

# TM500

TORQUE MONITOR

## OPERATION MANUAL

01AUG2020REV.1.07

# UNIPULSE

# Introduction



Thank you very much for purchasing our Torque Monitor TM500.

The TM500 is an indicator only for our company UTMII series. Being equipped with the waveform comparison and hold functions, the TM500 can be used for multipurposes, such as in automatic assembling machines, testing machines, etc.

For good performance, and proper and safe use of the TM500, be sure to read this instruction manual and properly understand the contents of it before use. Also, carefully keep this instruction manual so that it can be referred to at any time.

## Safety Precautions

**For safety reasons, please read the following safety precautions thoroughly.**

In order to have an TM500 Digital Indicator used safely, notes we would like you to surely follow divide into " WARNING" and " CAUTION", and are indicated by the following documents. Notes indicated here are the serious contents related to safely. Please use TM500 after understanding the contents well.



### WARNING

This sign forewarns the presence of hazards that could result in serious injury or fatality when incorrectly handled.



### CAUTION

This sign forewarns the presence of hazards that could result in personnel injury or property damage when incorrectly handled.



## WARNING

This sign forewarns the presence of hazards that could result in serious injury or fatality when incorrectly handled.

### Warning on design

- For the entire system to function safely when the TM500 becomes faulty or malfunctions, provide a safety circuit outside the TM500.
- Before using the TM500 as described below, make sure to consult with our sales personnel.
  - Use in environments not described in the operation manual.
  - Use greatly impacting human lives and assets, such as medical devices, transport devices entertainment devices, and safety devices.

### Warning on installation

- Do not modify the TM500. Doing so may cause fire or electric shocks.
- Do not install in the following environments.
  - Places containing corrosive gas or flammable gas.
  - Where the product may be splashed with water, oil or chemicals.

### Warning on wiring

- Do not connect a commercial power source directly to the signal input/output terminals.
- Be sure to ground the protective ground terminal.
- Before performing the following, make sure that no power is applied.
  - Attachment/detachment of each connectors.
  - Wiring/connection of cables to the power input terminals.
  - Wiring/connection of cables to the signal input/output terminals.
  - Connection to the ground terminal.
- For connection to the signal input/output terminals, check the signal names and pin assignment numbers, and then carry out wiring properly.
- Be sure to install the attached terminal block cover after wiring to the power input terminals. Otherwise, electric shocks may result.
- Before applying power, carefully check the wiring, etc.

### Warning during startup and maintenance

- Use power supply voltage and load within the specified range and rating.
- Do not damage the power cord. Doing so may cause fire or electric shocks.
- Do not touch any signal input/output terminal while applying power. Doing so may cause electric shocks or malfunctions.
- If the cover of the main body is opened, it may cause an electric shock internally. Even if the power is off, the internal capacitor is charged. Contact us for internal inspection or repair.
- In the case of smoke, an abnormal smell or strange sound, immediately turn off the power, and disconnect the power cable.



## CAUTION

This sign forewarns the presence of hazards that could result in personnel injury or property damage when incorrectly handled.

### Caution on installation

- Use the TM500 as it is incorporated in a control panel, etc.
- Do not install in the following environments.
  - Where the temperature/humidity exceeds the range of the specifications.
  - Locations subjected to drastic temperature fluctuations or icing and condensing;
  - Outdoors, or where the altitude exceeds 2000m.
  - Places exposed to direct sunlight
  - Dusty places
  - Poor-ventilated places
  - Places containing large quantities of salt or iron powder.
  - Where the main body is directly affected by vibrations or shocks.
- Take adequate shielding measures when using at the following locations.
  - Near a power line.
  - Where a strong electric field or magnetic field is formed.
  - Where static electricity, relay noise or the like is generated.
- Install as far away as possible from equipment generating high frequency, high voltage, large current, surge, etc. Perform wiring of cables separately from these power lines. Do not perform parallel wiring and identical wiring.
- Do not use the product if damaged.

### Caution on wiring

- Tighten the screws for the signal input/output terminals at the specified torque.  
If they are loose, shorts, fire or malfunctions may occur.  
Tightening torque: 0.5N•m
- For external inputs/outputs, RS-232C and options, use shielded cables.
- The temporary overvoltage applied to the power should not exceed 1500V.

### Caution during startup and maintenance

- For turning on/off the power, be sure to keep intervals of 5 seconds or more.
- Use after warming up for 30 minutes or longer following the startup of power supply.
- If the TM500 is not used by the specified method, its protective performance may be impaired.
- Maintenance
  - When performing maintenance, disconnect the power.
  - Do not wipe with a wet rag, or with benzine, thinner, alcohol, etc. Doing so may cause discoloration or deformation of the TM500. In the case of heavy contamination, wipe off the contamination with a cloth after dipping it into a diluted neutral detergent and wringing it well, and then wipe with a soft, dry cloth.

**CAUTION**

This sign forewarns the presence of hazards that could result in personnel injury or property damage when incorrectly handled.

**Caution during transportation**

- When the TM500 is shipped, spacers made of corrugated cardboard are used as cushioning materials.

Though it is factory-designed so that shocks can sufficiently be absorbed, breakage may result if shocks are applied when the spacers are reused for transportation. If you send the TM500 to us for repair, etc., take adequate measures against shocks by using polyurethane materials, etc., separately.

**Caution during disposal**

- If you dispose of the product, handle it as industrial waste.

## About the Built-in Lithium Battery

**WARNING**

This sign forewarns the presence of hazards that could result in serious injury or fatality when incorrectly handled.

- Never disassemble, deform under pressure or throw the battery into fire. The battery may explode, catch fire or leak.

- Battery

Model:	BR2450A made by Panasonic Corporation Energy Company
Nominal voltage:	3V
Nominal electric capacity:	550mAh
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, cadmium, 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).

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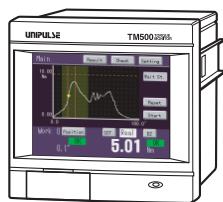
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# 1 OUTLINE

## 1-1. Contents of the package

The packaging box contains the following.

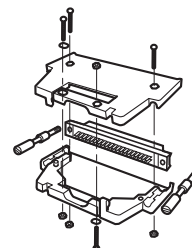
Be sure to check them before use.



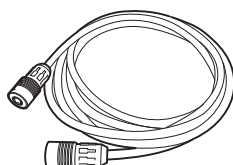
TM500 body . . . 1



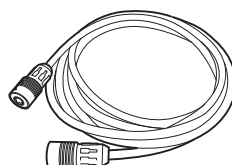
TM500 operation manual . . . 1



External input/output  
connector . . . 1set  
[Connector : FCN-361J040-AU]  
[Cover : FCN-360C040-B]



Cable for UTMII  
connection (Black: 2m) . . . 1  
(with connector)



Cable for rotary encoder  
connection (Gray: 2m) . . . 1  
(with connector)



SD card . . . 1  
\* When the SDC option  
is mounted.

The following is optionally available. Cable for UTMII connection (2m) . . . 1  
- RS-232C cable (cross)[CA81-232X]

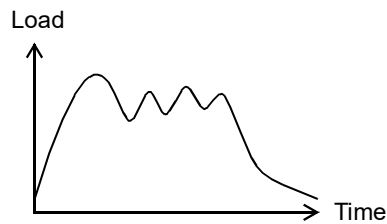
## 1-2. Features

TM500 is a torque monitor that enables waveform display of changes in torque with respect to displacement (mainly angles), combined with UTMII series with optional rotary encoder. Changes in torque that are hard to grasp numerically can be grasped visually on waveform display.

With the color liquid crystal touch panel display adopted, twists have been provided in many places by thoroughly paying attention to ease of understanding so that all operations can be performed without the instruction manual. Also, having a high-speed processing capability of 4,000 times/sec ready for fine changes in values, and being equipped with the waveform display, HI/LO limit comparison and other various hold and judgment functions, it can be used for a wide range of applications, such as in production control systems, automatic equipment, and testing machines.

### ● Drawing of torque-angle waveforms

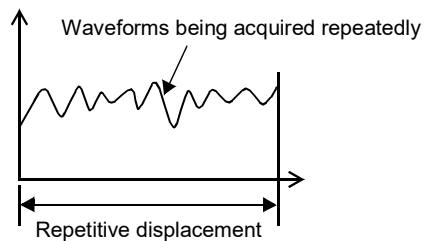
Waveforms of torque with respect to angles at low rotation, linear motion application can be drawn.



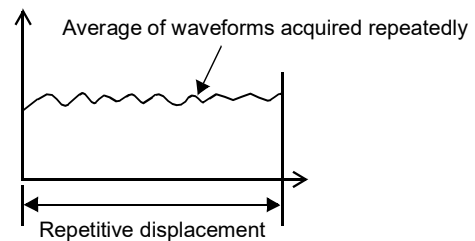
### ● Repetitive drawing of waveforms

For applications with large fluctuation or low repeatability, inspection can be repeated several times for judgment.

#### < In case of continuous >



#### < In case of average >



### ● Measurement waveform control as divided by using the hold function

A measurement waveform can be divided into up to five sections, and the waveform can be judged on each section by specifying each HI limit, LO limit, and method of judgment.

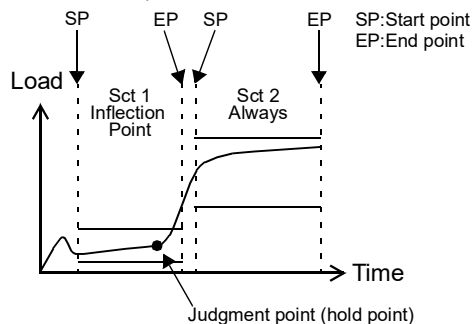
Each section can be specified by Setting (time or displacement) or external input signal "Hold."

The method of judgment can be changed by selection under "Use Hold."

Judgment point(s) can be kept depending on the selection under "Use Hold."

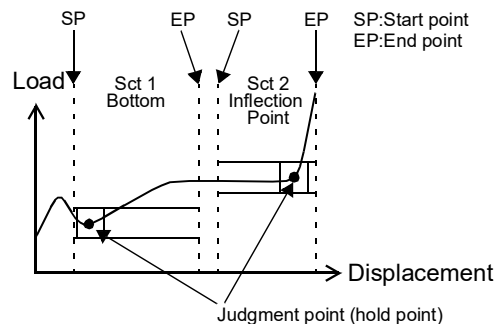
#### < In case of time >

Section Start-End specified by time or external input



#### < In case of displacement >

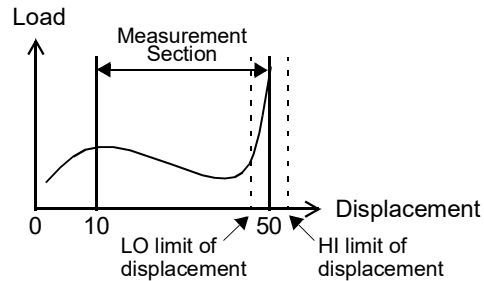
Section Start-End specified by displacement or external input



### ● Control of the position at the measurement completion

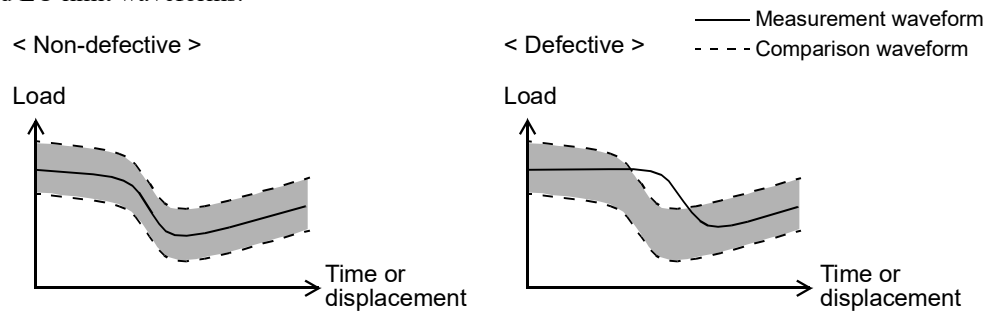
The position of the measurement completion can be judged by using the End Displacement for the Use Hold.

The End Displacement is different from other hold types, so it judges not based on a wave starting point but based on an original point of the displacement.



### ● Entire waveform control by using the waveform comparison function

Comparisons can be made to judge whether or not a measurement waveform is between HI limit and LO limit waveforms.

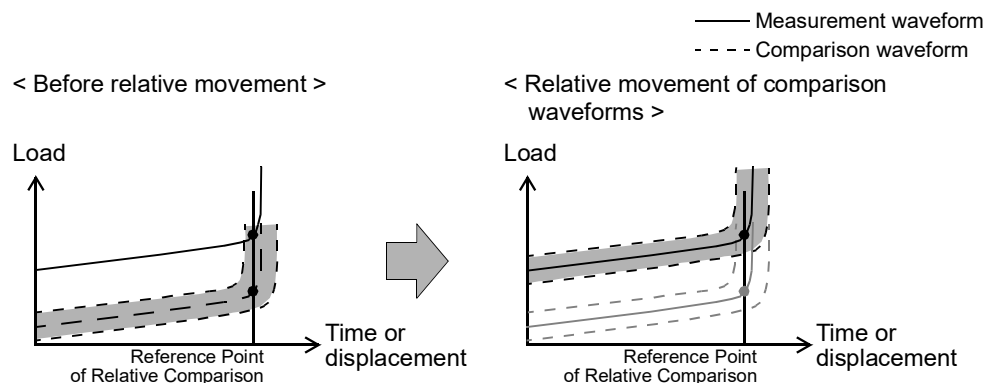


### ● Measurement-waveform-following control by using the relative comparison function

Waveforms fluctuating up and down with each measurement can be relatively compared.

By this function, comparison waveforms are relatively moved according to the load at the Reference Point of Relative Comparison, which should previously be set by time or displacement, on a measurement waveform.

\* Relative movement can only be made in the Y-axis direction.



