FS2000

DIGITAL INDICATOR

OPERATION MANUAL

05APR2024REV.1.08

UNIPULSE

Introduction

Thank you for purchasing our digital indicator FS2000.

The FS2000 is an indicator for measuring pressure, load, torque, etc. Being equipped with the waveform comparison and hold functions, the FS2000 can be used for multipurposes, such as in automatic assembling machines and testing machines, etc.

Be sure to read this operation manual before use in order to take full advantage of the superb quality of the FS2000 and to use it properly and safely. Use this product with accurate understanding of the contents. Keep this operation manual in a safe place to be used for further reference.

Safety precautions

Be sure to read for safety

Make sure that installation, maintenance, and inspection of the FS2000 are performed by personnel with electrical knowledge.

In this operation manual, precautions for safe use of the FS2000 are described separately as ⚠ Warning and ⚠ Caution in the following text. The precautions described in this text are important content regarding safety. Use this product having understood the content accurately.

⚠ Warning

Events that may cause death or severe injury to persons in cases of misuse.

⚠ Caution

Events that may cause injury to persons or material damage in cases of misuse.

⚠ Warning

Events that may cause death or severe injury to persons in cases of misuse.

Design warning

- Prepare a safety circuit outside the FS2000 so that the entire system functions safely if the FS2000 fails or malfunctions.
- Be sure to contact our sales representative before use if the FS2000 will be used in the following situations:
  - If the product is used in an environment not described in the operation manual;
  - If the product is used in a way that may have a substantial effect on medical devices, transportation equipment, entertainment devices, safety devices, etc.

Installation warning

- Do not disassemble, repair or alter the FS2000. Fire or electric shock may occur.
- Do not install the product in the following environments:
  - Locations with corrosive gases or combustible gases;
  - Locations over which water, oil, or chemicals splash.

Wiring warning

- Do not connect commercial power supply directly to the signal I/O terminal.
- Be sure to perform class D grounding when installing the main unit.
- Be sure to check that the power is off before the following actions:
  - Removal and installation of optional connectors and so forth;
  - Wiring and connecting cables to the input terminal of electric power measurement.
  - Wiring and connection of cables to a signal I/O terminal;
- Be sure to check signal names and pin assignment numbers before connecting to the signal I/O terminal in order to wire cables properly.
- Be sure to attach the included terminal block cover after wiring the power supply input. Electric shock may occur.
- Be sure to check the wiring and so on carefully before turning the power on.

Startup/maintenance warning

- Use power supply voltage and load within the specified range and rating.
- Do not damage the power cords. Fire or electric shock may occur.
- Do not touch the power input terminal and signal I/O terminal while the power is on. This may cause electric shock and malfunction.
- Electric shock may occur inside the main unit when the cover is opened. Internal capacitors are charged even when power supply is cut off. Contact us for internal inspection or repair.
- Turn power off and unplug power cable immediately if smoke, abnormal smell, or abnormal noise is detected.

⚠ Caution

Events that may cause injury to persons or material damage in cases of misuse.

Installation precautions

- The FS2000 must be incorporated into the control panel and so forth.
- Do not install the product in the following environments:
  - Locations where temperature or humidity exceeds specifications;
  - Locations subject to drastic temperature fluctuations or icing and condensation;
  - Outdoors or locations above 2,000m;
  - Locations exposed to direct sunlight;
  - Locations subject to dust accumulation;
  - Locations with poor ventilation;
  - Locations with a lot of salt and metal powder;
  - Locations where the main unit is subject to direct vibration and/or shock.
- Perform adequate shielding if the product is used in the following locations:
  - Near power lines;
  - Locations subject to strong electric field and magnetic field;
  - Locations subject to noise such as static electricity and relays.
- Install as far away as possible from equipment generating high frequency, high voltage, large current, surge, etc. Moreover, perform wiring of cables separately from these power lines. Do not perform parallel wiring and identical wiring.
- Do not use the product if it is damaged.

Wiring precautions

- Tighten power supply terminal screws to the torque specified.
  Loose tightening may cause short-circuiting, fire, or malfunction.
  Tightening torque: 0.5 N・m
- Use shielded cables for cables (load cell, external I/O, USB, and options).
- Avoid a temporary overvoltage exceeding 1500 V to be applied to the power source.

Startup/maintenance precautions

- Be sure to allow an interval of five seconds or longer between turning power ON and OFF.
- Use after warming up for 30 minutes or longer following the startup of power supply.
- Protective performance of the FS2000 may be lost if it is not used as specified.
- Cleaning
  - Unplug the power supply when cleaning.
  - Please use a dry cloth. When dirty, clean using a well squeezed cloth soaked in diluted neutral detergent. Afterwards wipe with a soft, dry cloth.
    Do not wipe with benzine, thinner, alcohol, etc. This may lead to discoloration and/or warping of the FS2000.

⚠ Caution

Events that may cause injury to persons or material damage in cases of misuse.

Transportation precautions

- Although the FS2000 is considered to be sufficiently shock absorbing during delivery, reusing the same packaging materials may damage the product when a shock is encountered. When sending this product to us for repair and so on, pack it with sufficiently shock-absorbing materials.

Disposal precautions

- Handle this product as industrial waste when disposing.
  Be sure to remove the lithium batteries inside and dispose them according to classification of waste collection.

About the built-in lithium battery

⚠ Warning

Events that may cause death or severe injury to persons in cases of misuse.

- Do not disassemble, apply pressure and deform or throw it into fires.
  The battery may explode, ignite or leak.

- Battery

Model	CR14250SE made by FDK
Nominal voltage	3 V
Nominal electric capacity	850 mAh
Battery life	Approx. 5 years or more

Product compliant to RoHS2 Directive

The parts and attachments (including the instruction manual, packaging box, etc.) used for this unit are compliant with the RoHS2 Directive, restricting the use of hazardous substances with regard to adverse effects on the environment and human body.

RoHS2 Directive

It is based on the restriction of the use of certain hazardous substances in electrical and electronic equipment (EEE). The Directive restricts the use of specific substances in electrical and electronic equipments that could harm environment and human body. The substances are lead, mercury, cadium, hexavalent chromium, PBB (polybrominated biphenyls), PBDE (polybrominated diphenyl ethers), DEHP (bis(2-ethylhexyl) phthalate), BBP (benzyl butyl phthalate), DBP (dibutyl phthalate), and DIBP (diisobutyl phthalate).

Compliance with EC directives

The FS2000 digital indicator is a product that complies with EC Directives (based on the European Community Council) included with CE mark.

- EMC Directive EN61326-1:2006
  EN55011:2009, A1:2010 Group1, ClassA *1
  EN61000-4-2:2009
  EN61000-4-3:2006, A1:2008, A2:2010
  EN61000-4-4:2004, A1:2010
  EN61000-4-5:2006
  EN61000-4-6:2009
  EN61000-4-8:2010

*1: Radiated only

Key points

The combination of the main unit of the FS2000 and a lightning surge protector conforms to EN61000-4-5 (lightning surge immunity) in the EMC Directives.

Refer to "◇Lightning surge protector connection" on p.24 for information regarding lightning surge protector connection.

Setting guidance

The FS2000 is a digital indicator which is used together with a load cell and can display loads as waveforms. It can visually capture as waveforms variations in load which are difficult to capture with only numerical values.
Its color LCD touch panel display and carefully thought-out design make it easy to understand. Also, with high speed processing at a maximum of 25000 times per second, it can respond to fine deviations in values. It is equipped with various hold functions and judgment functions, including a waveform display function and a HI/LO limit comparison function, and can be used for a wide variety of applications, such as in-production management control systems or with automatic devices and testers.

*** Mandatory ***

Wiring

Please read "Connection and installation" on p.13.

*** Mandatory ***

Calibrating

Please read "Calibration" on p.26.

Measuring

Please read "Measurement" on p.31 and "Judgment" on p.43.

Other useful functions

Please read "Other settings" on p.76.

Features of the FS2000

Please read "Features" on p.121.

When there is a problem

Please read "Measurement status display" on p.6, "Error messages" on p.74, and "Troubleshooting" on p.109.

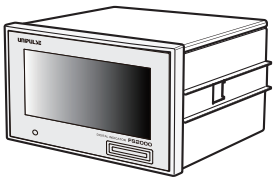
Contents

M E M O

1 Outline

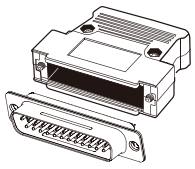
1-1. Package contents

The following items are included in the package box.
Be sure to check the contents before use.

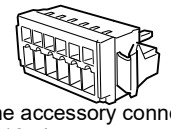


FS2000 main unit
... One unit

FS2000 operation manual
... One copy

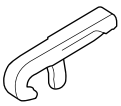


External I/O connector
... One set
[Model: CN36]



* The accessory connector is 16-pin

Sensor connector
... One piece
[Model: CN77]



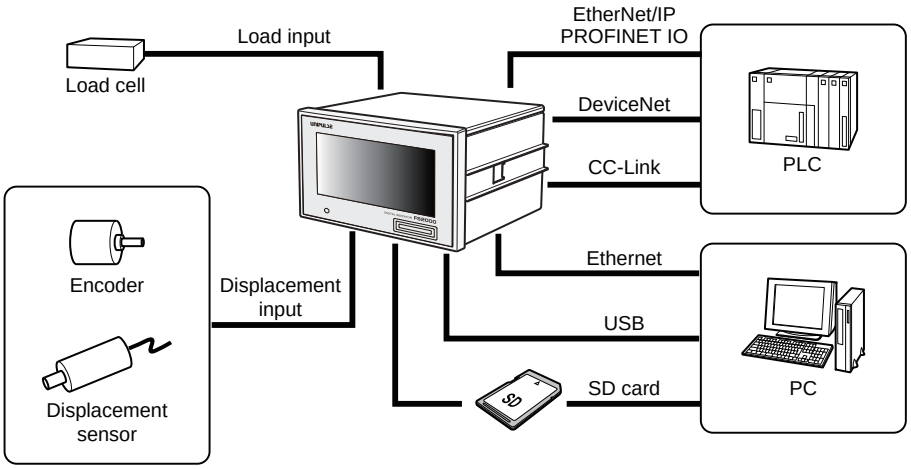
Operating tool
... One piece
[Attached to CN77]

SD memory card
... One card
[Model: SD1G]

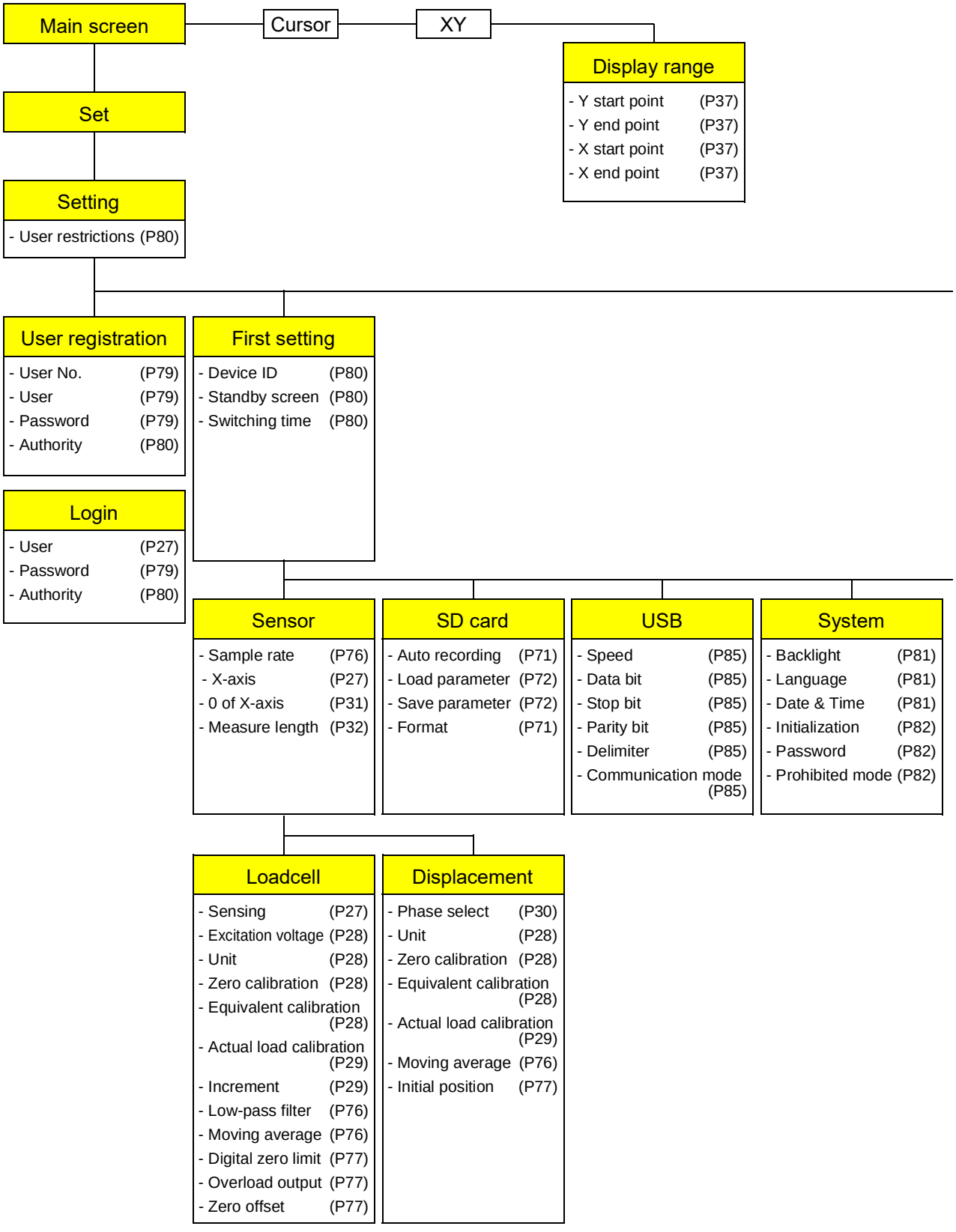
The item below is sold separately.

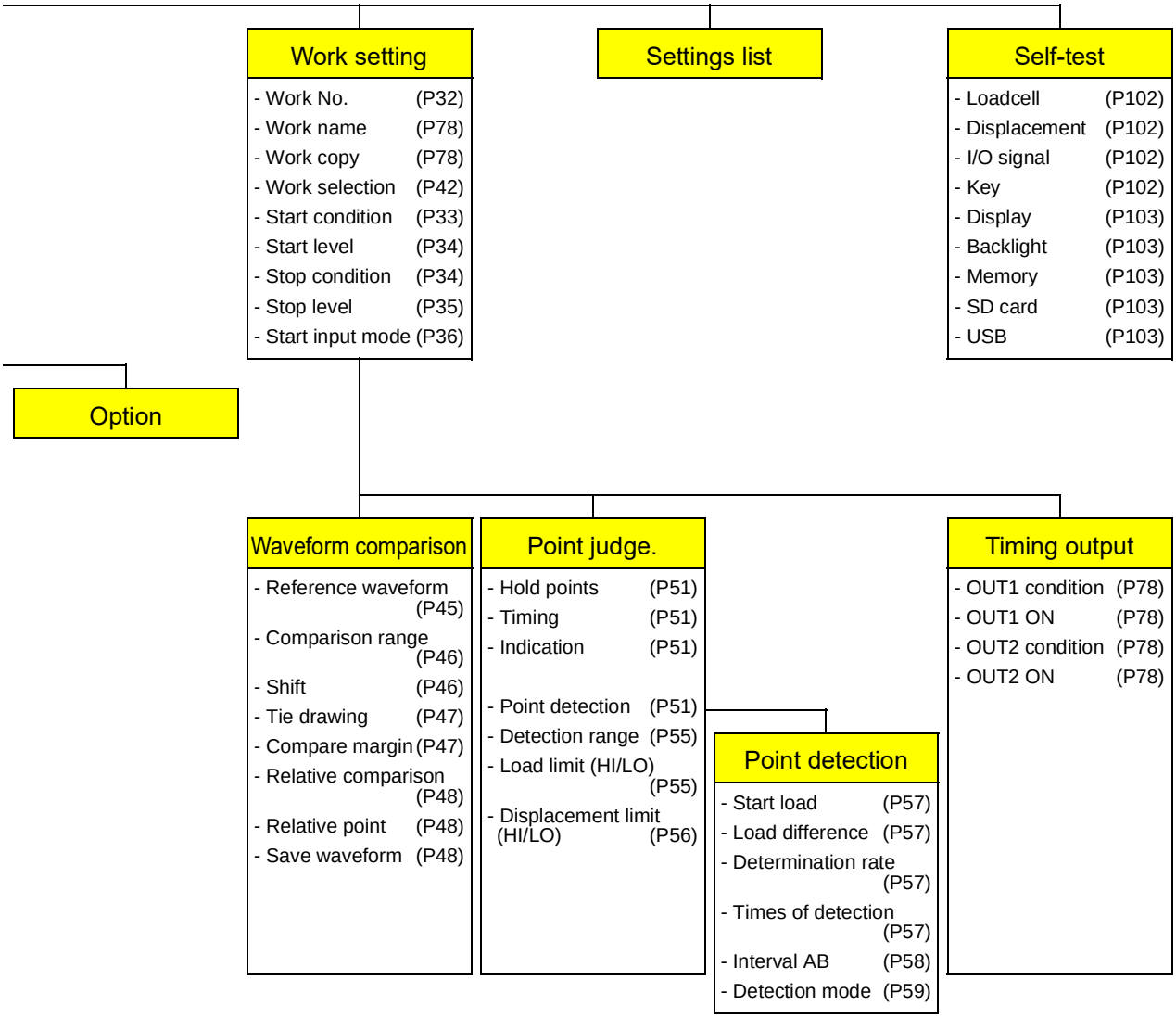
- USB cable [Model: CA81-USB]

1-2. Connection with other devices



1-3. Settings tree

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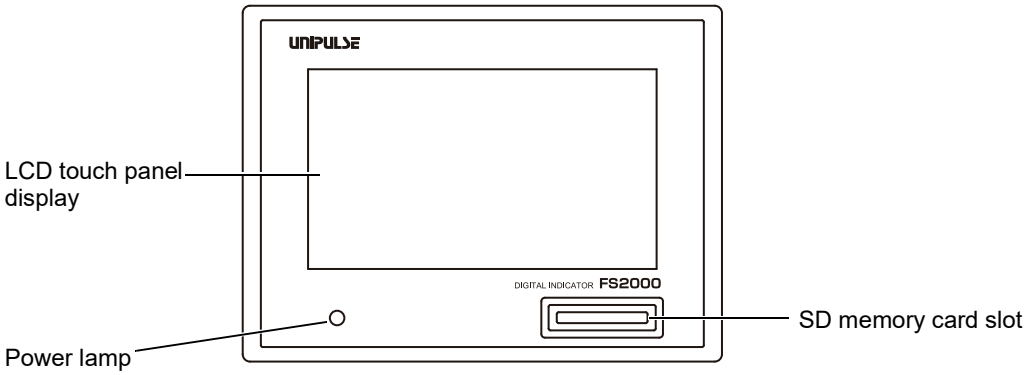
- OUT1 ON (P78)
- OUT2 condition (P78)
- OUT2 ON (P78)

1-4. Part names and functions

■ Front panel

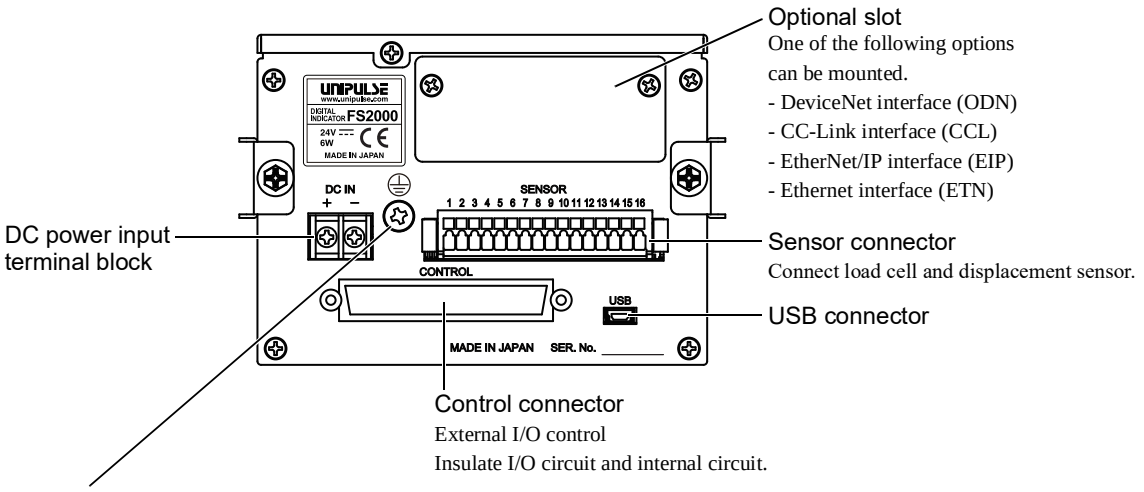


Light on Power ON

Fast flashing Processing writing to internal NOV RAM (nonvolatile memory).
Also indicates SD memory card processing.
Do not turn OFF the main unit power while the lamp is flashing.
Also, do not remove the SD memory card while writing to the SD memory card.

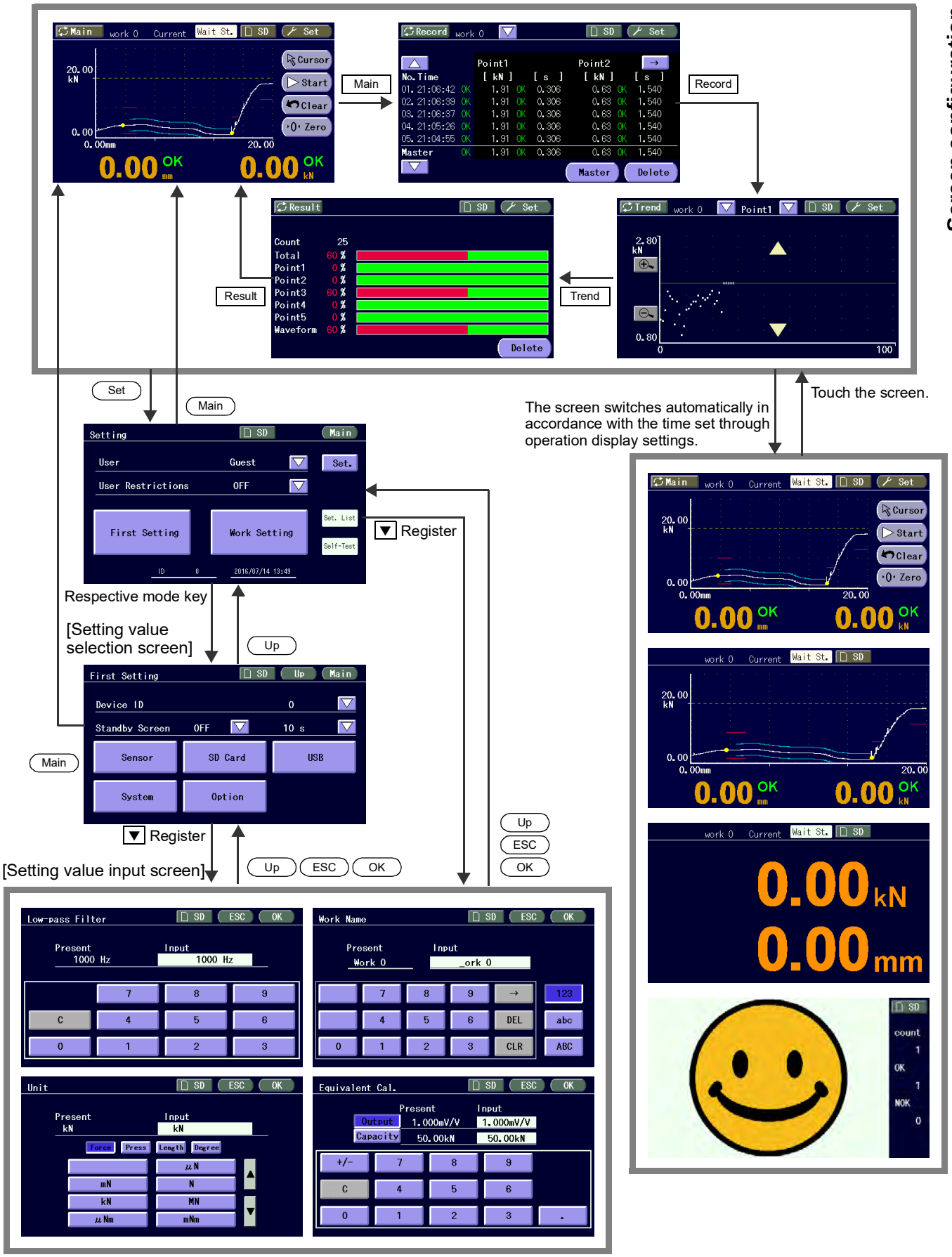
Slow flashing (Light ON ⇔ OFF every 2s)
Low voltage of lithium battery for internal memory backup.
The battery must be replaced.
Replacement of batteries is carried out by UNIPULSE, so please contact us.

■ Rear panel



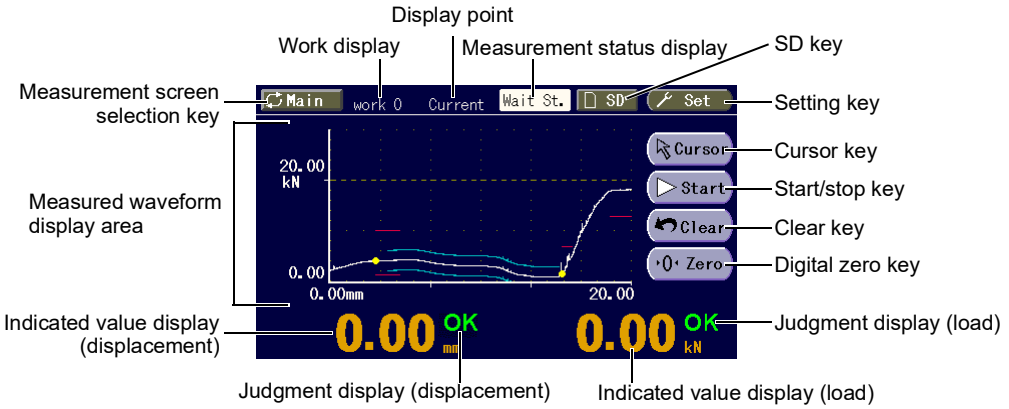
Ground to prevent problems arising from noise.
(The case and frame grounding terminal are in continuity.)
In some installation environments, it may perform better without the grounding.

1-5. Screen configuration



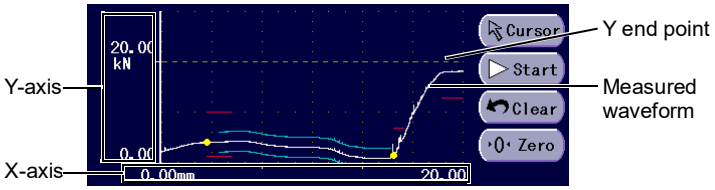
1-5-1. Description and key operation for each screen

■ Main screen



Display

Measured waveform display area: The measured waveform, the comparison waveform used for measurement, and the HI/LO limit values are displayed.



Measured waveform...The measured waveform is displayed in white.

Y-axis .....A load axis adapted to the indicated value of the load.

X-axis .....An axis that indicates how the displacement or time progresses after measurement starts. Basically, the origin will be at the left edge when the reference is front, and at the right edge when the reference is end.

Y end point.....The end point of the Y-axis is indicated by a yellow dotted line.

Measurement status display: The current measurement status is displayed.

Display	Measurement status
Wait St.	Waiting for measurement start signal input. Input a measurement start signal. Measurement can also be started by pressing the start key.
Wait Off	Waiting for the measurement start signal input to be turned OFF. Turn OFF the measurement start signal.
Wait LV.	Waiting for load or displacement to cross the measurement start level. Apply a load to the sensor so that the measurement start level will be crossed.
Sampling	Measurement is in progress. Measurement stops when the measurement stop condition is met.
Complete	Measurement is complete. The measured waveform is displayed.
Reset On	Waiting for the reset signal to be turned OFF.

Judgment display: The judgment is displayed.
Waveform comparison and judgment for each point are displayed comprehensively, according to priority.
* The displacement judgment is not displayed when the X-axis is time.

Priority	Judgment	Judgment condition
1	H/L	HI/LO limit over (HI limit over and LO limit over)
2	HI	HI limit over (Judgment point ＞ HI limit setting value)
	LO	LO limit over (Judgment point ＜ LO limit setting value)
3	NOK	<Point judgment operation> - Measurement was not performed up to the detection range. - The judgment point could not be detected. <Waveform comparison operation> - Measurement was not performed up to the comparison range. - Measurement was not performed up to the relative point when relative comparison was made.
4	OK	Normal (LO limit setting value ≦ judgment point ≦ HI limit setting value)

Indicated value display: The value (digital value of the load cell input and displacement sensor input) selected in indication of point judgment settings is displayed.
Load sensor and displacement sensor errors are also displayed.
* When the value selected in indication of point judgment settings is Point 1 to 5, if there is no hold point, "-----" is displayed.

Work display: The work No. currently specified by work selection of the external input is displayed.

Display point: The item selected in indication of point judgment settings is displayed.

Current .....Sensor input value

Point 1 to 5 .....Judgment point

Keys

: Moves to the result screen.

: Moves to the settings screen.

: Releases SD memory card errors, and saves the screen to the SD memory card. The letters on the key will change from SD → Auto during auto recording.
* The key turns red when there is an SD memory card error.

: Moves to the cursor display screen.

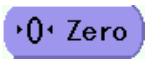
: Performs the same operation as the measurement start signal in a simple way.
This is valid when the measurement status display is Wait St. or Complete.
Changes to 

when pressed.

: Performs the same operation as the measurement stop signal in a simple way.
This is valid when the measurement status display is Wait LV or Sampling.
Changes to 

when pressed.

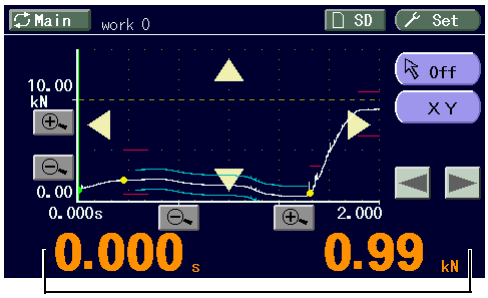
: Performs the same operation as the reset signal in a simple way.
Also, when there is an error display, this also clears the error display after the error has been avoided.



: Resets the load and displacement to zero in a simple way.

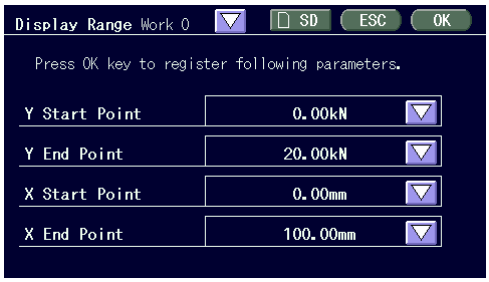
■ Cursor display screen

Waveform display



Cursor read values

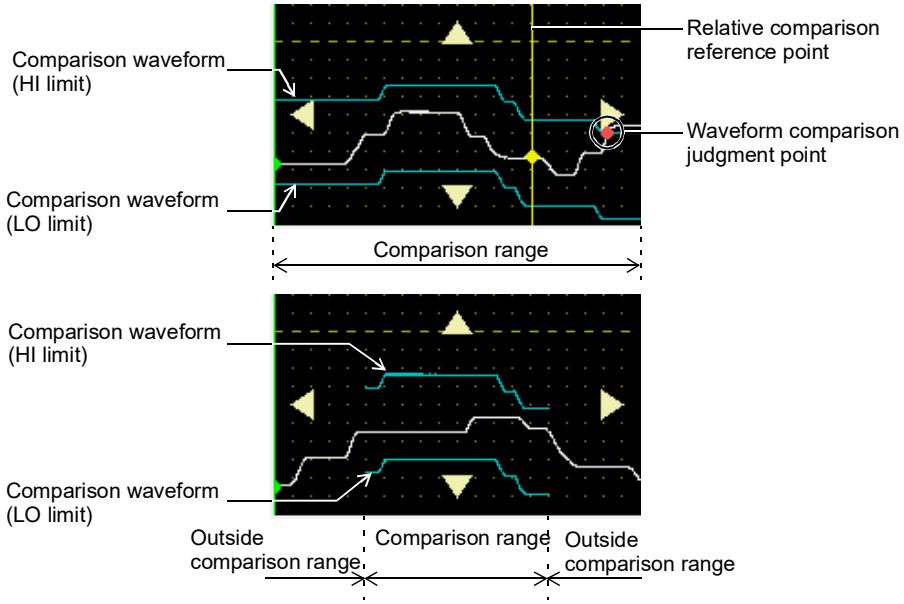
Graph display range



Display

Cursor read values: The load and displacement (time) at the cursor position are displayed.

- Waveform display



Comparison waveform (HI limit/LO limit):

The comparison waveform set in waveform comparison settings is displayed in blue only in the comparison range.

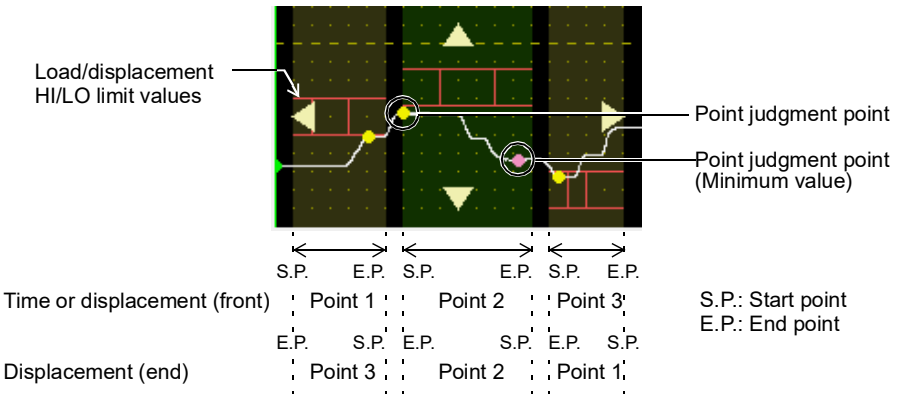
The comparison range can be recognized at a glance, because the comparison waveform is not displayed outside the comparison range.

Waveform comparison judgment point:

The point at which the HI/LO limit value of the comparison waveform is first exceeded is indicated in red.

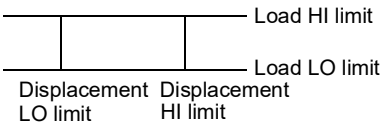
Relative point:

Displayed with a yellow point and line during relative comparison.



Point judgment point: Any judgment point (hold point) in each range is displayed with a yellow point. However in the case of peak to peak, the minimum value is displayed in pink and maximum value is displayed in yellow.

Load/displacement limit (HI/LO):
The HI/LO limits for each range are displayed with red lines.



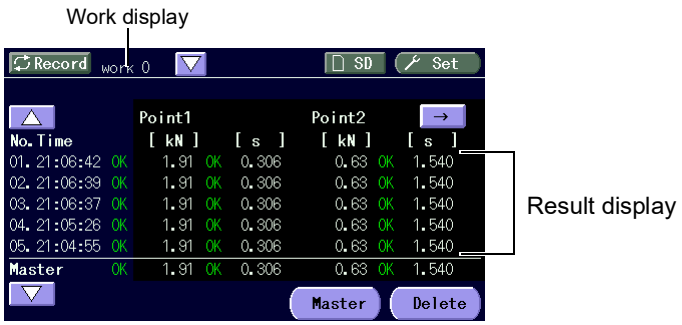
- Regarding the display range

This is a convenient function for, for example, changing the display range while looking at the waveform details.

1. Adjust the display range to make entire or partial waveform easily viewable by enlarging, reducing and moving the graph on the cursor display screen.
2. Press XY to move to graph display range setting screen, and select the work No. to set the current display range for.
3. A numerical value for the Y start point can be finely adjusted further by manual input, but if this is not necessary, just press OK.

■ Result screen

Judgment results for waveform comparison and point judgment (for the latest 100 data) can be checked.



Display

Result display: Judgment results for each range selected by No., measurement time, and overall judgment and waveform comparison are displayed.

