AT command, etc.
542	PPP: Login failed.	Check the calling user name, password, and PC settings.
560	Can not change while communication.	This item cannot be modified in remote operation.
561	FTP Auto Transfer has been changed.	Because auto save was modified, settings for automatic transfer of FTP data were also modified.
562	Please set Auto Save to Binary.	Unless auto save is binary, FTP data cannot be automatically transferred.
620	Battery low.	Recharge or replace the batteries.
621	Battery low. (Printer)	Battery voltage is low.

Concerning Noise Countermeasures

Mechanism of Noise Introduction into Thermocouple Temperature Measurements

What are the sources of noise?

Within a factory, power is provided by large current flows at 50/60Hz. The main loads are primarily L loads, such as motors and solenoids; in addition, large current pulses are produced by capacitor input-type switching power supplies for device such as inverters and high-frequency induction furnaces. Basic wave component leak current, harmonic wave current, and other types of noise become mixed into the flow from each ground point to ground lines.

What are the paths of noise propagation?

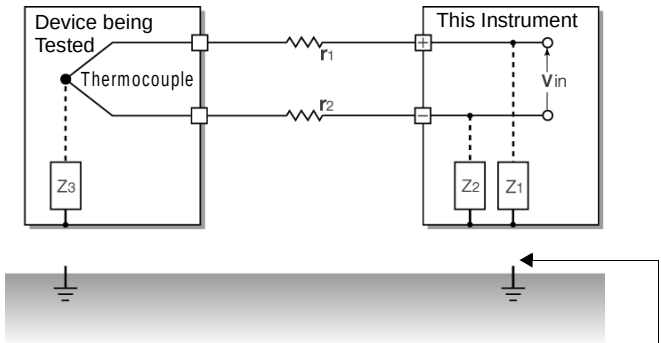
- Common mode voltage introduced between the ground points of the device being tested and the instrument leaks to the input signal lines
- AC magnetic fields produced by current in power lines couple into loops in the input signal lines
- Coupling due to electrostatic capacitance between input signal lines and power supply lines

What is common mode noise?

Noise that is generated between ground and the "+" and "-" input terminals of the instrument

What is normal mode noise?

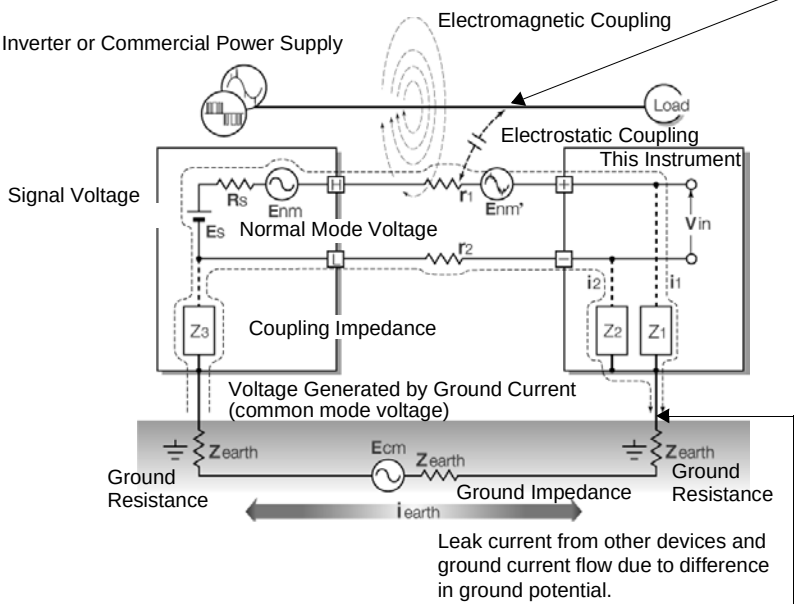
Inter-line noise that is generated between the "+" and "-" input terminals of the instrument



When using a thermocouple to measure temperature, noise can affect measurements unless both the device being tested and the instrument are grounded.
Although there is no problem if the instrument is running on battery power, the instrument must be connected to ground if an AC adapter is being used.

Example of Connections Where Noise Can Affect Measurements

Measurements are directly affected by normal mode voltages from electromagnetically induced noise resulting from electromagnetic coupling into looped instrument input lines by AC magnetic fields produced by inverters and commercial power lines, as well as the capacitive coupling that results from interline capacitance.