### ● Change of the control reference to the point at which loading is started or the point at which it is finished

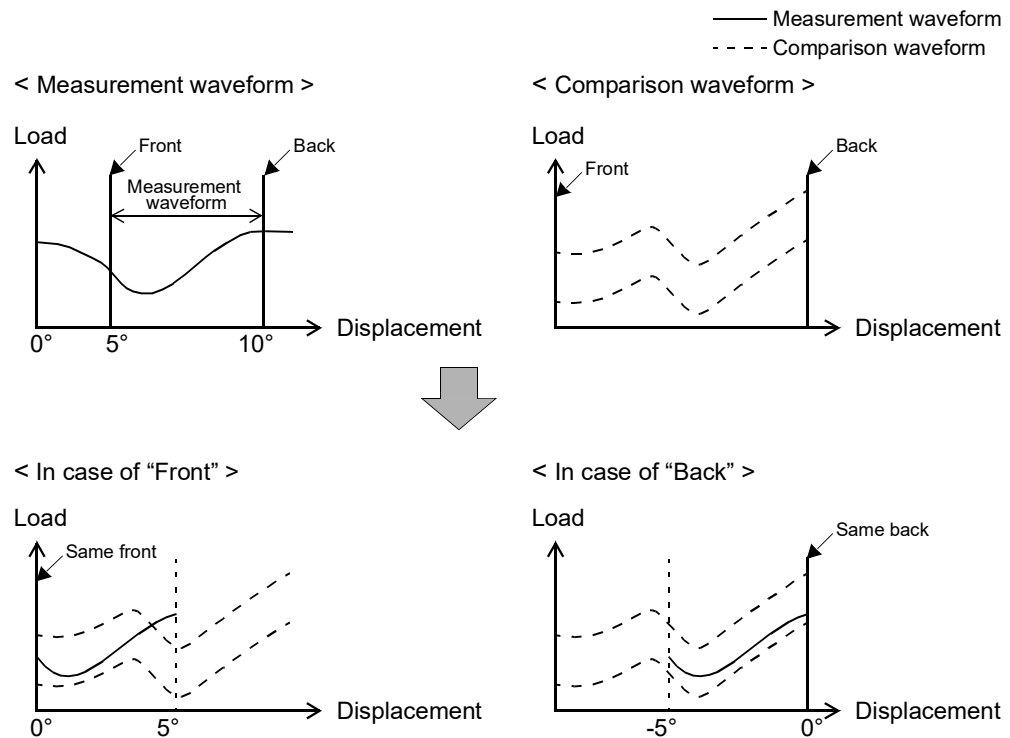
In the case where the X-axis of the waveform represents displacement, the reference for the hold function and waveform comparison function can be selected from either the measurement start point or measurement stop point.

For the measurement start point and measurement stop point, set “Front” and “Back,” respectively, as “Waveform Reference.”

Normally, “Front” is used; however, use “Back” if displacement of the measurement stop point is set as reference.

\* In case of “Front”, the waveform of which 0 is the measurement start point is displayed.

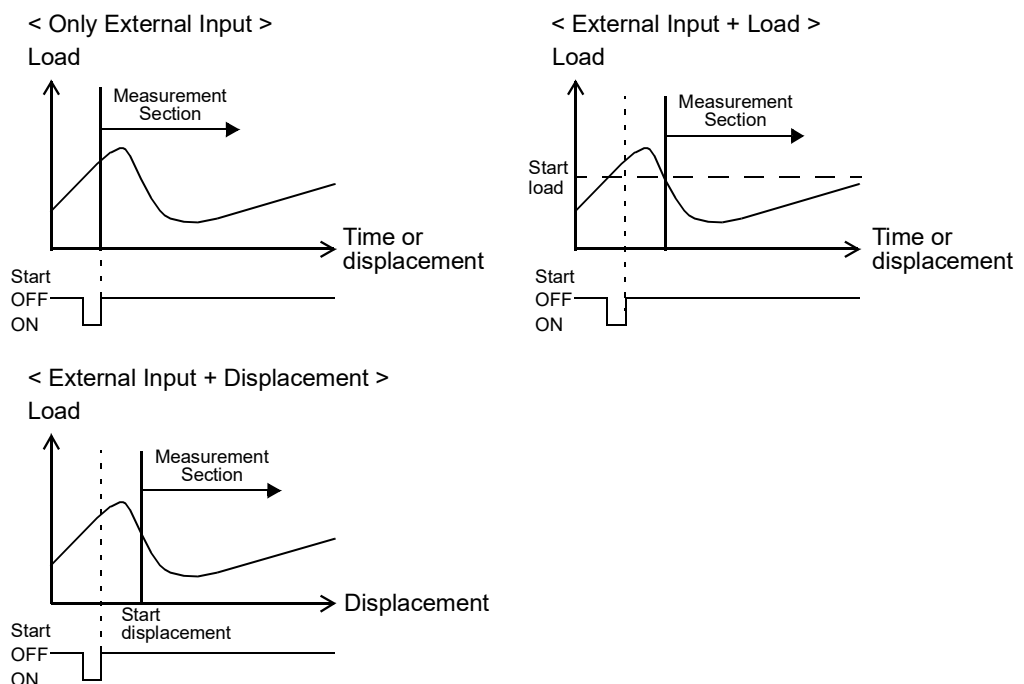
In case of “Back”, the waveform of which 0 is the measurement stop point is displayed.



### ● Various measurement start and stop conditions

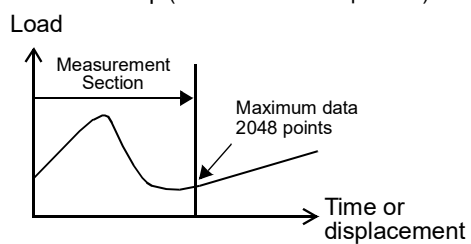
Measurement start and stop conditions can be selected according to application.

#### - Measurement Start Condition

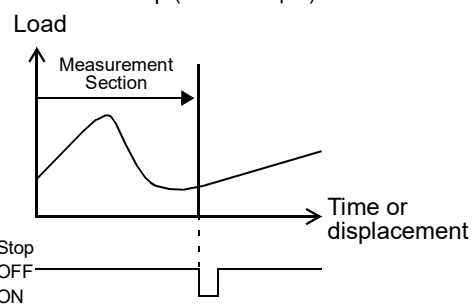


## - Measurement Stop Condition

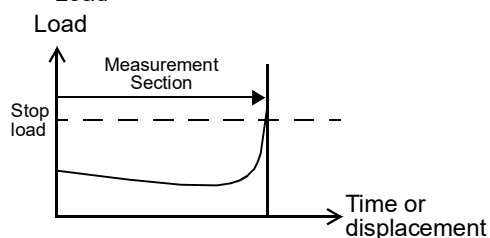
## &lt; Forced-Stop (maximum data acquisition) &gt;



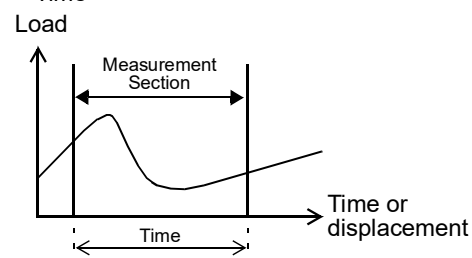
## &lt; Forced-Stop (external input) &gt;



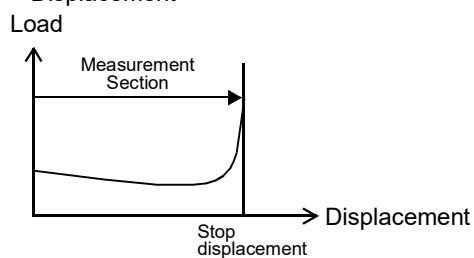
## &lt; Load &gt;



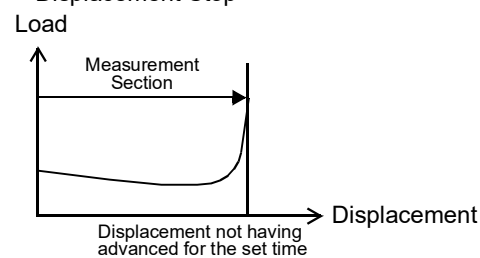
## &lt; Time &gt;



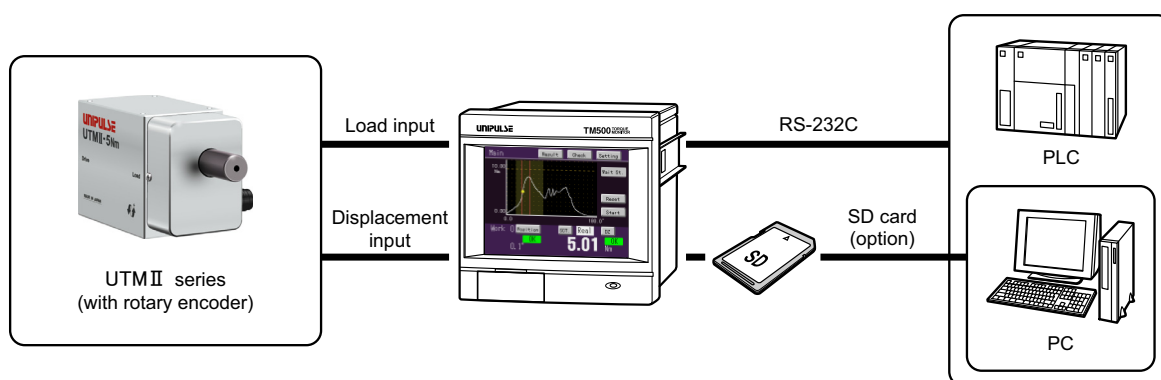
## &lt; Displacement &gt;



## &lt; Displacement Stop &gt;

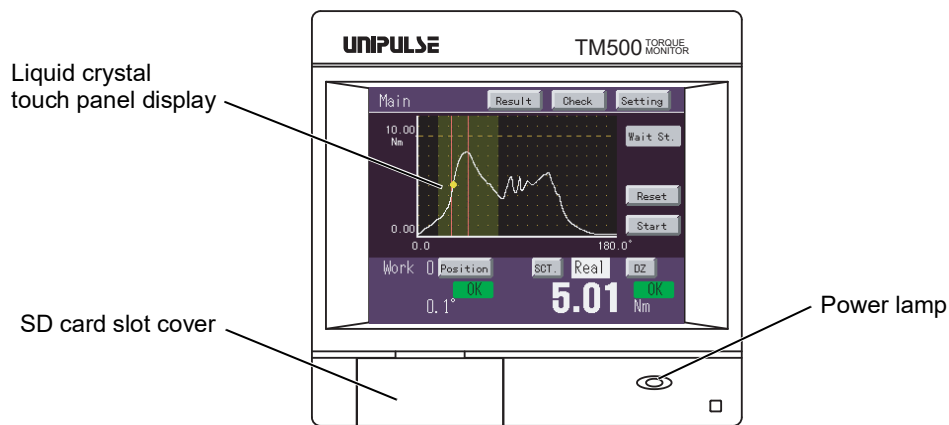


## 1-3. About connectable devices



# 1-4. Part names and functions

## ■ Front panel



### Liquid crystal touch panel display

Indicated values and graphs are displayed, and various items are set on this liquid crystal touch panel display.

### SD card slot cover

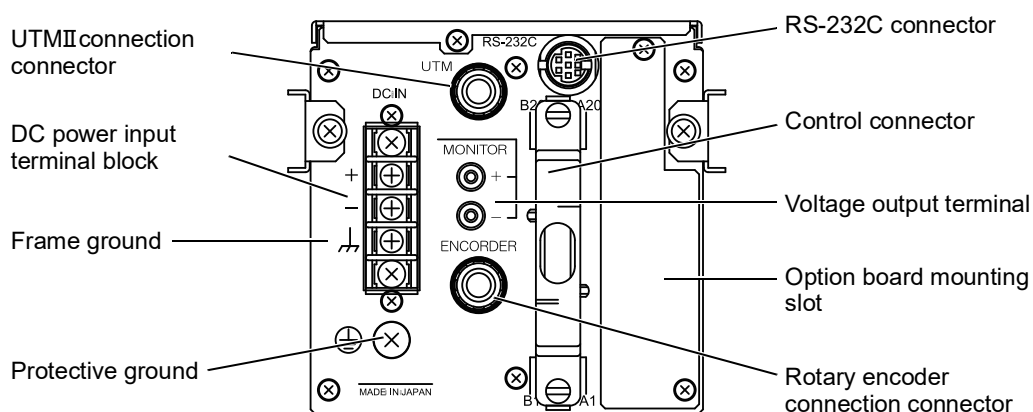
When the SD card slot option is mounted, insert/eject an SD memory card from here.

### Power lamp

This lamp indicates the power and internal processing status.

Lamp condition	Power and internal processing status
Lights (green)	Power ON
Flashes (red)	Writing in the internal NOV RAM (nonvolatile memory); or processing with an SD memory card when the SD card slot option is mounted. Do not turn off the power of the main unit while this lamp is flashing.
Flashes (yellow)	The voltage of the lithium battery for internal memory backup has dropped. The battery needs to be replaced. Ask us for replacement of the battery.

## ■ Rear panel



### DC power input terminal block

Connect the DC power cord. The power supply voltage is 24V DC ( $\pm 15\%$ ).

### Frame ground

Please ground the frame ground terminal to prevent failures due to static electricity.

(The frame and the frame ground terminal are conducted.)

It may be better to remove depending on the environment of the installation location.

### Protective ground

Be sure to ground the protective ground terminal to prevent electric shocks.

### UTMII connection connector

Connect a UTMII with a dedicated cable.

### Rotary encoder connection connector

Connect a UTMII rotary encoder with a dedicated cable.

### Voltage output terminal

Input voltage from the UTMII can be checked.

(This terminal is directly connected to the UTMII voltage output terminal.)

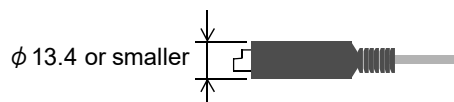
### RS-232C connector

RS-232C connector to transmit/receive measurement data and status information, etc.

The adaptable plug is HOSIDEN-manufactured TCP8080-015267 or equivalent (\*).

Optionally available RS-232C cable (cross) [CA81-232X] is connectable.

(\*) Note, however, that the external diameter of connector must be smaller than  $\phi 13.4$ .





## Control connector

Connector to input external signals and output control signals.

The input/output and internal circuits are photocoupler-isolated electrically.

Input: Plus common/minus common shared

Output: Sink type

The adaptable connector is manufactured by FUJITSU COMPONENT.

Connector: FCN-361J040-AU (attachments) or equivalent.

Cover: FCN-360C040-B

## Option board mounting slot

This slot is not in use as it is for future extension.

# 1-5. Terms

Terms used in this manual are explained below.

### - Load

Analog and digital values of torque meter (UTMII) input are expressed as load.

### - Displacement

Analog and digital values of rotary encoder input are expressed as displacement.

### - Waveform comparison

Checking to see if the acquired waveform is between the HI limit and LO limit waveforms having been prepared in advance is called waveform comparison.

### - Hold function

Controlling a measurement waveform by dividing it into up to five sections and specifying the method of judgment for each section is called the hold function.

Judgment point(s) can be kept depending on the selected method of judgment (“Use Hold”).

### - Measurement

Acquiring a waveform from the start until it stops is called measurement.

### - Waveform reference

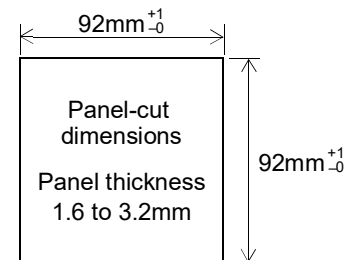
A reference point is required for controlling a measurement waveform. Such a reference point for controlling a measurement waveform is called the waveform reference. The reference can be the measurement start point or measurement stop point.