No. .....The order of measurement is displayed. No. 01 is the latest result.

Time.....The time of measurement is displayed.

Overall judgment ...Judgment for each point (load, displacement) and waveform comparison are displayed comprehensively.
The priority is as follows:
H/L > H,L > NOK > OK

Point 1 to 5 .....For the judgment results, load, displacement or time values for the judgment point of each range and the judgment results are displayed.

Waveform .....Load, displacement or time values for the point at which the HI/LO limit comparison waveform is first exceeded and the load judgment results are displayed.

Wave No. .....The management number (wave No.) for the waveform is displayed.
* A wave No. for the waveform can be set through USB communication etc. before starting measurement.
Refer to "● Wave No. read command" on p.97 for details.

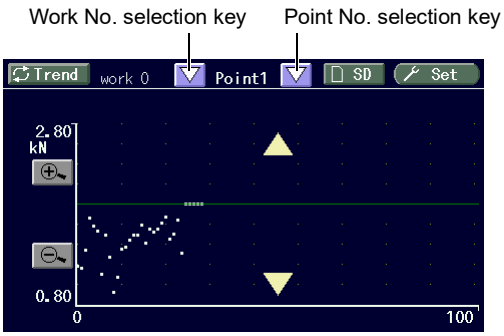
Work display: The current work No. is displayed.

Key points

- When measurement is performed when there are 100 data's worth of results remaining, the oldest data item (No. 100 (displayed as No. 00 on the screen)) will be deleted.
- Measurement can be performed while the result screen is still displayed. However, the measurement results will be updated. Stop measurement if you want to stop updating and confirm the results.

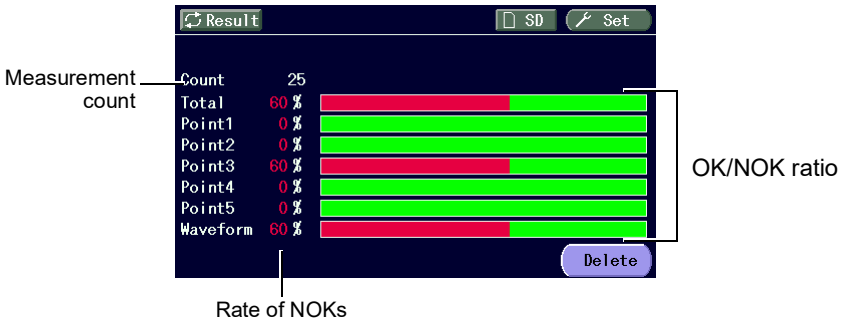
■ Trend display screen

Trends for point judgment and the zero point of the load are displayed in a graph (For the latest 100 data.)

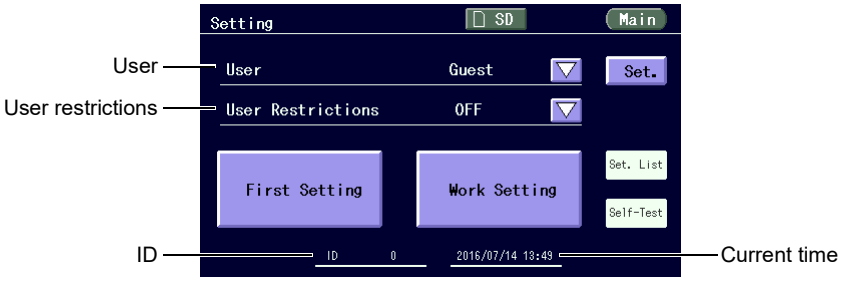


■ Statistics screen

The measurement count and rate of NOK results are displayed (For the latest 10000 data.)



■ Settings screen



Display

User: The currently logged in user is displayed.

User restrictions: The status regarding user restrictions is displayed.

ID: The device ID is displayed.

Current time: The current time is displayed.

2016/02/01/ 19:05

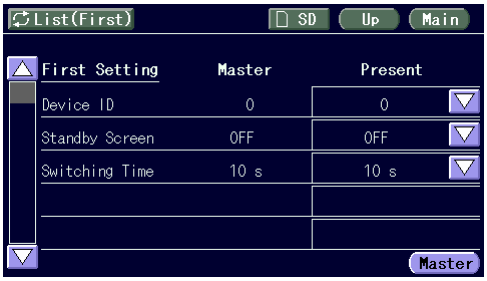
Year (Western calendar) / Month / Day / Hours (24h display) : Minutes

■ Settings list

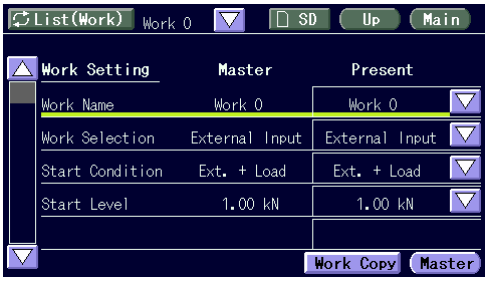
Each first setting and each work setting can be checked and changed from a list.

* If the current value and the master setting are different, the setting is displayed with a yellow underline.

First setting



Work setting



2 Basic settings

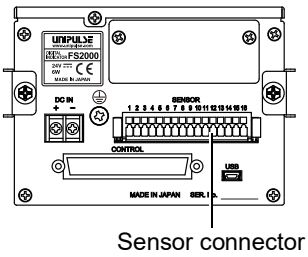
This chapter includes content which must be carried out in order to use FS2000 successfully. Refer to Chapter 3 and subsequent chapters for detailed settings according to use and circumstances.

2-1. Connection and installation

2-1-1. Connection of sensors

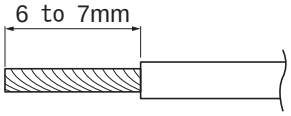
■ Connection of analog I/O terminals

A two-piece terminal block is used. Remove the plug before performing wiring work.
Use of the included analog connector lever is recommended to facilitate wiring.

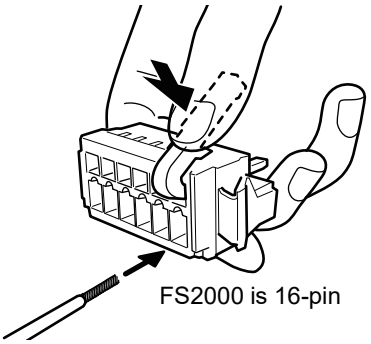


Connection procedure

1. Peel off 6 to 7 mm of coating of the electric wire to be connected, and twist the tip enough so that it does not spread apart.



2. Press the analog connector lever attached to the operation slot in the upper part with a finger and push down the spring.
3. While pressing the analog connector lever, insert the electric wire into the insertion opening until it hits the wall.
4. The wire will be connected once the analog connector lever is released. For confirmation, tug the electric wire gently.



The wire can be connected likewise without the analog connector lever by using a tool such as a flathead screwdriver (shaft diameter 2.5 mm or less) to press down the spring from the top.

⚠ Caution

- Electric wires between 0.08 to 1.5 mm^2 can be connected (AWG28 to 16).
- Do not attach crimping terminals to the tip of electric wires or perform soldering and so forth.
- Strand the wires in advance when connecting multiple electric wires.
- Be sure to turn off the main unit power when connecting cables.
- Never operate the lever while the plug is attached to the circuit board. There is a danger of the circuit board being damaged.

Pin assignments of analog I/O terminals

- Standard (Displacement input: Pulse input (line driver))

Type	Pin No.	Signal name	Use
Displacement input	1	SHIELD	Frame ground. Terminal to connect the shielded wire of the displacement sensor connection cable.
	2	5 V	Terminal to supply displacement sensor voltage. (Max. 200 mA.) Connect the power supply terminal (+) of the displacement sensor. *1
	3	0 V	Terminal to supply displacement sensor voltage. (Max. 200 mA.) Connect the power supply terminal (-) of the displacement sensor. *1
	4	B+	Terminal to input the B+ (PCB, ϕ B) output of the displacement sensor. Connect the B+ (PCB, ϕ B) output of the displacement sensor.
	5	B-	Terminal to input the B- (B/, $\overline{B}$, *PCB, $\overline{\phi B}$) output of the displacement sensor. Connect the B- (B/, B, *PCB, $\overline{\phi B}$) output of the displacement sensor.
	6	A+	Terminal to input the A+ (PCA, ϕ A) output of the displacement sensor. Connect the A+ (PCA, φA) output of the displacement sensor.
	7	A-	Terminal to input the A- (A/, $\overline{A}$, *PCA, $\overline{\phi A}$) output of the displacement sensor. Connect the A- (A/, A, *PCA, $\overline{\phi A}$) output of the displacement sensor.
Analog monitor output	8	+	Terminal to output voltage proportional to load cell input. (Approx. 2 V per 1 mV/V.) Connect a pen recorder etc. for monitoring the load cell input in a simple way.
	9	—	Ground terminal for analog monitor output.
Load input	10	+EXC	Terminal to supply load cell voltage. Connect +EXC (+IN) of the load cell.
	11	+S	Terminal to sense the excitation voltage of the load cell. 4-wire: Not wired. Sensing (First setting - Sensor - Loadcell) set to unused (4-wire) (initial value). 6-wire: Connect +S of the load cell. Sensing (First setting - Sensor - Loadcell) set to used (6-wire).
	12	-SIG	Terminal to input load cell signal. Connect -SIG (-OUT) of the load cell.
	13	-EXC	Terminal to supply load cell voltage. Connect -EXC (-IN) of the load cell.
	14	-S	Terminal to sense the excitation voltage of the load cell. 4-wire: Not wired. Sensing (First setting - Sensor - Loadcell) set to unused (4-wire) (initial value). 6-wire: Connect -S of the load cell. Sensing (First setting - Sensor - Loadcell) set to used (6-wire).
	15	+SIG	Terminal to input load cell signal. Connect +SIG (+OUT) of the load cell.
	16	SHIELD	Frame ground. Connect the shielded wire of the load cell connection cable.

*1 Prepare a separate power supply if 5 V cannot be used for the displacement sensor power, or if 200 mA or more is required.

Attention

Always perform calibration after wiring a sensor.

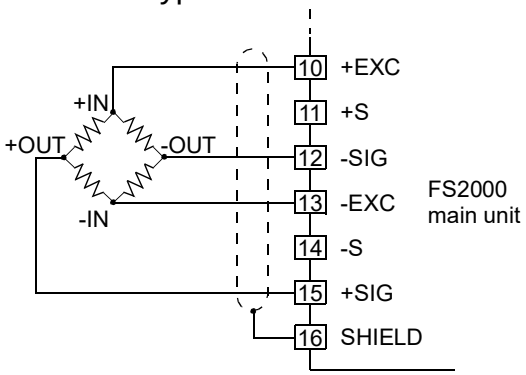
Refer to "2-2.Calibration" on p.26.

■ Load sensor connection

Load cell cable colors differ from one manufacturer to another. (They may also differ from one model to another for some products.)
Refer to the load cell manual (or data sheet) and check signal names and colors in order to connect the cables correctly.

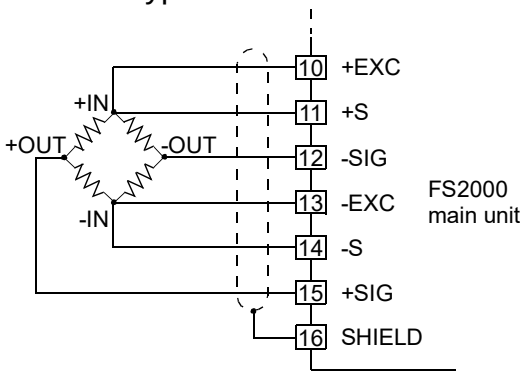
Before connecting the load cell as shown below, set the excitation voltage and turn off the power.

- Four-line type



Sensing (First setting - Sensor - Loadcell) set to unused (4-wire) (Initial value).

- Six-line type



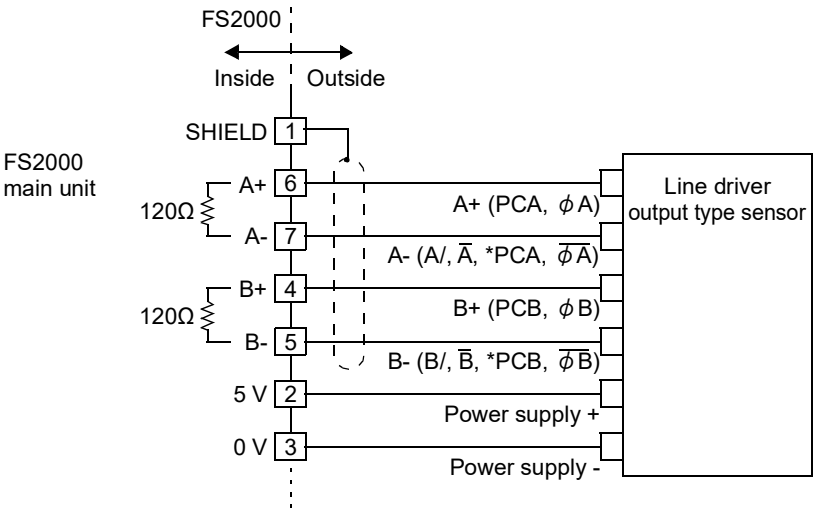
Sensing (First setting - Sensor - Loadcell) set to used (6-wire).

⚠ Caution

The excitation voltage of FS2000 is 2.5 V/ 5 V/ 10 V. If the maximum excitation voltage of the sensor is under 2.5 V/ 5 V/ 10 V, heating or damage may result.

■ Displacement sensor connection (Line driver)

A line driver output type sensor (incremental type) compliant with RS-422 can be connected, such as a contact type, eddy current type or laser type.



* Prepare a separate power supply if 5 V cannot be used for the displacement sensor power, or if 200 mA or more is required.
* 120 Ω terminators are attached to A+, A-, B+, and B-.

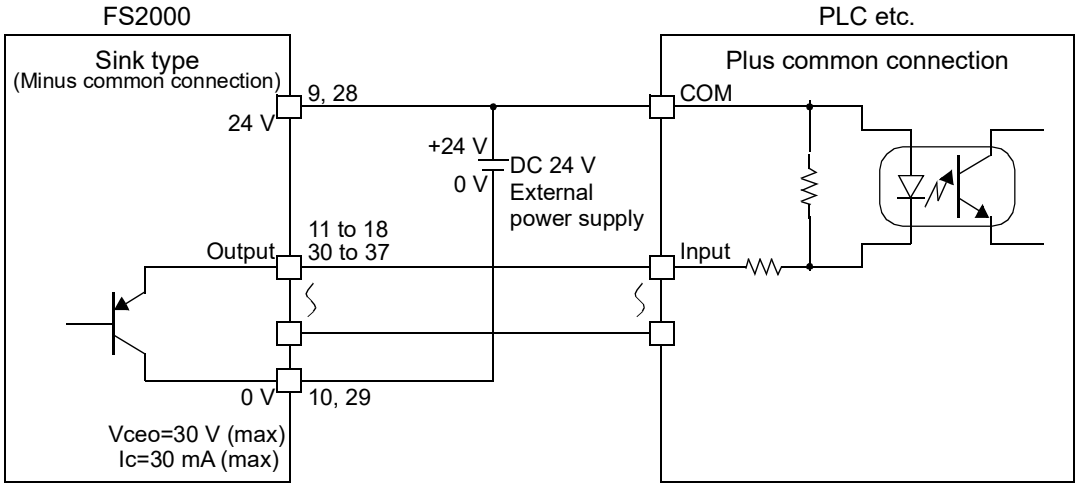
2-1-2. External control device connection

The external input signal and external output signal can only be connected to either the sink type or the source type.

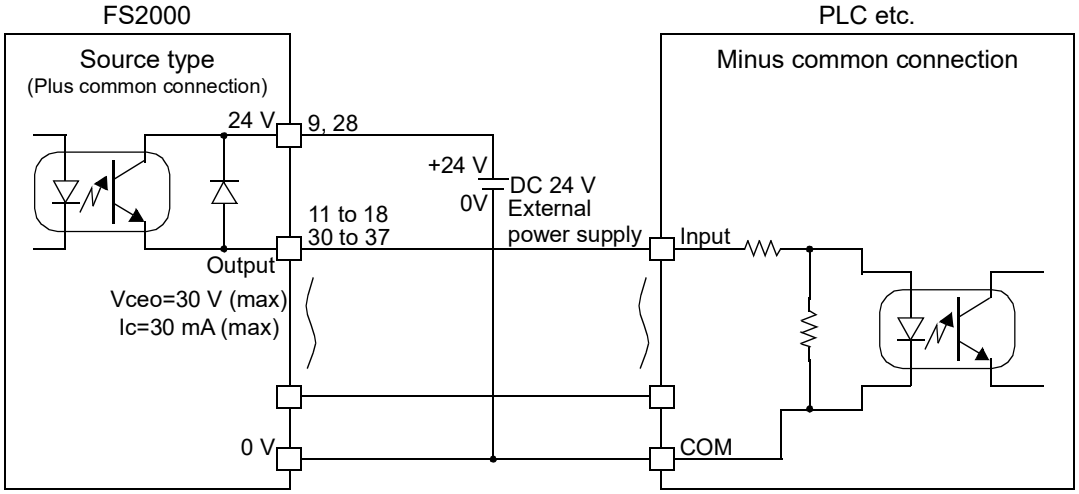
Please specify when you order. (Standard: sink type, ISC: source type)

■ External output equivalent circuits and connection examples

- Sink type (Standard: in the case of minus common connection) (Mainly in Japan)



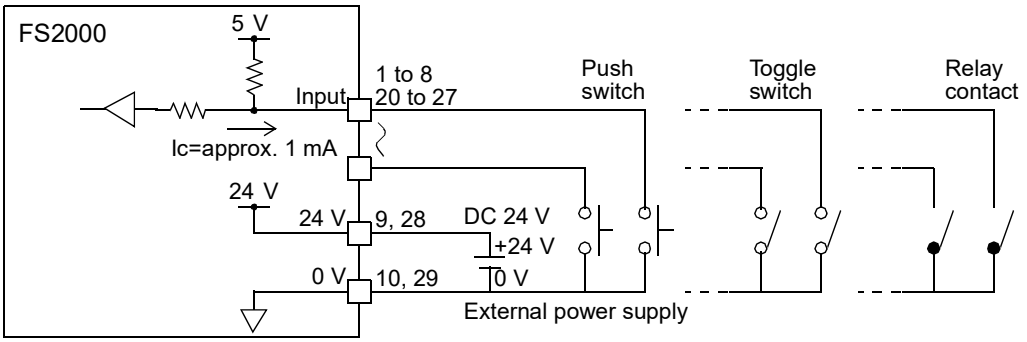
- Source type (Specified at time of order (ISC): in the case of plus common connection) (Mainly in Europe)



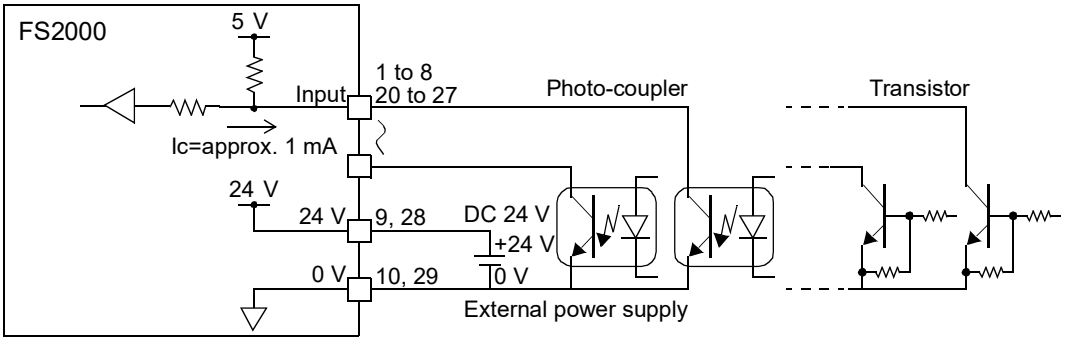
■ External input equivalent circuits and connection examples

- Sink type (Standard: in the case of minus common connection) (Mainly in Japan)

When connecting relays, switches and so on.

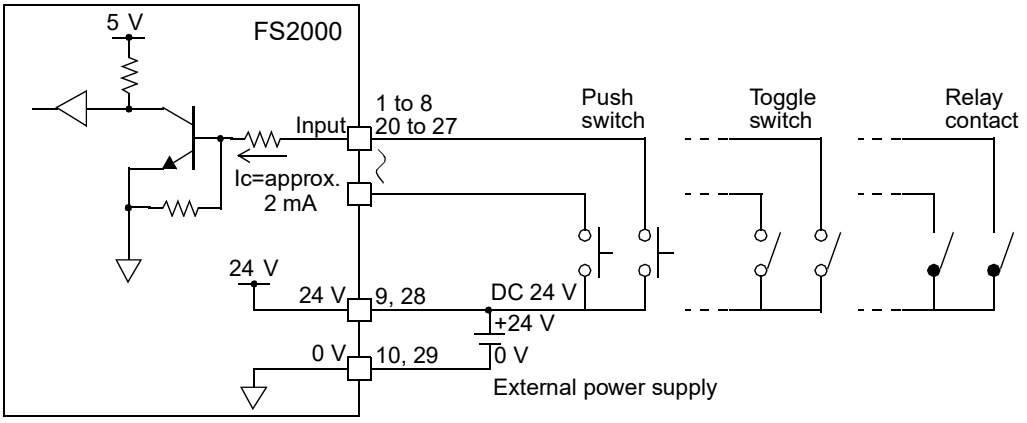


When connecting transistors, photo-couplers and so on.

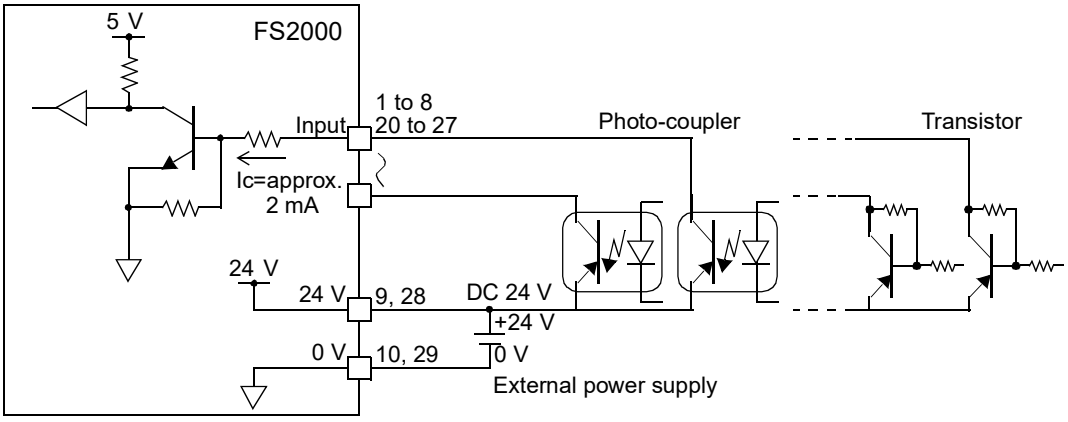


- Source type (Specified at time of order (ISC): in the case of plus common connection) (Mainly in Europe)

When connecting relays, switches and so on.



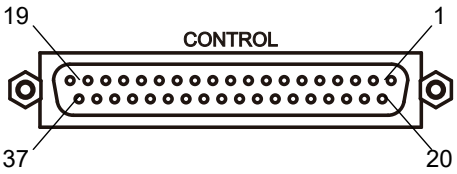
When connecting transistors, photo-couplers and so on.



Attention

- Use an element to which Ic=5 mA or more can be applied.
- The leak current of the connected element must be 100 µA or below.

■ Connector pin assignments



Compatible connector: CN36

1	IN	Load zero			20	IN	HOLD1		
2	IN	Displacement initial position			21	IN	HOLD2		
3	IN	Measurement start			22	IN	HOLD3		
4	IN	Measurement stop			23	IN	HOLD4		
5	IN	Work selection 1			24	IN	HOLD5		
6	IN	Work selection 2			25	IN	Reset		
7	IN	Work selection 4			26	IN	Backlight forced ON		
8	IN	Work selection 8			27	IN	Touch panel operation prohibited		
9		24 V			28		24 V		
10		0 V			29		0 V		
11	OUT	Point judgment	Load	LO retention Note 1	30	OUT	Waveform comparison	LO retention Note 1	
12	OUT			OK Note 1	31	OUT		OK Note 1	
13	OUT			HI retention Note 1	32	OUT		HI retention Note 1	
14	OUT		Displacement	LO retention Note 1	33	OUT	Measurement complete Note 1, 2		
15	OUT			OK Note 1	34	OUT	CPU normal operation		
16	OUT			HI retention Note 1	35	OUT	Load/displacement OK		
17	OUT	Timing output 1			36	OUT	SD memory card OK		
18	OUT	Timing output 2			37	OUT	Load overload		
19		N.C							

* 24 V and 0 V are power supply connection terminals.
  DC 24 V (±15%)
  Standard Approx. 10 mA
  ISC Approx. 10 mA + number of output points x 30 mA (approx. 500 mA for 16 points)

* The 24 Vs and 0 Vs are connected together respectively internally.

Note 1) There are judgments (NOK judgments) for which none of LO, OK, or HI are output.
Synchronize to the OFF → ON of measurement complete output and look at the judgment. (Refer to "- Input signal timing confirmation" on p.22)

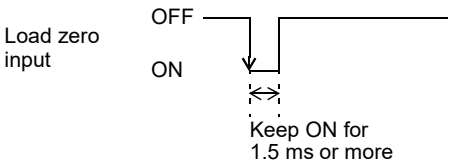
Note 2) Confirm the OFF and ON (OFF → ON) of the measurement complete output for each measurement in order to confirm that the measurement has been updated.

■ Signals

Input signals

- Load zero (Normally wired)

Load zero is performed before measurement by unloading the load sensor, in order to easily adjust load zero point deviation caused by temperature drift etc. The load is zeroed by turning the signal from OFF to ON.

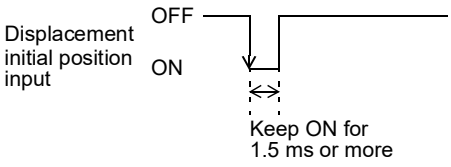


Turn OFF the load/displacement OK output while the signal is ON.

* The load zero value is cleared when the power is turned ON. Perform zero calibration if you want to retain the load zero value.

- Displacement initial position (Wire according to use)

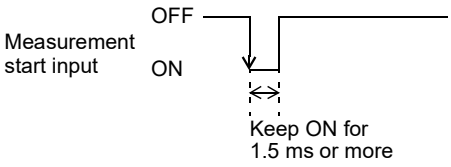
Used for adjusting the displacement zero point just before measurement start. It is not used when the X-axis of the waveform represents time or when the displacement zero point does not need to be adjusted. By turning the signal from OFF to ON, displacement is brought to the value set for the initial position, and the internal counter of the pulse input is cleared.



Turn OFF the load/displacement OK output while the signal is ON.

- Measurement start (Normally wired)

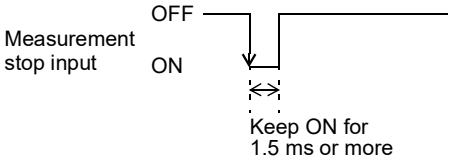
Used for starting measurement. By turning the signal from OFF to ON when the measurement status display is Wait St., the display changes to Wait Off, and point judgment, waveform comparison, measurement complete, load/displacement OK output, and SD memory card OK are turned OFF. By turning the measurement start signal from ON to OFF, the display changes to Wait LV or Sampling depending on the measurement start condition.



* OFF to ON of measurement start input will be ignored and measurement will not be started when there is an SD memory card error during auto recording, or when the waveform was not saved in time.

- Measurement stop (Normally wired)

Normally wired. Used for stopping measurement. Measurement stops when the signal is turned from OFF to ON during measurement.

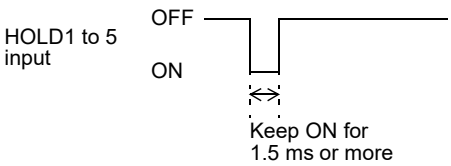


- Work selection (Wire according to use)

Used when working with multiple work Nos. It is not used when working with work No. 0 only, or when the measuring work is changed through settings. Specify the desired work No. before measurement.

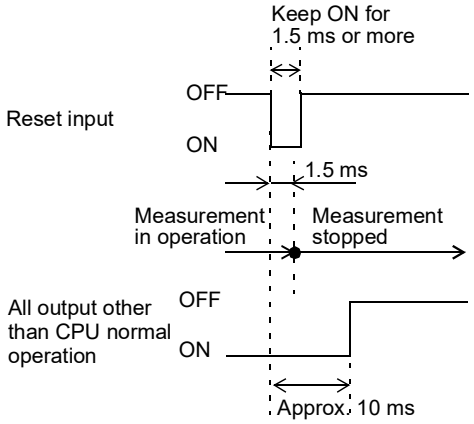
- HOLD1 to 5 (Wire according to use)

Used only when controlling the point judgment detection range by external control. It is not used when the point judgment function is not used or when the detection range is controlled through settings. The detection range is recognized while the signal is ON.



- Reset (Normally wired)

Used in emergencies, and for releasing some errors. If the signal is turned from OFF to ON regardless of measurement status, point judgment, waveform comparison, measurement complete, load/displacement OK, and SD memory card OK will be turned OFF and the measurement status display reset will turn ON. If the reset signal is turned from OFF to ON during measurement, measurement is forced to stop, and measurement data is deleted. If you want to retain the data, then after measurement stops, confirm the data and turn the reset signal from OFF to ON.



- Backlight forced ON (Wire according to use)

Used for externally controlling the backlight. The backlight turns ON when the signal is turned from OFF to ON. The backlight stays ON while the signal is ON.

- Touch panel operation prohibited (Wire according to use)

Used when you want to control the touch panel so as to prevent it from being operated. Touch panel operation is disabled while the signal is ON.

- 24 V, 0 V

Must be wired when input signals are to be used. These are the power supplies for input signals. The 24 Vs and 0 Vs are connected together respectively internally.

Output signals

- Point judgment (Load, displacement) (Wire according to use)

Used when acquiring judgment results using the point judgment function. If judgment of displacement is required, displacement judgment is also used. It is not used when the point judgment function is not used. It outputs the judgment of the point judgment function.

LO retention: Turns ON and the output is retained when the point judgment result falls below the LO limit.

HI retention: Turns ON and the output is retained when the point judgment result exceeds the HI limit.

OK: OK turns ON when judgment is made during measurement and LO retention and HI retention are not ON after measurement stops. OK will not turn ON if point judgment is not performed for the specified hold points.

- Timing output (Wire according to use)

Used when controlling a PLC using load or displacement values. Output turns ON and OFF using the timing set for timing output.

ON: LO limit value $\leqq$ load or displacement $\leqq$ HI limit value

OFF: Load or displacement $<$ LO limit value
Load or displacement $>$ HI limit value

- Waveform comparison (Wire according to use)

Used when acquiring waveform comparison judgment using waveform comparison. It is not used when waveform comparison is not used. Judgment results of waveform comparisons are output.

LO retention: Turns ON and the output is retained when the waveform comparison result falls below the LO limit.

HI retention: Turns ON and the output is retained when the waveform comparison result exceeds the HI limit.

OK: OK turns ON when the comparison range is passed through during measurement and LO retention and HI retention are not ON after measurement stops. OK will not turn ON if the measurement does not reach the comparison range, or if measurement does not reach the relative point when a relative comparison is made.

- Measurement complete (Normally wired)

Normally wired. Used for recognizing the completion of measurement.
Turns ON when measurement stops.

* If acquiring point judgments and waveform comparison, acquire them by synchronizing them to measurement complete.

- CPU normal operation (Normally wired)

Used for confirming that the CPU is operating normally. When the CPU is operating normally, the signal will switch between ON and OFF roughly once every 0.5 seconds. When monitoring using a PLC etc., as there will be deviations in the PLC timer, do not monitor every 0.5 seconds. Rather, make it so that it will be judged to be abnormal if the signal is ON or OFF for a few seconds.

- Load/displacement OK (Normally wired)

Normally wired. Used for recognizing load/displacement abnormalities. It is normally ON. Turns OFF when there is a sensor error (sensor ±error) or a display error (±OVER), when the load exceeds the overload, or when the load zero value exceeds the zero limit. It also turns OFF when measurement start, reset, load zero, or displacement initial position are ON, or when measurement points for 10 data or more are skipped because the pacing of displacement is too fast.

- SD memory card OK (Wire according to use)

Normally used when using an SD memory card. Turns OFF when there is an SD memory card error[*1], or when the OFF to ON of measurement start input is ignored because the waveform is not saved in time during auto recording[*2]. It also turns OFF when measurement start or reset is ON.

*1 It will not turn ON until the error is released.
*2 It recovers if measurement is started in a state in which the waveform is saved in time.

- Load overload (Wire according to use)

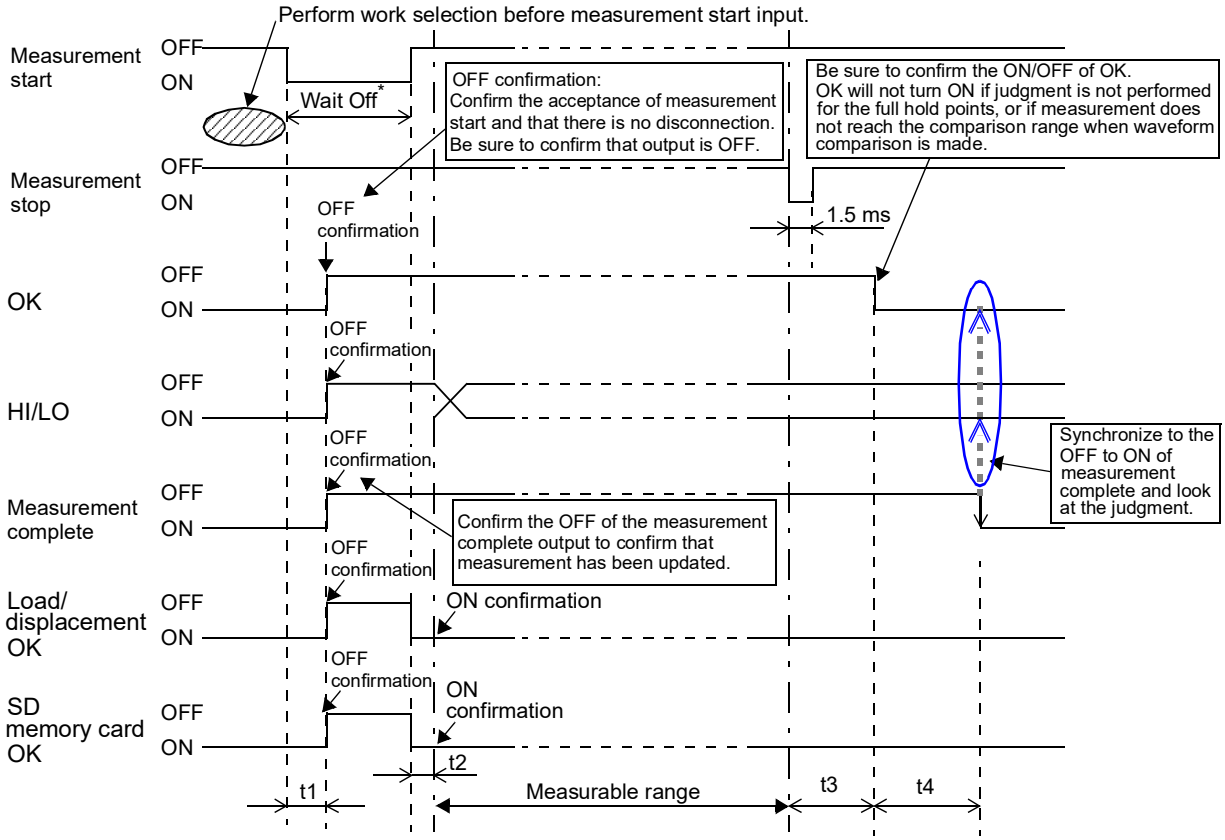
Used to stop the equipment in the case of an emergency caused by load sensor overload. Turns ON during overload regardless of measurement status. Turns OFF when overload is released.

- 24 V, 0 V (Must be wired)

Must be wired when external I/O signals are to be used. These are the power supplies for external I/O signals.
The 24 Vs and 0 Vs are connected together respectively internally.