Common mode noise results from the interposition of ground impedance between the ground point of the device being tested and the ground point of the instrument, and from CR coupling between the ground wire and noise source.
Common mode noise is converted to normal mode voltage (Enm) that is added to the "+" and "-" input terminals of the instrument as a result of the noise current (I1) and (i2) that flows to the coupling impedance (Z1) and (Z2) between the "+" and "-" input terminals of the instrument and ground. Because common mode noise is generated between the input pins, it has a direct effect on the measurements.

Equivalent Circuit of Noise Introduction Path

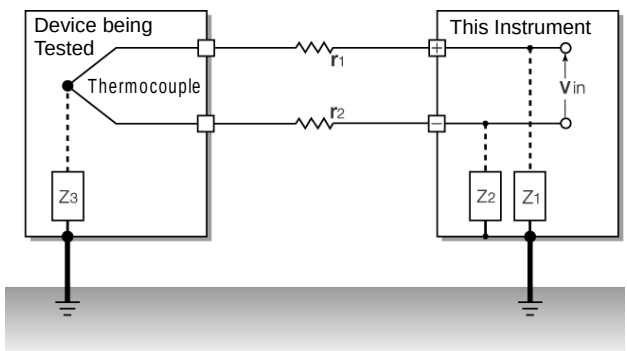
The Importance of Device Grounding

Ground the instruments (8420-51/ 8421-51) securely

The 8420-51/ 8421-51 can both be powered through an AC adapter. The instrument is designed so that the chassis is grounded when the three-prong power cord from the adapter is plugged directly into a grounded, three-prong receptacle.
If a three-prong-to-two-prong adapter must be used on the AC adapter power cord and therefore the instrument is not grounded, the instrument can still be grounded by connecting a grounded wire to the GND terminal (a pushbutton terminal) located on the side of the 8420-51/ 8421-51.

Securely ground the chassis of the device being tested.

Securely connect the chassis of the device being tested to a good ground.



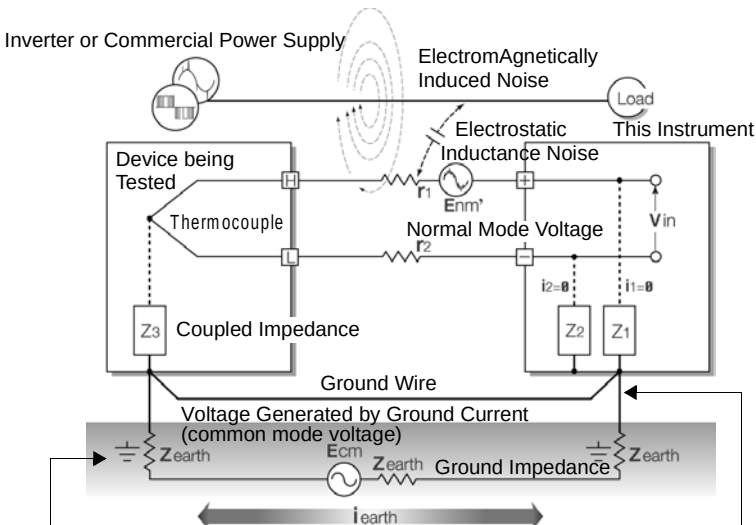
Grounding Both the Device Being Tested and the Instrument

Connecting the chassis GND on the signal side to the instrument chassis

When connecting the chassis ground of the 8420-51/ 8421-51 to the chassis ground of the device being tested and then to ground, use a wire that is as short and as thick as possible to bring both pieces of device to equal potential.

Running the instrument (8420-51/ 8421-51) on battery power

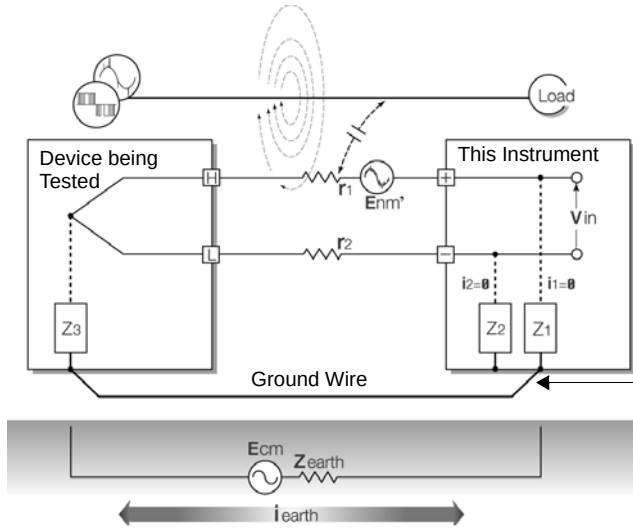
When the instrument is being powered by batteries and the AC adapter is not connected, the ground current loop is eliminated, making it possible to reduce the effects of common mode noise. For measurements of short duration, powering the 8420-51/ 8421-51 with batteries is an effective method for eliminating noise.