# 2 INSTALLATION AND CONNECTION

## 2-1. Installation

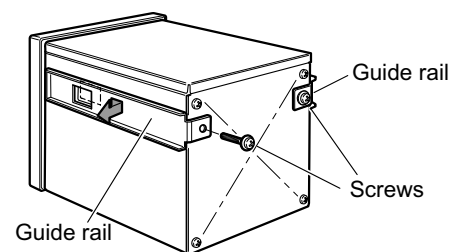
To install the TM500 into a control panel, use the following procedure.

1. Make a hole in the panel according to the panel-cut dimensions.

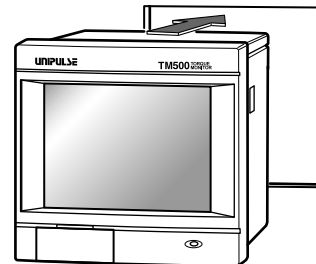


2. Remove the screws (two), and remove the guide rails from both sides.

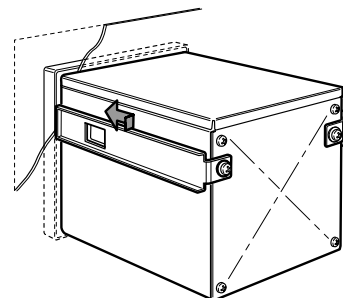
\* Do not use other screws than those installed to the TM500 body.



3. Fit in the TM500 from the front of the panel.



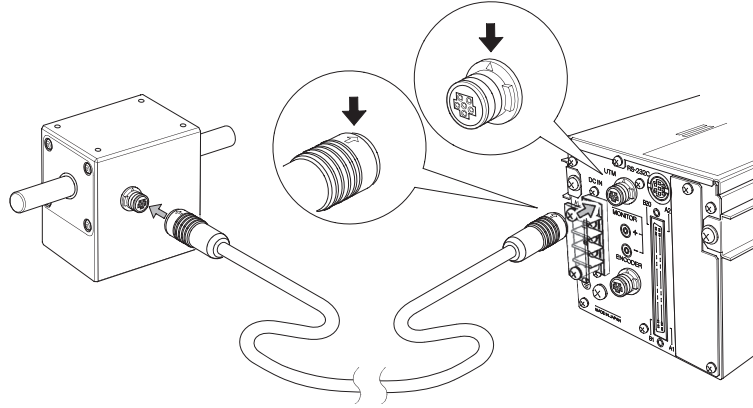
4. Install from the rear the guide rails having been removed from both sides in Step 2, and fix them with the screws (two).



## 2-2. Sensor connection

### ■UTMII connection

A UTMII can easily be connected with the attached dedicated cable. The cable is nonpolar. Connect paying attention to the orientation of the connector.



#### ●Pin assignments

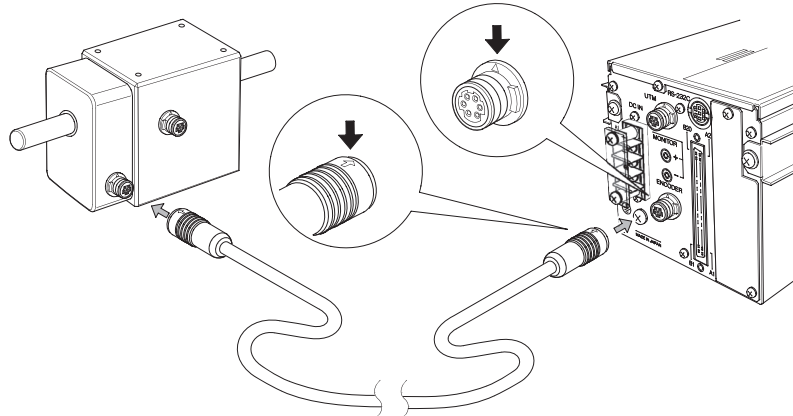
Pin arrangement	Pin No.	Cable color	Signal name
	1	Red	PWR + (+24V)
	2	Black	PWR – (0V)
	3	Green	SIG IN ( $\pm 5V$ DC)
	4	White	SIG GND
	5	Yellow	(Unused)
	6	Brown	(Unused)
	Shield	Braided wire	* The shield is not connected to the UTMII housing.

\* The wiring colors are those of the cable attached to the UTMII.

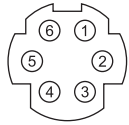
\* Compatible connector: HR30-6P-6P (HIROSE) (connector optional type: CN90)

### ■Rotary encoder connection

A UTMII rotary encoder can easily be connected with the attached dedicated cable. The cable is nonpolar. Connect paying attention to the orientation of the connector.



## ● Pin assignments

Pin arrangement	Pin No.	Cable color	Signal name
	1	—	NC
	2	Red	PWR + (+5V)
	3	Transparent	Z-phase input (Unused)
	4	Black	B-phase input
	5	Blue	A-phase input
	6	Shield (Green)	PWR GND

\* The wiring colors are those of the cable attached to the UTMII rotary encoder.

\* Compatible connector: HR30-6P-6S (HIROSE) (connector optional type: CN91)

## ■ Voltage output

The monitor output terminal is directly connected to the UTMII voltage output terminal.

Input voltage from the UTMII can be checked with voltmeter probe, etc.

Since the output voltage is taken out in a step prior to A/D conversion of the sensor input signal, it is not synchronized with indicated values processed digitally, such as Digital Zero and digital filter.

The  $\pm$ MONITOR terminals are not insulated from the internal circuit.

Use terminal: C-55-111A (manufactured by Miraial or an equivalent)  $\phi 2$ , Depth: 6mm

Compatible terminal: C-55-155B (manufactured by Miraial or an equivalent)

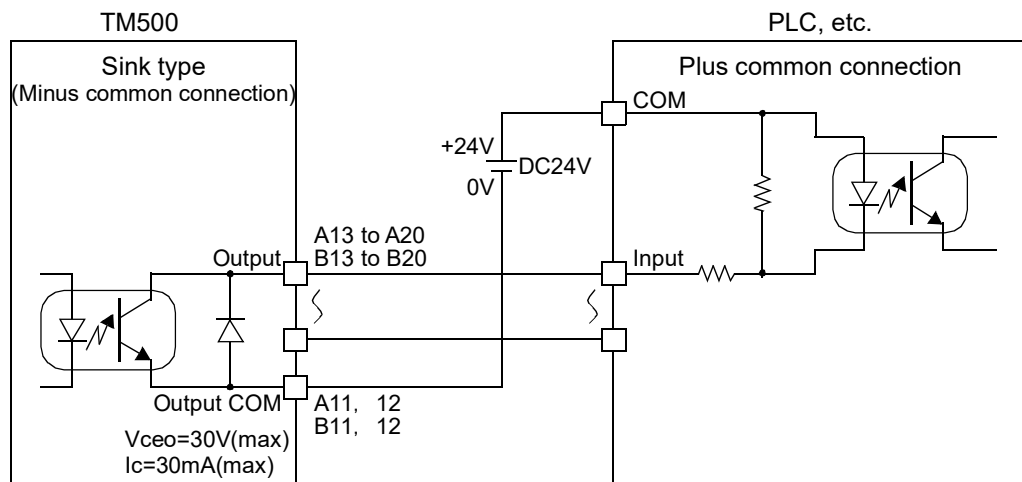
## ⚠ CAUTION

- Do not short-circuit. Doing so will cause a failure.
- Do not apply voltage externally. Doing so will cause breakage.

## 2-3. External control equipment connection

External input signals can be connected to sink type or source type; however, external output signals can be connected to sink type only.

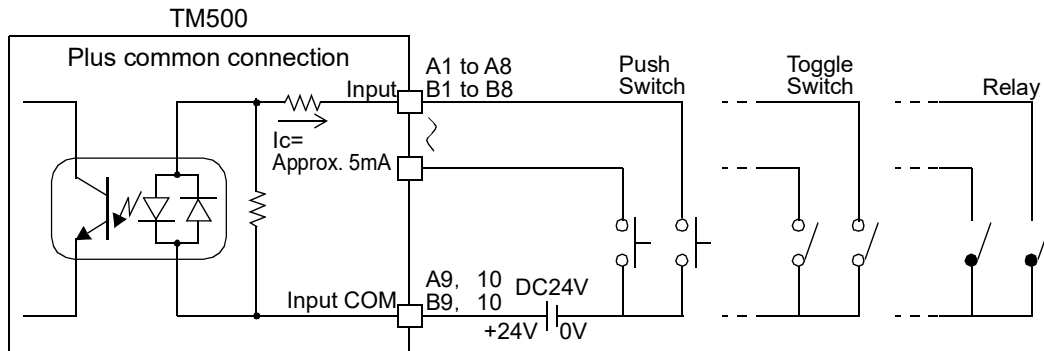
## ■ External output equivalent circuits and example connections (sink type)



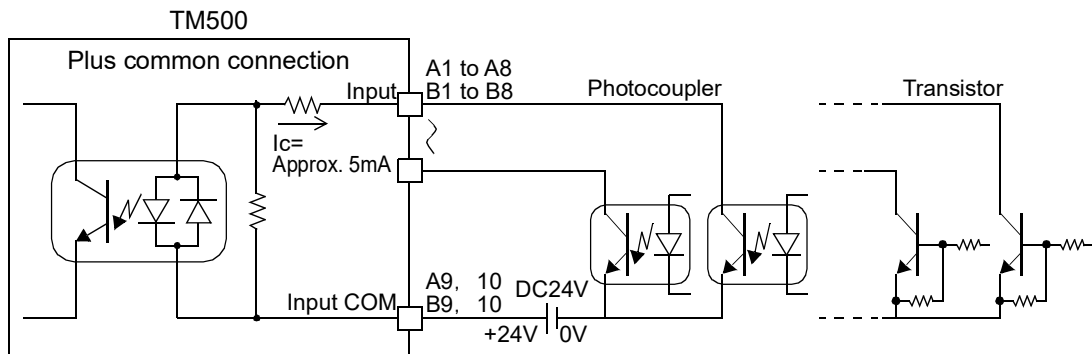
## ■ External input equivalent circuits and example connections (Plus common/minus common shared)

### - In case of plus common connection

When you connect the relay and the switch, etc.

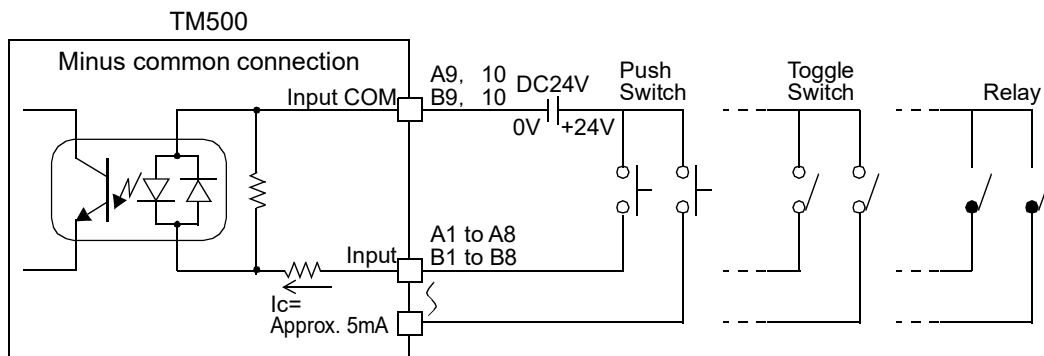


When you connect the transistor and the photocoupler, etc.

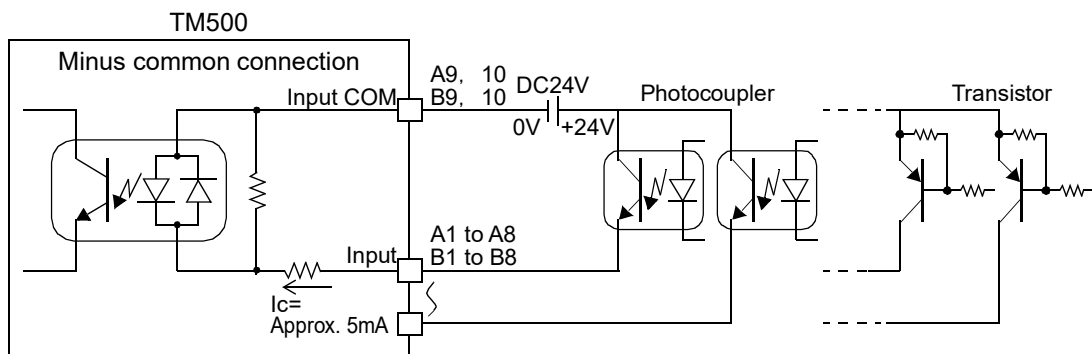


### - In case of minus common connection

When you connect the relay and the switch, etc.



When you connect the transistor and the photocoupler, etc.

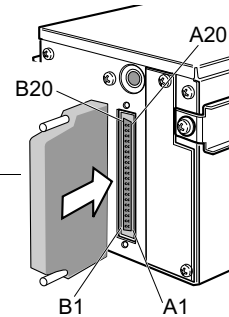


**Attention**

Connect elements that can pass  $I_c=10\text{mA}$  or more.  
The leak current of the elements connected should be  $400\mu\text{A}$  or less.

**Connector pin assignments**

The adaptable connector  
Connector: FCN-361J040-AU (attachments)  
Cover: FCN-360C040-B (attachments)



A1	IN	Load Digital Zero			B1	IN	Work 1	
A2	IN	DPM Positioning			B2	IN	Work 2	
A3	IN	Start			B3	IN	Work 4	
A4	IN	Stop			B4	IN	Work 8	
A5	IN	Hold			B5	IN	N.C	
A6	IN	Reset			B6	IN	N.C	
A7	IN	Backlight On			B7	IN	N.C	
A8	IN	Prohibit Touch Panel			B8	IN	N.C	
A9	IN	COM (Input)	Plus common connection: +24V Minus common connection: 0V		B9	IN	COM (Input)	Plus common connection: +24V Minus common connection: 0V
A10	IN	COM (Input)	Plus common connection: +24V Minus common connection: 0V		B10	IN	COM (Input)	Plus common connection: +24V Minus common connection: 0V
A11	OUT	COM (Output)	Sink type: 0V		B11	OUT	COM (Output)	Sink type: 0V
A12	OUT	COM (Output)	Sink type: 0V		B12	OUT	COM (Output)	Sink type: 0V
A13	OUT	Hold Result	Load	LO <sup>[1]</sup>	B13	OUT	Wave Result	LO <sup>[1]</sup>
A14	OUT			OK <sup>[1]</sup>	B14	OUT		OK <sup>[1]</sup>
A15	OUT			HI <sup>[1]</sup>	B15	OUT		HI <sup>[1]</sup>
A16	OUT		DPM	LO <sup>[1]</sup>	B16	OUT	Complete <sup>[1][2]</sup>	
A17	OUT			OK <sup>[1]</sup>	B17	OUT	Run	
A18	OUT			HI <sup>[1]</sup>	B18	OUT	Load OK	
A19	OUT	Overload			B19	OUT	DPM OK	
A20	OUT	N.C			B20	OUT	SD OK	

\* Input COM and Input COM, Output COM and Output COM are internally connected.