- Input signal timing confirmation

When performing a measurement, confirm the timing of I/O signals correctly.



t1: Delay time from when measurement start input is turned ON to when output other than CPU normal operation turns OFF... Approx. 3 ms

t2: Delay time from when measurement start input is turned OFF to when the measurable range starts... 1.5 ms
(However, the delay time varies depending on the measurement start condition.)

t3: Delay time from when measurement stops (when measurement stop input is ON) to when judgment output turns ON... Approx. 60 ms
(However, delay time differs depending on the measurement.)

t4: Delay time from when judgment output turns ON to when measurement complete output turns ON... Approx. 5 ms

* Be sure to confirm that output is OFF before turning OFF measurement start input.
(In case start input mode is set as "Normal (Seq.)". When "ON Edge Only" is set, it automatically transitions to the measurable range after t1.)

■ Wiring confirmation method

Operation

Main screen → Set → Self-Test → I/O Signal

Output

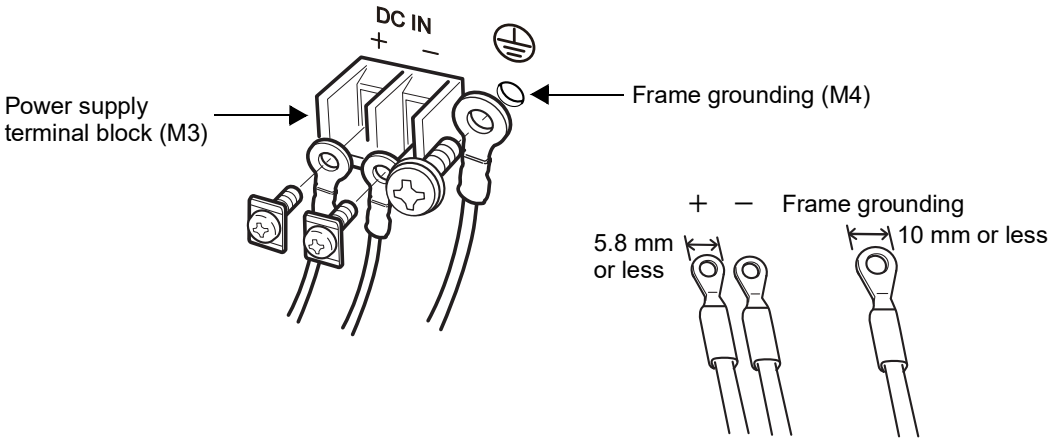
Press the output signal key, and confirm that there is input to the connected device.
(When the key is pressed, it changes to yellow and output turns ON.)

Input

Turn ON the output of the connected device. Pins recognized by the FS2000 will turn green.

2-1-3. Power supply connection

Connect the DC power cord. (DC 24 V (±15%) 6 W typ.)



1. Ensure that the power is OFF.
2. Remove the terminal block cover.
3. Remove the screws from the power input terminal block (two locations).
4. After fitting crimping terminals into the screw holes, secure them with screws.
   ＋: Red screw
   －: Black screw
5. Connect the frame grounding.
6. Attach the terminal block cover.

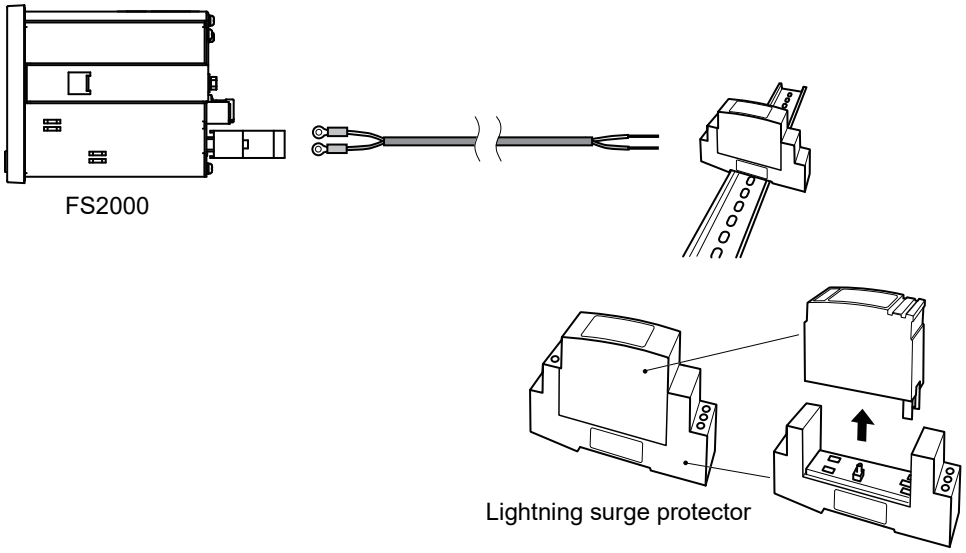
⚠ Caution

- Connect up the product when power is OFF, in order to prevent electric shock.
- Be careful, as the voltage will drop depending on the diameters and lengths of the wires. Also, never input an AC power supply. Doing so may cause failure.
- Because the FS2000 has no power switch, be sure to install a breaker.
- Be sure to ground the frame grounding terminal to prevent malfunctions arising from noise. Do not use screws other than those used for attaching the main unit. Furthermore, in some installation environments, it may perform better without the grounding.
- The lightning surge protector "TSU03" (optional) are for DC24V. Never use them in AC power supply.

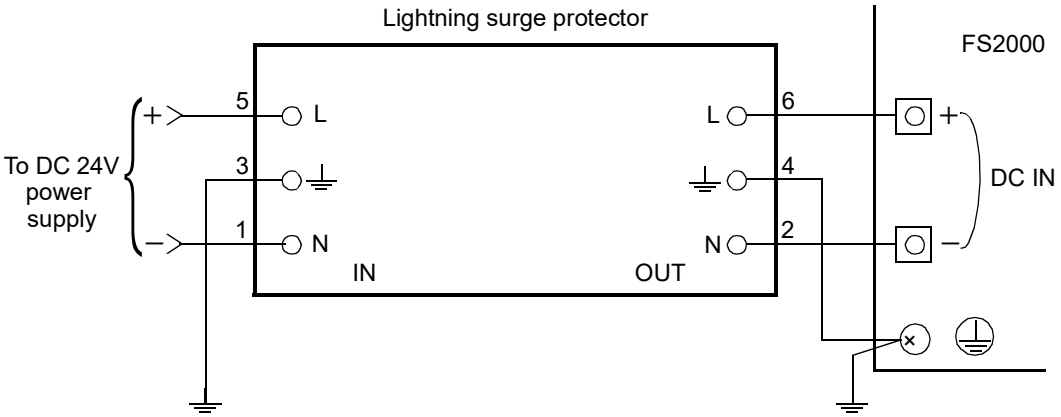
◇Lightning surge protector connection

Install a lightning surge protector to guard from lightning surges as necessary.

The combination of the main unit of the FS2000 and a lightning surge protector conforms to EN61000-4-5 (lightning surge immunity) in the EMC Directives.



<Connection>



Key points

A lightning surge protector is not included as standard (optional).
Our company carries an optional lightning surge protector (TSU03).
Contact our sales department for details.

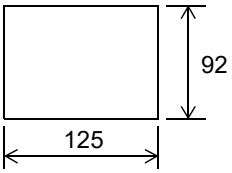
2-1-4. Installation to panel

Use the following procedure when installing the FS2000 to the control panel.

1. Make a hole in the panel in accordance with the panel cutout size.

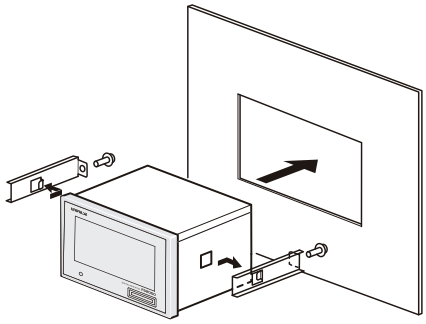
Panel cutout size
125 (W) x 92 (H) (mm)

Installation panel thickness
1.6 to 3.2 (mm)

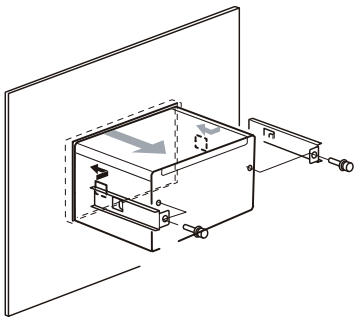


Unit: mm

2. Remove the installation rails on both sides of the indicator and insert the indicator into the panel.



3. Insert the installation rails into both sides from the rear of the indicator.



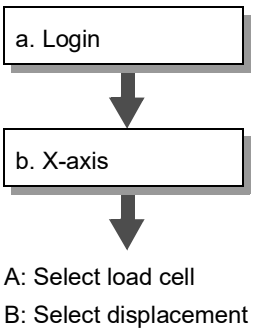
4. Tighten securely the clasp on both sides using the included M4 screws.

* Do not use screws other than those installed on the FS2000 main unit.

⚠ Caution
Be sure to avoid extreme shock and/or vibration when transporting after installation to the panel.

2-2. Calibration

2-2-1. Calibration procedure

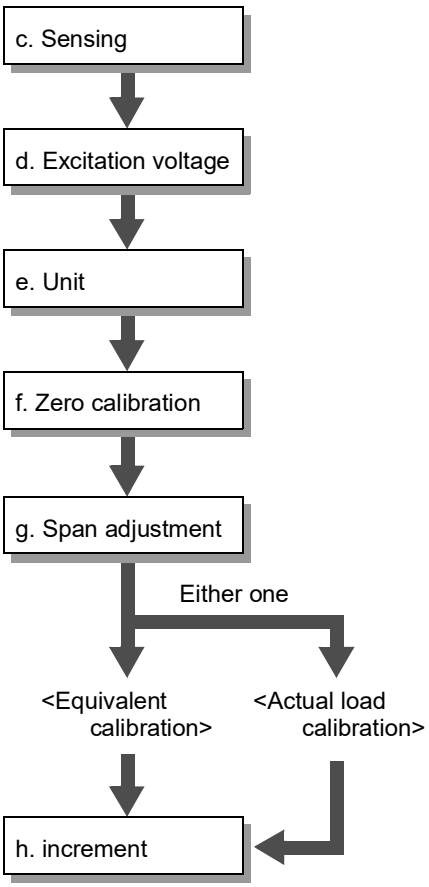


Login as a user with the authorities of a designer or higher.
(This can be omitted when user restrictions are OFF (initial value)).

Select either time or displacement for the X-axis.
(initial value: Time).

Select the sensor to be set (load cell or displacement sensor).
* When using the displacement sensor, set the displacement to be the X-axis.

A: Select load cell



Set sensing to ON/OFF in accordance with the load cell used (initial value: OFF (4-wire)).

Set the voltage to be applied in accordance with the load cell used.

Set the unit to display.

Register the zero point.

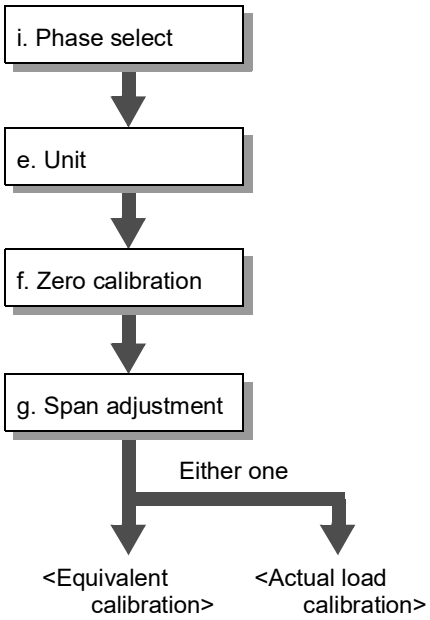
Perform either equivalent calibration or actual load calibration.

Equivalent calibration
Set the rated output and rated capacity indicated in the load cell data sheet.

Actual load calibration
Actually apply a load to the load cell, and set the applied load.

Set the minimum unit for load display.

B: Select displacement sensor



Set the phase select in accordance with the displacement sensor to be used, and the use. (normally, A/B-phase) (initial value: A/B-phase)

Set the unit to display.

Register the zero point.

Perform either equivalent calibration or actual load calibration.

Equivalent calibration
Input the number of pulses and the display value for same in accordance with the resolution of the displacement sensor.

Actual load calibration
Physically move the displacement sensor, and input the moved distance.

a. Login (Select a user)

Login as a registered user after user registration. Login is possible by entering the user and password, then pressing OK.

User: Select an applicable user from the registered users.
Password: Enter the registered password.

Operation

Main screen → Set → User▼

Key points

The user is "Guest" when the power is turned ON.
The authorities are operator authorities.

b. X-axis

Select either time or displacement for the X-axis.

Setting range Time: Load against time is indicated in a waveform.
Displacement: Load against displacement is indicated in a waveform.
Select displacement when using the displacement sensor.

Operation

Main screen → Set → First Setting → Sensor → X-axis▼

c. Sensing

Set sensing to ON/OFF.

Setting range: OFF (4-wire), ON (6-wire)

Operation

Main screen → Set → First Setting → Sensor → Loadcell → ① Sensing▼

d. Excitation voltage

Select excitation voltage.

* Perform re-calibration if the excitation voltage is changed.

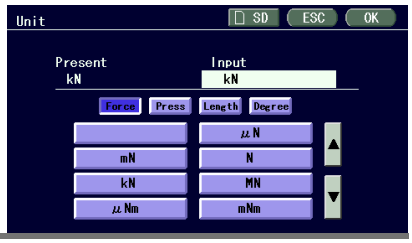
Setting range: 2.5 V, 5 V, 10 V

Operation

Main screen → Set → First Setting → Sensor → Loadcell → ② Excitation volt.▼

e. Unit

Select the unit.



Setting range (Refer to "12-1.Unit setting list" on p.120)

Operation

Main screen → Set → First Setting → Sensor → Loadcell → ③ Unit▼
Main screen → Set → First Setting → Sensor → Displacement → ② Unit▼

f. Zero calibration

The current sensor input is registered as zero.

Unload the sensor and press OK.

Setting range Load: -2.222 to 2.222 mV/V
Displacement: 0 to 1000000

Operation

Main screen → Set → First Setting → Sensor → Loadcell → Next → ④ Zero Calibration▼
Main screen → Set → First Setting → Sensor → Displacement → Next → ③ Zero Calibration▼

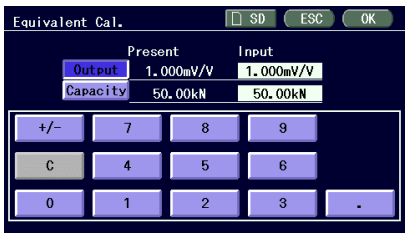
g. Span adjustment

- Equivalent calibration

For a load sensor, input the rated output and rated capacity (display value) indicated in the data sheet.

For a displacement sensor, determine and input the relationship between the number of pulses (rated output) from the data sheet and the displacement value (display value).

The decimal place is also set here. Input the decimal point when inputting the display value.



Displacement sensor calibration

Determine the calibration value from the figure for the resolution indicated in the displacement sensor data sheet. Normally, a displacement of 1/4 pulses is indicated for the resolution of A/B-phase types.

Example 1) When calibrating to display XXX.XX mm using a displacement sensor of 2.5 μm resolution

Number of pulses (rated output) 1
Display value 0.01 (mm) ← Resolution x 4

Example 2) When calibrating to display XXXX.X mm using a displacement sensor of 2.5 μm resolution

Number of pulses (rated output) 10 ← The number of pulses is adjusted to be the numerical value of the display value
Display value 0.1 (mm) ← Resolution x 4 x 10

Setting range	Load	Displacement
Output:	-9999 to 9999 mV/V (0 is excluded)	1 to 1000000
Capacity:	-99999 to 99999	-99999 to 99999

(Calibration can be made within ranges above, but the actual displayable range is -30000 to 30000 for both load and displacement.)

Operation

Main screen → Set → First Setting → Sensor → Loadcell → Next → ⑤ Equivalent cal.▼
Main screen → Set → First Setting → Sensor → Displacement → Next → ④ Equivalent cal.▼

- Actual load calibration

For a load sensor, apply an actual load to the sensor, and input the load value at that time.
For a displacement sensor, move the cylinder, and input its position.
The decimal place is also set here. Input the decimal point when inputting the calibration value.

Setting range Current: -99999 to 99999
(Calibration can be made within ranges above, but the actual displayable range is -30000 to 30000 for both load and displacement.)
Indication: Display only

Operation

Main screen → Set → First Setting → Sensor → Loadcell → Next → ⑤ Actual load cal.▼
Main screen → Set → First Setting → Sensor → Displacement → Next → ④ Actual load cal.▼

h. Increment

This is the minimum unit for load display. Load is displayed for every value set.

Setting range: 1, 2, 5, 10, 20, 50, 100

Operation

Main screen → Set → First Setting → Sensor → Loadcell → Next → Next → ⑥ Increment▼

i. Phase select

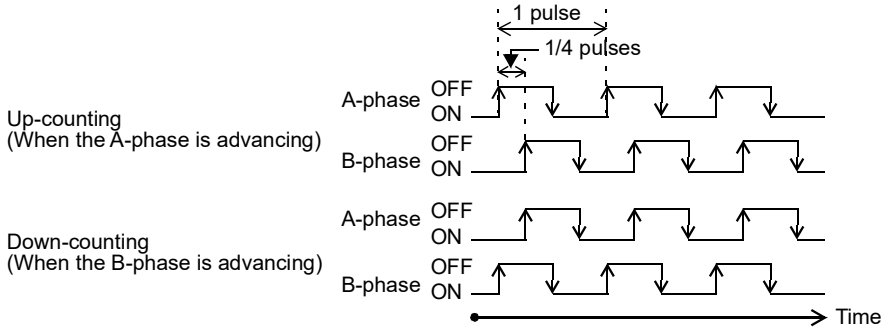
Select the output phase of the displacement sensor.

Setting range: A/B-phase, A-phase

Operation

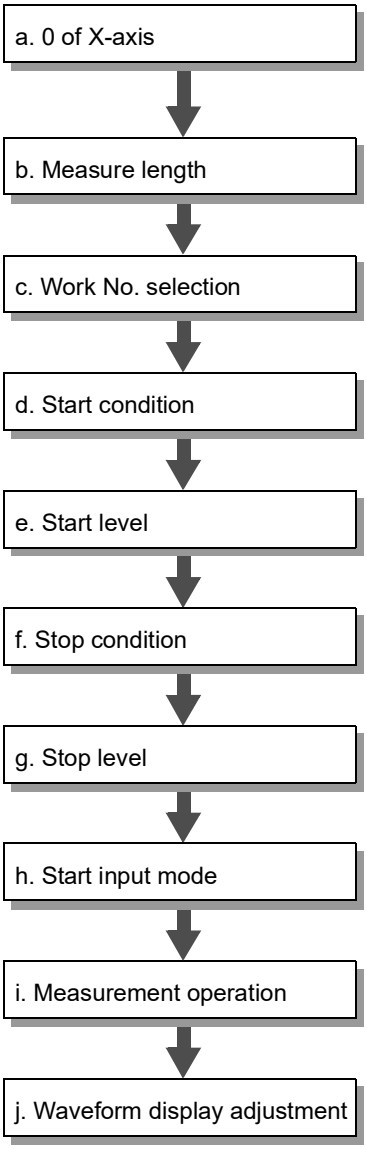
Main screen → Set → First Setting → Sensor → Displacement → (1) Phase Select▼

- A-phase: A-phase of the sensor is used. Resolution is 1 pulse. (Positive counting only).
- A/B-phase: A/B-phases of the sensor are used. Resolution is 1/4 pulses. The counting conditions are as follows:



2-3. Measurement

2-3-1. Measurement procedure (Until a waveform is displayed)



Select front or end for the 0 of X-axis (initial value: Front).
Example)
Front: The measurement start point becomes the reference
(The start of the loading is used as a referenced, etc.)
End: The measurement stop point becomes the reference
(The end of loading is used as a reference, etc.)

Set the maximum length of the waveform.

Select the work No. to be specified for measurement.

Select the timing for starting measurement
(initial value: Ext.+Load).

Set the level for starting measurement (load or displacement).
(Only when the start condition is "ext.+load" or "ext.+displ.".)

Select the timing for stopping measurement
(initial value: Forced-stop).

Set the level for stopping measurement.
(Only when the stop condition is other than "forced-stop".)

Set the operations of inputting measurement start signal.

Return to the main screen and actually perform the measurement.

Adjust the display range of the measured waveform.

a. 0 of X-axis (waveform reference)

Select front or end for the 0 of X-axis.

Setting range: Front, End

Operation

Main screen → Set → First Setting → Sensor → 0 of X-axis▼

(1) Front: The waveform will have the start point at the left-hand edge.

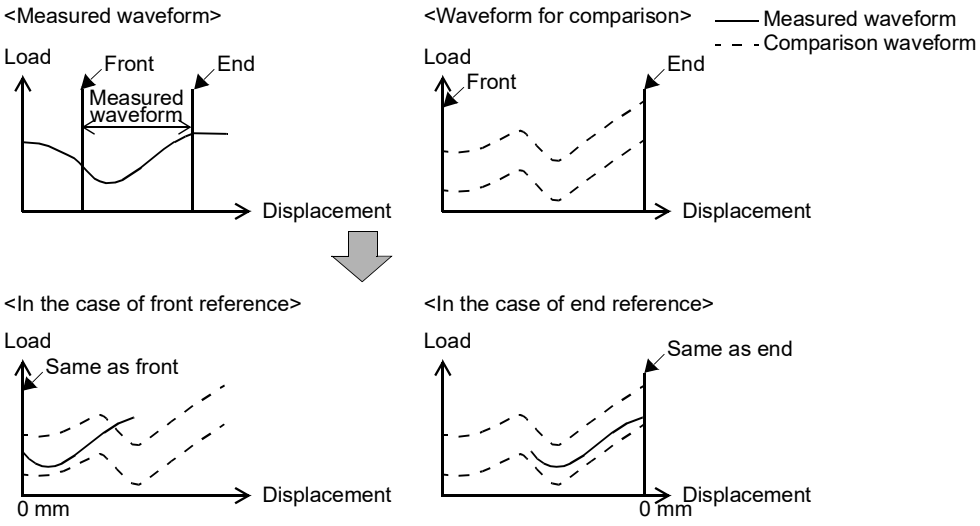
Example) When the start condition is "ext.+load" and a load of positive slope is set for the start level, a waveform which uses the rising load as a reference will be displayed.

(2) End: The waveform will have the stop point at the right-hand edge.

Example) When the stop condition is "displ. stop" and the retention time at the end of loading is set for the stop level, a waveform which uses the cut-off as a reference will be displayed.

Key points

When the 0 of X-axis is set to end, ranges cannot be selected externally.



b. Measure length

Set the time and length for waveform acquisition.

Setting range When X-axis is time:

80 ms, 160 ms, 400 ms, 800 ms, 2 s, 4 s, 10 s, 20 s, 40 s, 100 s

* 80 ms and 160 ms cannot be selected when the sample rate is 5 kHz.

(Refer to "■Sample rate" on p.76 for sample rate settings.)

When X-axis is displacement:

2000 mm, 4000 mm, 6000 mm, 8000 mm, 10000 mm

Operation

Main screen → Set → First Setting → Sensor → Measure Length▼

c. Work No. selection

Select the work No. to be specified for measurement. Specify the desired work No. by pressing ▽ on the work setting screen.

Start condition, start level, stop condition, and stop level can be set for each work No. Open and use a work No. which was set before the start of measurement.

Setting range: 0 to 15

Operation

Main screen → Set → Work Setting → Work No.▼

d. Start condition

Set the timing for starting measurement.

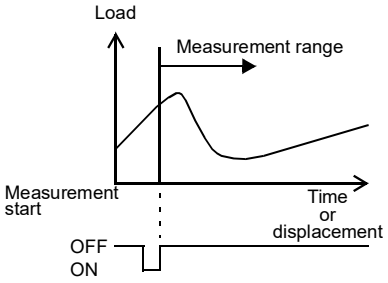
Setting range: External Input, Ext.+Load, Ext.+Displ.

Operation

Main screen → Set → Work Setting → Start (condition)▼

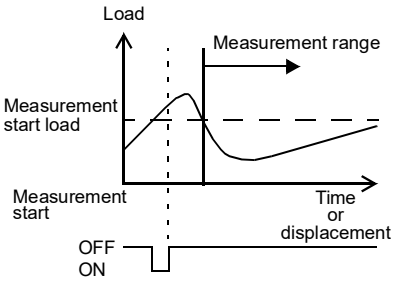
(1) External Input ("Start level" cannot be set)

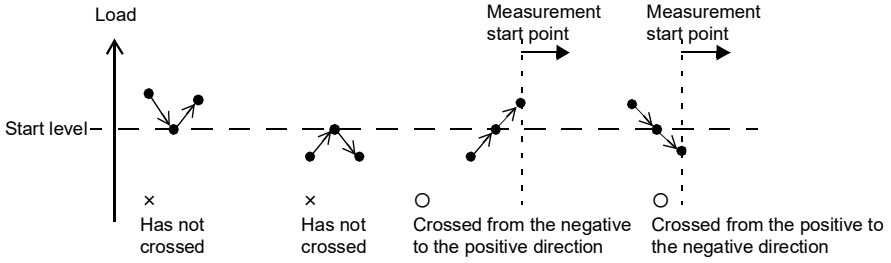
Measurement starts when "measurement start" of the external input signal is turned from OFF → ON → OFF.



(2) Ext.+Load

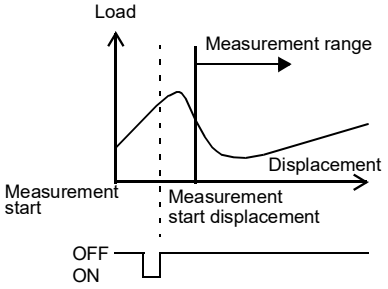
Measurement starts when load crosses the start level after "measurement start" of the external input signal is turned from OFF → ON → OFF.

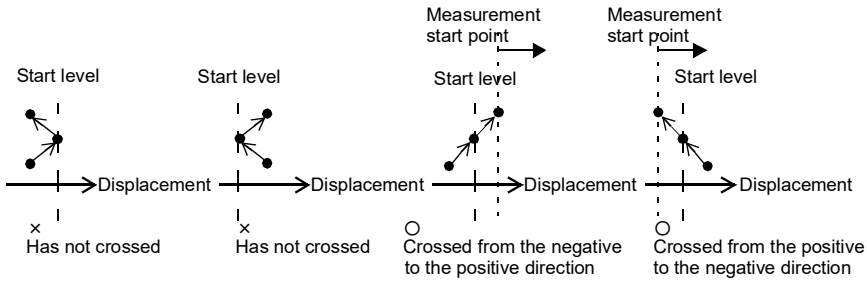




(3) Ext.+Displ.

Measurement starts when displacement crosses the measurement start level after "measurement start" of the external input signal is turned from OFF → ON → OFF.





Key points

The OFF → ON → OFF operation of the external input signal is the same as pressing ▷ Start on the main screen.

e. Start level

Load or displacement is set when the start condition is "ext.+load" or "ext.+displ.".

Setting range: -30000 to 30000

Operation

Main screen → Set → Work Setting → Start (level)▼

f. Stop condition

Set the condition for stopping measurement.

Setting range: Forced-stop, Load, Time, Displacement, Displ. Stop

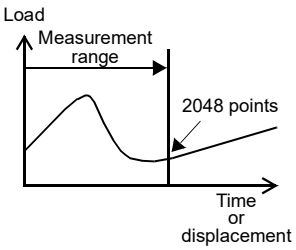
Operation

Main screen → Set → Work Setting → Stop (condition)▼

(1) Forced-stop ("Stop level" cannot be set)

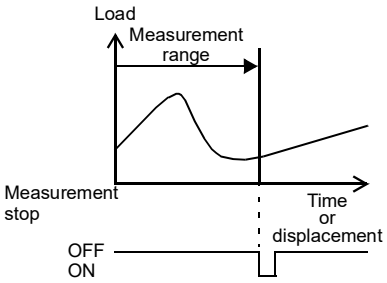
- 2048 points

Measurement stops when the measurement data exceeds 2048 points of data.



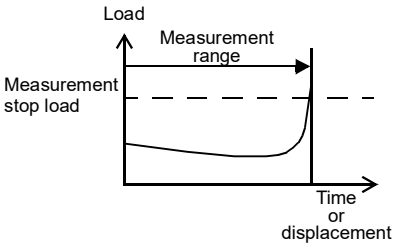
- External signal

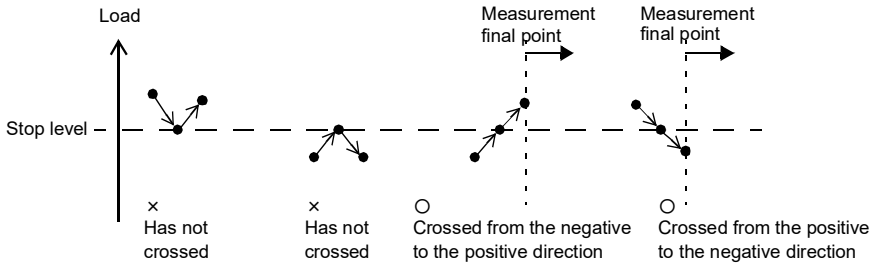
Measurement stops when "measurement stop" of the external input signal is turned from OFF → ON.



(2) Load

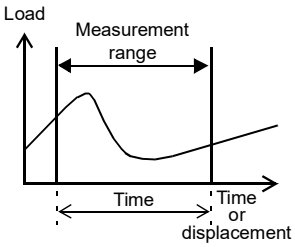
Measurement stops when there is a forced stop or when load crosses the stop level.





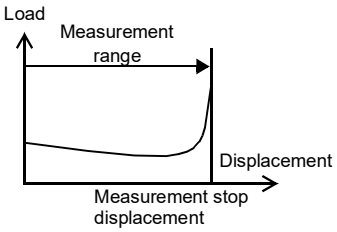
(3) Time

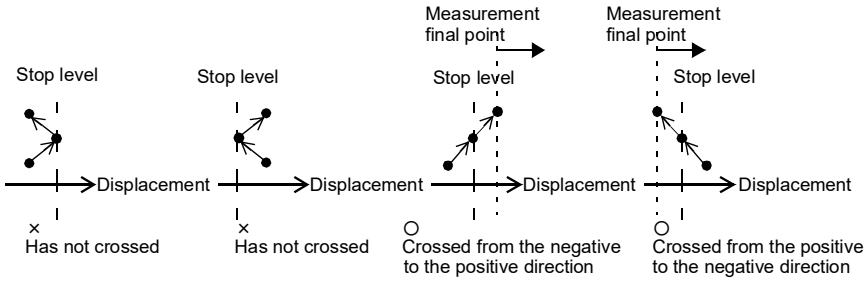
Stops when there is a forced stop or when measurement is performed for the time specified for the stop level.



(4) Displacement

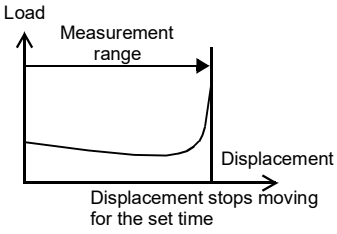
Measurement stops when there is a forced stop or when displacement reaches the stop level.





(5) Displ. stop

Measurement stops when there is a forced stop or when displacement stops moving for the set time at stop level.



g. Stop level

When the stop condition is "load", "time", "displacement", or "displ. stop", set the load, time or displacement.

Setting range When stop condition is load or displacement: -30000 to 30000
When stop condition is time or displ. stop: 0.1 to 100.0 sec

Operation

Main screen → Set → Work Setting → Stop (level)▼

h. Start input mode

Set the operations of inputting measurement start signal.

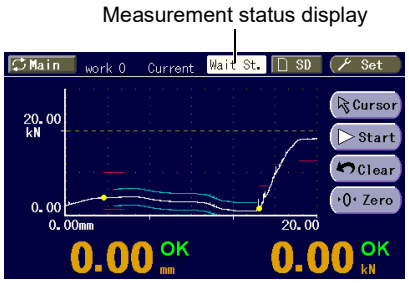
Setting range	Normal (Seq.):	Start measurement setup by ON Edge, and start measurement once OFF is recognized after completing the setup.
	ON Edge Only:	Start measurement setup by ON Edge, and start measurement automatically after completing the setup.

Operation

Main screen → Set → Work Setting → Start Input Mode▼

i. Measurement operation

Perform measurement from the main screen in accordance with the following procedure.



1. Confirm that the measurement status display is Wait St. or Complete.
If it is not Wait St. or Complete, confirm that a measurement start signal has not been input externally, and press Clear.

2. Satisfy the start condition, and start measurement.
When measurement starts, the measurement status display changes to Sampling.

* If it does not change to Sampling, check the following according to the measurement status display.

- Wait St.: The measurement start signal has not been recognized. Input measurement start signal or press Start.
- Wait Off: The measurement start signal is not OFF. Turn OFF the measurement start signal.
- Wait LV.: Load or displacement has not crossed the start level since the measurement start signal was input. Change the start level or the timing for measurement start signal input.
- Complete: Measurement has already stopped. (Go to "4".)

3. Satisfy the stop condition, and stop measurement.
When measurement stops, the measurement status display changes to Complete or Wait St., and a judgment will be displayed.

4. Check the waveform as necessary by pressing Cursor.

j. Waveform display adjustment

Adjust the waveform display axes.

■ Y start point

Set the Y-axis start point of the waveform.

Setting range: -30000 to 30000

Operation

Main screen → Cursor → XY → Y Start Point▼

■ Y end point

Set the Y-axis end point of the waveform.

Setting range: Y Start Point +
25, 50, 100, 200, 300, 400, 500, 1000, 2000, 3000, 4000, 5000, 10000, 20000, 30000

Operation

Main screen → Cursor → XY → Y End Point▼

■ X start point

Set the X-axis start point of the waveform.
The setting range varies depending on the settings for "0 of X-axis" and for the measure length.

Setting range When 0 of X-axis is set to front: 0 to 2000 x measure length/2000
When 0 of X-axis is set to end: -2000 to 0 x measure length/2000

Operation

Main screen → Cursor → XY → X Start Point▼

■ X end point

Set the X-axis end point of the waveform.
The setting range varies depending on the settings for 0 of X-axis and for the measure length.

Setting range: When 0 of X-axis is set to front:
X Start Point ＋ 25, 50, 100, 200, 400, 600, 800, 1000, 1200, 1400, 1600, 1800, 2000, 2200
x measure length/2000
When 0 of X-axis is set to end:
X Start Point ＋ -25, -50, -100, -200, -400, -600, -800, -1000, -1200, -1400, -1600, -1800, -2000, -2200
x measure length/2000

Operation

Main screen → Cursor → XY → X End Point▼

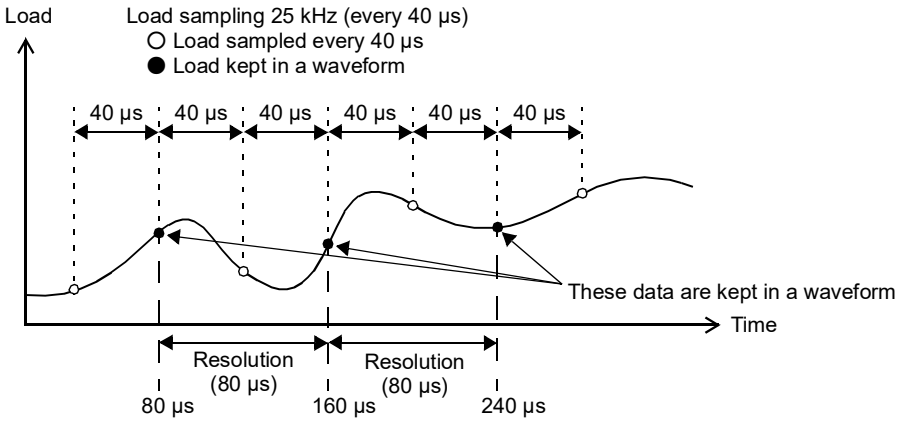
■ Measurement data

- The sample rate is 25 kHz or 5 kHz.
- Measurement is performed at 25 kHz and 5 kHz, but the data kept in the waveform is 2000 pieces for each measure length (maximum data: 2048 pieces).
  Therefore, the waveform resolution will be the measure length/2000.

The time/displacement selection is time

During measurement, the load is sampled at 25 kHz or 5 kHz, and after measurement stop, the load for each resolution remains as a waveform.