Connect the chassis GND on the signal side to a good ground with a sufficiently low ground resistance. If there is still a large amount of noise, it may be possible to reduce the effects of common mode voltage by connecting a bypass ground wire to the GND terminal on the instrument.

Noise current (i1) and (i2) can be suppressed by suppressing the common mode voltage with a low-resistance ground wire or a bypass between ground poles. This suppresses the generation of normal mode voltages and reduces the effect on measurements.

Common Mode Noise Countermeasures



If it is not possible to simply ground the instrument or the signal side, connect a ground wire between the chassis GND of the instrument and the signal side to equalize ground potentials. A basic requirement for obtaining stable measurements is to ground the device.

Common Mode Noise Countermeasures

Blocking Noise from External Sources

Keep signal lines away from noise sources

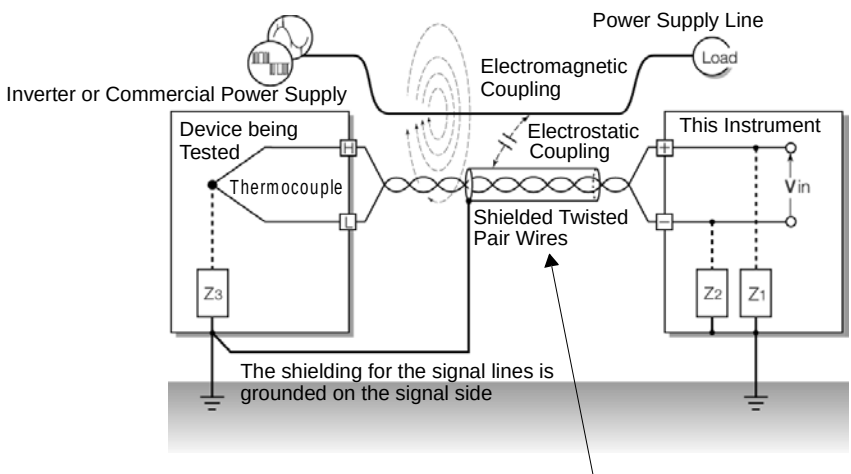
Keep input signal lines (of the thermocouple) away from wiring that is a noise source (such as power lines, etc.), and make any permanent installation with as much separation as possible; for example, by running wires through a separate duct.

Use shielded twisted pair wiring

It is effective to use shielded twisted pairs for the input signal lines (of the thermocouple). Twisted pairs are effective for preventing electromagnetic induction, and shielded wires are effective for preventing electrostatic induction.

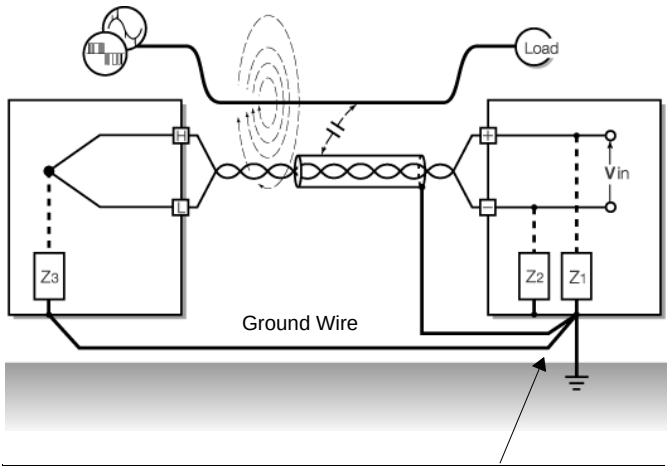
The shielded wires should basically be grounded on the signal source side. If it is not possible to connect the signal source to ground, connect it to the chassis GND on the 8420-51/ 8421-51. Note that doing so has no effect if the 8420-51/ 8421-51 is not itself connected to ground through the three-prong power cord, etc.

Shielded twisted pair wires for the thermocouple can be obtained from thermocouple manufacturers.



Keep the signal lines (of the thermocouple) away from wiring that is a noise source (such as power lines, etc.). It is also possible to shield the signal lines from electrostatic coupling and to block noise by grounding the shield.