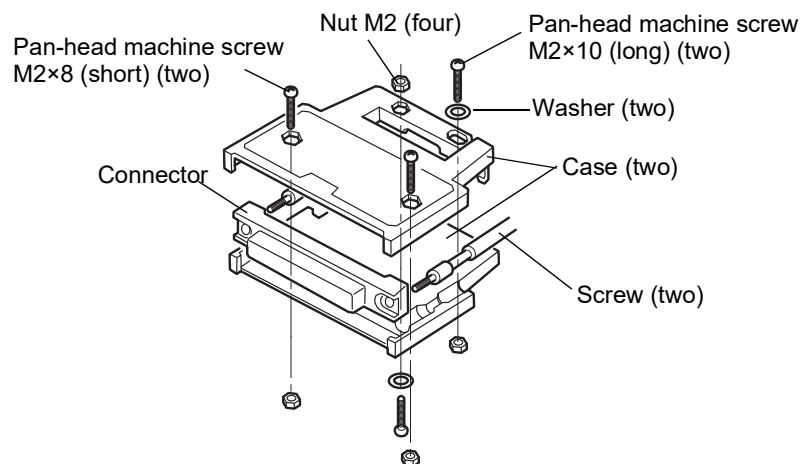
\* Input COM and Output COM are internally isolated.

\* Input COM and the frame (frame ground), Output COM and the frame (frame ground) are connected with the capacitor.

[1] There is a judgment (NG judgment) which all of the judgment outputs LO, OK and HI are not set to on. Please fetch the outputs in synchronization with the Complete output is changed from OFF→ON. (See Page 17 "- Input signal timing check" )

[2] Please confirm turning OFF and ON(OFF→ON) of the Complete output at every measurement to confirm the measurement has been updated.

## ■ How to assemble the connector

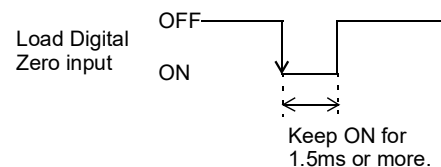


1. Set the connector and screws (two) into the grooves of the case (one side).
2. Cover with the other case, and fit the cases.
3. Tighten the M2×8 pan-head machine screws (two).  
Tighten the M2×10 pan-head machine screws (two).  
Be aware that washers should be set to the M2×10 pan-head machine screws (two).

### Input signals

#### - Load Digital Zero

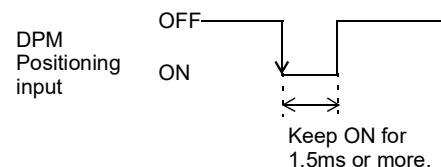
It should normally be wired. Perform Digital Zero by unloading the torque meter before measurement to simply adjust the deviation of the zero point of the load by temperature drift, etc. The load is zeroed by turning the signal from OFF to ON. As long as the signal is ON, the Load OK output is kept OFF.



\* Digital zero value is cleared when the power supply is turned on. If you want to maintain digital zero value, Please do zero calibration instead.

#### - DPM Positioning

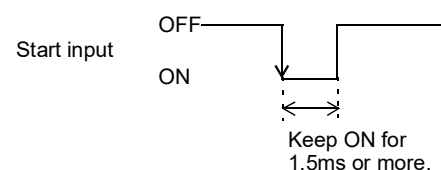
It should be wired according to application. Use it for adjusting the zero point of displacement just before measurement start.



It is not used if the X-axis of the waveform represents time or the zero point of displacement does not need to be adjusted. By turning the signal from OFF to ON, displacement is brought to the DPM Positioning set value, and the internal counter of the pulse input is cleared. As long as the signal is ON, the DPM OK output is kept OFF.

#### - Start (\*1)

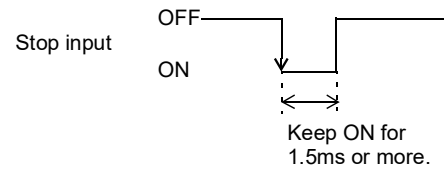
It should normally be wired. Use it for starting measurement. By turning the signal from OFF to ON when the Start signal input is waited for, a “Wait Off” state is brought about, and the Hold Result, Wave Result, Complete, Load OK, and DPM OK outputs are turned OFF. By turning the



signal from ON to OFF, a “Wait Lv.” State is brought about, or the measurement is started according to the Measurement Start Condition.

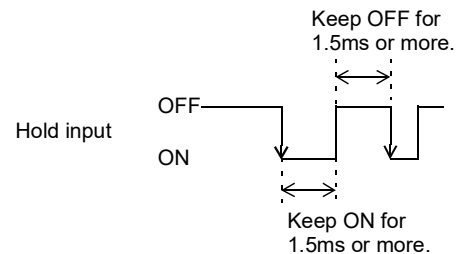
#### - Stop

It should normally be wired. Use it for stopping measurement. By turning the signal from OFF to ON during measurement, the measurement is stopped.



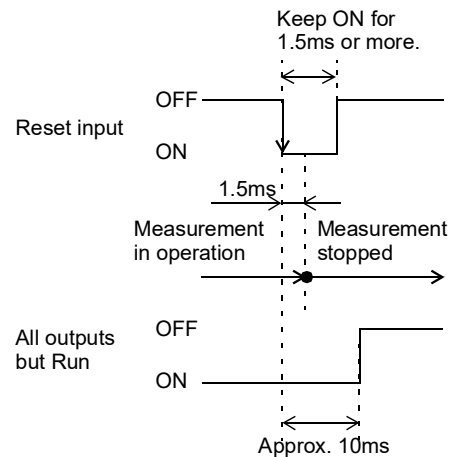
#### - Hold

It should be wired according to application. Use only for using the section control function by External Input. It is not used if the hold function is not used or Change of Section is made by Setting. By turning the signal from OFF to ON, the hold section is changed.



#### - Reset (\*1)

It should normally be wired. Use it for releasing some errors, etc., in emergencies. Irrespective of the measurement status, by turning the signal from OFF to ON, the Hold Result, Wave Result, Load OK, and DPM OK outputs are turned OFF, and a “Wait St.” state is brought about. If the Reset signal is turned from OFF to ON during measurement, the measurement is forcibly stopped and the measurement data is annulled. For keeping the data, check the data after completion of the measurement, and then turn the Reset signal from OFF to ON.



#### - Prohibit Touch Panel (\*1)

It should be wired according to application. Use it for controlling so as to prevent touch panel operations. As long as the signal is ON, no operation can be performed with the touch panel.

#### - Backlight On (\*1)

It should be wired according to application. Use it for controlling the backlight externally. By turning the signal from OFF to ON, the backlight lights up. As long as the signal is ON, the backlight stays ON.

#### - Work (\*1)

It should be wired according to application. Use it for using two or more work Nos. It is not used if only work No. 0 is used. Specify work No(s). to be used before measurement.

#### - COM (Input)

It should always be wired if input signals are used. It is a common terminal to input signals. Input COMs are internally connected.

\*1 These data are only effective when “External input” is selected at Priority of level input signal.



## Output signals

### - Hold Result (Load/DPM)

It should be wired according to application. Use it for acquiring judgment results by using the hold function. If displacement needs to be judged, also use DPM. It is not used if the hold function is not used. Hold results are output.

LO: Turns ON when the hold result falls below the LO limit, and the output is held.

HI: Turns ON when the hold result exceeds the HI limit, and the output is held.

OK: Turns ON when judgment is made during measurement and the LO and HI outputs are not ON after completion of the measurement. OK will not turn ON if no hold is made for the specified Number of Use Sections.

### - Overload

It should be wired according to each application. Use Overload to stop the equipment in case of emergency due to the excess load applied to the sensor. Irrespective of the measurement status, it turns ON at the Overload. It turns OFF, when the Overload is released.

### - Complete

It should normally be wired. Use it for recognizing the completion of measurement. It turns ON when the measurement is completed.

### - Wave Result

It should be wired according to application. Use it for acquiring judgment results by using the waveform comparison function. It is not used if the waveform comparison function is not used. Waveform comparison results are output.

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

HI: Turns ON when the waveform comparison result exceeds the HI limit, and the output is held.

OK: Turns ON when the Compare Area is passed through during measurement and the LO and HI outputs are not ON after completion of the measurement. OK will not turn ON if the measurement does not reach the Compare Area or the Reference Point of Relative Comparison when Relative Comparison is made.

### - Load OK

It should normally be wired. Use it for recognizing the abnormality of the torque meter. It is normally ON. It turns OFF with a sensor error (sensor  $\pm$ error), or display error ( $\pm$ OVER), or when load exceeds the Overload or when the Load-Digital-Zeroed value exceeds the Digital Zero Limit. It also turns OFF when the Start, Reset, or Load Digital Zero signal is ON.

### - DPM OK

It should be wired according to application. Use it if the X-axis of the waveform represents displacement. It is not used when the X-axis of the waveform represents time. It turns OFF when measuring points of 10 data or more are skipped because the pacing of displacement is too fast. It also turns OFF when the Start, Reset, or DPM Positioning signal is ON.

### - Run

It should normally be wired. Use it for confirming that the CPU is running normally.

When the CPU is running normally, switching between ON and OFF is done about every 0.5 sec. If it is ON or OFF for a few seconds, there may be something wrong.

### - SD OK

It should be wired according to application. Normally use it if the SD card slot option is used. It turns OFF with a memory card error\*<sup>1</sup>, or when the measurement start input OFF→ON is ignored because a measurement waveform is not saved in time while being saved automatically\*<sup>2</sup>. It also turns OFF when the Start or Reset signal is ON.

\*1 It does not turn ON until the error is cleared.

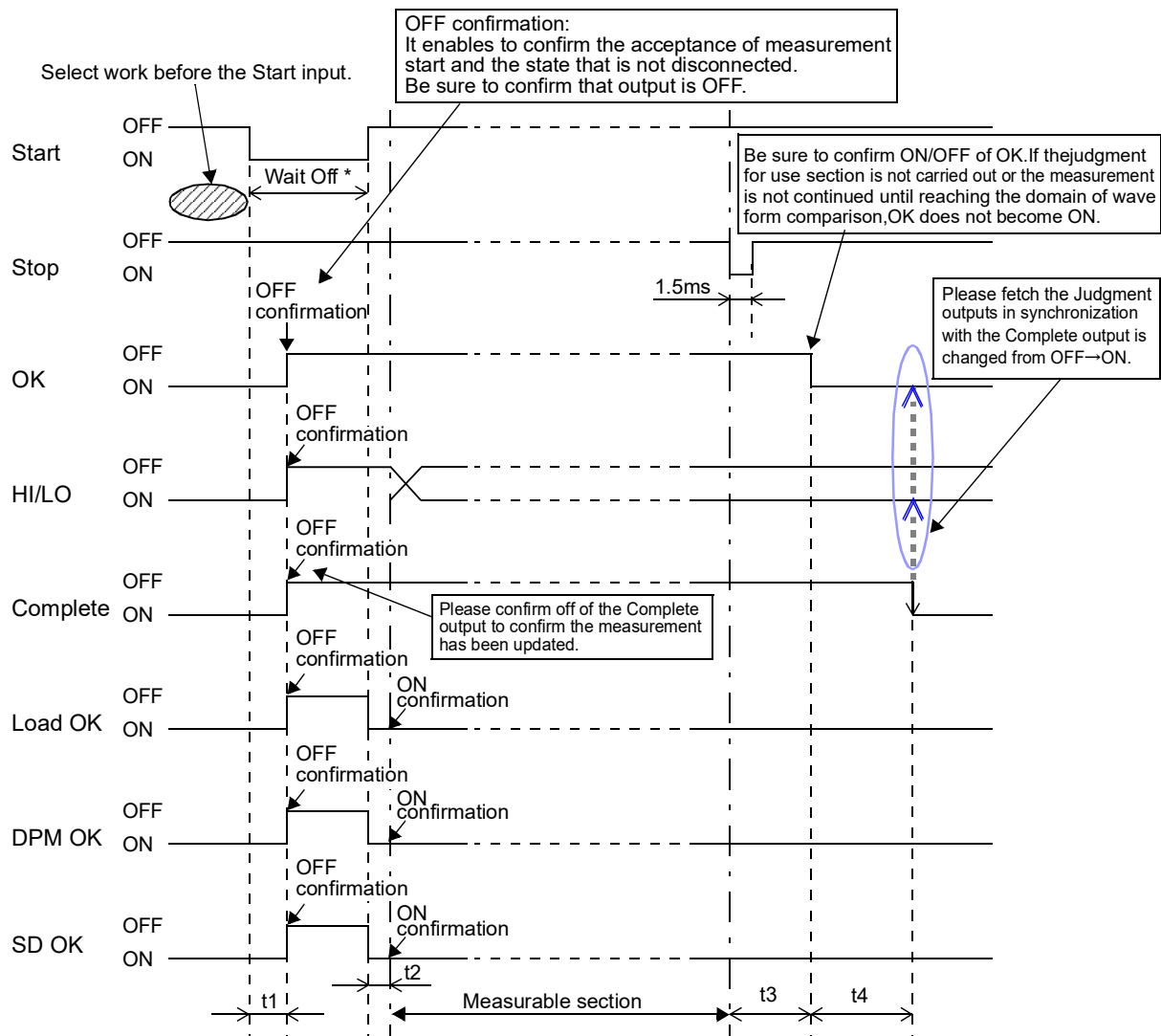
\*2 It is reset by starting measurement being saved in time.

### - COM (Output)

It should always be wired if output signals are used. It is a common terminal to external outputs. Output COMs are internally connected.

### - Input signal timing check

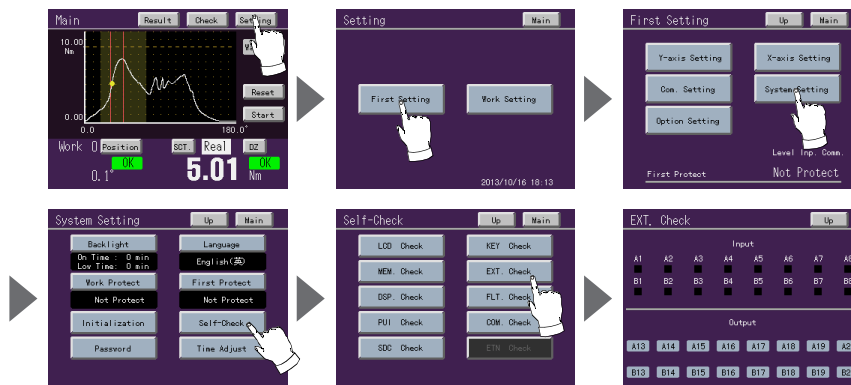
Before measurement, properly check the timing of input/output signals.



t1: Delay time between the instant when the Start input is turned ON and the instant when all outputs but Run are turned OFF ... Approx. 5ms

- t2: Delay time between the instant when the Start input is turned OFF and the instant when the measurable section is started ... 1.5ms  
(However, it varies depending on the Measurement Start Condition.)
- t3: Delay time between the instant when the measurement is stopped (the Stop input is turned ON) and the instant when the Result output is turned ON ... Approx. 50ms  
(However, there are differences between measurements.)
- t4: Delay time between the instant when the Result output is turned ON and the instant when the Complete output is turned ON ... Approx. 30ms
- \* Be sure to check that the output is OFF, and then turn OFF the Start input.