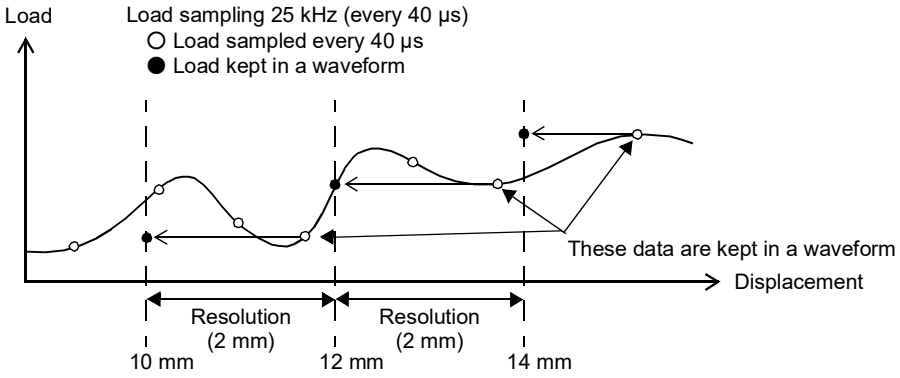
Example) When the measure length is 160 ms (at a sample rate of 25 kHz)



The time/displacement selection is displacement

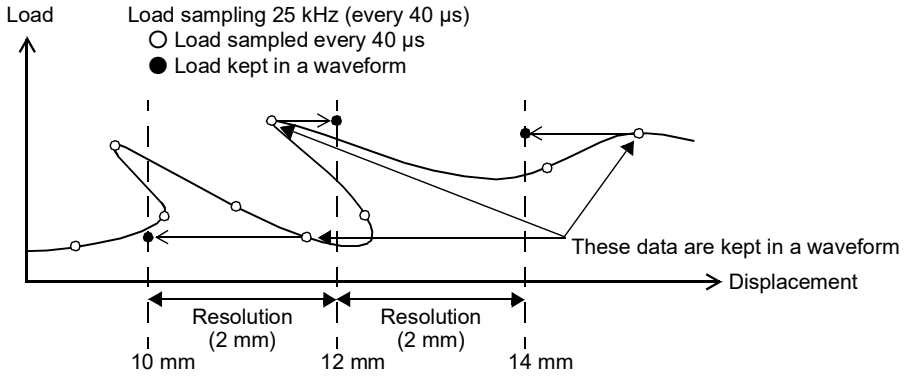
Load and displacement are sampled at 25 kHz or 5 kHz, and the load is kept in a waveform every time the displacement advances an amount equivalent to the resolution.

Example) When the measure length is 4000 mm (at a sample rate of 25 kHz)



When displacement returns, all the data for the corresponding load is recognized as that for the previous displacement.

Example) When displacement returns (at a sample rate of 25k Hz)

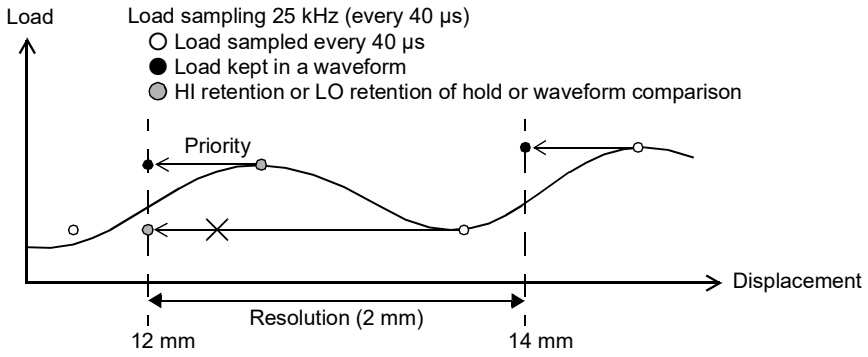


* Out of the points not kept in a waveform, those meeting the following conditions are preferentially kept in the waveform.

  (1) When data kept as sample, peak, valley, P-V, rel. max, rel. min, or inflect. was not kept in a waveform.

  (2) When data judged as HI retention or LO retention during waveform comparison was not kept in a waveform.

Example) When the HI retention or LO retention judgment points of hold or waveform comparison do not fall under data kept in a waveform (at a sample rate of 25 kHz)

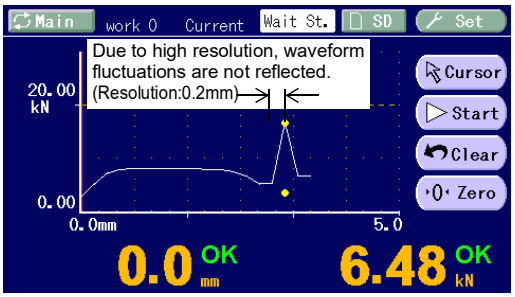


* When kept points overlap, the point with the larger point number out of Point 1 to 5 is kept in the waveform, but the other points will still be displayed on the screen.

■ Points of caution

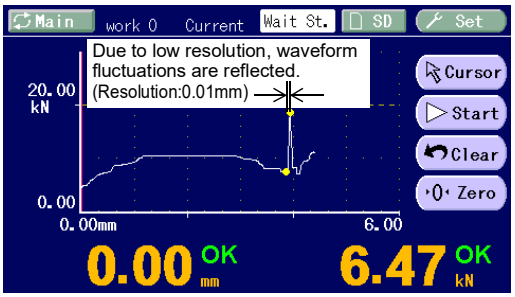
If waveform resolution is increased, there are more chances of load fluctuations to be dropped. As a result, it will be harder for actual waveform to be reflected on measured data.
If measurement is performed under such conditions, data detected by Hold function may be overlapped on X-axis, and thus a hold point may not be displayed on a waveform.

An example that a hold point cannot be drawn on a waveform since X-axis data on the waveform for Peak and Inflection Hold overlap.



For such case, lower resolution by changing calibration value & full scale of waveform for X-axis. Actual waveform will be reflected and thus a hold point can be plotted normally.

An example that X-axis data on waveform for Peak and Inflection Hold do not overlap, thus a hold point can be drawn on the waveform.

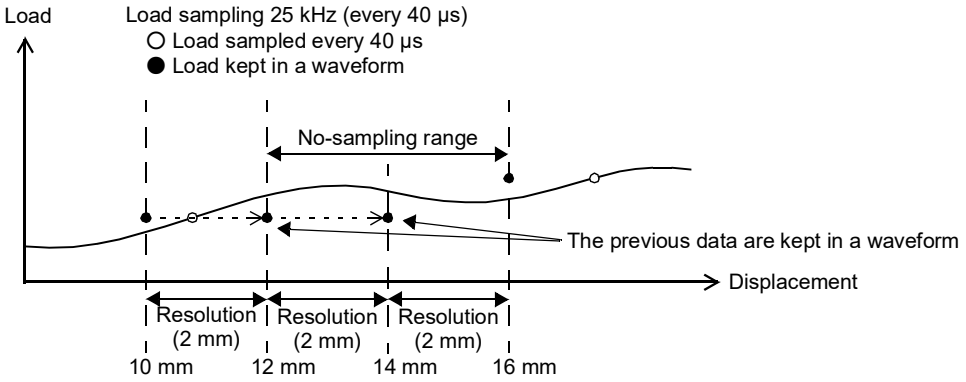


■ When displacement advances suddenly

When displacement advances suddenly, a phenomenon occurs in which sampling is not performed in time, and data that should be kept in a waveform is dropped. In such cases, the immediately preceding displacement data is kept in the waveform as the data for the dropped displacement. If 10 or more pieces of data are dropped, it will result in a pace error, and the load/displacement OK signal will turn OFF.

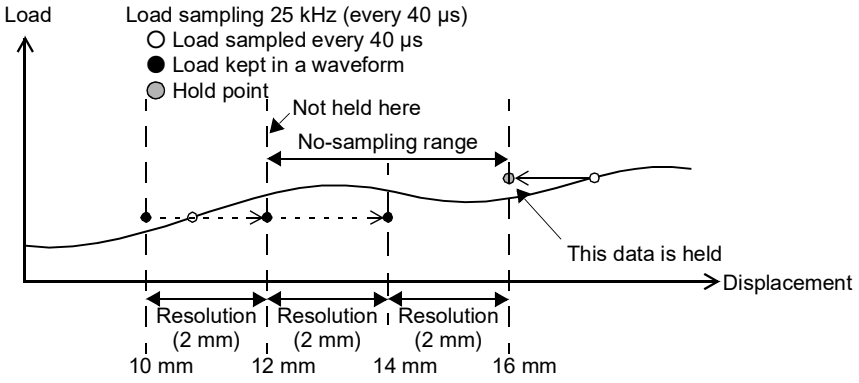
* Guide for displacement pace
Displacement pace for which one piece of data is dropped: Waveform resolution x 25 kHz
Example) When the measure length is 4000 mm → 2 mm x 25000 Hz = 50000 mm/s

Example) When displacement advances suddenly (at a sample rate of 25 kHz)



When the displacement pace is fast, sampling may not be performed at the detection range start point. In such cases, no load is held at the range start point, but the load for which sampling near the range start point was in time is held.

Example) When the detection range start point is 12 mm, and sample hold is used (at a sample rate of 25 kHz)



* When the detection range start point and end point are set to be the same, no load may be held if the displacement pace is fast. Set the range start point and end point with a margin which takes into account a fast displacement pace.

* When the reference is set to end, since the hold operation is performed with the waveform kept after measurement stop, the above phenomenon will not occur.

■ Measuring work specification

A maximum of 16 types of work setting values can be stored in the FS2000, and in order to use them for measurement, the set work No. that is to be used (the measuring work) must be specified using an external input signal (work selection 1, 2, 4, 8) or through settings.

* Take PLC communication into account, and as a basic rule, use the external input signal.

Setting range: External input: Use work selection 1, 2, 4, 8 of external input signal.
Setting: Work selection through key operation

Operation

Main screen → Set → Work Setting → Work selection▼

- When performing work selection by means of an external input signal

Input binary digits in work selection 1, 2, 4, 8 (0: Open, 1: ON).

Example)

Measuring work	Work selection 8 4 2 1
0	0 0 0 0
1	0 0 0 1
2	0 0 1 0
10	1 0 1 0

* Normally, if there is no input to work selection 1, 2, 4, 8, a setting value of work 0 will be selected.

Key points

- The measuring work is accepted when the measurement start input signal is turned ON.
- If you try to change the measuring work during measurement, the change will be ignored.

When performing work selection through settings

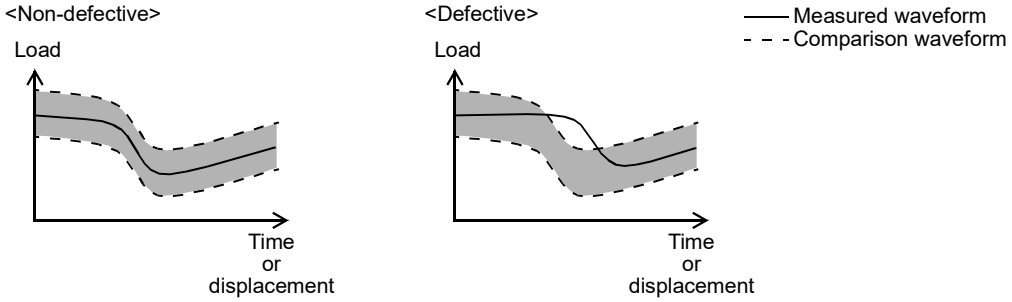
Specify the desired work No. using the Work No. in the Work Setting.

3 Judgment

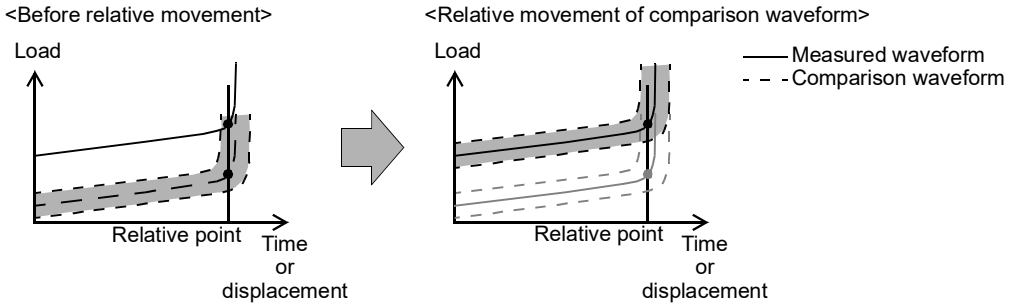
3-1. Waveform comparison judgment

3-1-1. Waveform comparison function

- With the waveform comparison function, you create comparison waveforms in advance, then judge whether a measured waveform is between the comparison waveforms.



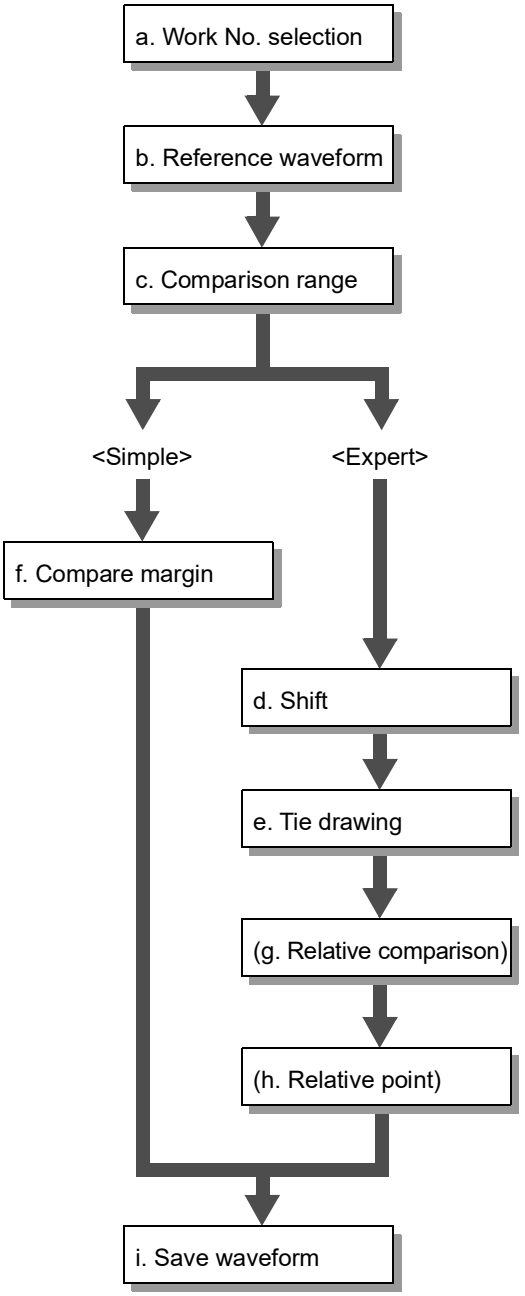
- When relative comparison is selected, waveforms that fluctuate up and down with each measurement can be compared relatively. This is used to monitor the load change range (smoothness etc.), therefore the load size is not important.
- This function shifts the comparison waveforms relatively according to the load at the reference point of the measured waveform, on the basis of a relative point set using time or displacement.
- Judgment is not made if measurement does not reach the reference point. (All waveform comparison judgment output OFF.)



Key points

Relative movement is only possible in the Y-axis direction.

3-1-2. Waveform comparison procedure



Select the work No. to be specified for judgment.

Measure the waveform that will be the basis for a comparison waveform.

Specify the waveform comparison range.

Select the method for creating a comparison waveform.

Simple
A comparison waveform is created in a simple way by offsetting the reference waveform up and down. Set the offset load as the compare margin.
Expert
Process a waveform as desired to create a comparison waveform.

Shift the waveform in the specified range up and down to create a waveform.

Display multiple points by touching the screen, and create a waveform by tying them together.

This function shifts a comparison waveform up and down to match the measured waveform. (Not normally used.) This is used to monitor the load change range (smoothness etc.), therefore the load size is not important.

Set the reference point to be used for relative comparison.

Save the created waveform.

a. Work No. selection

Select the work No. to be specified.

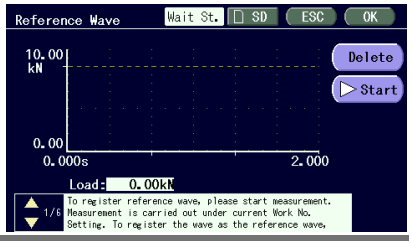
Setting range: 0 to 15

Operation

Main screen → Set → Work Setting → Work No.▼

b. Reference waveform

Input and register reference waveforms.



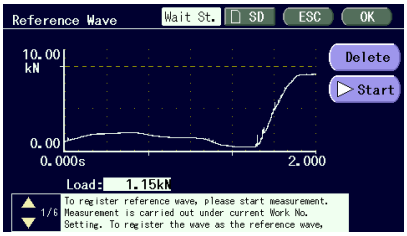
Operation

Main screen → Set → Work Setting → Waveform Comp. → ① Reference Wave▼

(1) Carry out the following procedure only when reacquiring a waveform.
(Start from step (2) if no reference waveform has been registered.)
- Press Delete, and select All Wave.

(2) Start measurement.
(The condition varies depending on the start condition.)

(3) Stop measurement.
(The condition varies depending on the stop condition.)

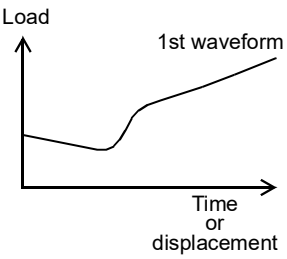


(4) The measured waveform is displayed.
To delete the waveform that has just been measured, press Delete, and select Last Wave.

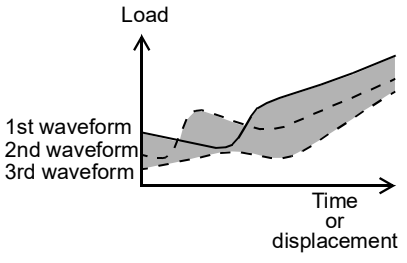
(5) Repeat (2) to (4) to input a waveform again.

(6) Press OK.
A reference waveform will be registered.
* The waveform will not be kept if ESC is pressed.

When there is one reference waveform, the HI limit waveform and LO limit waveform are recognized as the same.

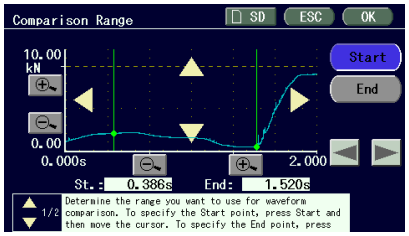


If multiple waveforms have been input, the upper limit of all the waveforms will be the HI limit waveform, and the lower limit of all the waveforms will be the LO limit waveform.



c. Comparison range

Set from where to where in the waveform will be the comparison target.



Setting range (Start, End)

When 0 of X-axis is set to front:

0 to 2047 x measure length/2000

When 0 of X-axis is set to end:

-2047 to 0 x measure length/2000

Operation

Main screen → Set → Work Setting → Waveform Comp. → ② Comparison Range▼

(1) To change the start of the range, press Start (Displacement (end): End), and then move the cursor to specify a start point.

(2) To change the end of the range, press End (Displacement (end): Start), and then move the cursor to specify an end point.

(3) To register the specified range, press OK.

(4) After the range has been registered, the background color outside the range will be turn gray on the waveform processing screens set later on, so that the range boundaries become clear.

d. Shift

This is one of the methods for processing a waveform. A part of a waveform can be shifted up and down.

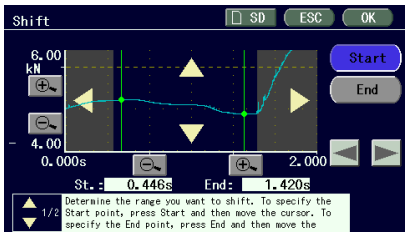
Setting range: Range set under comparison range

Operation

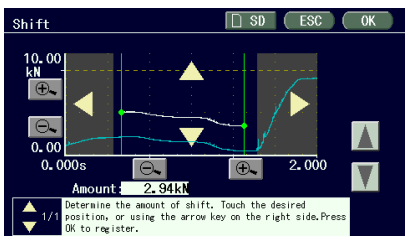
Main screen → Set → Work Setting → Waveform Comp. → Next → ③ Shift▼

(1) To shift the HI limit waveform up/down, press HI Limit, and to shift the LO limit waveform up/down, press LO Limit to select a waveform, then press OK.

(2) Determine the range you want to shift up/down. (2) To specify the left of the range, press Start, and then move the cursor to specify.
To specify the right of the range, press End, and then move the cursor to specify.
After specifying the range, press OK.



(3) Determine the amount of up/down shift.
Touch the position to shift up/down to or specify the amount of shift using ▲▼, and then press OK.



e. Tie drawing

A waveform can be created or processed as desired by creating one or more points and tying them together with straight lines. If there is only one point, a spine-like waveform passing that point will result.

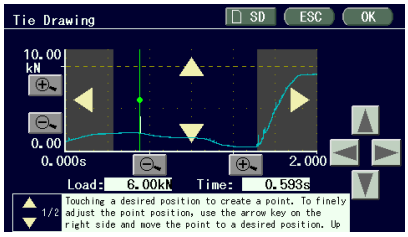
Setting range: 1 to 10 points

Operation

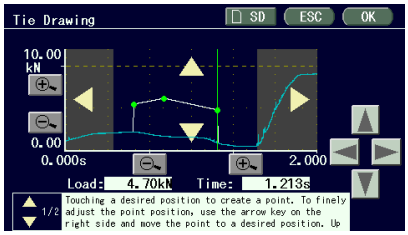
Main screen → Set → Work Setting → Waveform Comp. → Next → ③ Tie Drawing▼

(1) To create/process the HI limit waveform, press HI Limit, and to create/process the LO limit waveform, press LO Limit to select a waveform, then press OK.

(2) A point can be created by touching the desired position. To make fine adjustments to the point's position, press the arrow keys and move the point to the target position.



(3) Repeat the operation in (2) to add more points. Also, to correct points you have already created, touch the left side of the point(s) you want to correct. All the points to the right of the place where you touched will be erased, and a new point will be created at the place where you touched.

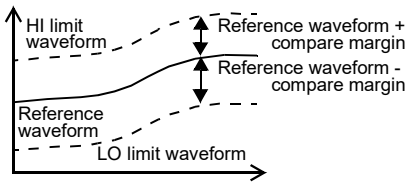


(4) After specifying all points, press OK.

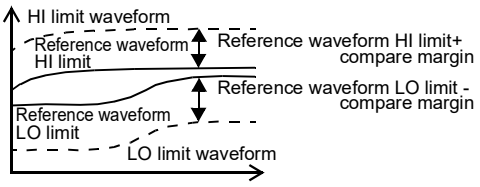
f. Compare margin

An entire waveform is shifted up/down by the setting value. This is used when shifting a reference waveform up/down by the set load. By setting a compare margin in advance, a comparison waveform can be created just by inputting and saving a reference waveform.

<When there is one reference waveform>



<When there are two reference waveforms>



Setting range: 0 to 30000

Operation

Main screen → Set → Work Setting → Waveform Comp. → Next → ④ Compare Margin▼

g. Relative comparison

Select whether to perform a standard waveform comparison or to perform a waveform comparison using relative values.

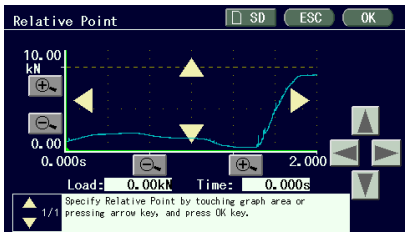
Setting range: OFF, ON

Operation

Main screen → Set → Work Setting → Waveform Comp. → Next → Next → ⑤ Relative Comp.▼

h. Relative point

Set the reference point for performing waveform comparison by means of relative movement. This setting is only possible when "ON" is selected for the relative comparison setting.



Setting range

X: When 0 of X-axis is set to front
0 to 2047 x measure length/2000
When 0 of X-axis is set to end
-2047 to 0 x measure length/2000

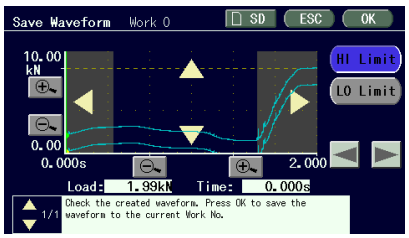
Y: -30000 to 30000

Operation

Main screen → Set → Work Setting → Waveform Comp. → Next → Next → ⑥ Relative Point▼

i. Save waveform

Confirm and save the waveform.
Press OK if there is no problem.
The current waveform is not saved until OK is pressed.



Operation

Main screen → Set → Work Setting → Waveform Comp. → Next → Next → ⑦ Save Waveform▼

Key points

After you have finished creating and processing a waveform, be sure to confirm and save the waveform using save waveform.

When comparison waveforms are not used...

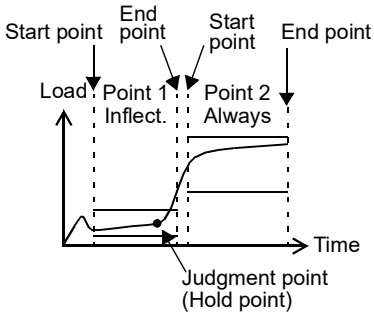
1. Press Delete on the reference waveform screen, and select All Wave.
2. You will return to the reference waveform screen, so press OK.
3. If relative comparison is set to "ON", set it to "OFF".
4. Press save waveform, and press OK.

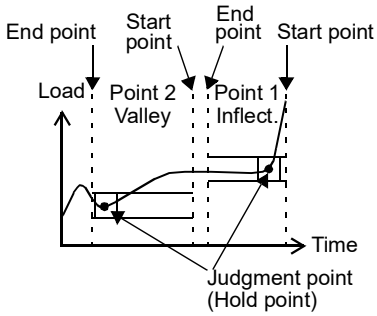
3-2. Point judgment (Hold setting)

3-2-1. Point judgment

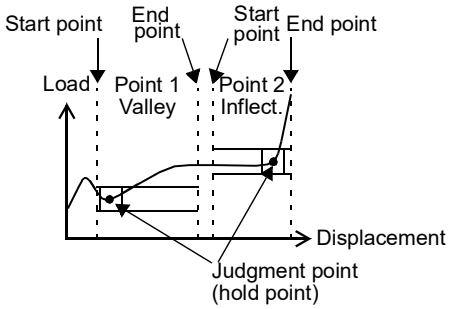
- This function detects and judges points from the waveform (maximum of 5 points).
- The detection method can be changed in accordance with the selected point detection.
- Judgment points can be kept according to the point detection selected.
- The ranges for point detection is specified by "HOLD1 to 5" of the external signal or through settings.
- Detection ranges may overlap.

<In the case of time>
Start point and end point of range specified using time or external signal

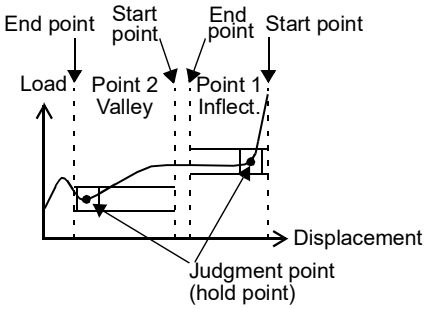




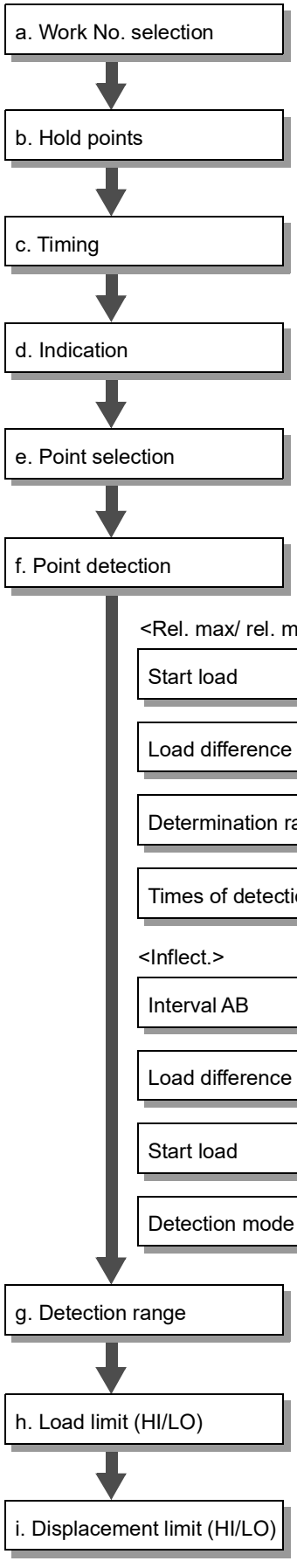
<In the case of displacement (front reference)>
Start point and end point of range specified using displacement or external signal



<In the case of displacement (end reference)>
Start point and end point of range specified using displacement



3-2-2.Point judgment procedure



Select the work No. to be specified for judgment.

Set the hold points to be judged.

Select whether to specify the detection range through external input (HOLD1 to 5) or through settings (detection range) (initial value: setting).

Set the points that you particularly want to display on the main screen.

Specify the point number to be set.

Set the point detection.

- Always: Load/displacement will always be monitored within the detection range.
- Sample: The start point of the detection range will be detected.
- Peak: The peak of the detection range will be detected.
- Valley: The valley of the detection range will be detected.
- P-V: The P-V of the detection range will be detected.
- Rel. max: Relative maximum values within the detection range will be detected.
- Rel. min: Relative minimum values within the detection range will be detected.
- Inflection: Inflection points within the detection range will be detected.
- Average: The average value for the detection range will be detected.
- End: The displacement when measurement stops will be detected.

For start load, load difference, determination rate, and times of detection, refer to "■Selection of Rel. Min/Rel. Max as the point detection" on p.57.

For interval AB, load difference, start load and detection mode, refer to "■Selection of inflect. as the point detection" on p.58.

If specifying the range using settings, set the detection range. (Initial value: 0 to 2047 x measure length/2000).

Set the HI/LO limits (load) for judging the detected points.

Set the HI/LO limits (displacement) for judging the detected points.

a. Work No. selection

Select the work No. to be specified.

Setting range: 0 to 15

Operation

Main screen → Set → Work Setting → Work No.▼

b. Hold points

Set the hold points to be judged.

Setting range: 1 to 5

Operation

Main screen → Set → Work Setting → Point Judge. → Hold Points▼

c. Timing

Select whether to specify the detection range through external input (HOLD1 to 5) or through settings (detection range).

Setting range: External Input, Setting

Operation

Main screen → Set → Work Setting → Point Judge. → Timing▼

d. Indication

Select the numerical value to display on the main screen.

Setting range: Real-time value, Point 1, Point 2, Point 3, Point 4, Point 5

Operation

Main screen → Set → Work Setting → Point Judge. → Indication▼

e. Point selection

Select the points to be set. You can select only the hold points set in "hold points".

Setting range: Point 1, Point 2, Point 3, Point 4, Point 5

Operation

Main screen → Set → Work Setting → Point Judge. → Point 1 to Point 5▼

f. Point detection

Set the hold for detecting the judgment points.

* For end point displacement, when the X-axis is displacement, you can only set the point number for which the number is largest out of the hold points set in "hold points".

Setting range: Always, Sample, Peak, Valley, P-V, Rel. Max, Rel. Min, Inflect., Average, End

Operation

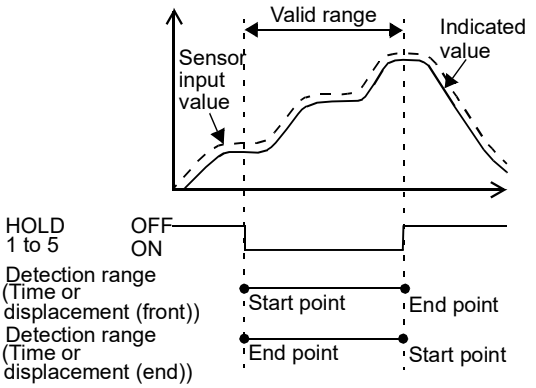
Main screen → Set → Work Setting → Point Judge. → Point Detection▼

■ Types of point detection

For point detection, all detection is carried out within the valid range. The valid range is either while HOLD1 to 5 of the external signal is ON, or from the start point to the end point of a set range.

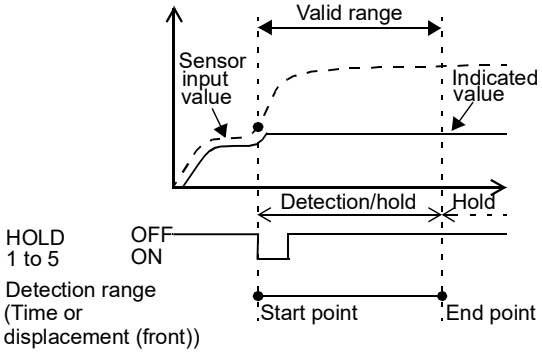
- Always

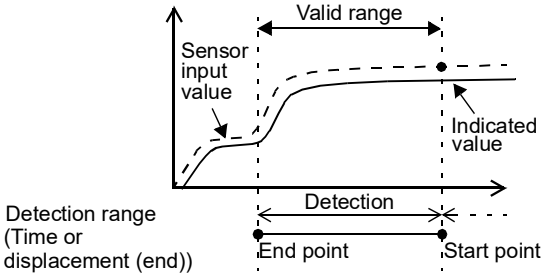
The indicated value and HI/LO limit setting values are compared regularly within the valid range.
The judgment points are all the data within the valid range.
The judgment points are not kept.



- Sample

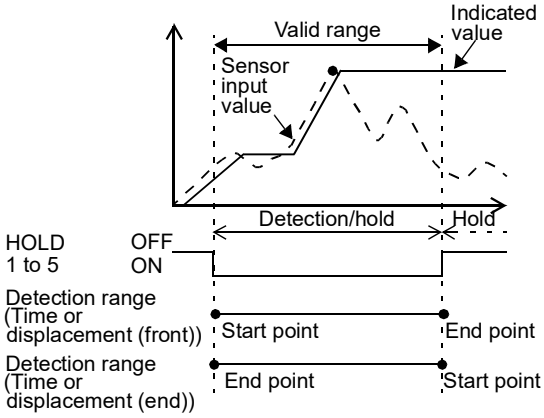
Holds the load at the start point of the valid range.
* The range start point and end point do not need to be the same.





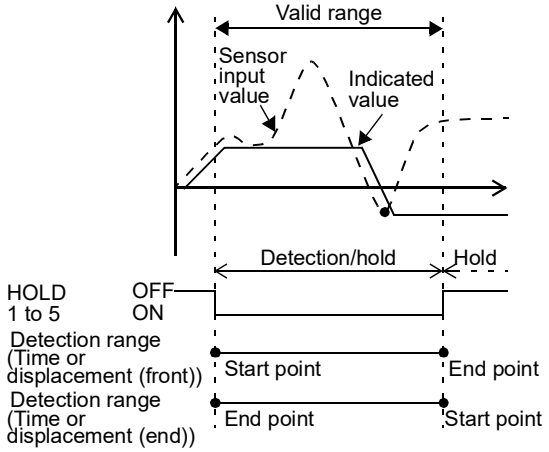
- Peak

Holds the maximum value (peak value).



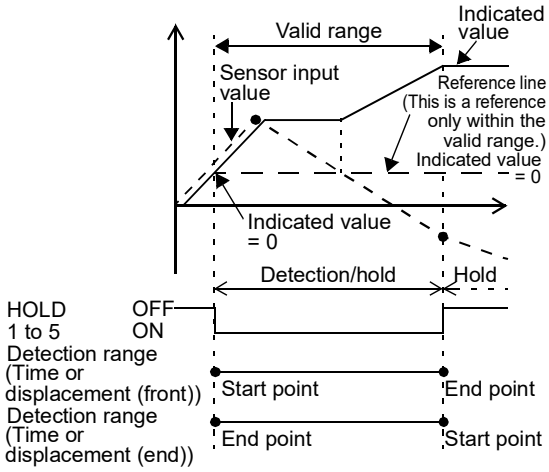
- Valley

Holds the minimum value (valley value).