Normal Mode Noise Countermeasures



If the signal side is not grounded or if it is grounded inadequately, connect the instrument to ground. Also ground the shielding for the signal wires on the instrument side securely.

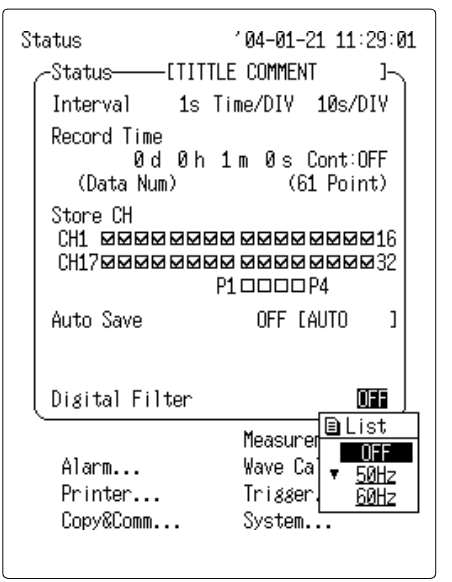
Insulation from noise sources (temperature measurement by thermocouple)

The analog input channels are insulated from the chassis and each other. Therefore, the instrument allows you to attach the thermocouple directly to a conductor with a potential to measure it, provided that the voltage to ground does not exceed the maximum rating. If noise is likely affect measurement, wrap heat-resistant tape around the thermocouple for insulation, or use an ungrounded thermocouple and electrically insulate the input line.

Setting the Digital Filter

To remove noise from input signals, the digital filter can be set for the analog channels.
The longer the recording interval is, the larger the noise reduction effect becomes; this ensures highly accurate measurement with little scatter.
❖See "Recording Interval and Cutoff Frequency table" (page 238.)

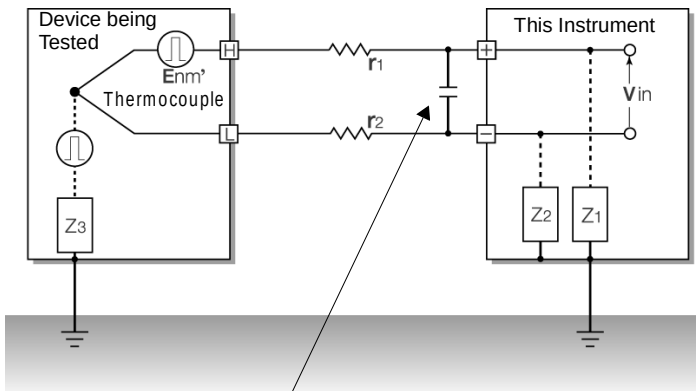
For example, assuming that channels CH1 to CH6 are used and the digital filter is set to 60Hz, noise reduction in the supply frequency is maximized at a recording interval from 2 sec. to 1 hr.



Status Screen

Inserting a Capacitor in the Signal Line

When noise affects the signal source directly or when measuring high-frequency pulses, it is effective to insert a capacitor between the "+" and "-" input terminals so that the noise does not enter the 8420-51/ 8421-51. When inserting a capacitor, use one with a rated voltage that is equal to or exceeds the input voltage.
When a capacitor is inserted between the "+" and "-" input terminals, there are no restrictions on the recording interval because the filter is applied before the channel scan operation.



The capacitance of the capacitor should range from several µF to several thousand µF. Insert the capacitor between the "+" and "-" input terminals.

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HIOKI

DECLARATION OF CONFORMITY

Manufacturer's Name:	HIOKI E.E. CORPORATION
Manufacturer's Address:	81 Koizumi, Ueda, Nagano 386-1192, Japan
Product Name:	MEMORY HiLOGGER
Model Number:	8420-51, 8421-51, 8422-51
Accessory:	9418-15 AC ADAPTER (SA145A-1240V-6, SINO AMERICAN)
Options:	8992 PRINTER UNIT 8993 DIGITAL I/O UNIT 9447 BATTERY PACK 9643 CHARGE STAND 9329 TERMINAL UNIT

The above mentioned products conform to the following product specifications:

Safety:	EN61010-1:2001
EMC:	EN61326-1:2006 ClassA equipment Basic immunity test requirement EN61000-3-2:2006 EN61000-3-3:1995+A1:2001+A2:2005

Supplementary Information:
The products herewith comply with the requirements of the Low Voltage Directive 2006/95/EC and the EMC Directive 2004/108/EC.

HIOKI E.E. CORPORATION

11 December 2008

Atsushi Mizuno

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Director of Quality Assurance

8420E999-03

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