## How to check wiring



### Operation

Main screen → Setting → First Setting → System Setting → Self-Check → EXT Check

### Output

Press the output signal key, and check that there is input to the connected equipment.  
(Pressing the key turns ON the output.)

### Input

Turn ON the output of the connected equipment.  
The pin recognized by the TM500 turns yellow.

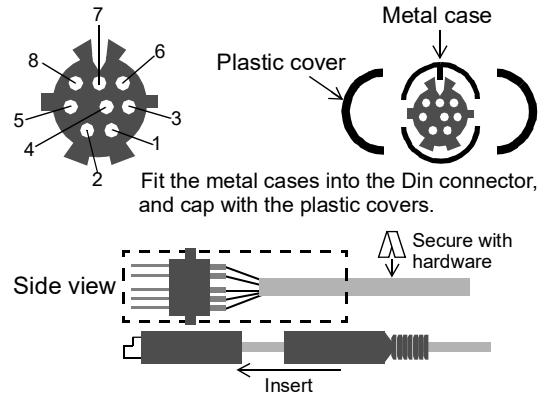
## 2-4. RS-232C Connection

### ■ Connector Pin Assignment

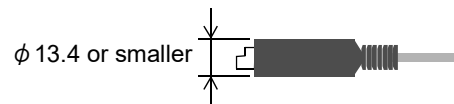
The adaptable connector is manufactured by Hosiden Corporation TCP8080-015267 or equivalent (\*).

Pin No.	Signal name
1	DCD
2	RXD
3	TXD
4	DTR
5	GND
6	DSR
7	RTS
8	CTS
Case	F.G.

Wire connection surface



(\*) Note, however, that the external diameter of connector must be smaller than  $\phi 13.4$ .



### ■ Communication establishment procedure

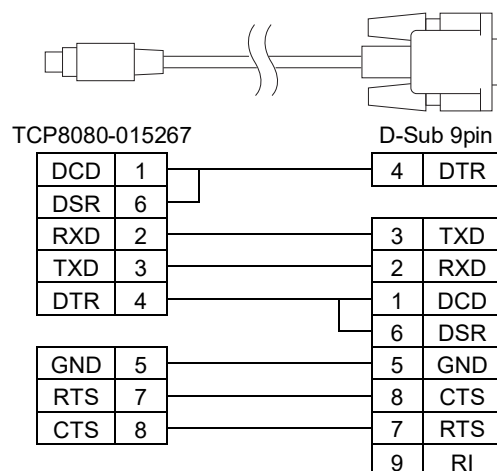
#### 1. Connect the cable.



For connection with DTE (data terminal equipment), such as a PC, use optionally available RS-232C cross cable (CA81-232X).

For connection with DCE (data circuit-terminating equipment), such as a modem, use optionally available RS-232C straight cable (CA81-232S).

When connecting RS-232C cross cable [CA81-232X].



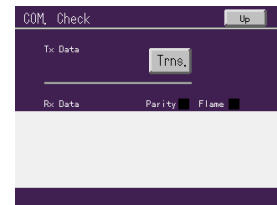
**2.** Coordinate the communication settings with the equipment connected.

- Transmission Speed      - Data Bit      - Stop Bit      - Parity Bit
- Header      - Flow Control      - Delimiter

**3.** Set the Communication Mode to Normal. (The default is Normal.)

## Operation

Main screen → Setting → First Setting → Com. Setting → Com. Mode

**4.** Go to the COM. Check screen under Self-Check.

## Operation

Main screen → Setting → First Setting → System Setting → Self-Check → COM. Check

**5.** Transmit any statement from the equipment connected.

(Check only when the Communication Mode is Normal.)

The data received by the TM500 is displayed.

Check that the transmitted data is displayed.

If the Parity or Frame lights in red and the data is not displayed properly, go back to Step 1 or 2, and check again the cable or communication settings.

**6.** Press the Trns. Key.

Pressing the Trns. key transmits the statement having the same contents as the display reading.

Check that it can be received properly on the side of the equipment connected.

If not, go back to Step 1 or 2, and check again the cable or communication settings.

**7.** Set again the Communication Mode according to application.

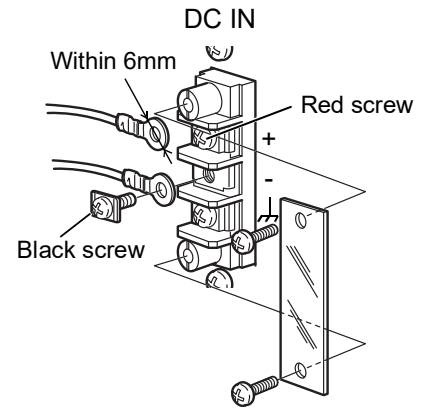
## Operation

Main screen → Setting → First Setting → Com. Setting → Com. Mode

## 2-5. Power-on

Connect the DC power cord. (24V DC ( $\pm 15\%$ ) 24W)

1. Check that no power is applied.
2. Remove the screws (two), and remove the terminal block cover.
3. Remove the screws (two) from the terminal block.
4. Fit the crimp contacts to the screw holes, and fix them with the screws.  
Carry out wiring from the silk-screen-printed side.  
+: Red screw  
-: Black screw



5. Install the terminal block cover, and fix it with the screws (two).

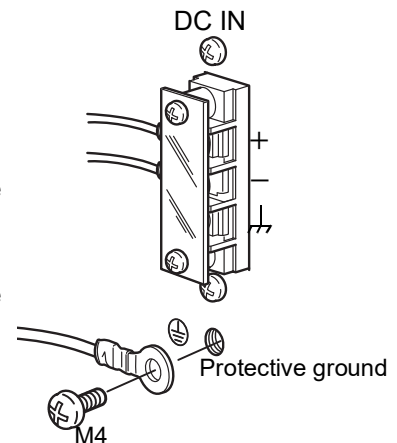
### Attention

Be aware that the voltage drops depending on the wire thickness and length.  
Also, never input an AC power source. Doing so will cause a failure.

## 2-6. Protective Ground Connection

The grounding terminal is for prevention of electric shocks.  
Use an approx.  $0.75\text{mm}^2$  thick wire, and be sure to ground.

1. Make sure that no power is applied.
2. Remove the screws(M4) at the protective ground.
3. Align the solderless terminals(M4) with the screw holes, and then tighten the screws.



### CAUTION

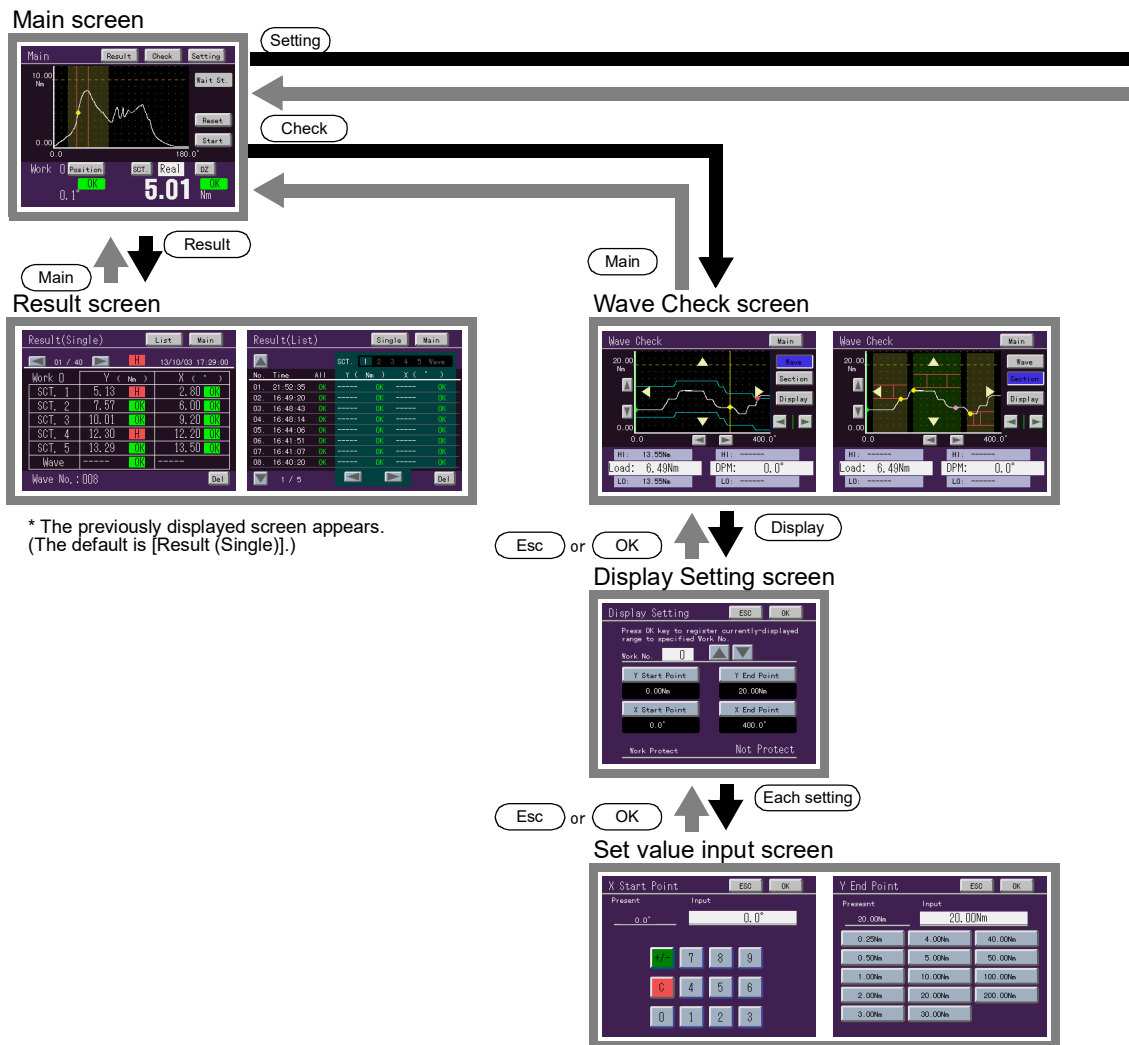
- Connect with no power applied because it may cause an electric shock.
- Since the TM500 has no power switch, install a breaker.
- Be sure to ground the protective ground terminal to prevent electric shocks.  
Do not use other screws than that attached to the main body.

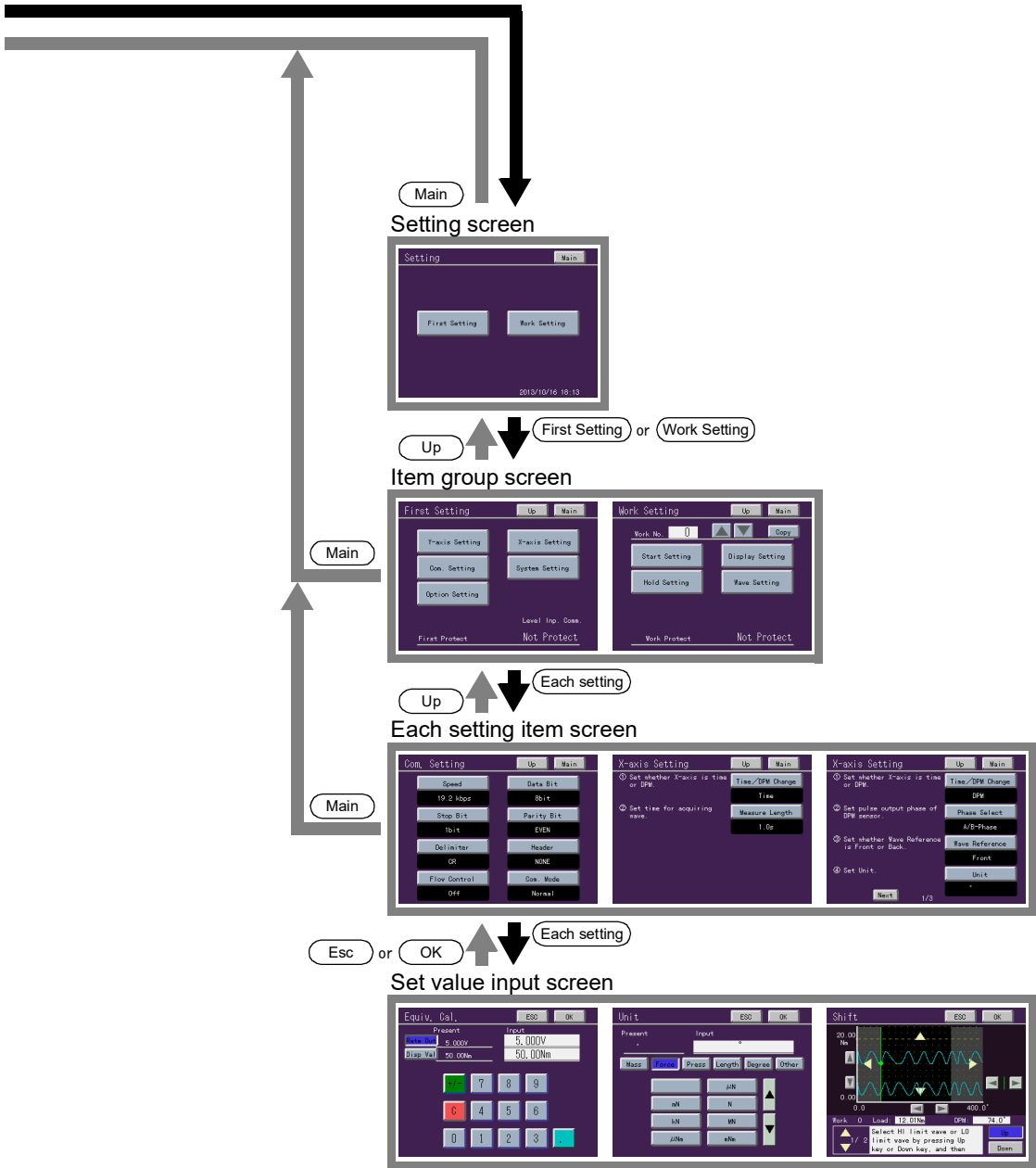
# 3 SCREENS AND OPERATIONS

## 3-1. Screen configuration

### Chapter 3

### SCREENS AND OPERATIONS

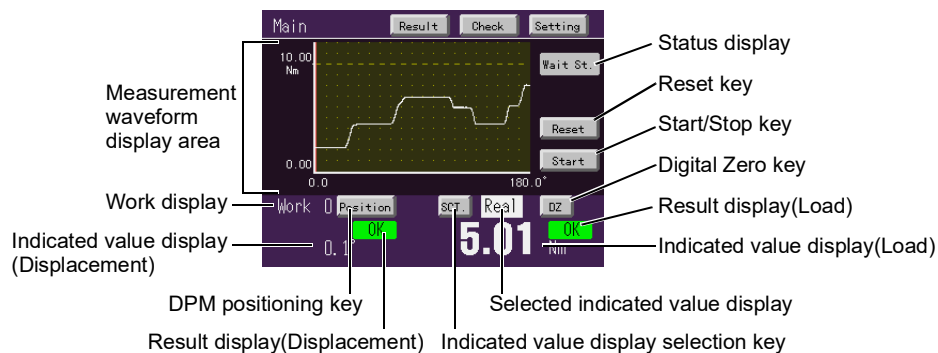






## 3-2. Explanation of each screen and key operations

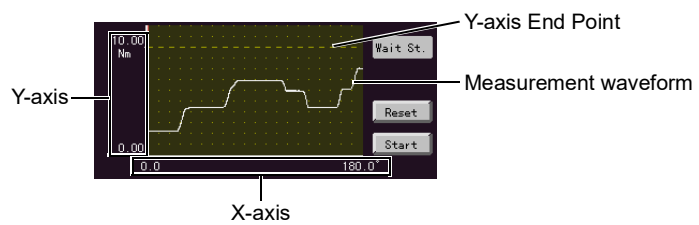
### ■ Main screen



### Display

#### Measurement waveform display area:

Displays a measurement waveform, comparison waveforms used for measurement, section(s), and HI/LO limit.