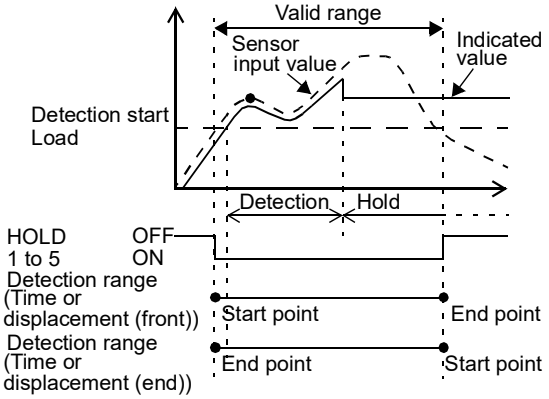
- P-V (peak to peak)

Holds the difference between the peak and valley values.



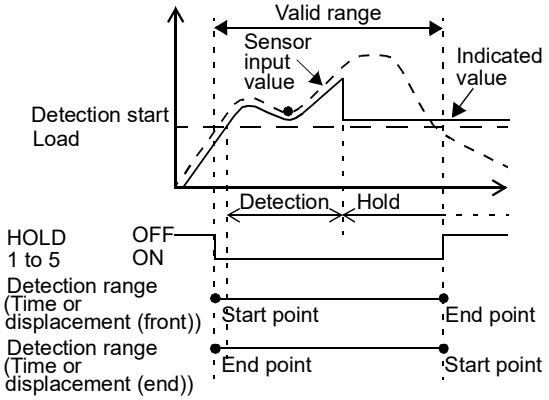
- Rel. max (Relative maximum value)

Detection starts from the point at which the start load is crossed, and the rel. max is held if the detection condition for the rel. max is satisfied.



- Rel. min (Relative minimum value)

Detection starts from the point at which the start load is crossed, and the rel. min is held if the detection condition for the rel. min is satisfied.

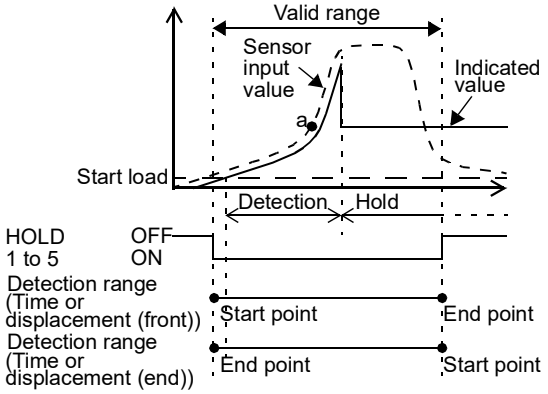


- Inflect. (Inflection)

Holds change points at which the load changes suddenly.

Detection starts from the point at which the start load is crossed, and the inflect. is held if the detection condition for the inflect. is satisfied.

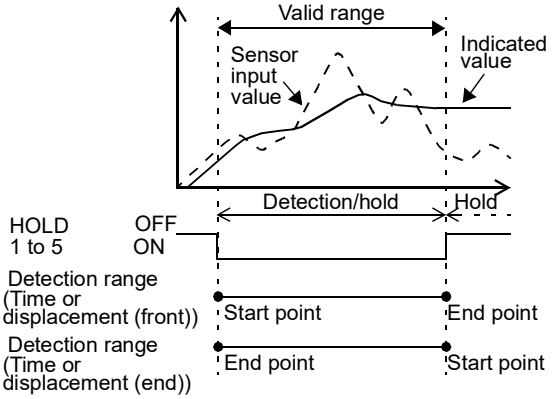
Depending on a direction of angle variation, Inflection point detecting mode (A, B, C or D) is selectable. For details, refer to "- Detection mode" on p.59.



- Average

Calculates and holds the average value.

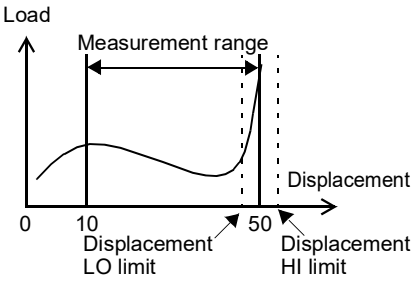
When the X-axis represents displacement, calculates and holds the average when measurement stops.



- End (End point displacement)

Judges the displacement when measurement stops.

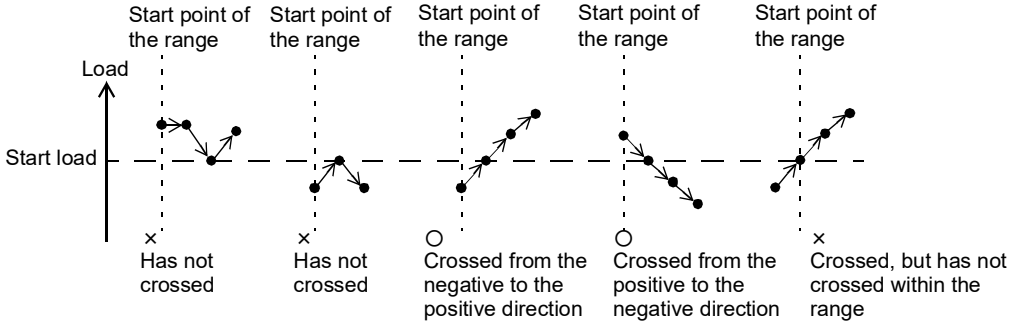
Unlike other hold types, for end, judgment is performed on the basis of the origin for displacement, and not on the basis of the origin for the waveform.



* It is not necessary to input HOLD1 to 5 or to set the detection range.
* For end, when the X-axis is displacement, you can only set the point number for which the number is largest out of the hold points set in "hold points".
* The lines for the displacement HI/LO limits are not displayed on the actual measurement screen.

What is "crossing" the start load?

When the load passes the start load from positive to negative or from negative to positive, it is called "crossing". If detection does not start, refer to the example below, and recheck the start load settings and the change in the load within the range.



g. Detection range (start, end)

Set the start point and end point of the selected range.

These settings are not required when selecting the detection range through HOLD1 to 5 input.

Setting range (The range is the same for both start and end.)

When 0 of X-axis is set to front: 0 to 2047 x measure length/2000

* Setting start ＞ end is not possible

When 0 of X-axis is set to end: -2047 to 0 x measure length/2000

* Setting start ＜ end is not possible

Operation

Main screen → Set → Work Setting → Point Judge. → Detection Range▼

Key points

If the displacement pace is fast, sampling may not be performed in time, and no load may be held at the range start. In such cases, the load for which sampling near the range start point was in time is held.

Also, when the detection range start and end are set to be the same, no load may be held if the displacement pace is fast. Set the range start and end with a margin which takes into account a fast displacement pace.

It is preferable to give them a margin of at least measure length/2000 x 10.

h. Load limit (HI/LO)

Set the range of load within which the judgment point is judged to be OK.

The judgment will be OK if the detected point is between the HI limit and LO limit.

Setting range: -30000 to 30000 (The range is the same for both HI limit and LO limit.)

* Setting HI limit ＜ LO limit is not possible.

Operation

Main screen → Set → Work Setting → Point Judge. → Load Limit▼

Key points

Load HI/LO limit setting values for P-V

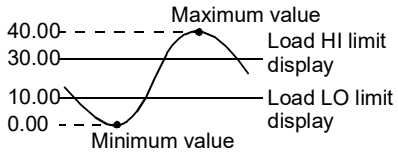
P-V judgment is made using maximum value - minimum value.
Therefore, set the load limit (HI/LO) within the range 0 to 30000, because the judgment value will never be negative.

On the main screen, the load limit (HI/LO) are offset-displayed (red line) on the basis of the minimum value (0).

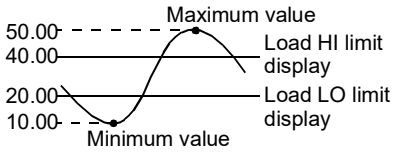
Load HI limit display value = Load HI limit setting value + minimum value
Load LO limit display value = Load LO limit setting value + minimum value

Example) When the load HI limit value is 30.00 kN
and the load LO limit value is 10.00 kN

[Measurement 1]
When the detected minimum value is 0.00 kN and the maximum value is 40.00 kN



[Measurement 2]
When the detected minimum value is 10.00 kN and the maximum value is 50.00 kN



i. Displacement limit (HI/LO) (only when X-axis represents displacement)

Set the range of displacement within which the judgment point is judged to be OK.
The judgment will be OK if the detected point is between the HI limit and LO limit.

Setting range (The range is the same for both HI limit and LO limit.)

When 0 of X-axis is set to front: 0 to 2047 x measure length/2000
When 0 of X-axis is set to end: -2047 to 0 x measure length/2000

* Setting HI limit < LO limit is not possible.

When end is selected for the point detection, the displacement limit (HI/LO) are set using the numerical keypad.

Setting range: -30000 to 30000

Operation

Main screen → Set → Work Setting → Point Judge. → Displ. Limit▼

■ Selection of Rel. Min/Rel. Max as the point detection

The following setting items are displayed.

- Start load - Load difference - Determination rate - Times of detection

- Start load

Set the load for starting detection of relative maximum value (relative minimum value).
Press No Use if you will not use a start load.

Setting range: -30000 to 30000

Operation

Main screen → Set → Work Setting → Point Judge. → Point Detection▼ → Rel. max (or rel. min) → Start Load▼

- Load difference

Set the load difference between the relative maximum value and relative minimum value. Select with the Up key for the relative maximum value and the Down key for the relative minimum value.

Setting range: 1 to 60000

Operation

Main screen → Set → Work Setting → Point Judge. → Point Detection▼ → Rel. max (or rel. min) → Load Difference▼

- Determination rate

Set the rate for determining the relative maximum value (relative minimum value).
The relative maximum value (relative minimum value) is determined to be the value when the determination rate is exceeded starting from the relative minimum value.

Setting range: 1/4, 1/2, 3/4, 1, 1.25, 1.5, 1.7, 5, 2, 3, 4 times

Operation

Main screen → Set → Work Setting → Point Judge. → Point Detection▼ → Rel. max (or rel. min) → Determinat. Rate▼

- Times of detection

Set which relative maximum value (relative minimum value), the 1st, the 2nd, the 3rd etc., is to be made the judgment point.

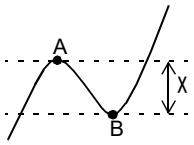
Setting range: 1 to 15 times

Operation

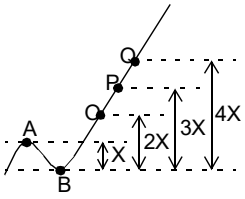
Main screen → Set → Work Setting → Point Judge. → Point Detection▼ → Rel. max (or rel. min) → Times of Detect.▼

Rel. max/rel. min detection method

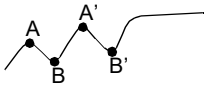
First, when the difference X between point A and point B is greater than or equal to "load difference", point A is judged to be the rel. max and point B is judged to be the rel. min.



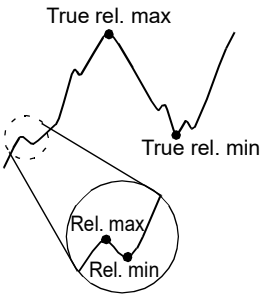
When rel. max A and rel. min B are detected and the difference X between them exceeds the set determination rate (1/4 to 4 times), at each point (point Q if the rate is 4 times, for example), A and B are displayed and held when the hold setting is rel. max and rel. min, respectively.



In cases where a rel. max/min appears more than once in a waveform, the rel. max/min is held after counting the same number of rel. max/min as the number set in "times of detect.". For example, if the setting is 2, then, A' and B' are held as rel. max and rel. min, respectively.



If the value of "load difference" is too small, then as shown in the diagram on the right, noise in the waveform may be regarded as a rel. max or rel. min, and the correct value may not be held. Set an appropriate value by checking the input waveform on the screen.



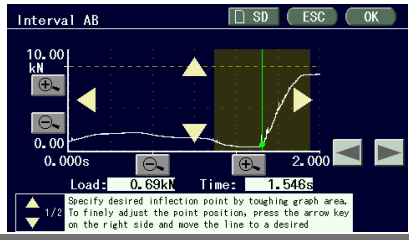
■ Selection of inflect. as the point detection

The following setting items are displayed.

- Interval AB - Load difference - Start load - Detection mode

- Interval AB

Set interval A and interval B.



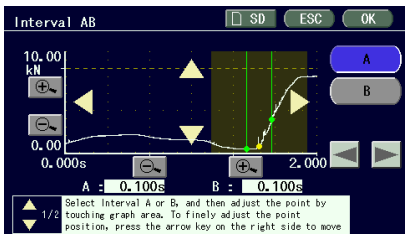
Setting range: 1 to 999 x measure length/2000
(The range is the same for both A and B.)

Operation

Main screen → Set → Work Setting → Point Judge. → Point Detection▼ → Inflect. → Interval AB▼

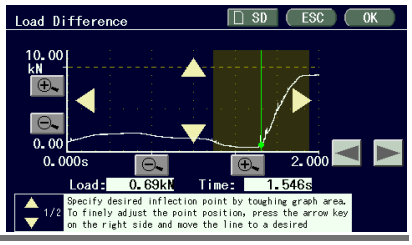
(1) Set the inflection point you want to detect. Touch the graph area or specify with the cursor keys, then press OK.

(2) To set interval A, press Start, and to set interval point B, press End. Then set the value. After setting A and B, press OK.



- Load difference

Set the load difference between load A and load B.



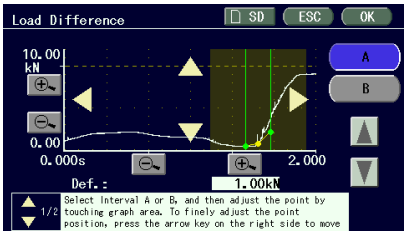
Setting range: 1 to 60000

Operation

Main screen → Set → Work Setting → Point Judge. → Point Detection▼ → Inflect. → Load Difference▼

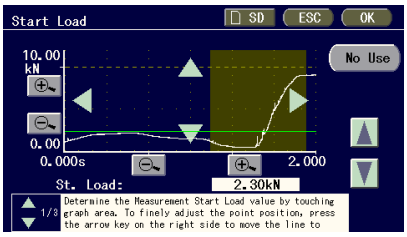
(1) Set the inflection point you want to detect. Touch the graph area or specify with the cursor keys, then press OK.

(2) To set load A, press Start, and to set load B, press End. Then set the value. After setting A and B, press OK.



- Start load

Set the load for starting detection of the inflection point.
Start detecting the inflection point after the load crosses the start load in the section.
Press No Use if you will not use a start load. Inflection point will be detected since the load crosses the start point of the section.



Setting range: -30000 to 30000

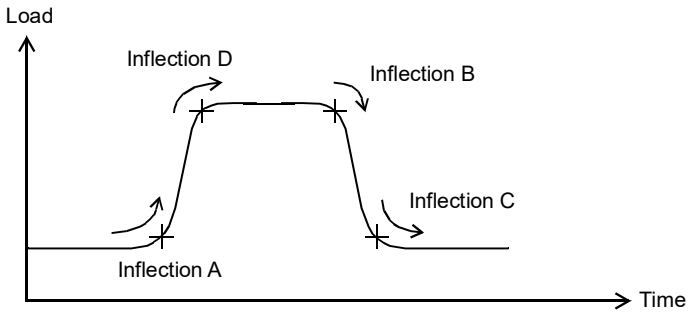
Operation

Main screen → Set → Work Setting → Point Judge. → Point Detection▼ → Inflect. → Start Load▼

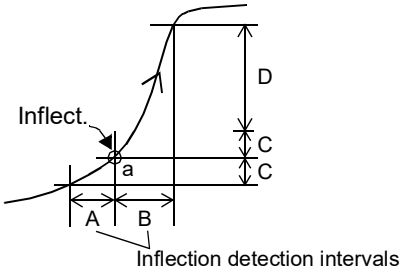
- Detection mode

You can select four types of inflection.
Select inflection based on different load change patterns.

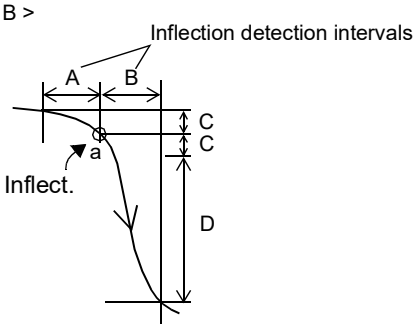
Four types of Inflection



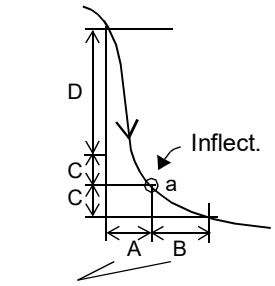
< Inflection A >



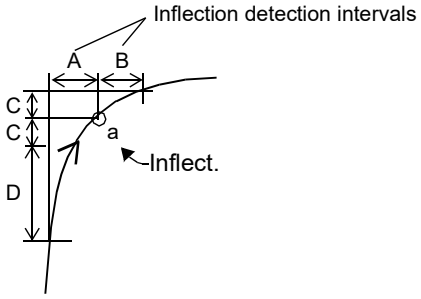
< Inflection B >



< Inflection C >



< Inflection D >



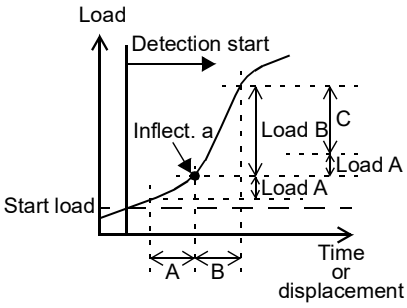
Setting range: Inflection A, Inflection B, Inflection C, Inflection D

Operation

Main screen → Set → Work Setting → Point Judge. → Point Detection▼ → Inflect. → Detection mode▼

Inflect. detection

The amount of change in the indicated value at "interval A" (load A) and the amount of change in the indicated value at "interval B" (load B) are compared, and when difference C between these loads exceeds the setting value for "load difference", point a is held as an inflection point. If there are multiple inflection points within the hold range, the point with the largest amount of change is held. A and B are normally equal, but if for example the inclination is gradual, it is easier to detect the inflection point if A＜B.



A: Interval A
B: Interval B
C: Load difference

Held as an inflection point if "C ＞ Load difference".

Key points

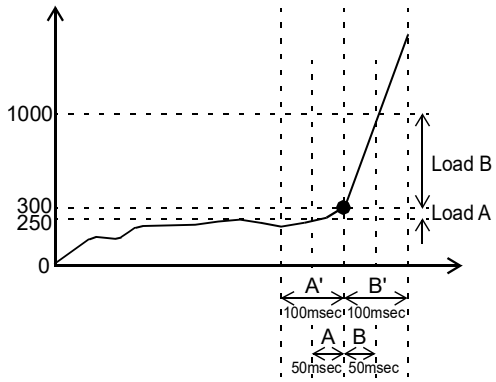
It is easier to hold the inflection point if the inflection AB setting is set to be smaller than the load change time (or displacement) and the load difference setting is set to a smaller than the load difference between the interval AB. (About 50% of the change in each)
However, if the setting of the inflection AB is too short, small load changes may be detected and the target inflection point may not be held, so the setting value varies depending on the waveform.
When holding the inflection point at a position different from the desired inflection point position, check the hold position by changing the detection time AB slightly.

Setting example for inflection point hold

● Example of setting a typical waveform

(1) Interval AB setting

Set to the interval AB at 50% of the inflection point that you want to hold and load change time (or displacement) until no change.
For examples, the load change time is 100msec, so set it to 50msec.



Interval A = 50, Interval B = 50

(2) Inflection load difference settings

Load at inflection point - Load at interval A = Load A.
Load at interval B - Load at inflection point = Load B.
Load B - Load A = Load C.

Load C is the load to be compared to the load difference set value.
An inflection point will be detected when the load C that is calculated for every measurement is larger than the load difference.
Take measurement dispersion into account, and set the load difference to a value smaller than load C.

For examples, load A = 50, load B = 700, load C = 650
Therefore, set the load difference to 325 (about 50% of load C).
Load difference = 325

* The hold value of the inflection point is updated to a higher position than the load difference comparison value (load C).

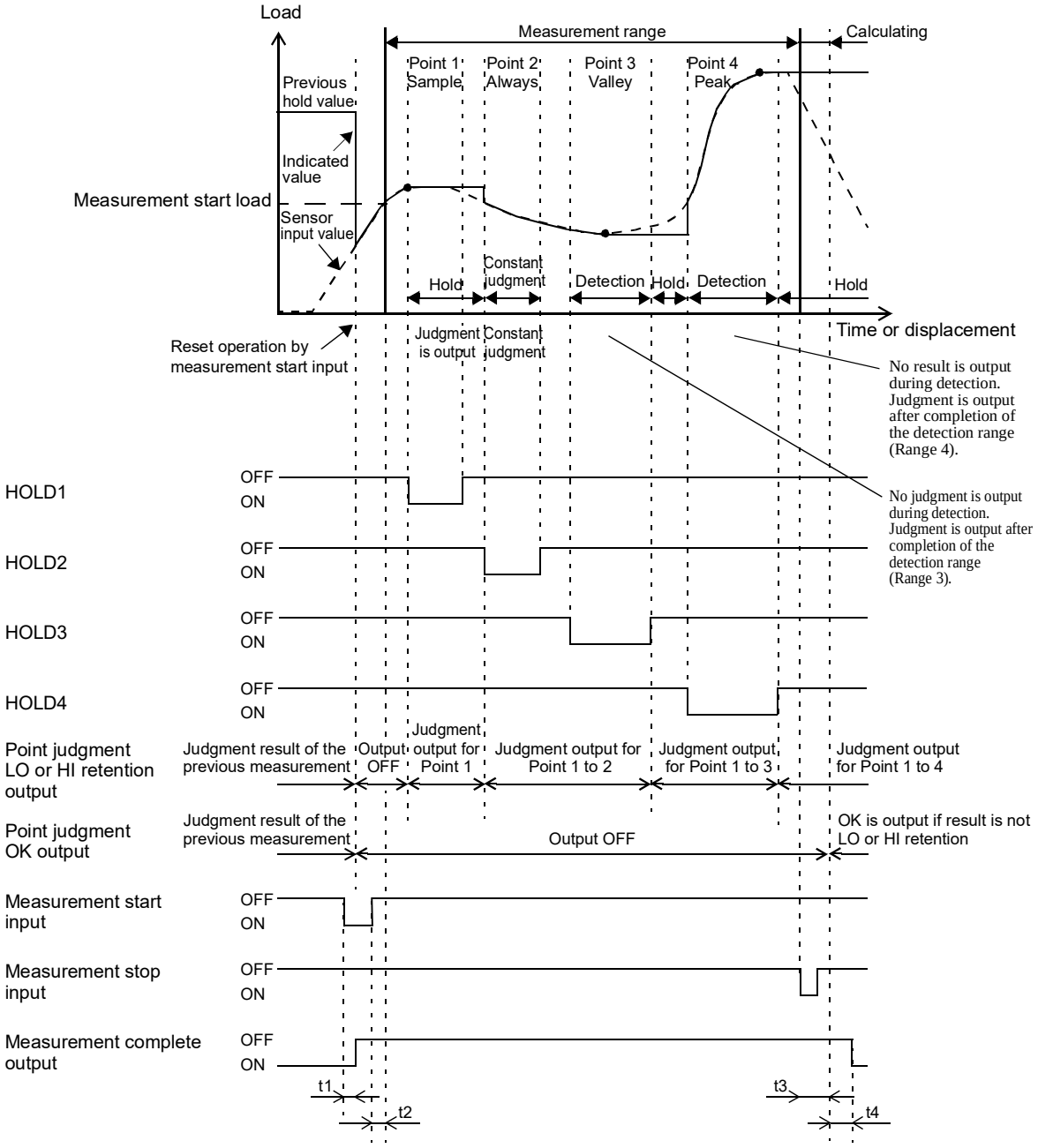
* When detecting changes in waveforms under more severe conditions, the detection conditions can be made more severe by increasing the ratio to the amount of change in the settings.
(If the waveform is out of the condition and is not held, the judgment result will be become NG.)

4 Judgment timing chart

Here, some example timing charts for when using the point judgment function and waveform comparison function are given.

4-1. Example timing chart for the point judgment function

- External control (Only when reference is set to front)



t1: Delay time from when measurement start input is turned ON to when output other than CPU normal operation turns OFF... Approx. 3 ms

t2: Delay time from when measurement start input is turned OFF to when the measurable range starts varies depending on the time taken until the measurement start load is crossed.

t3: Delay time from when measurement stops (when measurement stop input is turned ON) to when judgment output turns ON ... Approx. 50 ms
(However, delay time differs depending on the measurement.)

t4: Delay time from when judgment output turns ON to when measurement complete output turns ON ... Approx. 5ms

- When "measurement start" of the external input signal is turned from OFF → ON, hold is released and all output is turned OFF except for CPU normal operation, load, timing output 1, 2, and overload. (Reset operation by measurement start input.)

- When alway or sample is specified for the point detection, the judgment (except for OK) is output from the beginning of the range. If something other than these is specified, judgment will not be output until the end of the range, but judgments (except for OK) for points for which judgment is complete will be output.

- Once the judgment becomes LO or HI, that output is maintained.

- The OK signal will be output upon completion of measurement, when it has been confirmed that judgment has been made at all points and the results are not HI or LO.
  OK will not result if judgment is not performed for the full hold points.

  Example 1: Failure in point detection when rel. max, rel. min, or inflect. is used.

  Example 2: When the HOLD inputs corresponding to the full hold points to be used that was specified for the hold points have not all turned ON.

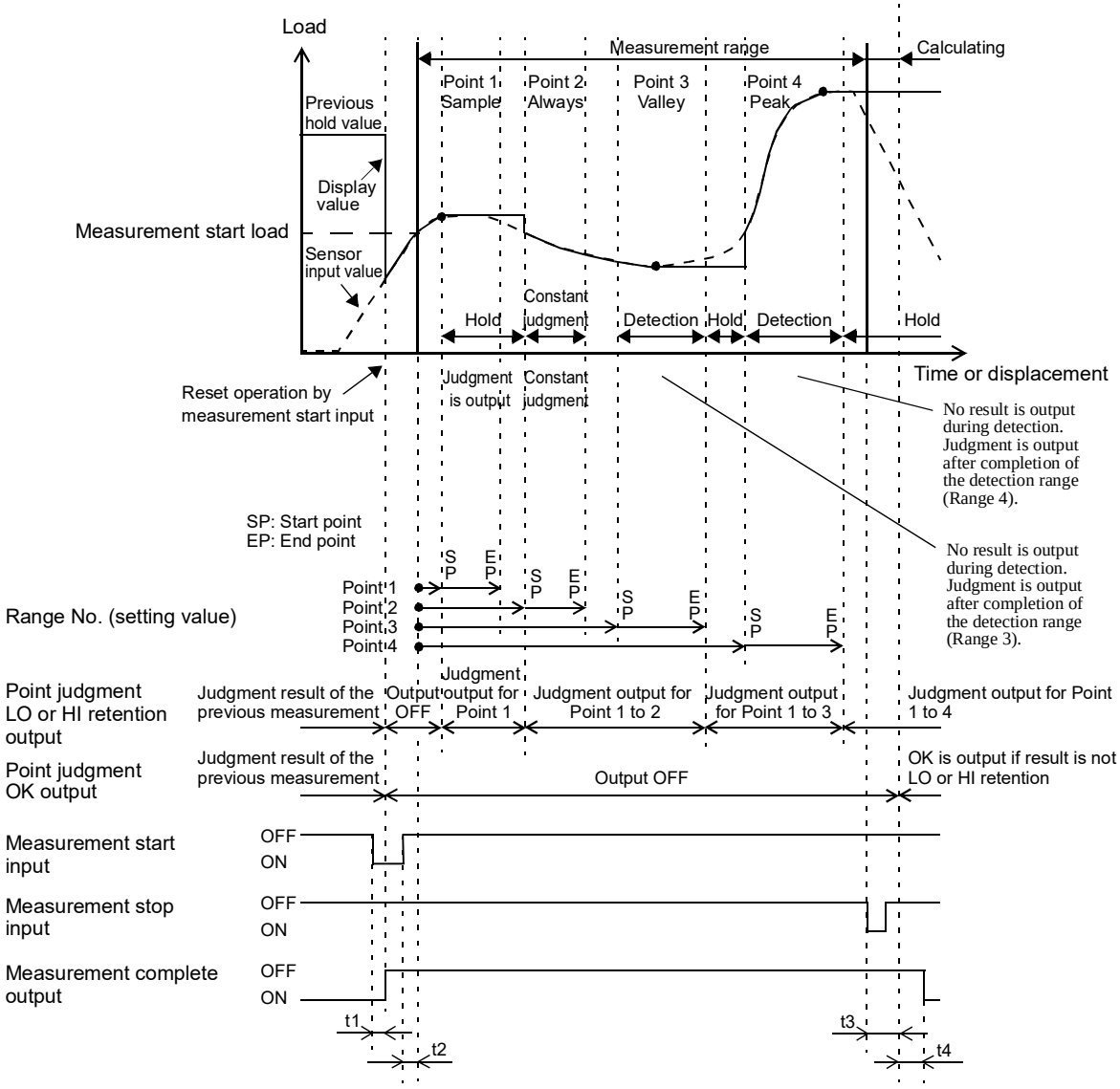
- "Measurement complete" will turn ON when "measurement stop" is turned from OFF to ON, or when 2048 pieces of data have been acquired.

- When the X-axis represents displacement, the rel. max, rel. min, inflect., and average are judged upon completion of measurement.

Key points

To start the detection range from the start of measurement, turn ON the external input signals HOLD1 to 5 before the start of measurement.

- Internal setting control (Only when reference is set to front)



t1: Delay time from when measurement start input is turned ON to when output other than CPU normal operation turns OFF... Approx. 3 ms

t2: Delay time from when measurement start input is turned OFF to when the measurable range starts varies depending on the time taken until the measurement start load is crossed.

t3: Delay time from when measurement stops (when measurement stop input is turned ON) to when judgment output turns ON ... Approx. 50 ms
(However, delay time differs depending on the measurement.)

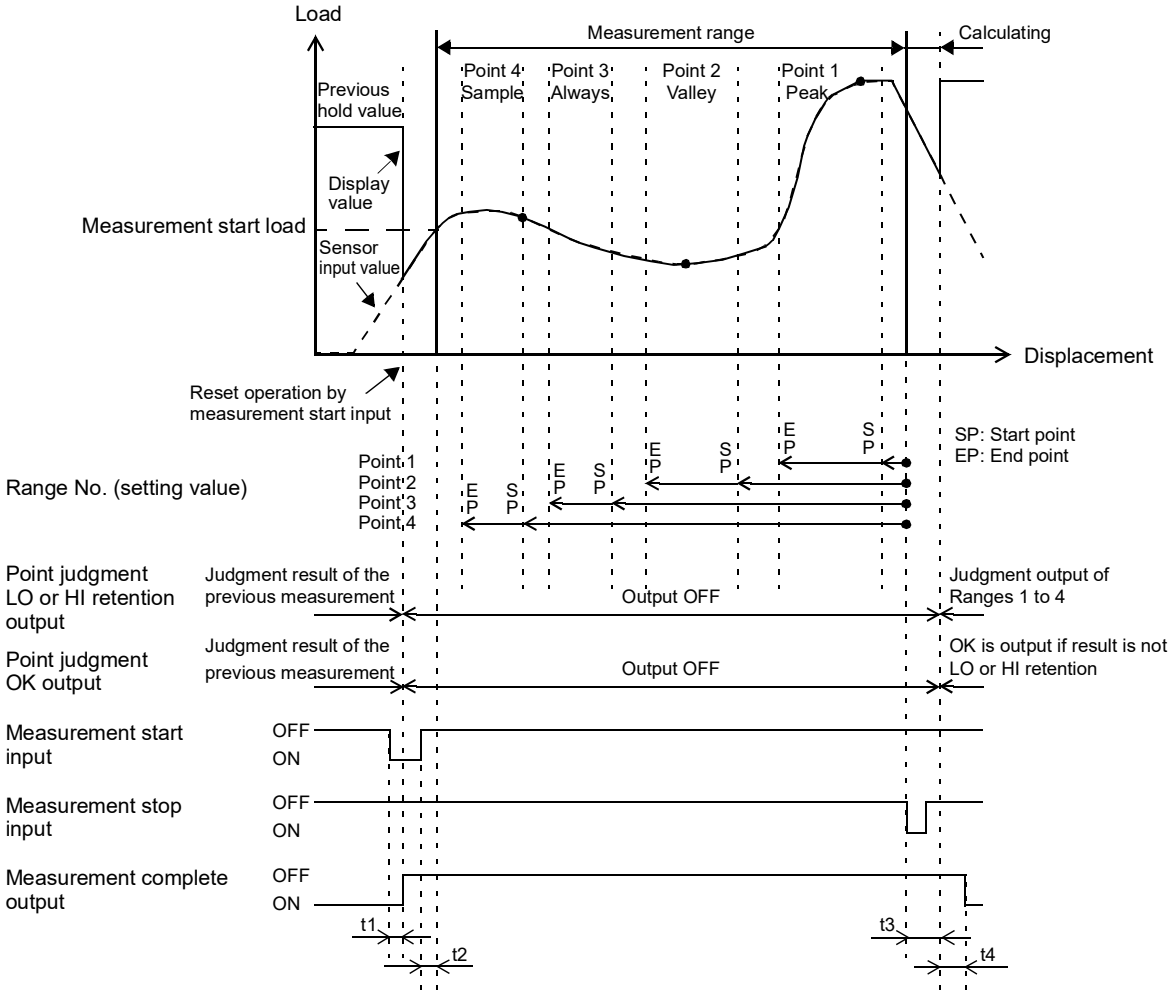
t4: Delay time from when judgment output turns ON to when measurement complete output turns ON ... Approx. 5ms

- Specify the start point and end point of the detection range using time or displacement.
- During measurement, each hold operation is performed within the set detection range.
- When "measurement start" of the external input signal is turned from OFF → ON, hold is released and all output is turned OFF except for CPU normal operation, load, timing output 1, 2, and overload. (Reset operation by measurement start input.)
- When always or sample is specified for the point detection, the judgment (except for OK) is output from the beginning of the detection range. If something other than these is specified, judgment will not be output until the end of the range, but judgments (except for OK) for points for which judgment is complete will be output.
- Once the judgment becomes LO or HI, that output is maintained.
- The OK signal will be output upon completion of measurement, when it has been confirmed that judgment has been made at all points and the results are not HI or LO.
  OK will not result if judgment is not performed for the full hold points.

  Example 1: Failure in point detection when rel. max, rel. min, or inflect. is used.

  Example 2: When the HOLD inputs corresponding to the full hold points to be used that was specified for the hold points have not all turned ON.
- "Measurement complete" will turn ON when "measurement stop" is turned from OFF to ON, or when 2048 pieces of data have been acquired.
- When the X-axis represents displacement, the rel. max, rel. min, inflect., and average are judged upon completion of measurement.