Measurement waveform ..... Displays a measurement waveform in white.

Y-axis .....Load axis consistent with the indicated value of load.

X-axis .....Axis showing the amount of displacement or time advanced after measurement start. Basically, in the case of time or displacement (Reference; Front), the left end corresponds to the point of origin, and in the case of displacement (Reference; Back), the right end corresponds to the point of origin.

#### Y-axis End Point

.....Indicates the end point of the Y-axis by a dotted line.

Status display : Displays the present measurement status.

Wait St.....The Start signal input is waited for. Input the Start signal. Measurement can also be started by pressing the Start key.

Wait Off.....It is waited for that the Start signal input is turned OFF. Turn OFF the Start signal.

Wait Lv. ....It is waited for that load or displacement crosses the Measurement Start Level. Apply load to the sensor so as to cross the Measurement Start Level.

Sampling.....Measurement is in progress. The measurement is stopped when the Measurement Stop Condition is met.

\* During measurement, the present measurement waveform is not displayed.

Complete .....Measurement is completed. The measurement waveform is displayed.

Reset On .....It is waited for that the Reset signal is turned OFF.

Result display : The result is displayed.

The waveform comparison and the hold results of each section are displayed overall according to the priority.

\* The displacement result is not displayed if X axis is time.

Priority	Result	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 set value)
	LO	LO limit over (judgment point < LO limit set value)
3	NG	<Hold operation> - Measurement did not reach the section. - Failure to detect the judgment point. * If the setting is such that Start Point of Section n = End Point of Section n = Start Point of Section n+1, the result of the present section is always "NG." <Waveform comparison operation> - Measurement did not reach the Compare Area. - Measurement did not reach the Reference Point of Relative Comparison when Relative Comparison is made.
4	OK	Normal (LO limit set value $\leq$ Judgment point $\leq$ HI limit set value)

Indicated value display:

Displays the indicated value selected by **SET.** (digital value of the torque meter/rotary encoder input), and also displays torque meter/rotary encoder errors.

\* When the indicated value selected by **SET.** is Section 1 - 5, if there is no hold value, "-----" is displayed.

Work display: Displays the present work No. specified by external input "Work."

Selected indicated value display: Displays the currently-selected indicated value.

Present..... Present value

1 ..... Section 1

2 ..... Section 2

3 ..... Section 3

4 ..... Section 4

5 ..... Section 5

## Keys

**Result** : Moves to a result screen.

There are two types of screens: [Result (Single)] and [Result (List)].

In moving from the Main screen, the previously displayed screen appears.

(The default display is [Result (Single)].)

**Check** : Moves to the Wave Check screen.

**Setting** : Moves to the Setting screen.

**Reset** : Simply makes the same movement as the Reset signal.

Also, when the error display appears, this key clears it after release.

**Start** : Simply makes the same movement as the Start signal.

This key is valid when the status display is Complete or Wait St.

When pressed, it changes to **Stop**.

**Stop** : Simply makes the same movement as the Stop signal.

This key is valid when the status display is Wait Lv. or Sampling.

When pressed, it changes to **Start**.

**Position** : Simply makes the same movement as the DPM Positioning signal.

However, it cannot be operated when the X-axis represents time.

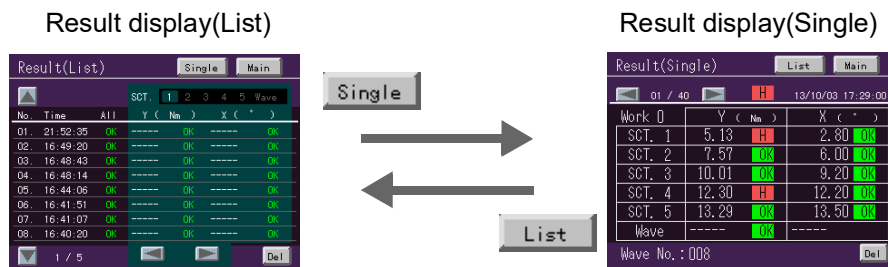
**D Z** : Simply makes the same movement as the Load Digital Zero signal.

**SCT.** : Selects the indicated value to be displayed. Each time you press the key, the displayed indicated value changes.

\* The displayed section is stored even if the power is turned off.

## Comparison result screen

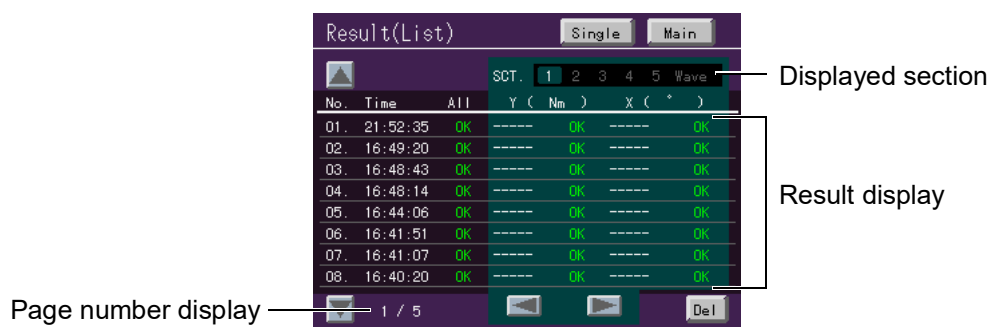
Judgment results by the waveform comparison function and hold function (last 40 data) can be checked. A selection can be made from the List display and Single display.



### Point

If the power is turned OFF with the comparison result screen displayed, the comparison result screen will appear at next power-on.

## Result display(List)



## Display

**Result display:** Displays Nos., measurement times, overall judgments, each section selected by SCT., and waveform comparison judgment results.

**No.:**.....Displays the order of measurement. No. 01 is the most recent result.

**Time:** .....Displays the time of measurement.

**All:**.....Displays the judgments (Y-axis and X-axis) of each section and the judgments of waveform comparisons overall.


The order of priority is as follows:  
H/L > H,L > NG > OK

SCT.1~5: ... Displays the Y-axis (load) and X-axis (displacement or time) values of the judgment point of each section and judgment results.

Wave: ..... Displays the Y-axis (load) and X-axis (displacement or time) values of the point at which the upper/lower limit comparison waveform is first exceeded, and the Y-axis (load) judgment result.








SCT.: Displays the currently displayed section.

Page number display: Displays the current page. 8 pieces of data are displayed per page.

 Point


- For the 41st and subsequent measurements, the data of No. 40 is deleted, and the most recent data is saved at No. 01.
- Measurement can be made as the comparison result screen is displayed. However, measurement results are updated. For checking the comparison results of the same contents, stop measurement.


Keys

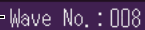
- 、 (display page selection keys): Switch the page number displayed.
-  : Deletes all comparison results.  
\* When the Delete key is pressed, the deletion confirmation screen appears.
- 、 (display selection keys): Switch the section displayed.
-  : Switches the display to Single.
-  : Moves to the Main screen.




■ Result display(Single)

No.  01 / 40


Work No.  Work 0

Wave No.  Wave No. : 008

Result(Single)		
	Y ( Nm )	X ( ° )
SCT. 1	5.13 H	2.80 OK
SCT. 2	7.57 OK	6.00 OK
SCT. 3	10.01 OK	9.20 OK
SCT. 4	12.30 H	12.20 OK
SCT. 5	13.29 OK	13.50 OK
Wave	----- OK	-----

Comprehensive judgment 

Result display



Display

- Result display: Displays the date and time of measurement, overall judgment, each section, and judgment results of waveform comparisons.
- Date and time: .....Displays the date and time of measurement.

Comprehensive judgment: ...Displays the judgments (Y-axis and X-axis) of each section and the judgments of waveform comparisons overall.

The order of priority is as follows:

H/L > H,L > NG > OK

Work No.: ..... Displays the work No. used for measurement.

SECT.1 to 5:..... Displays the Y-axis (load) and X-axis (displacement or time) values of the judgment point of each section and judgment results.

Wave: ..... Displays the Y-axis (load) and X-axis (displacement or time) values of the point at which the upper/lower limit comparison waveform is first exceeded, and the Y-axis (load) judgment result.

No.: Displays the order of measurement. No. 01 is the most recent result.

Wave No.: Displays the Wave No. associated with judgment results. It is not displayed if not established.



#### Point

- For the 41st and subsequent measurements, the data of No. 40 is deleted, and the most recent data is saved at No. 01.
- Measurement can be made as the comparison result screen is displayed. However, measurement results are updated. For checking the comparison results of the same contents, stop measurement.

### Keys

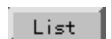


: Deletes all comparison results.

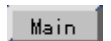
\* When the Delete key is pressed, the deletion confirmation screen appears.



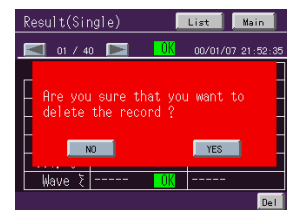
(display No. selection keys): Switch the number displayed.



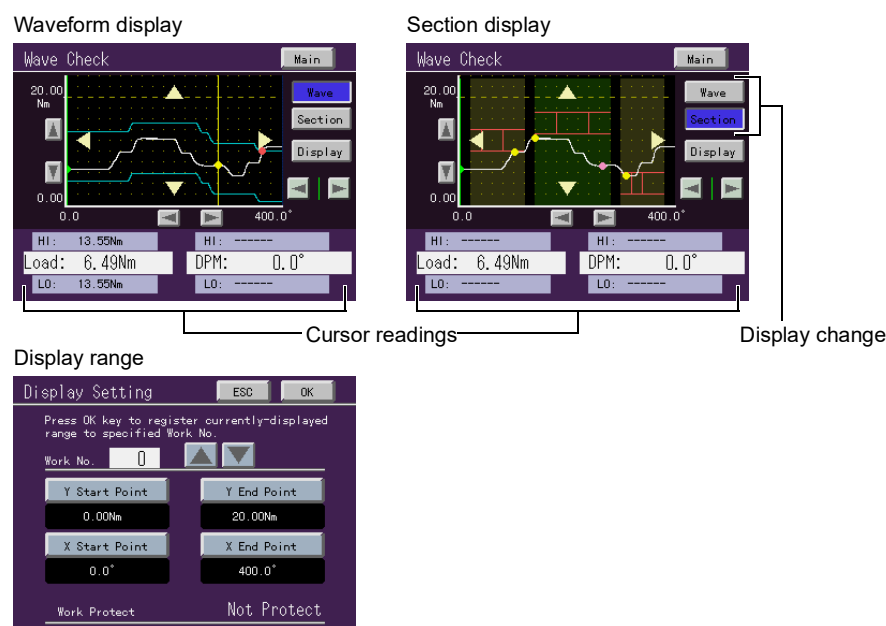
: Switches the display to List.



: Moves to the Main screen.



## ■ Wave Check screen



### Display

**Cursor readings:** Display the cursor-positioned load and displacement (time).

Also, the HI and LO limits of comparison waveforms and the HI and LO limits of the currently-cursor-positioned section are displayed on waveform display and section display, respectively.

### Keys

**Display:** Switches the display between that for waveform comparison and that for section (hold).

**Wave** ..... Switches the display to that for waveform comparison.  
Displays the HI limit waveform, LO limit waveform, and area.  
The HI and LO limits correspond to the values of comparison waveforms.

**Section** ..... Switches the display to that for section (hold).  
Displays the range, HI limit, and LO limit of each section.  
The HI and LO limits correspond to those of each section.

**Display** : Moves to the Display Setting screen.

**Main** : Moves to the Main screen.

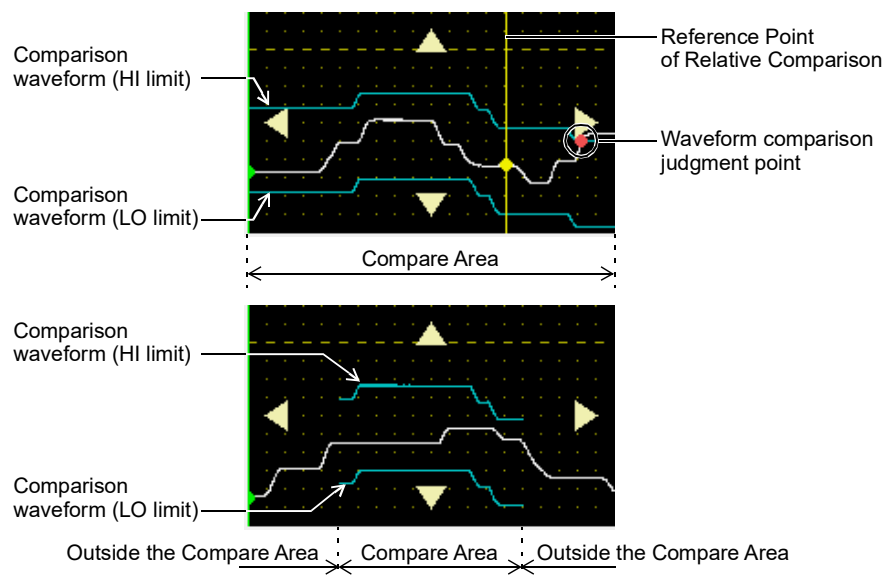
(cursor keys): Move the cursor rightward/leftward.

(area move keys): Move the waveform display area by 1/8 of the screen.

(X-axis zoom keys): Zoom in/out the waveform in the X-axis direction.  
( : Zooms in. : Zooms out.)

(Y-axis zoom keys): Zoom in/out the waveform in the Y-axis direction.  
( : Zooms in. : Zooms out.)

## - About the waveform display



## Comparison waveforms (HI and LO limits):

The comparison waveforms set by Waveform Comparison Setting are displayed in blue only in the Compare Area. Since the comparison waveforms are not displayed outside the Compare Area, the Compare Area can be seen at a glance.

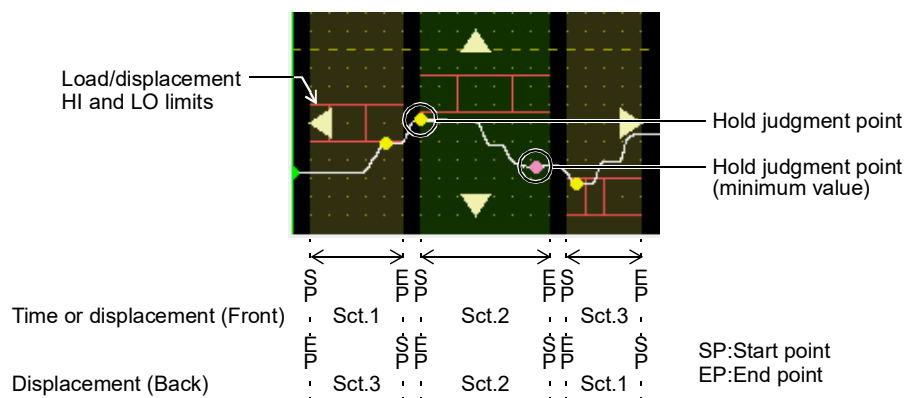
## Waveform comparison judgment point:

Indicates in red the point at which the HI/LO limit of comparison waveforms is first exceeded.

## Reference Point of Relative Comparison:

Indicated by a yellow dot and line when Relative Comparison is made.

## - About the section display



## Clear indication of sections: Sections are separated by color for ease of understanding.

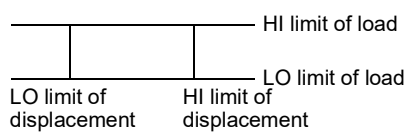
Sections 1, 3, and 5: Shaded in gray.

Sections 2 and 4: Shaded in green.

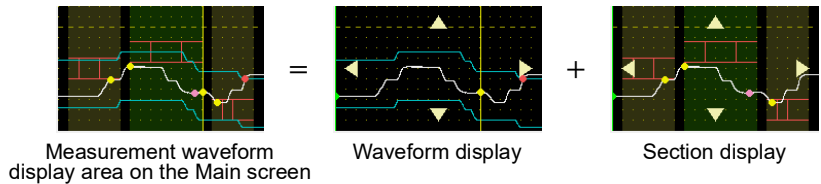
## Hold judgment point:

Judgment point(s) (hold point(s)) of each section, if any, is indicated by a yellow dot. However, at a "Peak to Peak" section, the minimum value is indicated in pink, and the maximum value is indicated in yellow.

Load/displacement HI and LO limits:  
The HI and LO limits of each section are indicated by red lines.



The measurement waveform display area on the Main screen is as follows:



- About the display range

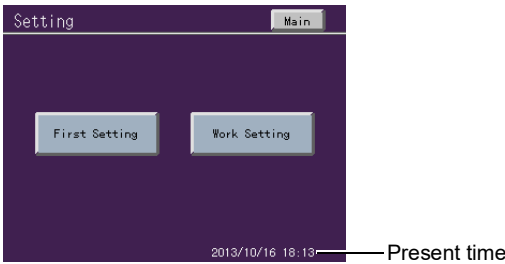
For example, this function is convenient for changing the display range with an observation of the details of the waveform.

1. On the Wave Check screen, display the part you want to analyze by zooming in/out and/or moving the graph.
2. Press **Display**, and select the work No. to set the present display range.
3. You can input numerical values to Y-axis Start Point, etc., but press **OK** as it is if such an input is not needed.

**Point**

Although it will be explained later, “Work Setting” includes the item “Display Range Setting.” With this, you cannot make settings while observing the waveform; therefore, do so from Wave Check.

■ Setting screen



Display

The present time is displayed.

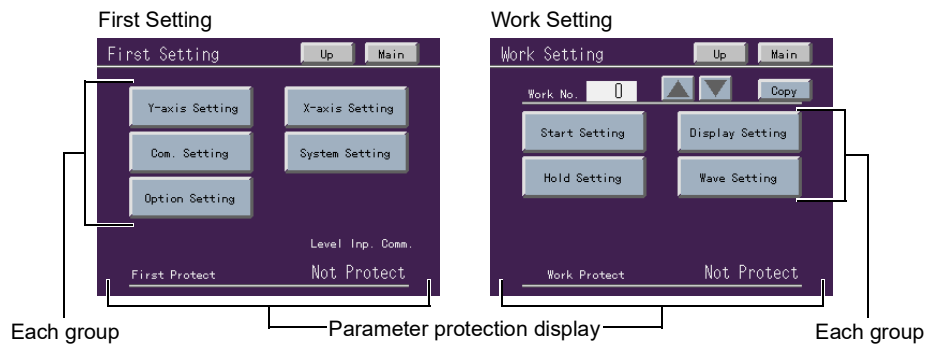
2 0 0 6 / 0 2 / 0 1 / 1 9 : 0 5  
Year Month Day Hour Minute  
(24-hour display)

Keys

- First Setting** : Moves to the First Setting screen.
- Work Setting** : Moves to the Work Setting screen.
- Main** : Moves to the Main screen.



# Item group screen



## Display

First Protect: Displays whether parameters can be changed or not. Select by System Setting.

Work Protect: Displays whether parameters can be changed or not. Select by System Setting.

## Keys

**Main** : Moves to the Main screen.

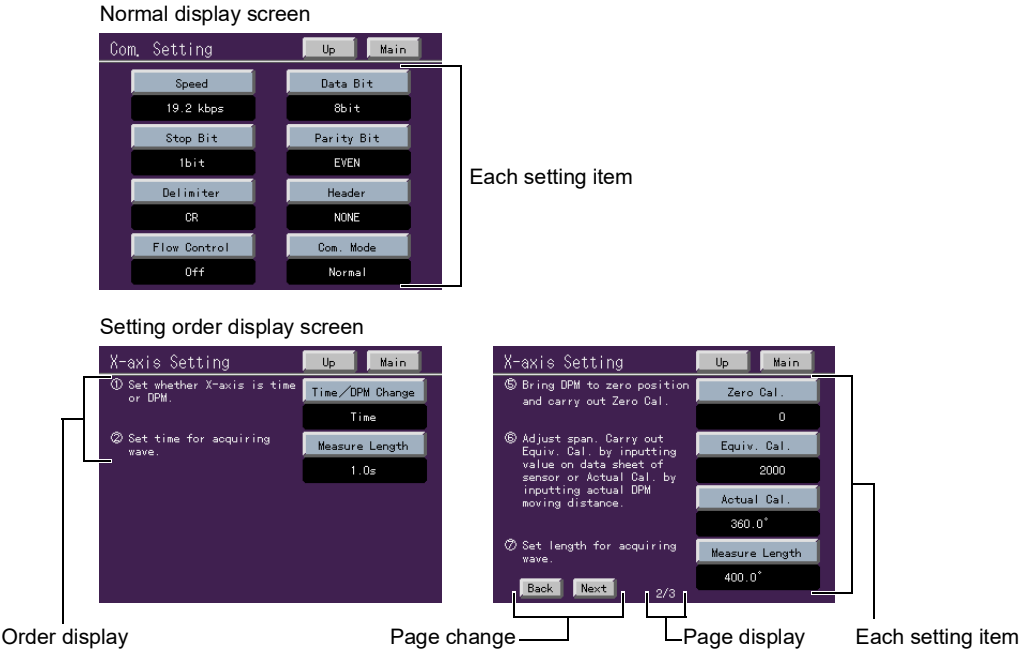
**Up** : Moves to the Setting screen.

**▲ ▼** : Select the work No. to make settings.  
The main work No. display will not change even if this work No. is changed.

**Copy** : Moves to the set value input screen for Copy.

Each group: Moves to each group screen.

■ Each setting item screen



Display

Page display: Displays the page number/total number of pages when there are two or more pages of setting items.

Order display: Displays the setting order.

Keys

**Up** : Moves to the item group screen.

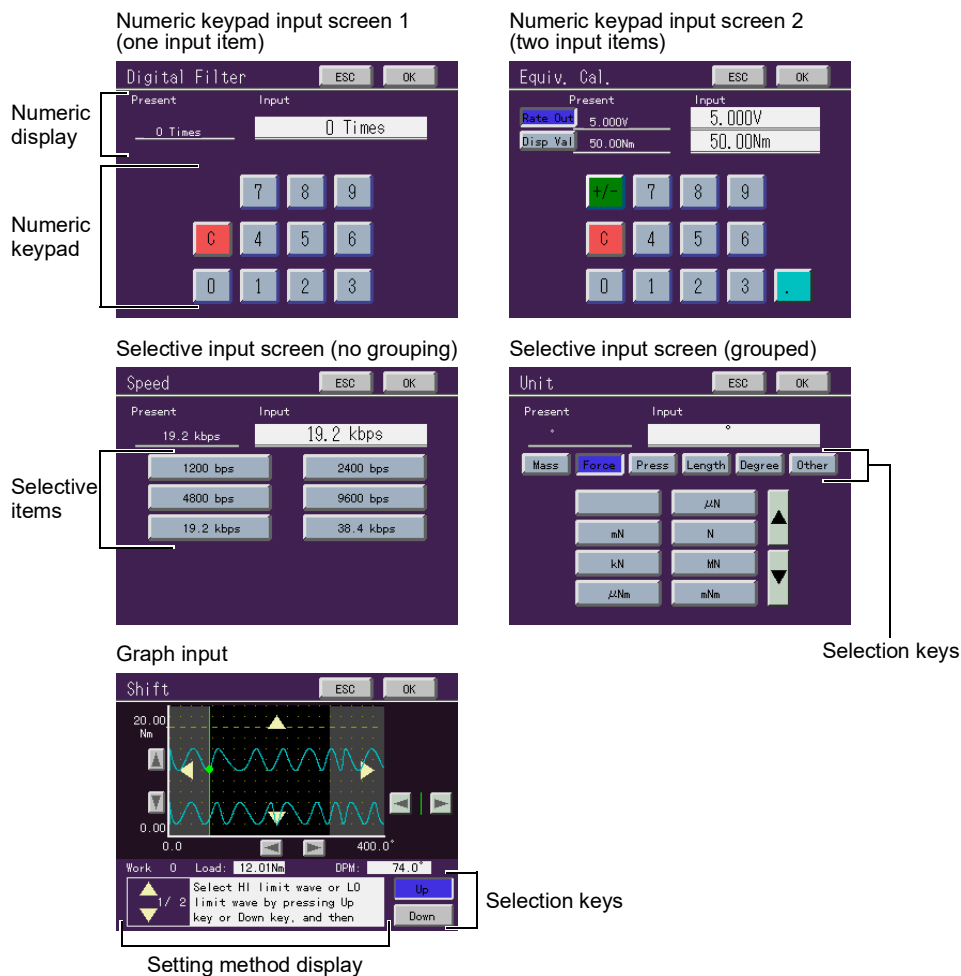
**Main** : Moves to the Main screen.

Each setting item: Moves to the set value input screen.

**Next** : Moves to the next page.

**Back** : Moves to the previous page.

## ■ Set value input screen



### Display

**Numeric display:** Displays the currently-set value and currently-input value.

**Setting method display:** Displays the setting method, and also the page number/total number of pages of the message.

### Keys


**OK** : Accepts the currently-input value.

**ESC** : Cancels the currently-input value, and moves to the setting item screen.

 ,  ,  ,  ,  : Move the cursor/waveform/point according to the setting item.

**Selective item keys:** Select the item of a set value.

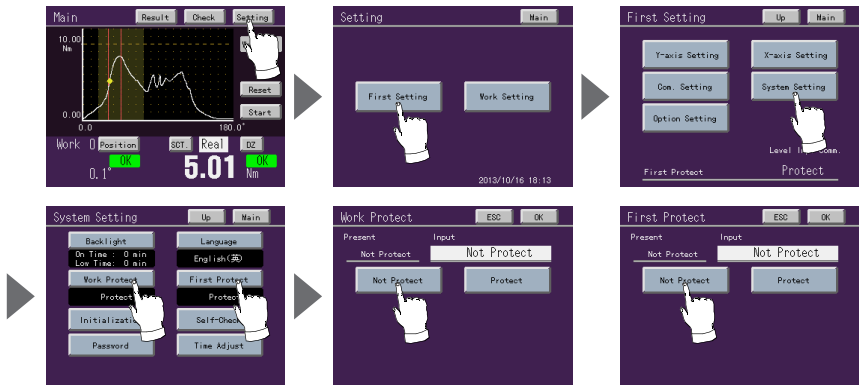
**Selection keys:** Select the corresponding cursor/waveform/input item(s)/group(s).  
The button of the selected item turns blue.

 : Scroll the description of the setting method line by line.

# 4 SETTINGS AND CALIBRATIONS

## 4-1. Release of parameter protection

To change set values, release their respective locks.



### Release of Work Setting Parameter Protection

Operation

Main screen → Setting → First Setting → System Setting → Work Protect → Not Protect

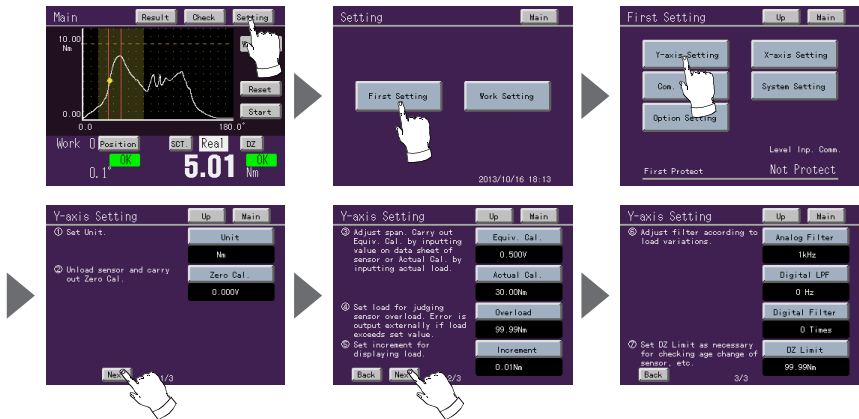
### Release of First Setting Parameter Protection

Operation

Main screen → Setting → First Setting → System Setting → First Protect → Not Protect

## 4-2. Y-axis setting

Calibrate and set the torque meter by Y-axis Setting. Set each item according to the setting order.



Operation

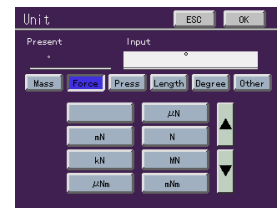
Main screen → Setting → First Setting → Y-axis Setting (→ Next → Next)

**1. Unit**

Select a unit.

Setting range (See "9-3.Unit setting list" on p.141.)

Operation



Main screen → Setting → First Setting → Y-axis Setting → Unit

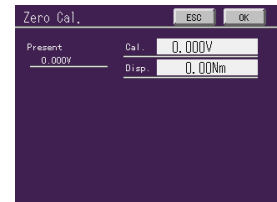
**2. Zero Calibration**

Register the present sensor input as zero.