- Internal setting control (Only when reference is set to end)



t1: Delay time from when measurement start input is turned ON to when output other than CPU normal operation turns OFF... Approx. 3 ms

t2: Delay time from when measurement start input is turned OFF to when the measurable range starts varies depending on the time taken until the measurement start load is crossed.

t3: Delay time from when measurement stops (when measurement stop input is turned ON) to when judgment output turns ON ... Approx. 50 ms
(However, delay time differs depending on the measurement.)

t4: Delay time from when judgment output turns ON to when measurement complete output turns ON ... Approx. 5ms

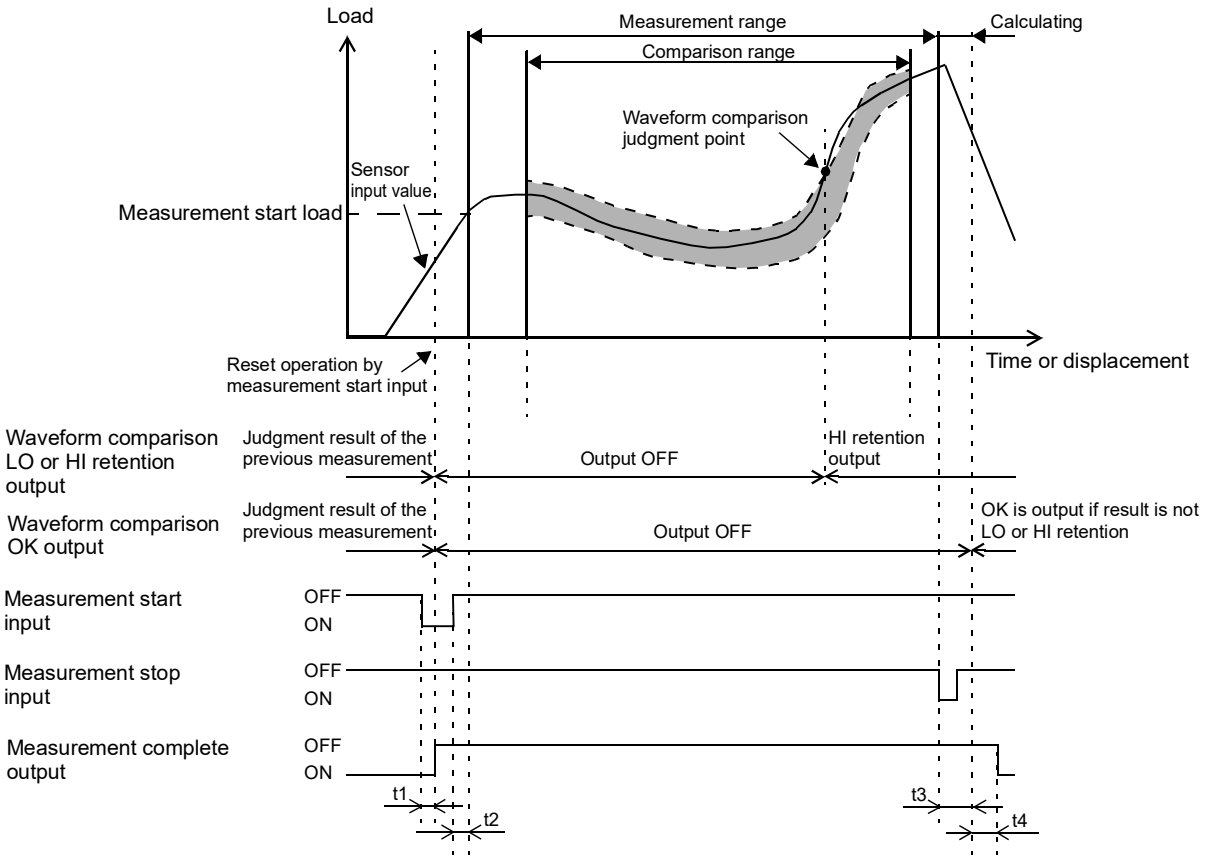
- Specify the start point and end point of the range using time or displacement.
- After measurement stops, the waveform is scanned from the front, and each point detection is performed in the set detection range.
- When "measurement start" of the external input signal is turned from OFF → ON, hold is released and all output is turned OFF except for CPU normal operation, load, timing output 1, 2, and overload. (Reset operation by measurement start input.)
- "Measurement complete" will turn ON when "measurement stop" is turned from OFF to ON, or when 2048 pieces of data have been acquired.
- All judgment results are output after measurement stops.
- The OK signal will be output upon completion of measurement, when it has been confirmed that judgment has been made at all points and the results are not HI or LO.
  OK will not result if judgment is not performed for the full hold points.

  Example 1: Failure in point detection when rel. max, rel. min, or inflect. is used.

  Example 2: When the HOLD inputs corresponding to the full hold points to be used that was specified for the hold points have not all turned ON.

4-2. Example timing chart for waveform comparison

- When reference is set to front (When waveform relative comparison is unused)



t1: Delay time from when measurement start input is turned ON to when output other than CPU normal operation turns OFF... Approx. 3 ms

t2: Delay time from when measurement start input is turned OFF to when the measurable range starts varies depending on the time taken until the measurement start load is crossed.

t3: Delay time from when measurement stops (when measurement stop input is turned ON) to when judgment output turns ON ... Approx. 50 ms
(However, delay time differs depending on the measurement.)

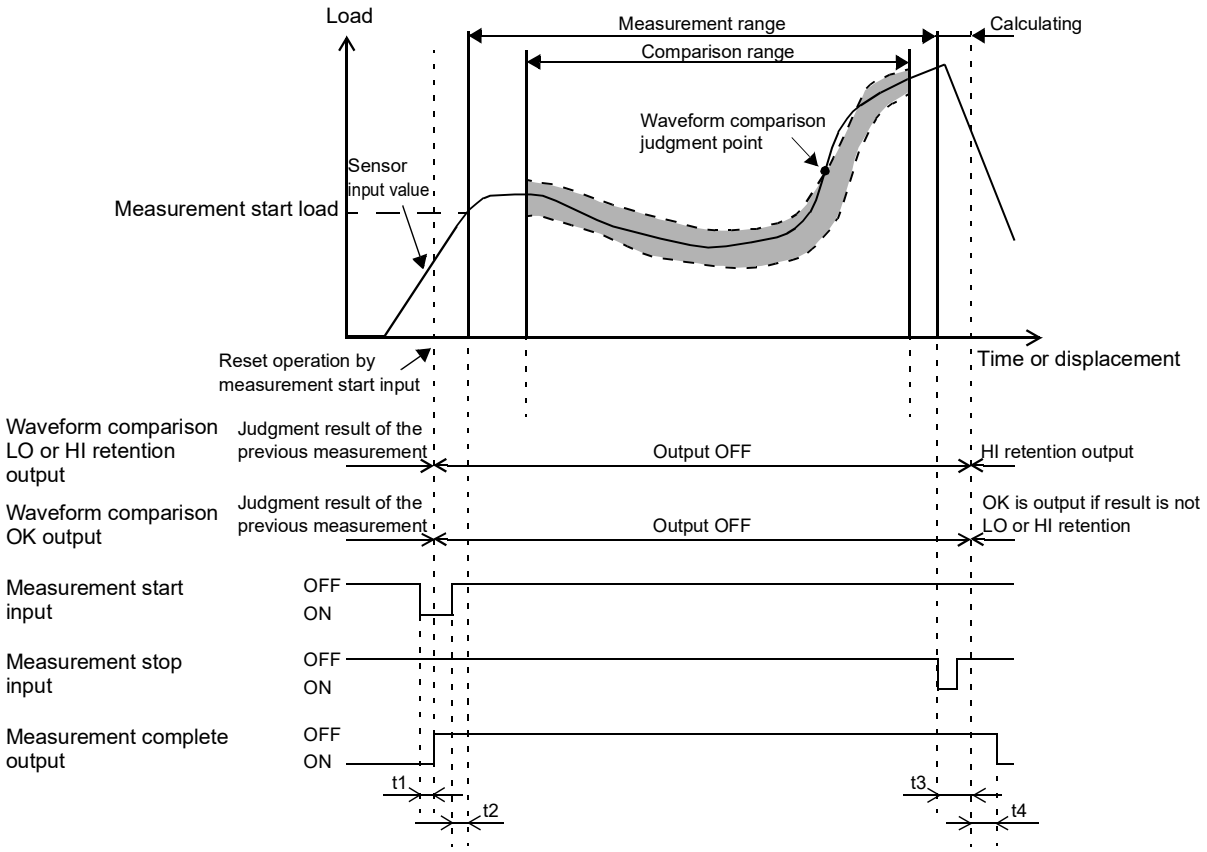
t4: Delay time from when judgment output turns ON to when measurement complete output turns ON ... Approx. 5ms

- When "measurement start" of the external input signal is turned from OFF → ON, hold is released and all output is turned OFF except for CPU normal operation. (Reset operation by measurement start input.)
- "Measurement complete" will turn ON when "measurement stop" is turned from OFF to ON, or when 2048 pieces of data have been acquired.
- Once the judgment becomes LO or HI, that output is maintained.
- OK turns ON when the comparison range is passed through during measurement and the judgment result is not LO retention or HI retention after measurement stops.

Key points

If measurement does not reach the comparison range, all comparison waveform judgment outputs turn OFF.

- When reference is set to end or when waveform relative comparison is used



t1: Delay time from when measurement start input is turned ON to when output other than CPU normal operation turns OFF... Approx. 3 ms

t2: Delay time from when measurement start input is turned OFF to when the measurable range starts varies depending on the time taken until the measurement start load is crossed.

t3: Delay time from when measurement stops (when measurement stop input is turned ON) to when judgment output turns ON ... Approx. 50 ms
(However, delay time differs depending on the measurement.)

t4: Delay time from when judgment output turns ON to when measurement complete output turns ON ... Approx. 5ms

- When "measurement start" of the external input signal is turned from OFF → ON, hold is released and all output is turned OFF except for CPU normal operation. (Reset operation by measurement start input.)
- "Measurement complete" will turn ON when "measurement stop" is turned from OFF to ON, or when 2048 pieces of data have been acquired.
- After measurement stops, the waveform is scanned and judged from the front, and HI retention or LO retention or OK will turn ON.
- OK turns ON when the comparison range is passed through during measurement and the judgment result is not LO retention or HI retention after measurement stops.

Key points

- If measurement does not reach the comparison range, all comparison waveform judgment outputs turn OFF.
- When waveform relative comparison is used, a judgment is not made if measurement does not reach the reference point.
(All waveform comparison judgment output OFF)

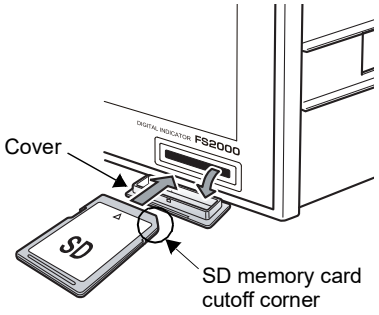
5 SD memory card

5-1. SD memory card outline

- Setting values and comparison waveform data can be saved to an SD memory card.
- Settings can be restored by reading the setting values and comparison waveform data saved on the SD memory card.
- Measured waveform data and judgment point data can be automatically saved to the SD memory card upon measurement completion.
- A wave No. can be set for each waveform.
- The screen can be saved in bitmap format.

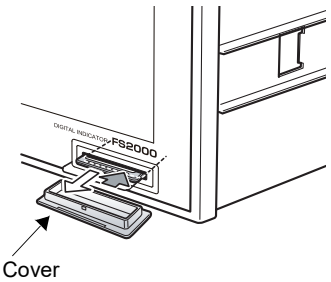
■ SD memory card insertion

1. Open the SD memory card slot cover.
2. Take note of the cutoff corner of the SD memory card, and insert as shown in the diagram on the right.
3. Push it in until it clicks.
4. Close the SD memory card slot cover.



■ SD memory card ejection

1. Check that the SD memory card is not processing by looking at the power lamp. (High speed flashing means it is processing.)
2. Open the SD memory card slot cover of the main unit.
3. Push the SD memory card in, then release it.
   There will be a clicking sound, and the SD memory card will pop out slightly.
4. Remove the SD memory card by taking hold of it and drawing it out.
5. Close the SD memory card slot cover.



⚠ Caution

Be sure to use the included SD memory card. Data may not be read or written properly if a card other than the one provided is used.

5-2. Formatting the SD memory card

Format the SD memory card when it is going to be used for the first time.

Operation

Main screen → Set → First Setting → SD Card → Format▼

To format, press OK.

The formatting confirmation screen will appear.

Press YES to format, and press NO if you do not want to.

⚠ Caution

- Be sure to format the SD memory card using FS2000 or the dedicated formatting software. Formatting it in any other way will mean writing measured waveforms in an average of approximately 1 s will no longer be possible, because the SD memory card processing speed will become slower owing to having an inappropriate format for the FS2000.
  In such cases, reformat it using the FS2000 before use.
- It takes longer than formatting on a PC. (Approx. 1mins. with 16GB)
- When data is being saved or read or when the SD memory card is being formatted, a warning is displayed across the screen, and you must never eject the SD memory card or turn the power OFF. In addition, measurement cannot be started.

5-3. Measured waveform auto recording

This setting is used to save the current measured waveform data and judgment point data to the SD memory card automatically upon measurement complete.

Setting range

OFF	
ON (Overwrite):	When the SD memory card is full, the oldest file is erased and the current waveform is saved.
ON (No Overwrite):	When the SD memory card is full, nothing is overwritten.

Operation

Main screen → Set → First Setting → SD Card → Auto Recording▼

When it is set to "ON", SD will change to Auto, and the data will be written to the SD memory card when measurement is complete.

SD turns red there is an error.

⚠ Caution

After the power is turned on, until checking the measured data file on the SD memory card ends*, writing to the SD memory card by measured waveform auto recording cannot be performed. Also be aware that the larger the capacity of the SD memory card is, the longer this operation will take. (Approx. 10 mins. with 16GB)

(*) The LED at the bottom-left of the front panel is fast flashing, or SD memory card OK signal is OFF

Key points

- It takes about 1 s on average to write a measured waveform. (It will vary depending on the conditions.)
- When auto recording is set to [ON (Overwrite)] and the SD memory card is full, a waveform is saved by overwriting the oldest file, so in such cases, writing may take a few seconds.
- When auto recording is [ON], “load parameter”, “save parameter” and “format” can not be performed during a measurement.
- Approximately 80 waveforms can be stored in 1 MB.
- Although measurement can be performed while writing a waveform to the SD memory card, if the writing of the previously measured waveform is not complete when measurement stops, the next measurement will not be able to start until the writing of the previous measured waveform is complete. (The SD OK signal turns OFF. It recovers when measurement is started in a state where waveforms are saved in time.)

5-4. Load parameter

Setting values are read from the SD memory card.

Setting range
Partial: The specific settings for FS2000 remain, but all the other setting values are restored.
All parameters: The specific settings for FS2000 do not remain, and all setting values are restored.

(Device-specific settings are setting values marked with a *1 in "11.List of setting items" on p.113.)

Operation

Main screen → Set → First Setting → SD Card → Load Parameter▼

Reading starts when OK is pressed.

5-5. Save parameter

Setting values are saved to the SD memory card.

Operation

Main screen → Set → First Setting → SD Card → Save Parameter▼

To save, press OK. Saving starts. The processing screen will appear.

Files created on the SD memory card

When waveforms and setting values are saved, the following files are created on the SD memory card.

FS20SETT.200 (Setting values other than comparison waveforms)
FS20COMP.200 (Comparison waveforms)
] All setting values

FS20D***.200 (Measured waveforms) (***: 000 to 199)

Measured waveform data are written to these files sequentially.

When the capacity of the file to which data is written exceeds the prescribed file size*, measured waveform data are written to a new file.

* The file size changes in accordance with the capacity of the card.

SD1G, SD2G:	About 10 MB (about 820 waveforms)
SD16G:	About 80 MB (about 6500 waveforms)
SD32G:	About 160 MB (about 13000 waveforms)

FS20B***.bmp (Screen save data) (***: 001 to 999)

Key points

FS20SETT.200, FS20COMP.200, and FS20D***.200 are UNIPULSE's own original data.
A dedicated piece of PC software, "FILE CONVERTER", is required to convert them into CSV files.
Please download it from our company website.

5-6. Releasing an error

This function releases an error when it is displayed.

When an error is displayed, the release screen will appear if you press SD (Auto during auto recording).

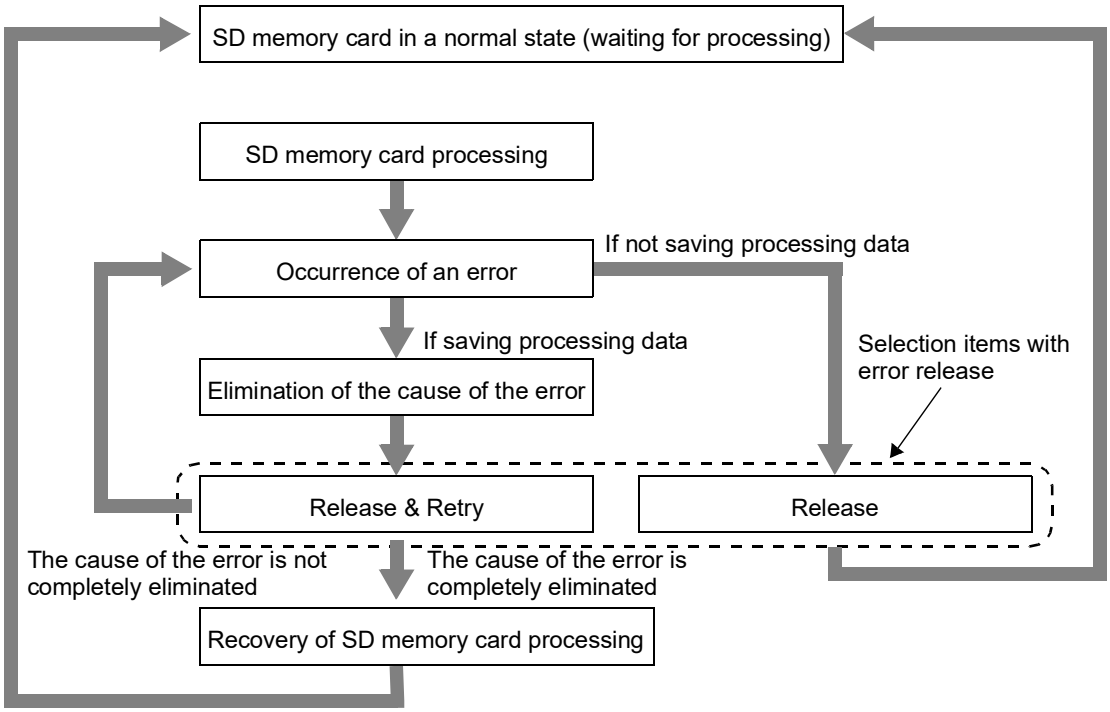
No SD memory card processing can be performed until the displayed error is released.

Also, an SD memory card error cannot be released by pressing Clear on the main screen.

Release & Retry: When an error is released during waveform automatic save, processing resumes if the SD memory card is in a normal state.

Release: When an error occurs during auto recording, the data that were about to be written to the current SD memory card will be discarded to release the error.

- SD memory card error release flow during waveform auto recording



Key points

The processing data can also be discarded to release the error by turning the power OFF and then ON again, or by setting auto recording to OFF.

■ Error messages

Error	Description
Error 01	No SD memory card has been set in the main unit. Check again to see if an SD memory card is in the SD memory card slot, or if it is inserted properly.
Error 02	Initialization error. Initialization of the SD memory card was unsuccessful. Release the error, and format the SD memory card again.
Error 03	The format is incompatible. The FS2000 format is FAT16 (for SD1G and SD2G) and FAT32 (for SD16G and SD32G).
Error 04	Not ready for SD memory card processing.
Error 21	A system error is occurred when FS2000 writes measured data in SD card. (This error may occur when turning FS2000 off during writing or when SD card is replaced.) Please remove the measured waveform file(FS20D***.200) by "SD card format" or the like.
Error 33	The SD memory card is write-protected.
Error 88	There is no file that can be read by the FS2000.
Error 8B	This error is displayed when the number of files on the SD memory card is about to exceed its capacity.
Error 8C	Data cannot be saved because there is no free space on the SD memory card.
Error 91	The data file is read-only.
Error BS	This error is displayed when a measured waveform is not written in time and the measurement start input OFF → ON is ignored. It recovers when measurement is started with the error released or when waveform is saved in time.
Other Errors	Errors with indefinite causes. The cause may be noise or SD memory card failure. If it happens frequently, the working environment must be reviewed.

5-7. Setting wave No. for measured waveforms

Setting wave No. makes it possible to manage the waveforms saved on the SD memory card by means of numbers.
Set the wave No. through communication (USB, DeviceNet, CC-Link, EtherNet/IP, Ethernet). (Refer to "7.USB interface" on p.83 for the setting method.)
The wave No. of a measured waveform can be confirmed on the result screen.

Operation

Main screen → Main

5-8. Saving the screen in bitmap format

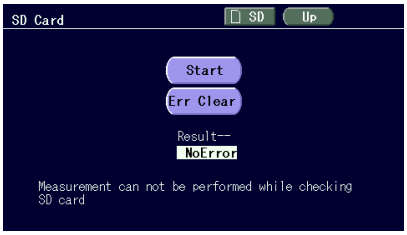
The displayed screen can be saved to the SD memory card by pressing SD .

5-9. SD memory card self-test

Go to the SDC check screen of self-test.

Press Start .

Reading from and writing to the SD memory card are checked.
Press Err Clear if an error is displayed.



Operation

Main screen → Set → Self-Test → SD Card

6 Other settings

This chapter describes settings for using the FS2000 better.

6-1. Settings related to sensors

These settings are related to sensors, and are used to reduce fluctuations in load display, display with an offset added to the zero point, etc.

■ Sample rate

This function changes the rate for referring to sampled data.
Set a fast sample rate when making high-speed measurements.
Set a slow sample rate when stability is required.
Such as a case where low-pass filter requires cut-off frequency lower than 10Hz, when stability is needed in particular, select 5kHz.

Setting range: 25 kHz, 5 kHz

Operation

Main screen → Set → First Setting → Sensor → Sample Rate▼

■ Filter selection

- Low-pass filter

A low-pass filter with the set cut-off frequency is inserted with respect to the input of the load sensor.

Setting range When the sample rate is 25 kHz: 10 to 10000 Hz
When the sample rate is 5 kHz: 2 to 2000 Hz

Operation

Main screen → Set → First Setting → Sensor → Loadcell → Next → Next → ⑦ Low-pass Filter▼

- Moving average filter

A moving average is taken using the number of times load and displacement have been set.

Setting range: 0, 2 to 999 times

Operation

Main screen → Set → First Setting → Sensor → Loadcell → Next → Next → ⑦ Moving Average▼
Main screen → Set → First Setting → Sensor → Displacement → Next → Next → ⑤ Moving Average▼

■ Digital zero limit

This is the limit of the load that can be zeroed. If digital zero is performed with a load that is larger (smaller) than the zero-calibrated load by the set load, it will result in an error and the load will not be zeroed.
By setting a proper threshold, abnormalities on load sensors such as load cells can be found early.

Setting range: 0 to 99999

Operation

Main screen → Set → First Setting → Sensor → Loadcell → Next → Next → Next → ⑧ Zero Limit▼

■ Overload output

Set the load that is to be judged a sensor overload. The load/displacement OK output turns OFF when the load exceeds the set value.
Also, overload output turns ON.

Setting range: 0 to 30000

Operation

Main screen → Set → First Setting → Sensor → Loadcell → Next → Next → Next → ⑨ Overload Output▼

■ Zero offset

This function offsets the load by the set value. Set the load to be offset.

Setting range: -30000 to 30000

Operation

Main screen → Set → First Setting → Sensor → Loadcell → Next → Next → Next → ⑩ Zero Offset▼

■ Initial position

Set the initial position that is to be displayed when the displacement position is returned to the initial position by internal counter reset at power ON or through the main screen operation or external input.

Setting range: -30000 to 30000

Operation

Main screen → Set → First Setting → Sensor → Displacement → Next → Next → ⑥ Initial Position▼

6-2. Settings related to work settings

These settings are related to works, and are used to display a process name for each work, output control timings, etc.

6-2-1. Work name

A name can be registered for each work number.
The work number displayed on the main screen etc. will become the registered name, such as the process name.

Operation

Main screen → Set → Work Setting → Work Name▼

6-2-2. Work copy

A work can be copied onto a different work. Press Copy on the work setting screen. Set the copy source and copy destination.
All setting values of the work setting, including the comparison waveforms, are copied.

Setting range Source: 0 to 15
Copy to: 0 to 15

Operation

Main screen → Set → Work Setting → Copy▼

6-2-3. Timing output

A signal can be output in synchronization with the load or displacement.
(The signal will be output from OUT 1 or OUT 2.)

■ OUT1 condition, OUT2 condition

Select load or displacement.

Setting range: Load, Displacement

Operation

Main screen → Set → Work Setting → Timing Output → OUT1 condition/OUT2 condition▼

■ OUT1 ON (HI/LO), OUT2 ON (HI/LO)

Specify the timing for turning the output ON.

OUT 1 ON: OUT1 ON (LO limit value) ≦ load or displacement ≦ OUT1 ON (HI limit value)
OFF: Load or displacement ＜ OUT1 ON (LO limit value)
Load or displacement ＞ OUT1 ON (HI limit value)
OUT 2 ON: OUT2 ON (LO limit value) ≦ load or displacement ≦ OUT2 ON (HI limit value)
OFF: Load or displacement ＜ OUT2 ON (LO limit value)
Load or displacement ＞ OUT2 ON (HI limit value)

Setting range: -30000 to 30000

Operation

Main screen → Set → Work Setting → Timing Output → OUT1 ON (HI/LO)/OUT2 ON (HI/LO)▼

6-3. User management

These are settings related to user management, such as prohibiting setting operations by users.

■ User authorities

Which users can change settings can be restricted by setting authorities for each user. User authorities can be selected from the following.

Administrator: Changing and registration of all settings, including user registrations, are possible.

Engineer: Changing and registration for all settings except for user registrations are possible.

Operator: Only viewing of settings is possible. Settings cannot be changed or registered.
* The Zero, Start, Clear, and Cursor key operations are possible.

Attention

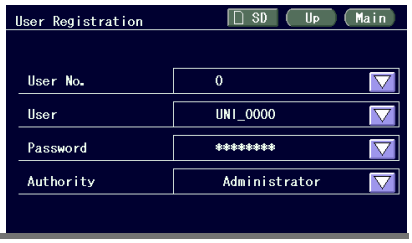
The factory default is a state in which no user restrictions are set.
To manage users, activate user restrictions after registering users.

■ User registration

After entering the user No., user name, password, and authority, press Up or Main.

■ User No.

Specify the user No. to register a user with.



Setting range: 0 to 9

Operation

Main screen → Set → Set. → User No.▼

■ User name

Enter a user name for the user No. being registered.

Setting range: 0 to 9 a to z A to Z -, _ (Maximum 8 characters)

Operation

Main screen → Set → Set. → User (name)▼

■ Password

Enter a password for the user No. being registered.

Setting range: 0 to 9 a to z A to Z -, _ (Maximum 8 characters)

Operation

Main screen → Set → Set. → Password▼

■ Authority

Select the authorities for the user No. being registered.

Setting range: Administrator, Engineer, Operator

Operation

Main screen → Set → Set. → Authority▼

After registering all the users, activate the user restrictions.
* User restrictions can only be changed by a user with administrator authorities.

Key points

User restrictions can be temporarily removed by entering the password below for System - Password.

Derestriction password "6842"

■ User restrictions

This setting activates/deactivates user restrictions.

Setting range: OFF, ON

Operation

Main screen → Set → User Restrictions▼

6-4. First settings

■ Device ID

The FS2000 can be distinguished from other FS2000 units by setting an ID.

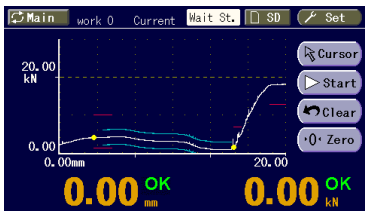
Setting range: 0 to 999

Operation

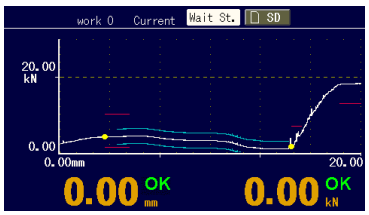
Main screen → Set → First Setting → Device ID▼

■ Operation display

The screen that is displayed when no key operation is performed on the main screen for a certain period of time can be set.



OFF



Waveform

Numeric

OK/NOK

Setting range Standby Screen: OFF, Waveform, Numeric, OK/NOK
Switching Time: 1 to 200 sec

Operation

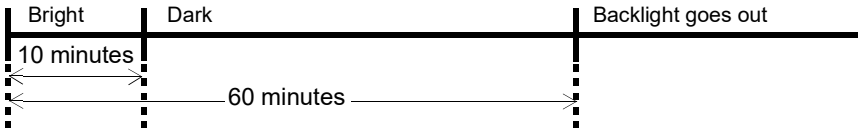
Main screen → Set → First Setting → Standby Screen/Switching Time▼

6-4-1. System settings

■ Backlight

This function changes the brightness of the backlight when no keys have been operated for the set time (minutes). The backlight lighting time and the switching time for the brightness (bright → dark) are set.
Set the ON time to 0 minutes to have the display visible at all times.
Also, to have the backlight always bright, set both the ON time and the Low time to 0 minutes.
When the backlight is OFF or when it is dark, it becomes bright again if the panel is touched.

Example) When the ON time is set to 60 minutes and the low time is set to 10 minutes



Setting range: 0 to 99 minutes (for both ON Time and Low Time)

Operation

Main screen → Set → First Setting → System → Backlight (OFF/Low)▼

■ Language

Select the language.

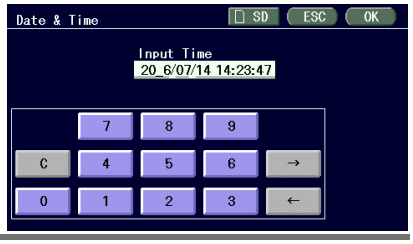
Setting range: Japanese (日), English (英)

Operation

Main screen → Set → First Setting → System → Language▼

■ Date & time

Set the current time displayed on the settings screen.



Setting range:
2000/01/01 00:00:00 to 2099/12/31 23:59:59

Operation

Main screen → Set → First Setting → System → Date & Time▼

1. Press → or ← to make the place you want to set flash.

Each time → or ← is pressed, the place moves from Year → Month → Day → Hours → Minutes → Seconds → Year → ...

2 0 0 0 / 0 1 / 0 1 / 0 1 : 2 3 : 5 5
Year Month Day Hours Minutes Seconds

2. Input numerical values.

Year/Month/Day/Hours/Minutes/Seconds are all input in two digits.

Year:	00 to 79 (last two digits of the year)
Month:	01 to 12
Day:	01 to 31 (The last day changes according to the set month.)
Hours:	00 to 23 (24h display)
Minutes:	00 to 59
Seconds:	00 to 59

3. Press OK .

■ Initialization

Setting values are returned to their factory defaults.

Setting range	First setting:	Setting values of all first setting items other than device specific settings
	Work setting:	Setting values of all work setting items
	All:	First setting + Work setting

(Device-specific are setting values marked with a *1 in "11.List of setting items" on p.113.)

Operation

Main screen → Set → First Setting → System → Initialization▼

■ Password

This setting is for maintenance and inspections.

User restrictions can be temporarily removed by entering the derestriction password "6842" here.

Setting range: 0 to 9999

Operation

Main screen → Set → First Setting → System → Password▼

■ Prohibited mode

Set a valid range for "touch panel operation prohibited" of the external input.

Setting range	All Prohibited:	Prohibits all operations on touch panel.
	Set. Prohibited:	Prohibits any operations relating to settings. Displaying measurement results and trends, and cursor display are allowed.

Operation

Main screen → Set → First Setting → System → Prohibited Mode▼

7 USB interface

7-1. USB interface outline

The USB interface is used to read the indicated values from the FS2000 and to write setting values to the FS2000. This interface is convenient for carrying out processing such as totals and records by connecting the FS2000 to a PC. Furthermore, reading and writing setting values and reading graph data are possible using a dedicated PC application.

- Judgments can be read (Refer to P.92 for the result read command.)
- Point judgment results can be read (Refer to P.90 for the point judgment result read command.)
- Measured waveforms can be read (Refer to P.93 for the waveform read command.)
- Comparison waveforms can be read and written (Refer to P.93 and P.95 for the waveform read command and waveform write command.)
- Setting values can be read and written (Refer to P.86, P.87, and P.88 for the setting value read command and setting value write command.)
- Calibration is possible (Refer to P.89 for calibration commands.)
- Wave No. can be read and written (Refer to P.97 for the wave No. read command and wave No. write command.)
- Point judgment results can be automatically be output when measurement stops (Refer to P.100 for when the communication mode is set to Auto.)
- There is a communication check function (Refer to P.84 for communication establishment procedure.)

■ Communication specifications

Communication standard	USB Ver.2.0 compliant, full speed (12 Mbps)
Class	Communication class
Speed	Select from 9600, 19.2k, 38.4k, 57.6k, 115.2k, 230.4k bps
Bit configuration	Start bit: 1 bit Data bit: Select from 7 or 8 bits Stop bit: Select from 1 or 2 bits Parity bit: Select from None, even, or odd Delimiter during transmission: Select from CR or CR+LF
Code	ASCII
Connector	mini-B TYPE

■ PC operating environment

OS	Windows 10/11
Display	800 x 640 pixel or above
USB port	One free port
USB driver	Virtual COM Port (VCP) Drivers (manufactured by FTDI Limited)

■ USB driver installation

In order to connect to the USB of the FS2000, USB driver must be installed.
For details, refer to the FTDI website, and download and install the driver by following the procedure.

Guide http://www.ftdichip.com/Support/Documents/InstallGuides.htm
Driver http://www.ftdichip.com/Drivers/VCP.htm

■ USB connection

Connect with a USB cable.
The USB connector of the FS2000 is mini-B TYPE.

■ Virtual COM port check

Check the virtual COM port number to which the FS2000 is connected from the Device Manager of the PC.

7-2. Communication establishment procedure

1. Connect the cable.

2. Adjust the communication settings to suit the connected device.
- Speed - Data bit - Stop bit
- Parity bit - Delimiter

3. Go to the USB screen of self-test.
Main screen → Set → Self-Test → USB

4. Transmit a statement from the connected device.
The data received by the FS2000 is displayed.
Confirm that the transmitted data is displayed.
If parity bit or frame lights up red and the data is not displayed properly, go back to step (1) or (2), and check the cable and communication settings again.

5. Press the Send key.
Pressing the Send key transmits a statement with the same content as the display reading.
Confirm that the connected device can receive properly.
If not, go back to step (1) or (2), and check the status of the cable and communication settings again. Also, check that COM port number is displayed correctly on Device Manager, and FTDI is set as the driver.

7-3. USB settings

These settings are for USB communication.

■ Speed

Setting range: 9600 bps, 19.2k bps, 38.4k bps, 57.6k bps, 115.2k bps, 230.4k bps

Operation

Main screen → Set → First Setting → USB → Speed▼

■ Data bit

Setting range: 7 bit, 8 bit

Operation

Main screen → Set → First Setting → USB → Data Bit▼

■ Stop bit

Setting range: 1 bit, 2 bit

Operation

Main screen → Set → First Setting → USB → Stop Bit▼

■ Parity bit

Setting range: NONE, EVEN, ODD

Operation

Main screen → Set → First Setting → USB → Parity Bit▼

■ Delimiter

Setting range: CR, CR+LF

Operation

Main screen → Set → First Setting → USB → Delimiter▼

■ Communication mode

Select whether to communicate by giving commands (command) or to output judgment points automatically when measurement stops (auto).

Setting range: Command, Auto

Operation

Main screen → Set → First Setting → USB → Communicat. mode▼

7-4. Communication method

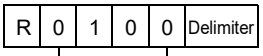
By transmitting commands from the host, the operations corresponding to the commands are performed.

(When the communication mode is set to command, commands are not accepted by auto.)

● Setting value read command (First setting)

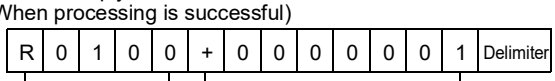
Example: First setting Reading the excitation voltage of the loadcell

Host
(Transmission to the FS2000)



Setting value (Excitation voltage in the example)
Transmit the setting value number in ASCII code with the 10^3 digit at the front.
* Refer to "11.List of setting items" on p.113 for setting value numbers.

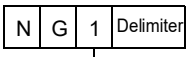
FS2000's reply
(When processing is successful)



Data of the specified setting value
The setting value data will be transmitted in ASCII code with the 10^6 digit at the front (with +, -).

Command received by the FS2000

FS2000's reply
(When there is an error)



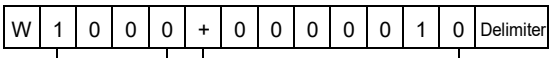
NOK No.
1: Received a statement that was different from the command format.

● Setting value read command (Work setting)

Example: Work setting Reading the Y start point within the display range of work No. 10

(1) Writing "10" to the work No.

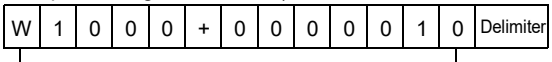
Host
(Transmission to the FS2000)



Data to write
(The number of pieces of data varies depending on the setting value.)
Transmit the data to write in ASCII code with the 10^6 digit at the front (with +, -).

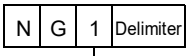
Setting value (Work No. in the example)
Transmit the setting value number in ASCII code with the 10^3 digit at the front.
* Refer to "11.List of setting items" on p.113 for setting value numbers.

FS2000's reply
(When processing is successful)



Command received by the FS2000

FS2000's reply
(When there is an error)



NOK No.
1: Received a statement that was different from the command format.
2: Attempted to write a setting value that was outside the setting range.
4: Attempted to write a setting value through communication during measurement.

(2) Reading the Y start point after the work No. has been written successfully.

Host
(Transmission to the FS2000)

R	1	2	0	0	Delimiter

Setting value (Y start point in the example)
Transmit the setting value number in ASCII code with the 10^3 digit at the front.
* Refer to "11.List of setting items" on p.113 for setting value numbers.

FS2000's reply
(When processing is successful)

R	1	2	0	0	+	0	0	0	1	0	0	0	Delimiter

Data of the specified setting value
The setting value data will be transmitted in ASCII code with the 10^6 digit at the front (with +, -).
Command received by the FS2000

FS2000's reply
(When there is an error)

N	G	1	Delimiter

NOK No.
1: Received a statement that was different from the command format.

● Setting value write command (First setting)

Example: First setting Writing 1:5[V] to the excitation voltage of the loadcell

Host
(Transmission to the FS2000)

W	0	1	0	0	+	0	0	0	0	0	0	1	Delimiter

Data to write ("1" in the example)
Transmit the data to write in ASCII code with the 10^6 digit at the front (with +, -).
Setting value (Excitation voltage in the example)
Transmit the setting value number in ASCII code with the 10^3 digit at the front.
* Refer to "11.List of setting items" on p.113 for setting value numbers.

FS2000's reply
(When processing is successful)

W	0	1	0	0	+	0	0	0	0	0	0	1	Delimiter

Command received by the FS2000

FS2000's reply
(When there is an error)

N	G	1	Delimiter

NOK No.
1: Received a statement that was different from the command format.
2: Attempted to write a setting value that was outside the setting range.
4: Attempted to write a setting value through communication during measurement.

● Setting value write command (Work setting)

Example: Work setting Writing "1000" to the Y start point within the display range of work No. 10

(1) Writing "10" to the work No.

Host
(Transmission to the FS2000)

W	1	0	0	0	+	0	0	0	0	0	1	0	Delimiter

Data to write ("10" in the example)
Transmit the data to write in ASCII code with the 10^6 digit at the front (with +, -).

Setting value (Work No. in the example)
Transmit the setting value number in ASCII code with the 10^3 digit at the front.
* Refer to "11.List of setting items" on p.113 for setting value numbers.

FS2000's reply
(When processing is successful)

W	1	0	0	0	+	0	0	0	0	0	1	0	Delimiter

Command received by the FS2000

FS2000's reply
(When there is an error)

N	G	1	Delimiter

NOK No.
1: Received a statement that was different from the command format.
2: Attempted to write a setting value that was outside the setting range.
4: Attempted to write a setting value through communication during measurement.

(2) Writing "1000" to the Y start point after the work No. has been written successfully.

Host
(Transmission to the FS2000)

W	1	2	0	0	+	0	0	0	1	0	0	0	Delimiter

Data to write ("1000" in the example)
Transmit the data to write in ASCII code with the 10^6 digit at the front (with +, -).

Setting value (Y start point in the example)
Transmit the setting value number in ASCII code with the 10^3 digit at the front.
* Refer to "11.List of setting items" on p.113 for setting value numbers.

FS2000's reply
(When processing is successful)

W	1	2	0	0	+	0	0	0	1	0	0	0	Delimiter

Command received by the FS2000

FS2000's reply
(When there is an error)

N	G	1	Delimiter

NOK No.
1: Received a statement that was different from the command format.
2: Attempted to write a setting value that was outside the setting range.
4: Attempted to write a setting value through communication during measurement.

● Zero Calibration command

Example: Performing zero calibration (load)

Host
(Transmission to the FS2000)

C	0	1	0	0	Delimiter

Setting value (Load cell calibration in the example)

For displacement sensor calibration

C	0	2	0	0	Delimiter

FS2000's reply
(When processing is successful)

C	0	1	0	0	Delimiter

Command received by the FS2000

FS2000's reply
(When there is an error)

N	G	1	Delimiter

NOK No.

1: Received a statement that was different from the command format.
2: Attempted to write a setting value that was outside the setting range.
3: Attempted to perform calibration with the actual load outside the calibration range.
4: Attempted to write a setting value through communication during measurement.

● Actual load calibration command

Example: Performing actual load calibration (load)

Host
(Transmission to the FS2000)

C	0	1	0	1	+	0	0	0	1	0	0	0	Delimiter

Value of applied load ("1000" in the example)

Setting value (Load cell calibration in the example)

For displacement sensor calibration

C	0	2	0	1	±	0	0	10^4	10^3	10^2	10^1	10^0	Delimiter

FS2000's reply
(When processing is successful)

C	0	1	0	1	+	0	0	0	1	0	0	0	Delimiter

Command received by the FS2000

FS2000's reply
(When there is an error)

N	G	1	Delimiter

NOK No.

1: Received a statement that was different from the command format.
2: Attempted to write a setting value that was outside the setting range.
3: Attempted to perform calibration with the actual load outside the calibration range.
4: Attempted to write a setting value through communication during measurement.

● Point judgment result read command

Example: Reading the point judgment results for Point 1 to 3

(1) Confirm that measurement has finished.

If "1" is read for waveform update, go to step (2), and if "1" is not read, repeat step (1).

(Leave an interval of 100 ms or more when transmitting SAMPLE commands consecutively.)

Host
(Transmission to the FS2000)

S	A	M	P	L	E	Delimiter

FS2000's reply
(When processing is successful)

S	A	M	P	L	E	1	1	3	8	1	5	0	Delimiter

- Undefined
- Device ID
  * Device ID is a setting value.
- Work No. used for measurement
- Waveform update
  0: Not made
  1: Made
  (If an update is made, this bit changes from 0 to 1 only once upon reading.)

FS2000's reply
(When there is an error)

N	G	1	Delimiter

- NOK No.
  1: Received a statement that was different from the command format.

(2) Reading point judgment results.

Host
(Transmission to the FS2000)

H	L	D	SP	1	-	3	Delimiter

- Last point number to be read (1 to 5)
  1 to 5: Range
  Specify in such a way that the end ≧ start.
- Hyphen (2dH)
- First point number to be read (1 to 5)
  1 to 5: Range
  If the start of the range = end of the range, only the specified range can be read.
- Space (20H)

FS2000's reply
(When processing is successful)

H	L	D	SP	1	-	3	,

Command received by the FS2000

Data of the specified start of the range

-	0	0	.	1	0	0	,	1	,	-	0	1	.	0	2	2	,	2	,

Load
-30000 to +30000
(with a decimal point)

Load judgment
-: Range unused
1: OK
2: HI
3: LO
4: H/L
5: NOK

Displacement or time*

Displacement judgment
-: Range unused
or X-axis is time
1: OK
2: HI
3: LO
4: H/L
5: NOK

*

Displacement (front): 0 to 10235 (with a decimal point)
Displacement (end): -10235 to 0 (with a decimal point)
Time: +00000 to +16376 (with a decimal point)
The unit for time vary according to the measure length.

80 ms:	Unit ms	2 s:	Unit s
160 ms:	Unit ms	4 s:	Unit s
400 ms:	Unit ms	10:	Unit s
800 ms:	Unit ms	20 s:	Unit s
		40 s:	Unit s
		100 s:	Unit s

2nd data

-	0	0	.	2	0	0	,	2	,	-	0	5	.	0	1	2	,	2	,

3rd data

-	-	-	-	-	-	-	-	,	-	,	-	-	-	-	-	-	-	,	-	,	Delimiter

Hyphens (2dH) are inserted into load and displacement (time) if there is no hold point in the specified range, and also if the specified range is set to always.

FS2000's reply
(When there is an error)

N	G	1	Delimiter

NOK No.
1: Received a statement that was different from the command format.
2: Attempted to write a setting value that was outside the setting range.

● Result read command

(1) Confirm that measurement has finished.

If "1" is read to waveform update, go to step (2), and if "1" is not read, repeat step (1).

(Leave an interval of 100 ms or more when transmitting SAMPLE commands consecutively.)

Host
(Transmission to the FS2000)

S	A	M	P	L	E	Delimiter

FS2000's reply
(When processing is successful)

S	A	M	P	L	E	1	1	3	8	1	5	0	Delimiter

- Undefined
- Device ID
  * Device ID is a setting value.
- Work No. used for measurement
- Waveform update
  0: Not made
  1: Made
  (If an update is made, this bit changes from 0 to 1 only once upon reading.)

FS2000's reply
(When there is an error)

N	G	1	Delimiter

- NOK No.
  1: Received a statement that was different from the command format.

(2) Reading the measurement results.

Host
(Transmission to the FS2000)

R	E	S	U	L	T	Delimiter

FS2000's reply
(When processing is successful)

R	E	S	U	L	T	4	4	,	1	3	,	2	4	,	3	1	,

Load | Displacement | Load | Displacement | Load | Displacement | Load | Displacement

- Command received by the FS2000
- Total result
- Point 1 Judgment
- Point 2 Judgment
- Point 3 Judgment

3	3	,	1	3	,	2	4	Delimiter

Load | Displacement | Load | Displacement | Load | Displacement

- Point 4 Judgment
- Point 5 Judgment
- Waveform comparison Judgment

Load judgment
-: Range unused
1: OK
2: HI
3: LO
4: H/L
5: NOK

Displacement judgment
-: Range unused or X-axis is time
1: OK
2: HI
3: LO
4: H/L
5: NOK

FS2000's reply
(When there is an error)

N	G	1	Delimiter

- NOK No.
  1: Received a statement that was different from the command format.

● Waveform update check/device ID read command

Host
(Transmission to the FS2000)

S	A	M	P	L	E	Delimiter

FS2000's reply
(When processing is successful)

S	A	M	P	L	E	1	1	3	8	1	5	0	Delimiter

- Undefined
- Device ID
  * Device ID is a setting value.
- Work No. used for measurement
- Waveform update
  0: Not made
  1: Made
  (If an update is made, this bit changes from 0 to 1 only once upon reading.)

FS2000's reply
(When there is an error)

N	G	1	Delimiter

- NOK No.
  1: Received a statement that was different from the command format.

● Waveform read command

Example: Reading a measured waveform

(1) Confirm that measurement has finished.
If "1" is read to waveform update, go to step (2), and if "1" is not read, repeat step (1).
(Leave an interval of 100 ms or more when transmitting SAMPLE commands consecutively.)

Host
(Transmission to the FS2000)

S	A	M	P	L	E	Delimiter

FS2000's reply
(When processing is successful)

S	A	M	P	L	E	1	1	3	8	1	5	0	Delimiter

- Undefined
- Device ID
  * Device ID is a setting value.
- Work No. used for measurement
- Waveform update
  0: Not made
  1: Made
  (If an update is made, this bit changes from 0 to 1 only once upon reading.)

FS2000's reply
(When there is an error)

N	G	1	Delimiter

- NOK No.
  1: Received a statement that was different from the command format.

(2) Reading the measurement range.

Host
(Transmission to the FS2000)

W	A	V	Delimiter

FS2000's reply
(When processing is successful)

W	A	V	SP	0	0	0	0	-	2	0	4	7	Delimiter

- Start of range (Data No.)
  When the X-axis is
  Front: Fixed at 0000
  End: 0000 to 2047
- End of range (Data No.)
  When the X-axis is
  Front: 0000 to 2047
  End: Fixed at 2047
- Hyphen (2dH)
- Space (20H)
- Command received by the FS2000

FS2000's reply
(When there is an error)

N	G	1	Delimiter

- NOK No.
  1: Received a statement that was different from the command format.

(3) Reading the measured waveform.

Host
(Transmission to the FS2000)

W	A	V	0	0	SP	0	0	0	0	-	2	0	4	7	Delimiter

- Start of range (Data No.) 0000 to 2047
- End of range (Data No.) 0000 to 2047
  If the start of the range = the end of the range, only the specified point can be read.
- Hyphen (2dH)
- Space (20H)
- Load or displacement (time) selection
  0: Load
  1: Displacement (time)
- Waveform selection
  0: Measured waveform (reading only)
  1: Comparison waveform (HI limit)
  2: Comparison waveform (LO limit)
  3: Comparison waveform used for measurement (HI limit)
  4: Comparison waveform used for measurement (LO limit)
  * 3 and 4 are irrelevant to the work No. for the USB.

FS2000's reply
(When processing is successful)

W	A	V	0	0	SP	0	0	0	0	-	2	0	4	7

Command received by the FS2000

-	0	1	.	0	0	0	-	0	0	.	9	8	7	- - -	+	0	1	.	2	9	9

Waveform data at the start of the range — 2nd — Waveform data at the end of the range

Waveform data

Number of pieces of data: Data for the specified range
"the end of the range - the start of the range + 1"
2048 pieces of data in the example (2048 x 7 byte)
* If the same data number is specified for the start and end of the range, only 1 piece of data is read.

0: Load: -30000 to +30000 (with a decimal point)

1: Displacement (front): 0 to 10235 (with a decimal point)

Displacement (end): -10235 to 0 (with a decimal point)

Time: +00000 to +16376 (with a decimal point)
The unit for time vary according to the measure length.

80 ms:	Unit ms	2 s:	Unit s
160 ms:	Unit ms	4 s:	Unit s
400 ms:	Unit ms	10:	Unit s
800 ms:	Unit ms	20 s:	Unit s
		40 s:	Unit s
		100 s:	Unit s

S	U	M	=	1	0	E	4	Delimiter

Checksum of the waveform data

All the read waveform data is totaled, ignoring the decimal points, and the two lower-order bytes of the result are expressed as a 4-digit hexadecimal.

Example: Checksum of three pieces of waveform data

-01.00	+ (+31.25)	+ (+12.99)	=
-0100	+ (+3125)	+ (+1299)	= 4324 = 10E4H

FS2000's reply
(When there is an error)

N	G	1	Delimiter

NOK No.
1: Received a statement that was different from the command format.
2: Attempted to write a setting value that was outside the setting range.

● Waveform write command

Example: Writing to the comparison waveform (LO limit) of work No. 3

(1) Writing "3" to the work No.

Host
(Transmission to the FS2000)

W	1	0	0	0	+	0	0	0	0	0	3	Delimiter

Data to write
"3" in the example

Setting value (Refer to the list of setting value commands.)
Work No. in the example

FS2000's reply
(When processing is successful)

W	1	0	0	0	+	0	0	0	0	0	3	Delimiter

Command received by the FS2000

FS2000's reply
(When there is an error)

N	G	1	Delimiter

NOK No.
1: Received a statement that was different from the command format.
2: Attempted to write a setting value that was outside the setting range.
4: Attempted to write a setting value through communication during measurement.

(2) Writing comparison waveform (LO limit)

Host
(Transmission to the FS2000)

W	A	V	2	0	SP	0	0	0	0	-	+	0	0	1	.	3	3	Delimiter

Data No. specification
0000 to 2047

Load data
-30000 to +30000
The decimal place should be the same as that of load calibration.
If they are different, the decimal point is ignored.
Example) If +23.42 is specified when the decimal place is 0.000,
it will be handled as +2.342.

Hyphen (2dH)
Space (20H)
Fixed at 0
Waveform selection
1: Comparison wave form (HI limit)
2: Comparison wave form (LO limit)

FS2000's reply
(When processing is successful)

W	A	V	2	0	SP	0	0	0	0	-	+	0	0	1	.	3	3	Delimiter

Command received by the FS2000

Host
(Transmission to the FS2000)

W	A	V	2	0	SP	0	0	0	1	-	+	0	0	1	.	7	2	Delimiter

To change all of the waveform data, repeat the process for 2047 pieces of data by adding "1" to the data No. after confirming that processing was successful (after confirming the reply for when processing is successful).
To modify part of a waveform, specify the desired data number, and repeat until all the desired data has been changed.

FS2000's reply
(When there is an error)

N	G	1	Delimiter

NOK No.
1: Received a statement that was different from the command format.
2: Attempted to write a setting value that was outside the setting range.
4: Attempted to write a setting value through communication during measurement.

● Wave No. read command

Host
(Transmission to the FS2000)

A	Delimiter

FS2000's reply
(When processing is successful)

A	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	Delimiter

Alphanumeric characters and symbols, from 1 to 20 digits
Setting range (20H to 7EH, 80H to FCH)

FS2000's reply
(When there is an error)

N	G	1	Delimiter

NOK No.
1: Received a statement that was different from the command format.

● Wave No. write command

Host
(Transmission to the FS2000)

A	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	Delimiter

Alphanumeric characters and symbols, from 1 to 20 digits
Setting range (20H to 7EH, 80H to FCH)

FS2000's reply
(When processing is successful)

A	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	Delimiter

Command received by the FS2000

FS2000's reply
(When there is an error)

N	G	1	Delimiter

NOK No.
1: Received a statement that was different from the command format.
2: Attempted to write a setting value that was outside the setting range.

* The wave No. is accepted when the measurement start signal is turned from OFF to ON.

● Display read command

Host
(Transmission to the FS2000)

R	A	Delimiter

FS2000's reply
(When processing is successful)

R	A	+	0	3	.	0	0	0	,	1	,

Load data
-30000 to +30000
(with a decimal point)

Load judgment
-: Without judgment
1: OK
2: HI
3: LO
4: H/L
5: NOK

Command received by the FS2000

0	0	0	0	0	0	,	+	1	0	.	1	2	5	,

Load error status*1

Displacement: -30000 to +30000
(with a decimal point)

Time: −−−−−

0	,	0	0	0	0	,	0	5	,	1	Delimiter

Displacement error status*2

Work No.

Displacement judgment
-: X-axis is time
1: OK
2: HI
3: LO
4: H/L
5: NOK

Measurement status
0: Waiting for start
1: Waiting for OFF
2: Waiting for level
3: Measuring
4: Calculating
5: Measurement complete
6: Reset

* 1

0	0	0	0	0	0

Comp. error
0: None 1: Comp. error

Zero limit
0: None 1: Zero limit

OVERLOAD
0: None 1: OVERLOAD

OVER
0: None 1: +OVER 2: -OVER

Sensor error
0: None 1: Sensor + error 2: Sensor - error

Calibration error
0: None 1: Zero error 2: Span error

* 2 (−−−− for time)

0	0	0	0

Pace error
0: None 1: Pace error

OVER
0: None 1: +OVER 2: -OVER

Sensor error
0: None 1: Sensor + error 2: Sensor - error

Calibration error
0: None 1: Zero error 2: Span error

FS2000's reply
(When there is an error)

N	G	1	Delimiter

NOK No.
1: Received a statement that was different from the command format.

● Time read command

Host
(Transmission to the FS2000)

T	I	M	E	Delimiter

FS2000's reply
(When processing is successful)

T	I	M	E	1	6	/	0	2	/	1	9	SP	2	3	:	3	0	:	3	0	Delimiter

Command received by the FS2000
Year
Month
Day
Hours
Minutes
Seconds
Colon (3aH)
Slash (2fH)

23:30:30 February 19, 2016 in the example.

FS2000's reply
(When there is an error)

N	G	1	Delimiter

NOK No.
1: Received a statement that was different from the command format.

● Time write command

Host
(Transmission to the FS2000)

T	I	M	E	1	6	/	0	2	/	1	9	SP	2	3	:	3	0	:	3	0	Delimiter

Year
Month
Day
Hours
Minutes
Seconds
Colon (3aH)
Slash (2fH)

23:30:30 February 19, 2016 in the example.

FS2000's reply
(When processing is successful)

T	I	M	E	1	6	/	0	2	/	1	9	SP	2	3	:	3	0	:	3	0	Delimiter

Command received by the FS2000

FS2000's reply
(When there is an error)

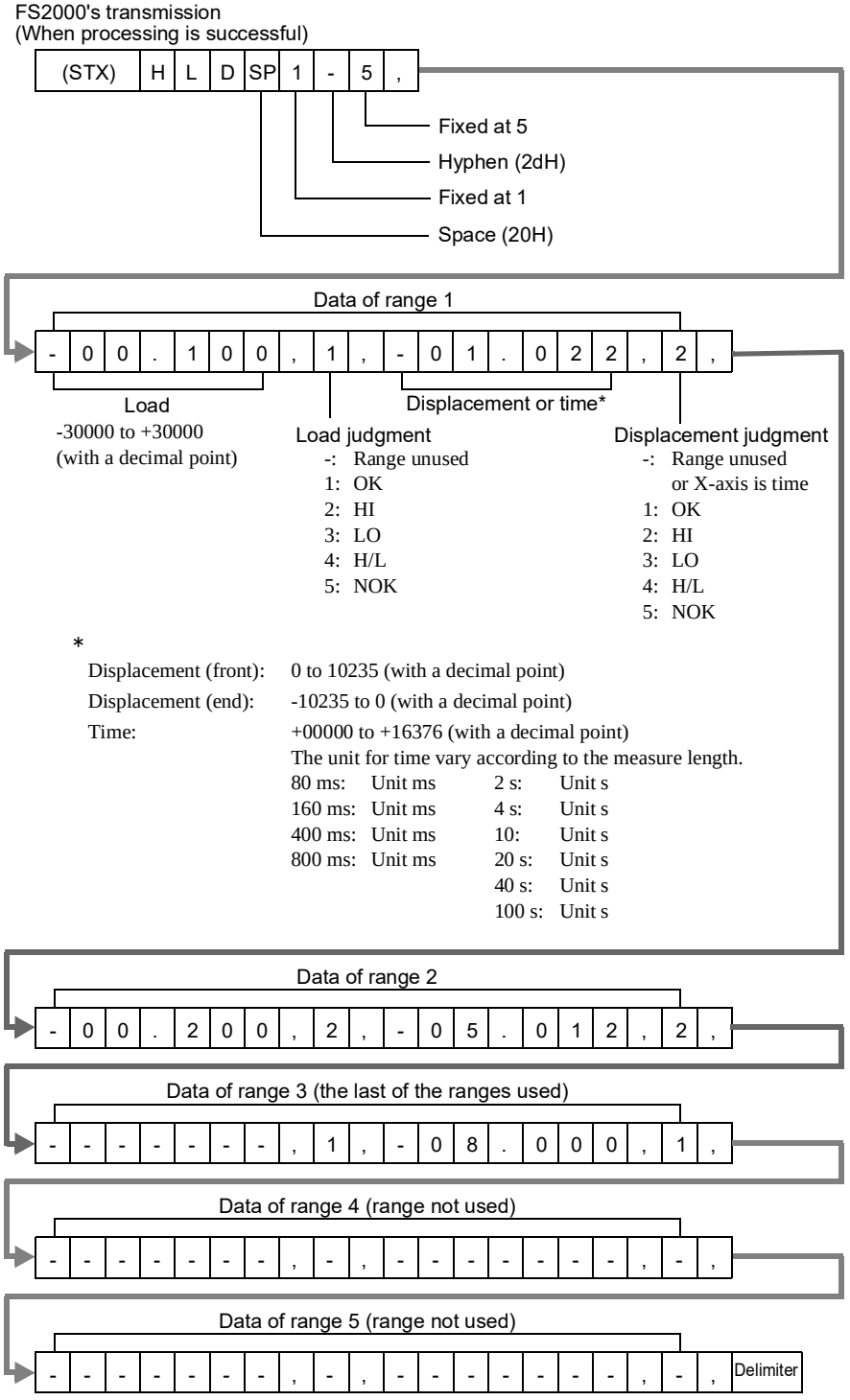
N	G	1	Delimiter

NOK No.
1: Received a statement that was different from the command format.
2: Attempted to write a setting value that was outside the setting range.
4: Attempted to write a setting value through communication during measurement.

■ When the communication mode is set to Auto

The point judgment results of each range are automatically transmitted to the host after measurement stops.

Example: When used by the measured waveform with the hold points set to 3



Hyphens (2dH) are inserted into load and displacement (time) if there is no hold point in the specified range, and also if the specified range is set to always.

■ Points of caution

- Work No. for USB communications

Once a work No. is written, it will be reflected in all subsequent reading and writing of settings by work. This work No. is only for USB communications. It is not used for changing the work of the FS2000. Also, the work No. display in work setting will not be changed.

- Point Nos. for USB communications

Once a point No. is written (for the currently specified work No.), it will be reflected in all subsequent reading and writing of point judgment settings. This point No. is only for USB communications. The hold points displayed in point judgment settings will not be changed.

- Communications during measurement

Writing and calibration cannot be carried out through communication during measurement. Only reading is possible.

- Statements

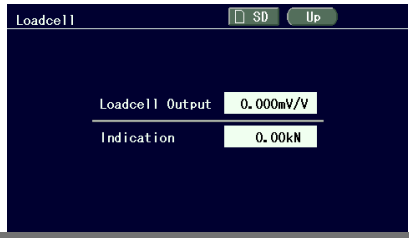
Unless noted otherwise, all statements are in ASCII code.

8 Self-test

Perform self-tests.

■ Loadcell

Check that the loadcell input is being recognized.
The current input (mV/V) and load are displayed.

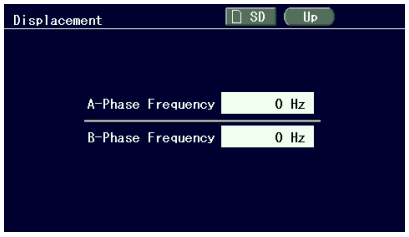


Operation

Main screen → Set → Self-Test → Loadcell▼

■ Displacement

Check that the displacement sensor input is being recognized.
The current A-phase and B-phase frequencies are displayed.

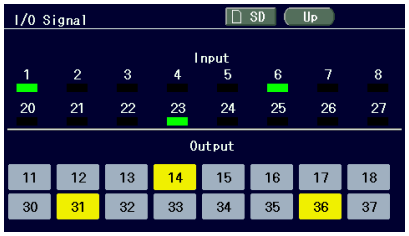


Operation

Main screen → Set → Self-Test → Displacement▼

■I/O signal

Check that the external I/O signals work.
Output turns the pressed pin numbers ON.
Input turns pin numbers that have been recognized as ON yellow.

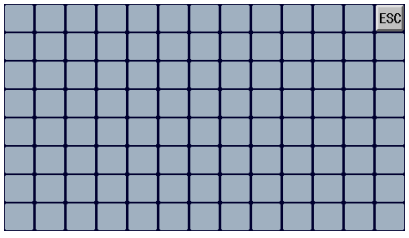


Operation

Main screen → Set → Self-Test → I/O Signal▼

■ Key

Check that the touch panel is free from unrecognizable places. Each square turns yellow when touched. Return to the original screen by pressing ESC in the upper right of the screen.



Operation

Main screen → Set → Self-Test → Key▼

■ Display

Check that the display is free from defects in color or indication.

The screen changes from red → green → blue → horizontal stripes → vertical stripes.
Return to the original screen by touching the screen.

Operation

Main screen → Set → Self-Test → Display▼

■ Backlight

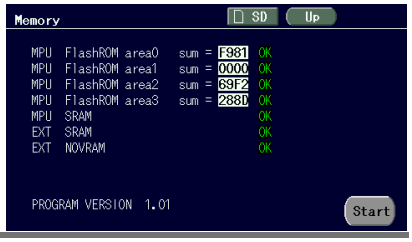
Check that the backlight works.
The backlight becomes bright when [+] is pressed and dark when [−] is pressed.
Also, the backlight turns off when [Light Out] is pressed, and turns back on if the screen is touched.

Operation

Main screen → Set → Self-Test → Backlight▼

■ Memory

Check that the memory is free from defects. The results are displayed shortly after [Start] in the lower right of the screen is pressed.
You also check the version here.



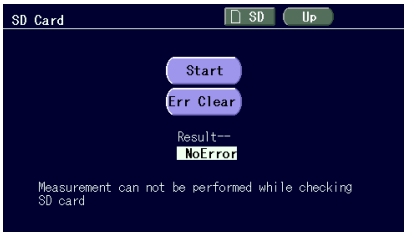
Operation

Main screen → Set → Self-Test → Memory▼

■ SD card

Selection range

Start:	Check that the SD memory card is working normally.
Err Clear:	Clear SD memory card error that occurred.



Operation

Main screen → Set → Self-Test → SD Card▼

■ USB

Check that the USB reception and transmission are working properly.
By pressing the transmission key, the same statement as the display reading will be transmitted, and the received data will be displayed in the Rx Data field. Also, in the case of a parity error/framing error, the parity/frame lamp turns red.

Operation

Main screen → Set → Self-Test → USB▼

9 Specifications

9-1. Specifications

■ Sensor input section

- Load sensor input (load cell)

Excitation voltage	DC 2.5 V, 5 V, 10 V ± 10% (factory default initial value 2.5 V)	
	Output current	30 mA or less
Signal input range	-2.0 mV/V to +2.0 mV/V	
Accuracy	Non-linearity	0.02%FS ± 1 digit or less (at 2.0 mV/V input)
	Zero drift	0.1 μV/℃ RTI or less
	Gain drift	15 ppm/℃ or less
Low-pass filter	Select from 10 to 10k Hz (At A/D conversion rate 25000 times/sec.)	
	Select from 2 to 2k Hz (At A/D conversion rate 5000 times/sec.)	
	Characteristic	-6 dB/oct.
A/D converter	Rate	Select from 25000 times/sec. or 5000 times/sec.
	Resolution	24 bits (binary)
	Effective resolution	Approx. 1/20000 to 2.0 mV/V

- Displacement sensor input (pulse input: line driver)

Maximum input frequency	1 MHz
Internal counting range	Approx. 1000000
Adaptable sensor	Output
	Incremental type 2-phase output (A/B signal output) Also capable of single-phase output (A-phase input is used. All pulses are counted as the positive direction.)
	Output stage circuit specification
	Line driver
	(RS-422-compliant. However, termination must be at 120 Ω.)

* Use the signal input of the indicator in such a way that termination is at 120 Ω on a one-to-one basis.
One (sensor)-to-many (indicators) may sometimes not be used owing to the sensor side drive capacity.

- Analog voltage output

Output level	Approx. 2 V per 1.0 mV/V input
Load resistance	2 kΩ or above

■ Display section

Display	4.3-inch TFT color LCD module	
	Display area	95.0W x 53.9H [mm]
	Dot configuration	480 x 272 [dot]
Indicated value	Load, displacement	-30000 to +30000
	Decimal point	The display position is to be input at the same time as a value at the time of calibration. 0.0000, 0.000, 0.00, 0.0, 0
Display frequency	Fixed at 3 times/sec.	

■ Setting section

Setting method: Set by operation of analog type touch panel.

Saving setting values:
First setting values etc. NOV RAM (non-volatile RAM)
Other setting values
C-MOS RAM backed up by lithium batteries
(The storage period is approximately 5 years or more, depending on the operating conditions and storage environment.)

* Refer to "11.List of setting items" on p.113 for setting value categories.

■ Comparison judgment function

Multi-point comparison mode 16ch (Settings can be saved)
Comparison judgment can be made simultaneously for up to 5 arbitrary points of hold.
Sample, Peak, Valley, P-V, Rel. max, Rel. min, Inflect., Average, End

Waveform comparison mode 16ch (Settings can be saved)
Comparison is made between the waveforms set as HI/LO limits and the actual measured waveform. The overall measured waveform is compared with the HI/LO limits, and an NOK will result even if one point exceeds the set waveform.

■ Backup maintenance support

Trend display unit	By managing the trend of changes in measured values, abnormalities can be detected promptly.
Statistics	Statistics are collected for measured results for the most recent 10000 times. Displays the number of measurements, OKs and NOKs, and the OK rate.
Screen capture	The displayed screen can be captured as bmp data.
Arbitrary work name	Can arbitrarily display the work process linked to the work No..
Display of list of setting values	Settings that have been changed from the master settings can be displayed in a different color.
User management	User management is possible with a login ID and password.
Digital zero limit	When a load exceeds the set limit value when performing digital zero, display "zero limit" error, thus abnormalities on force sensors can be found early.

■Input/output section

Input signal (16 points)

Load zero/ displacement initial position/ measurement start/ measurement stop/ work selection 1, 2, 4, 8/ HOLD1 to 5/ reset/ backlight forced ON/ touch panel operation prohibited

Input format: Selectable from plus common/minus common (Minus common is optional [ISC])

When connecting a transistor, connect the NPN output type (sink type) for plus common, and PNP output type (source type) for minus common.

Output signal (16 points)

Point judgment (load, displacement)/ timing output 1, 2/ waveform comparison/ measurement complete/ CPU normal operation/ load/displacement OK/ SD memory card OK/ load overload

Output format: Selectable from sink type/source type (Source type is optional [ISC])

The output transistor should be turned ON when the signal is ON.

When connecting an input unit such as a PLC, connect plus common for sink type, and minus common for source type.

Rated voltage: 30 V

Rated current: 30 mA

■Interface

USB interface

Asynchronous type

Baud rate	9600, 19.2k, 38.4k, 57.6k, 115.2k, 230.4k bps
Data bit	7 or 8 bits
Parity bit	None, even, or odd
Stop bit	1 or 2 bits
Delimiter	CR, CR+LF

Setting values can be read and written.

All comparison waveforms can be read and written.

Measured waveforms and judgment points can be read.

■General performance

Power supply voltage	DC 24 V (±15%)		
Power consumption	6 W typ.		
Inrush current (Typ)	2 A, 10 msec. (at room temperature, cold start)		
Operating conditions	Temperature	Operating temperature range	-10℃ to +40℃
		Storage temperature range	-20℃ to +60℃
	Humidity	85% RH or less (non-condensing)	
Outside dimensions	132W × 98H × 110D [mm] (not including protruding sections)		
Weight	Approx. 1.0 kg		

■Accessories

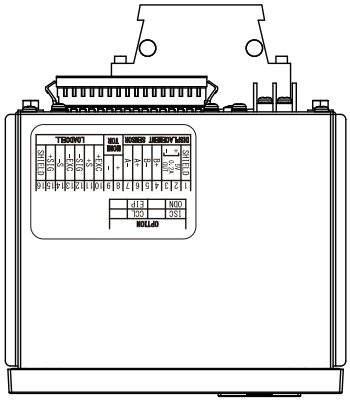
I/O connector (with cover) [CN36] 1
Sensor connector [CN77].....1
Operating tool [attached to CN77].....1
SD memory card [SD1G] 1
Operation manual.....1
Connector for DeviceNet (when equipped with DeviceNet option) [CND01] 1
Connector for CC-Link (when equipped with CC-Link option) [CN71].....1

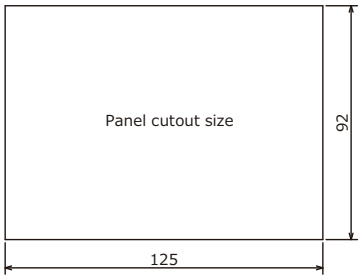
■Options

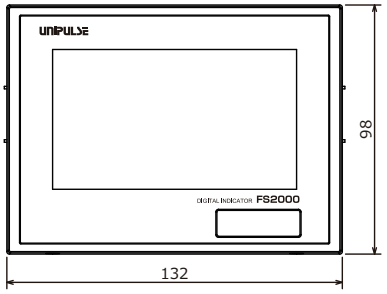
SD1G:	SD memory card 1 Gbyte
SD2G:	SD memory card 2 Gbyte
SD16G:	SD memory card 16 Gbyte
SD32G:	SD memory card 32 Gbyte
CA81-USB:	USB cable (A-mini B type) 1.8 m
CN36:	I/O connector (with cover)
CN71:	CC-Link connector
CN72:	CC-Link two-row connector
CN77:	Sensor connector
CND01:	DeviceNet connector
TSU03:	Lightning surge protector

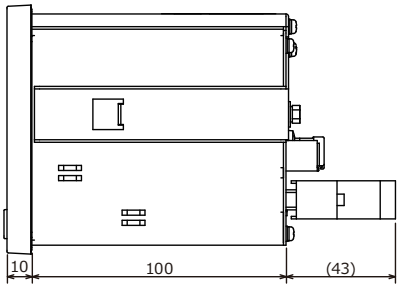
9-2. Outside dimensions

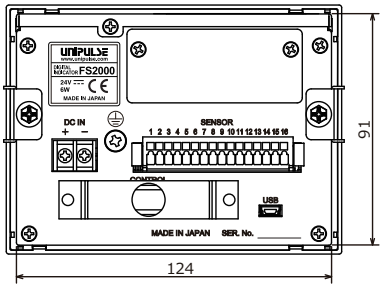
Unit: mm



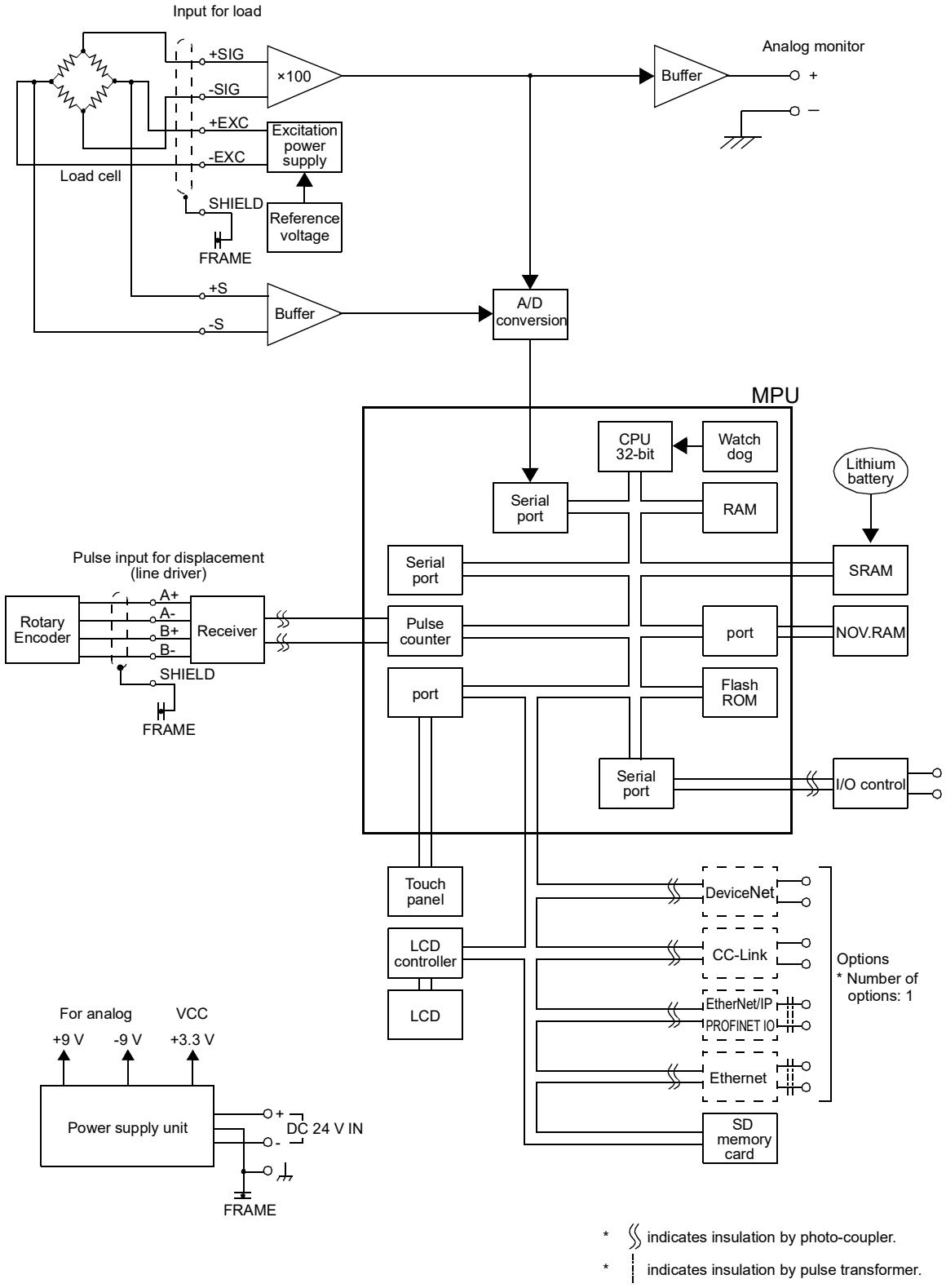








9-3. Block diagram



10 Troubleshooting

10-1. Error messages

■ Load errors

Error	Description
Zero Err	The sensor input signal when performing zero calibration is outside the zero calibration range. Check that no unnecessary force is being applied to the sensor, and that there are no breaks in the cables or mistakes in the wiring, and perform zero calibration again.
Span Err	[During actual load calibration] The sensor input signal is outside the actual load calibration range. Or, the same value as the zero calibration value is input. Check that a load within the actual load calibration range is being applied to the sensor and that there are no breaks in the cables or mistakes in the wiring, and perform calibration again. [During equivalent calibration] The values input to the rated output and the capacity are outside the equivalent calibration range. Or, "0" is input. Check that they are not different from the data sheet of the sensor, and perform calibration again.
Sensor +	The sensor input signal exceeds the signal input range. It is possible that an excessive force is being applied to the sensor. Remove the load. If overload cannot be confirmed and the error is not released, a break in the cable, a mistake in the wiring, or sensor failure may be the cause.
Sensor -	The sensor input signal is below the signal input range. It is possible that a reversely-directed force is being applied to the sensor. Check around the sensor. If a reversely-directed force cannot be confirmed and the error is not released, a break in the cable, a mistake in wiring, or sensor failure may be the cause.
+ OVER	A signal equivalent to a display value exceeding +30000 is input. It is possible that an unexpectedly excessive load is being applied to the sensor. Perform calibration using a setting such that the maximum measured value will not exceed +30000.
- OVER	A signal equivalent to a display value below -30000 is input. It is possible that an unexpectedly excessive reversely-directed load is being applied to the sensor. Perform calibration using a setting such that the minimum value of measurement will not be below -30000.
OVERLOAD	A signal equivalent to a display value exceeding the overload output setting value is input. It is possible that an excessive force is being applied to the sensor. Remove the load.
DZ Limit	The digital-zeroed load (|load subjected to digital zero - zero calibration load|) exceeds the digital zero limit setting value. It is possible that the sensor's zero point has deviated due to degradation from aging, etc. Return the input signal to the setting range, or perform digital zero again with a wider digit zero limit setting value, and input the reset signal.
Comp Err	When the relative comparison in the waveform comparison setting was set to "ON", measurement was not carried out up to the set relative point. Perform measurement up to the relative point.

■ Displacement error

Error	Description
Zero Err	The sensor input signal when performing zero calibration is outside the zero calibration range. Check that no unnecessary force is being applied to the sensor, and that there are no breaks in the cables or mistakes in the wiring, and perform zero calibration again.
Span Err	[During actual load calibration] The sensor input signal is outside the actual load calibration range. Or, the same value as the zero calibration value is input. Check that a load within the actual load calibration range is being applied to the sensor and that there are no breaks in the cables or mistakes in the wiring, and perform calibration again. [During equivalent calibration] The values input to the rated output and the capacity are outside the equivalent calibration range. Or, "0" is input. Check that they are not different from the data sheet of the sensor, and perform calibration again.
Sensor+	The sensor output pulse count exceeds the FS2000 internal count range. Set the sensor output pulse count so that it will not exceed the internal count range. Also, input the displacement initial position with an arbitrary timing, because the internal count is cleared to zero when the displacement initial position is input.
Sensor-	The sensor output pulse count is below the FS2000 internal count range. Set the sensor output pulse count so that it will not be below the internal count range. Also, input the displacement initial position with an arbitrary timing, because the internal count is cleared to zero when the displacement initial position is input.
+ OVER	A signal equivalent to a display value exceeding +30000 is input. It is possible that the displacement is moving beyond the maximum expected displacement. Perform calibration using a setting such that the maximum measured value will not exceed +30000.
- OVER	A signal equivalent to a display value below -30000 is input. It is possible that the displacement is moving below the expected displacement in the reverse direction. Perform calibration using a setting such that the minimum value of measurement will not be below -30000.
PaceErr	The displacement pace is too fast to perform sampling in time, and 10 or more data measurement points are skipped. Adjust the displacement pace so that it is within 10 pieces of data/sample rate. One piece of data corresponds to the measure length/2000.

■ Error release

- Common to load errors and displacement errors

Error	Error release
Zero Err	Perform zero calibration within the zero calibration range.
Span Err	Perform actual load calibration within the actual load calibration range. Or, perform equivalent calibration within the equivalent calibration range.
Sensor + Sensor -	Bring the sensor input into the signal input range/internal count range.
+ OVER - OVER	Load: Indicated value of - 30000 to +30000. Displacement: Indicated value of - 30000 to +30000.

- Load errors

Error	Error release
OVERLOAD	After the indicated value falls within the overload output setting value, turn the reset input from OFF to ON, or press Clear on the main screen.
DZ Limit Comp Err	Turn the reset input from OFF to ON, or press Clear on the main screen. Or, turn the power OFF then ON again.

- Displacement errors

Error	Error release
PaceErr	Turn the reset input from OFF to ON, or press Clear on the main screen. Or, turn the power OFF then ON again.

10-2. Q & A

Item	Question	Countermeasures
Sensor	Can four sensors be connected?	When the excitation voltage is 2.5 V, up to four 350 Ω sensors can be connected in parallel. When the excitation voltage is 5 V, up to two 350 Ω sensors can be connected in parallel. Use them so that the total output current does not exceed 30 mA.
	Does the indicated value display change according to the unit of the sensor used?	The indicated value is not converted according to changes in unit. After a change, perform actual load calibration or equivalent calibration.
Wiring and connection	Cables connected to the terminal block.	The analog I/O terminals are of screw type. Directly connect individual cables. Refer to "2-1-1.Connection of sensors" on p.13 for details. Use crimp contacts of 6 mm or less for connection to the power input terminal.
	The power cannot be turned on.	Is the power cord connected properly? Connect the power cord properly.
		Is the power supply used within the range of the specifications? Use a power supply that is within the range of the specifications, and connect correctly, confirming plus and minus.
Settings and operation	How can the decimal place be changed?	The decimal place of HI limit, LO limit etc. are linked to the decimal place set at the time of actual load calibration or equivalent calibration. Perform calibration again, and change the decimal place.
	No judgment/value is output, or a judgment/value is abnormal.	Is the output cable properly connected? Connect the output cable properly, referring to the equivalent circuit diagram.
		Is the power ON? External I/O signals require external power supply. Turn ON the power.
	Are setting data erased when the power is turned OFF?	The setting data are not erased even when the power is turned OFF.
	Are setting data erased when the power is not turned ON for a long time?	The FS2000 stores setting data for approximately 5 years with the power OFF. However, the storage period may be shorter depending on the operating conditions and installation environment.
	What happens when a number other than the selectable item is selected in a setting?	The maximum possible numerical value within the setting range is set. Example) If "5" is selected for a setting with items "0", "1", and "2", "2" is set.
USB	Communication is not possible.	Is the communication cable properly connected? Turn the power supply OFF and connect the communication cable properly.
		Is the correct communication cable being used? Confirm the wiring and connect the communication cable properly.
		Check that FTDI driver is working normally, and COM port number is displayed on Device Manager.
		Are the communication conditions between the device and FS2000 consistent? Confirm the communication conditions and make the settings consistent with those of the device to be connected.
	Is a program necessary when communicating with a PC?	A program is required. Create software for serial communication that exchanges commands in ASCII strings with the necessary timing.
Options	Can two or more options be mounted?	An option can be mounted for each of the items below. - Communication (DeviceNet / CC-Link/ EtherNet/IP/ Ethernet) - I/O (Source type)

11 List of setting items

11-1. List of setting items _ User registration

Setting item	Setting range (Display range)	Initial value	Memory *2	Command number	Page
User No.*1	0 to 9	0	N		P79
User*1	0 to 9 a to z A to Z -,_ Maximum 8 characters	UNI_0000 to UNI_0009	N		P79
Password*1	0 to 9 a to z A to Z -,_ Maximum 8 characters	unipulse	N		P79
Authority*1	0: Administrator 1: Engineer 2: Operator	Administrator	N		P80
User restrictions*1	0: OFF 1: ON	OFF	N		P80

*1: Function-specific setting value (calibration values etc.). The current setting values will remain even if initialization is performed.

*2: "N: Non-volatile memory", "S: Memory that requires backup batteries"

11-2. List of setting items _ First setting

Setting item			Setting range (Display range)	Initial value	Memory *2	Command number	Page
		Device ID	0 to 999	0	N	409	P80
		Standby screen	0: OFF 1: Waveform 2: Numeric 3: OK/NOK	OFF	N	410	P80
		Switching time	1 to 200 seconds	10 seconds	N	411	P80
Sensor							
		Sample rate	0: 25 kHz 1: 5 kHz	25 kHz	N	212	P76
		X-axis	0: Time 1: Displacement	Time	N	200	P27
		0 of X-axis	0: Front 1: End	Front	N	202	P31
		Measure length	X-axis: Time 0: 80 ms* 1: 160 ms* 2: 400 ms 3: 800 ms 4: 2 s 5: 4 s 6: 10 s 7: 20 s 8: 40 s 9: 100 s (*) Not selectable when sample rate is 5 kHz. X-axis: Displacement 0: 2000 1: 4000 2: 6000 3: 8000 4: 10000	2.0 s	N	208	P32

*2: "N: Non-volatile memory", "S: Memory that requires backup batteries"

Setting item	Setting range (Display range)	Initial value	Memory *2	Command number	Page
Sensor					
Loadcell					
Sensing*1	0: OFF (4-wire) 1: ON (6-wire)	OFF (4-wire)	N	111	P27
Excitation voltage*1	0: 2.5 V 1: 5 V 2: 10 V	2.5 V	N	100	P28
Unit*1	Refer to "12-1.Unit setting list" on p.120.	kN	N	101	P28
Zero calibration*1	-2.222 to 2.222 mV/V	0.000 mV/V	N	103	P28
Equivalent calibration*1 (Output)	-9999 to 9999 mV/V (0 is excluded)	1.000 mV/V	N	104	P28
Equivalent calibration*1 (Capacity)	-99999 to 99999*3	50.00	N	105	P28
Actual load calibration*1	-99999 to 99999*3	50.00	N		P29
(Decimal place)	0: 00000 1: 0000.0 2: 000.00 3: 00.000 4: 0.0000	000.00	N	102	
Increment*1	0: 1 1: 2 2: 5 3: 10 4: 20 5: 50 6: 100	0.01 kN	N	107	P29
Low-pass filter	At sample rate 25 kHz 10 to 10000 Hz At sample rate 5 kHz 2 to 2000 Hz	1000 Hz	N	108	P76
Moving average	0, 2 to 999 times	0 times	N	109	P76
Digital zero limit	0 to 99999	999.99 kN	N	110	P77
Overload output	0 to 30000	300.00 kN	N	106	P77
Zero offset	-30000 to 30000	0	N	112	P77

*1: Function-specific setting value (calibration values etc.). The current setting values will remain even if initialization is performed.
*2: "N: Non-volatile memory", "S: Memory that requires backup batteries"
*3: Calibration can be made within this range, but the usable range is -30000 to 30000.

Setting item	Setting range (Display range)	Initial value	Memory *2	Command number	Page
Sensor					
Displacement					
Phase select*1	0: A/B-Phase 1: A-Phase	A/B-Phase	N	201	P30
Unit*1	Refer to "12-1.Unit setting list" on p.120.	mm	N	203	P28
Zero calibration*1	0 to 1000000	0	N	205	P28
Equivalent calibration*1 (Output)	1 to 1000000	5000	N	206	P28
Equivalent calibration*1 (Capacity)	-99999 to 99999*3	50.00	N	207	P28
Actual load calibration*1	-99999 to 99999*3	10.00	N		P29
(Decimal place)	0:00000 1:0000.0 2:000.00 3:00.000 4: 0.0000	000.00	N	204	
Moving average	0, 2 to 999 times	0 times	N	211	P76
Initial position	-30000 to 30000	0.00	N	209	P77

*1: Function-specific setting value (calibration values etc.). The current setting values will remain even if initialization is performed.
*2: "N: Non-volatile memory", "S: Memory that requires backup batteries"
*3: Calibration can be made within this range, but the usable range is -30000 to 30000.

Setting item		Setting range (Display range)	Initial value	Memory *2	Command number	Page
SD card						
	Auto recording	0: OFF 1: ON (Overwrite) 2: ON (No Overwrite)	OFF	N	500	P71
	Load parameter	0: Partial 1: All parameters	Partial			P72
	Save parameter					P72
	Format					P71

*2: "N: Non-volatile memory", "S: Memory that requires backup batteries"

Setting item		Setting range (Display range)	Initial value	Memory *2	Command number	Page
USB						
	Speed	0: 9600 bps 1: 19.2k bps 2: 38.4k bps 3: 57.6k bps 4: 115.2k bps 5: 230.4k bps	19.2k bps	N	300	P85
	Data bit	0: 7 bits 1: 8 bits	8 bits	N	301	P85
	Stop bit	0: 1 bit 1: 2 bits	1 bit	N	303	P85
	Parity bit	0: NONE 1: EVEN 2: ODD	EVEN	N	302	P85
	Delimiter	0: CR 1: CR+LF	CR	N	304	P85
	Communication mode	0: Command 1: Auto	Command	N		P85

*2: "N: Non-volatile memory", "S: Memory that requires backup batteries"

Setting item		Setting range (Display range)	Initial value	Memory *2	Command number	Page
System						
	Backlight	ON time: 0 to 99 minutes Low time: 0 to 99 minutes	10 minutes 0 minutes	N	400 405	P81
	Language*1	0: Japanese (日) 1: English (英)	Japanese (日)	N	401	P81
	Date & time*1	2000/01/01 00:00:00 to 2099/12/31 23:59:59		S		P81
	Initialization	0: First Setting 1: Work Setting 2: All				P82
	Password	0 to 9999	0			P82
	Prohibited Mode	0: All Prohibited 1: Set. Prohibited	All Prohibited	N	406	P82

*1: Function-specific setting value (calibration values etc.). The current setting values will remain even if initialization is performed.

*2: "N: Non-volatile memory", "S: Memory that requires backup batteries"

11-3. List of setting items _ Work setting

[Work 1 to 15] (for each work No.)

Setting item		Setting range (Display range)	Initial value	Memory *2	Command number	Page
	Work No.	0 to 15	0		1000	P32
	Work name	0 to 9 a to z A to Z -,_ Maximum 8 characters	Work 0 to Work 15	S		P78
	Copy No.	0 to 15	0			P78
	Work selection	0: External Input 1: Setting	External Input		1104	P42
	Start condition	0: External Input 1: Ext. + Load 2: Ext. + Displ. ("2" can only be set when the X-axis (sensor) represents the displacement.)	Ext. + Load	S	1100	P33
	Start level	-30000 to 30000	1.00	S	1101	P34
	Stop condition	0: Forced-Stop 1: Load 2: Time 3: Displacement 4: Displ. Stop ("3" and "4" can only be set when the X-axis (sensor) represents the displacement.)	Forced-Stop	S	1102	P34
	Stop level	When stop condition is load or displacement -30000 to 30000 When stop condition is time or displ. stop 0.1 to 100.0	10.0	S	1103	P35
	Start input mode	0: Normal (Seq.) 1: ON Edge Only	Normal (Seq.)	S	1105	P36

*2: "N: Non-volatile memory", "S: Memory that requires backup batteries"

Setting item		Setting range (Display range)	Initial value	Memory *2	Command number	Page
Waveform comparison						
	Reference waveform					P45
	Comparison range (Start, end)	0 of X-axis: Front 0 to 2047 x measure length/2000 0 of X-axis: End -2047 to 0 x measure length/2000	Start: 0 End: 2047	S	1401 1402	P46
	Shift	Range: Time or displacement (front) 0 to 2047 x measure length/2000 Displacement (end) -2047 to 0 x measure length/2000 Amount of movement: -60000 to +60000	0 to 2047 ms 0.00 kN			P46
	Tie drawing					P47
	Compare margin	0 to 30000	0.00	S	1403	P47
	Relative comparison	0: OFF 1: ON	OFF	S	1400	P48
	Relative point (X-axis)	0 of X-axis: Front 0 to 2047 x measure length/2000 0 of X-axis: End -2047 to 0 x measure length/2000	0	S	1404	P48
	Relative point (Y-axis)	-30000 to 30000	0.00	S	1405	P48
	Save waveform					P48

*2: "N: Non-volatile memory", "S: Memory that requires backup batteries"

Setting item	Setting range (Display range)	Initial value	Memory *2	Command number	Page
Point judgment					
Hold points	1 to 5	1	S	1301	P51
Timing	0: External Input 1: Setting	Setting	S	1300	P51
Indication	0: Real-time value 1: Point 1 2: Point 2 3: Point 3 4: Point 4 5: Point 5	Real-time value	S	1316	P51
Point 1 to 5	0: Point 1 1: Point 2 2: Point 3 3: Point 4 4: Point 5	Point 1		1302	P51
Point detection	0: Always 1: Sample 2: Peak 3: Valley 4: P-V 5: Rel. Max 6: Rel. Min 7: Inflect. 8: Average 9: End	Always	S	1303	P51
Detection range (Start, end)	0 of X-axis: Front 0 to 2047 x measure length/2000 0 of X-axis: End -2047 to 0 x measure length/2000	Start: 0 End: 2.047	S	1304 1305	P55
Load limit (HI, LO)	-30000 to 30000	HI: 30000 LO: -30000	S	1306 1307	P55
Displacement limit (HI, LO)	0 of X-axis: Front 0 to 2047 x measure length/2000 0 of X-axis: End -2047 to 0 x measure length/2000 Point detection: End point -30000 to 30000	HI: 61.41 LO: 0	S	1308 1309	P56
Start load	-30000 to 30000	-30000	S	1310	P57 P59
Load difference	1 to 60000	1.00	S	1311	P57 P59
Determination rate	0: 1/4 times 1: 1/2 times 2: 3/4 times 3: 1 times 4: 1.25 times 5: 1.5 times 6: 1.75 times 7: 2 times 8: 3 times 9: 4 times	3/4 times	S	1312	P57
Times of detection	1 to 15 times	1 time	S	1313	P57
Interval AB (A, B)	1 to 999 x measure length/2000	A: 100 B: 100	S	1314 1315	P58
Detection mode	0: Inflection A 1: Inflection B 2: Inflection C 3: Inflection D	Inflection A	S	1317	P59

*2: "N: Non-volatile memory", "S: Memory that requires backup batteries"

Setting item		Setting range (Display range)	Initial value	Memory *2	Command number	Page
Timing output						
	OUT1 condition	0: Load 1: Displacement	Load	S	1500	P78
	OUT1 ON (HI, LO)	-30000 to 30000	HI: 30000 LO: -30000	S	1501 1502	P78
	OUT2 condition	0: Load 1: Displacement	Displacement	S	1503	P78
	OUT2 ON (HI, LO)	-30000 to 30000	HI: 30000 LO: -30000	S	1504 1505	P78

*2: "N: Non-volatile memory", "S: Memory that requires backup batteries"

Setting item		Setting range (Display range)	Initial value	Memory *2	Command number	Page
Display range						
	Y start point	-30000 to 30000	0.00	S	1200	P37
	Y end point	0: SP + 25 1: SP + 50 2: SP + 100 3: SP + 200 4: SP + 300 5: SP + 400 6: SP + 500 7: SP + 1000 8: SP + 2000 9: SP + 3000 10: SP + 4000 11: SP + 5000 12: SP + 10000 13: SP + 20000 14: SP + 30000 * SP: Start point	20.00	S	1201	P37
	X start point	0 of X-axis: Front 0 to 2000 x measure length/2000 0 of X-axis: End -2000 to 0 x measure length/2000	0	S	1202	P37
	X end point	0 of X-axis: Front 0: SP + 25 1: SP + 50 2: SP + 100 3: SP + 200 4: SP + 400 5: SP + 600 6: SP + 800 7: SP + 1000 8: SP + 1200 9: SP + 1400 10: SP + 1600 11: SP + 1800 12: SP + 2000 13: SP + 2200 * SP: Start point The above figure x measure length/2000 0 of X-axis: End 0: SP - 25 1: SP - 50 2: SP - 100 3: SP - 200 4: SP - 400 5: SP - 600 6: SP - 800 7: SP - 1000 8: SP - 1200 9: SP - 1400 10: SP - 1600 11: SP - 1800 12: SP - 2000 13: SP - 2200 * SP: Start point The above figure x measure length/2000	2000 ms	S	1203	P37

*2: "N: Non-volatile memory", "S: Memory that requires backup batteries"

12 Appendices

12-1. Unit setting list

Force		Pressure		Length		Angle	
0	No unit	0	No unit	0	No unit	0	No unit
1	μN	14	μPa	22	μm	27	rad
2	mN	15	mPa	23	mm	28	°
3	N	16	Pa	24	cm	29	deg
4	kN	17	hPa	25	m		
5	MN	18	kPa	26	km		
6	μNm	19	MPa				
7	mNm	20	GPa				
8	Nm	21	N/m^2				
9	kNm						
10	MNm						
11	gf						
12	kgf						
13	Mgf						

12-2. Terms

The terms used in this manual are explained below.

- Load

Analog and digital values of load cell input on Y-axis are expressed as load.

- Displacement

Input and digital values of displacement sensor input on X-axis are expressed as displacement.

- Waveform comparison

Checking to see if the acquired waveform is between a HI limit waveform and LO limit waveform prepared in advance is called waveform comparison.

- Point judgment function

The point judgment function detects and judges points from the waveform.
Judgment points can be kept according to the selected point detection.

- Measurement

Measurement means acquiring a waveform from the start to when it stops.

- 0 of X-axis (waveform reference)

In order to manage a measured waveform, a reference point is required. A 0 of X-axis is a reference point used to manage a measured waveform. The measurement start point or the measurement stop point can be used as reference.

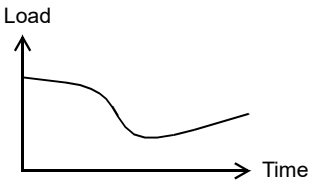
(Refer to "●Change of control reference to the point at which application of the load starts or ends" on p.123.)

12-3. Features

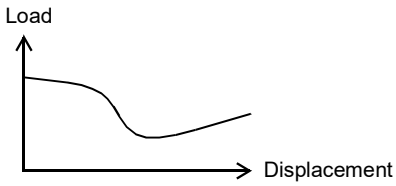
● Drawing of load-time and load-displacement waveforms

Not only can a load-time waveform be drawn by connecting a load sensor, but by combining the load sensor with a displacement sensor, a load-displacement waveform can also be drawn.

<In the case of time>



<In the case of displacement>

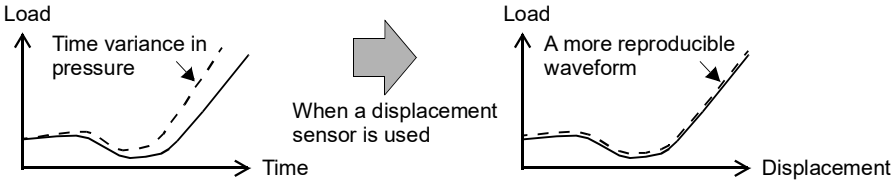


● Compensation for time variance in pressurization by a pressing machine using a displacement sensor

The influence on time variance in pressurization by a pressing machine pressure can be eliminated by using a displacement sensor.

<In the case of time>

<In the case of displacement>

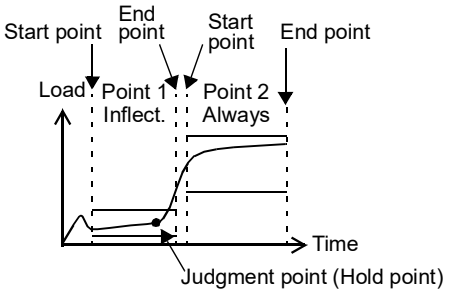


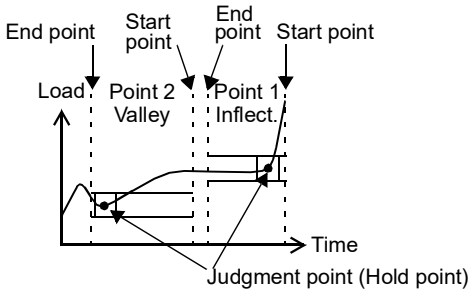
● Point judgment function

- This function detects and judges points from the waveform (maximum of 5 points).
- The detection method can be changed in accordance with the selected point detection.
- Judgment points can be kept according to the point detection selected.
- The ranges for point detection is specified by "HOLD1 to 5" of the external signal or through settings.
- Detection ranges may overlap.

<In the case of time>

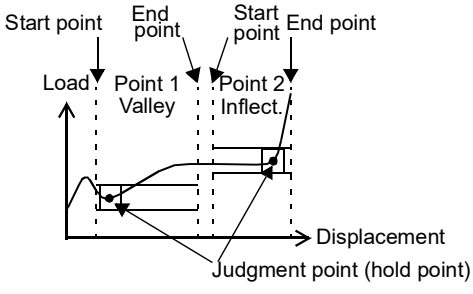
Start point and end point of range specifiedusing time or external signal using time or external signal





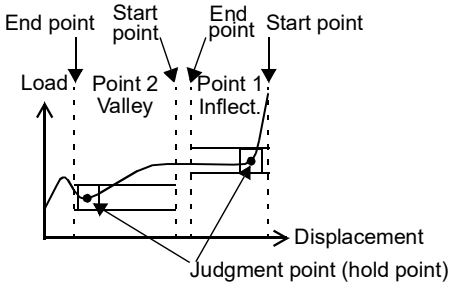
<In the case of displacement (front reference)>

Start point and end point of range specified using displacement or external signal



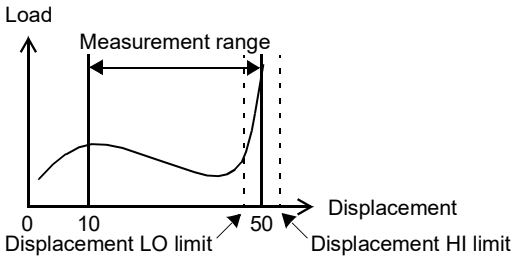
<In the case of displacement (end reference)>

Start point and end point of range specified using displacement



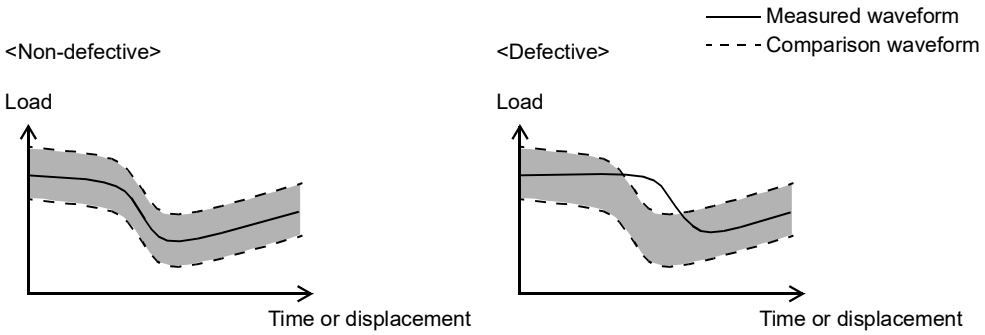
● Control of position when measurement stops

The position when measurement stops can be judged by using the end for the point judgment. Unlike point detection, for end, judgment is made on the basis of the origin of displacement, and not on the basis of the origin of the waveform.



● Control of an entire waveform using the waveform comparison function

Waveforms can be compared to judge whether the measured waveform is between HI limit and LO limit waveforms.

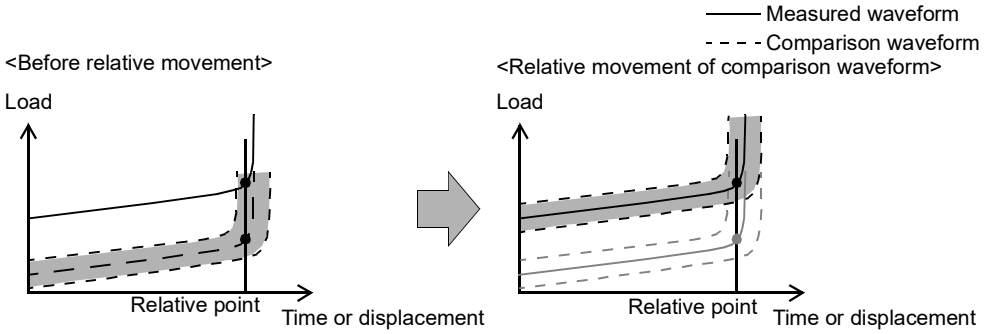


● Control by following the measured waveform using the waveform relative comparison function

Waveforms that fluctuate up and down with each measurement can be compared relatively. This is used to monitor the load change range (smoothness etc.), therefore the load size is not important.

With this function, comparison waveforms are shifted relatively according to the load at the reference point of the measured waveform, for which a relative point has set using time or displacement.

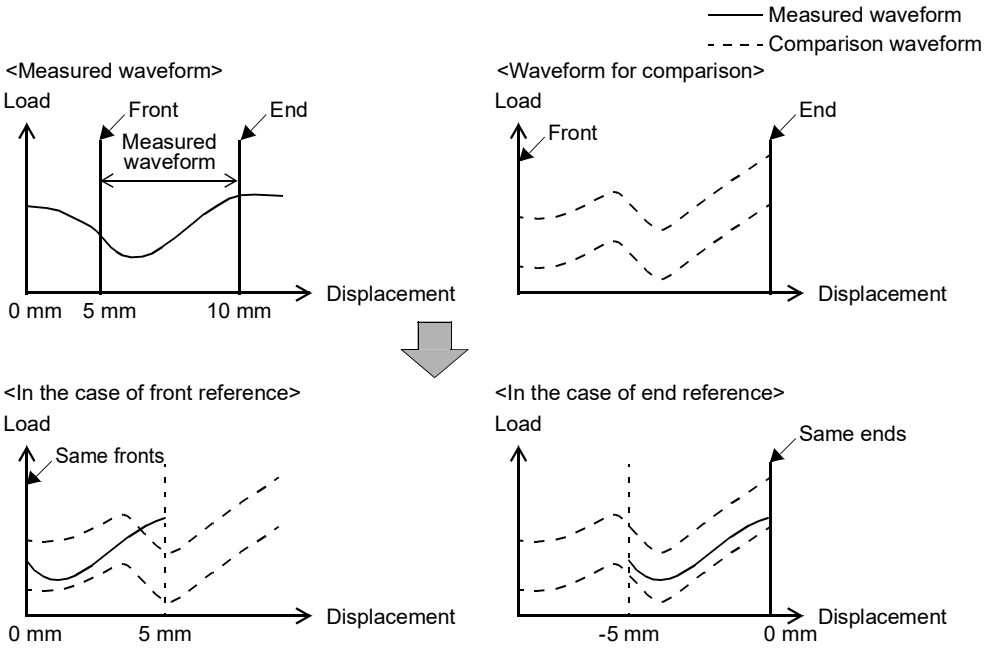
* Relative movement is only possible in the Y-axis direction.



● Change of control reference to the point at which application of the load starts or ends

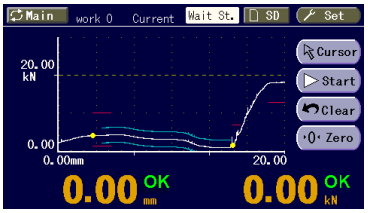
Either the measurement start point or the measurement stop point can be selected as the reference for the point judgment function and waveform comparison function.
For the point judgment function and waveform comparison function, set front and end, respectively, as reference.
Normally, front is set as reference, but end is set as reference if referencing the displacement for press-fitting work.

* When the reference is set to front, the waveform is displayed with 0 mm as the measurement start point.
When the reference is set to end, the waveform is displayed with 0 mm as the measurement stop point.

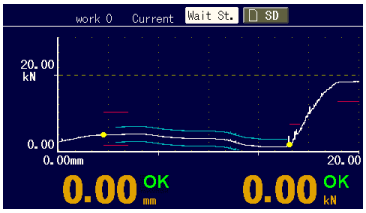


● Selectable from operating screens

Main screen will be changed to "Standby screen" automatically when no key operation is made in "Switching time". Standby screen is selectable from "Waveform with keys", "Waveform", "Numeric" and "OK/NOK".



OFF



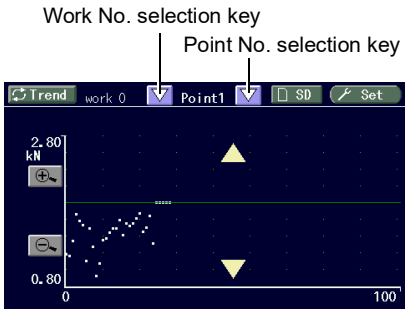
Waveform

Numeric

OK/NOK

● Confirmation of changes through trend display

Deviations in point judgment values and the zero point are displayed in a graph.
Registering a master and displaying it together with the deviation can serve as material on which to base judgments pertaining to equipment maintenance etc. (for the latest 100 data)



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