Press **OK** with the torque meter unloaded.

Setting range (-5.555 to 5.555 V)

Operation



Main screen → Setting → First Setting → Y-axis Setting → Zero Cal.

**3. Equivalent Input Calibration**

Check the specification of the sensor, and register the rated output value and the value you want to display at that time (rated capacity value).

Also, set the decimal place here. Input the decimal point together when inputting the display value.

Setting range

Rated output (-9.999 to 9.999 V)

Display value (rated capacity) (-9999 to 9999)

Operation



Main screen → Setting → First Setting → Y-axis Setting → Next → Equiv. Cal.

**4. Actual Load Calibration**

Apply actual load to the torque meter, and input the load value at that time.

Also, set the decimal place here. Input the decimal point together when inputting the calibration value.

Setting range

Calibration value (-9999 to 9999)

Display value (display only)

Operation



Main screen → Setting → First Setting → Y-axis Setting → Next → Actual Cal.

**5. Overload**

Set the load at which the sensor is judged to be overloaded. The Load OK output turns OFF when the load exceeds the set value.

Setting range (0 to 9999)

Operation



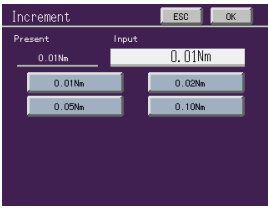
Main screen → Setting → First Setting → Y-axis Setting → Next → Overload

## 6. Increment

Set the minimum unit of load display. Loads are displayed in the set increments.

Setting range (1, 2, 5, 10)

Operation



Main screen → Setting → First Setting → Y-axis Setting → Next → Increment

## 7. Analog Filter

The low-pass filter of the set cut-off frequency is inserted with respect to the input of the torque meter.

Setting range (10, 30, 100, 300 Hz)

Operation



Main screen → Setting → First Setting → Y-axis Setting → Next → Next → Analog Filter

## 8. Digital LPF

The low-pass filter of the set cut-off frequency is digitally processed and inserted with respect to the input of the torque meter.

Setting range (0(OFF) to 30 Hz)

Operation



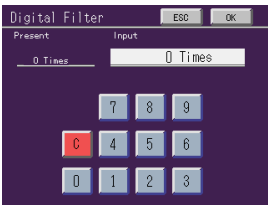
Main screen → Setting → First Setting → Y-axis Setting → Next → Next → Digital LPF

## 9. Digital Filter

Loads are moving-averaged by the set number of times.

Setting range (0, 2 to 999 Times)

Operation



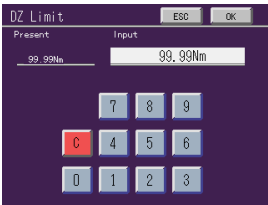
Main screen → Setting → First Setting → Y-axis Setting → Next → Next → Digital Filter

## 10. Digital Zero Limit

Set the limit of load that can be digital-zeroed. If Digital Zero is performed with a load larger (smaller) than the zero-calibrated load by the set load, an error will result, and the load will not be zeroed.

Setting range (0 to 9999)

Operation



Main screen → Setting → First Setting → Y-axis Setting → Next → Next → DZ Limit

## 4-3. X-axis setting

Calibrate and set the rotary encoder by X-axis Setting. Set each item according to the setting order. Settings vary depending on whether the X-axis represents time or displacement.



### Operation

Main screen → Setting → First Setting → X-axis Setting (→ Next → Next)

#### 1. Time/Displacement Change

Select whether the X-axis represents time or displacement.

When using the rotary encoder, select displacement, continuous or average.

#### Setting range

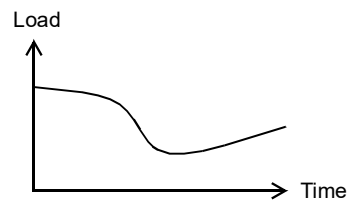
- |               |  |
|---------------|--|
| Time:         | Load relative to time is wave-formed.  |
| Displacement: | Load relative to displacement is wave-formed.  |
| Continuous:   | Load relative to displacement is repeated and wave-formed until the measurement stops. <ul style="list-style-type: none"> <li>- Waveform reference is front only.</li> <li>- Hold setting and Relative Comparison are invalid.</li> <li>- Measurement Waveform Preservation by the Automatic Operation preserves only waveforms upon completion.</li> <li>- It can be repeated up to a maximum of 99 times.</li> </ul> |
| Average:      | Load relative to displacement is repeated and wave-formed on simple average until the measurement stops. <ul style="list-style-type: none"> <li>- Waveform reference is front only.</li> <li>- It can be repeated up to a maximum of 99 times.</li> </ul>  |

### Operation

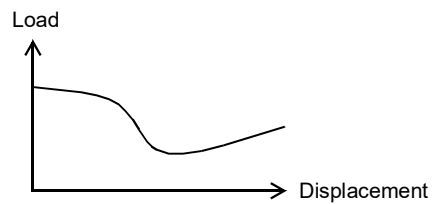
Main screen → Setting → First Setting → X-axis Setting → Time/DPM Change



< In case of time >



< In case of displacement >



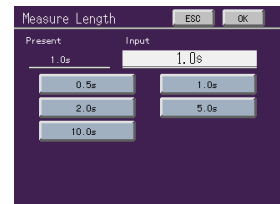
When the X-axis represents time

## 2 Measurement Length

Set the time for waveform acquisition.

Setting range (0.5, 1.0, 2.0, 5.0, 10.0 s)

Operation



Main screen → Setting → First Setting → X-axis Setting → Measure Length

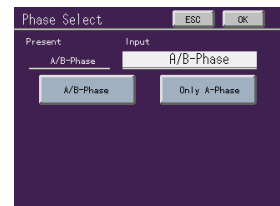
When the X-axis represents displacement

## 2 Sensor Phase Select

Select the output phase of the rotary encoder.

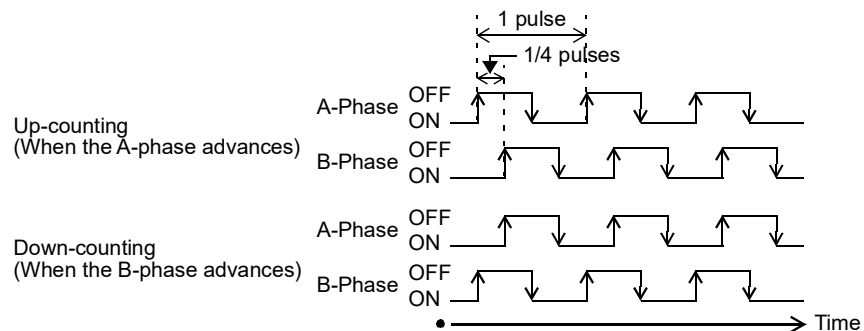
Setting range (A/B-Phase, Only A-Phase)

Operation



Main screen → Setting → First Setting → X-axis Setting → Phase Select

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





**3. Waveform Reference**

Select whether the waveform reference is front or back.

**Setting range**

**Front:** The measurement start point becomes the waveform reference.

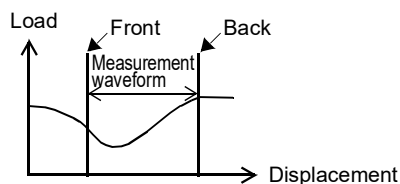
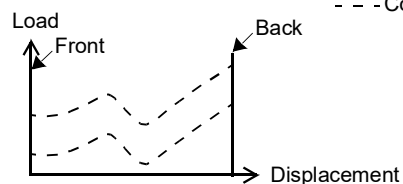
**Back:** The measurement stop point becomes the waveform reference.

**Operation**

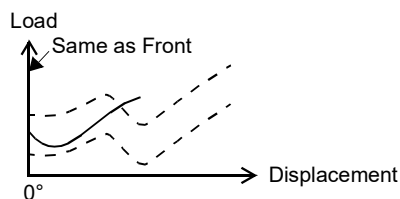
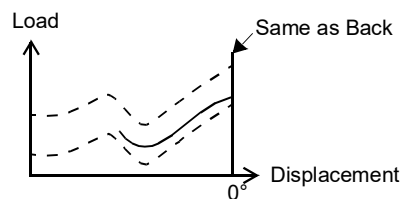
Main screen → Setting → First Setting → X-axis Setting → Wave Reference

**Point**

When the Waveform Reference is set at Back, Change of Section cannot be made externally.

**< Measurement waveform >****< Comparison waveform >**

— Measurement waveform  
- - Comparison waveform

**< In case of "Front" >****< In case of "Back" >****4. Unit**

Select a unit.

Setting range (See "9-3.Unit setting list" on p.153.)

**Operation**

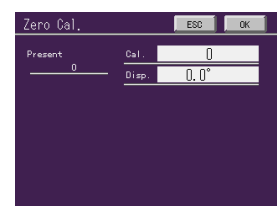
Main screen → Setting → First Setting → X-axis Setting → Unit

**5. Zero Calibration**

Register the present sensor input as zero.

Press **OK** with the rotary encoder zeroed.

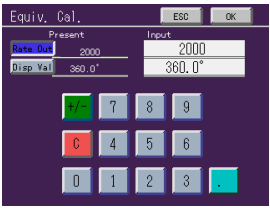
Setting range (0 to 1000000)

**Operation**

Main screen → Setting → First Setting → X-axis Setting → Next → Zero Cal.

## 6. Equivalent Input Calibration

Input the relationship between the number of pulses (rated output) and displacement value (display value) determined from the specifications of the rotary encoder. Also, set the decimal place here. Input the decimal point together when inputting the display value.



### Setting range

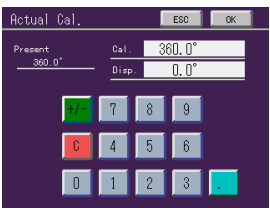
Rated output (number of pulses) (1 to 1000000)  
Display value (displacement value) (-99999 to 99999)

### Operation

Main screen → Setting → First Setting → X-axis Setting → Next → Equiv. Cal.

## 7. Actual Load Calibration

Move the cylinder, and input its position. Also, set the decimal place here. Input the decimal point together when inputting the calibration value.



### Setting range

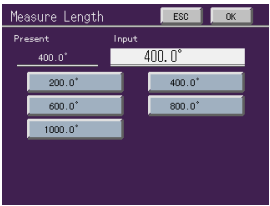
Calibration value (-9999 to 32000)  
Display value (display only)

### Operation

Main screen → Setting → First Setting → X-axis Setting → Next → Actual Cal.

## 8. Measurement Length

Set the length for waveform acquisition.



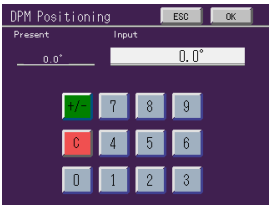
Setting range (2000, 4000, 6000, 8000, 10000)

### Operation

Main screen → Setting → First Setting → X-axis Setting → Next → Measure Length

## 9. Displacement Positioning

Set the position for displacement adjustment at power-on, on the Main screen, and by external input.



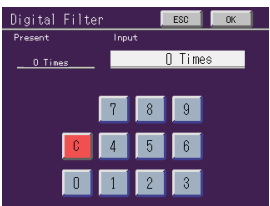
Setting range (-9999 to 32000)

### Operation

Main screen → Setting → First Setting → X-axis Setting → Next → Next → DPM Positioning

## 10. Digital Filter

Displacements are moving-averaged by the set number of times.



Setting range (0, 2 to 999 Times)

### Operation

Main screen → Setting → First Setting → X-axis Setting → Next → Next → Digital Filter

# 11. Repetitive displacement

In "Continuous" "Average" mode, set the repetitive displacement of measurement.

Setting range (720, 810, 900, 990, 1080, 1170, 1260, 1350, 1440, 1530, 1620, 1710, 1800, 2000  
 $\times$  Measurement Length/2000)

Operation



Main screen  $\rightarrow$  Setting  $\rightarrow$  First Setting  $\rightarrow$  X-axis Setting  $\rightarrow$  Next  $\rightarrow$  Next  
 $\rightarrow$  Repetitive DPM



## 4-4. Work No. selection and work copy



### Work No. selection

Press   on the Work Setting screen, and specify the work No. you want to set.


Setting range (0 to 15, All)

When each item is set with the work No. specified as "All," the same set value enters into all of work 0 to 15 on the set item. This function is convenient when there is any item you want to set all work in common.

Operation

Main screen  $\rightarrow$  Setting  $\rightarrow$  Work Setting  $\rightarrow$  Work No.

### Work copy

Work can be copied. Press  on the Work Setting screen. Set Source and Copy.

Data to be copied are all set values in Work Setting including comparison waveforms.

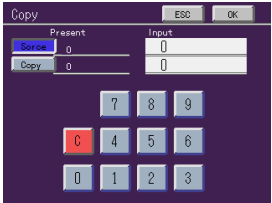
Setting range

Source (0 to 15)

Copy (0 to 15)

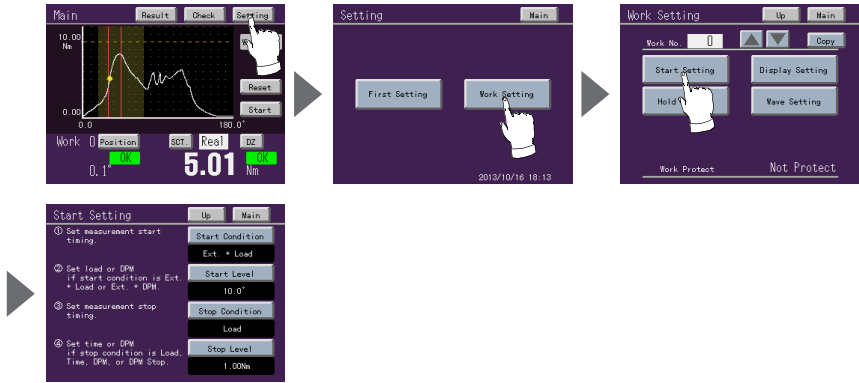
Operation

Main screen  $\rightarrow$  Setting  $\rightarrow$  Work Setting  $\rightarrow$  Copy



# 4-5. Measurement start condition setting

Set measurement conditions by Measurement Start Condition Setting. The Measurement Start Condition is as follows:



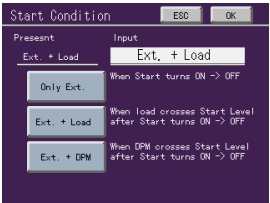
## Operation

Main screen → Setting → Work Setting → Start Setting

### 1. Measurement Start Condition

Set the measurement start timing.

If the X-axis represents continuous or average, set "Only external input".

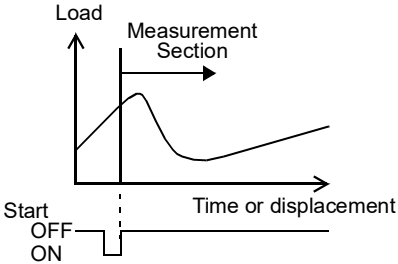


## Operation

Main screen → Setting → Work Setting → Start Setting → Start Condition

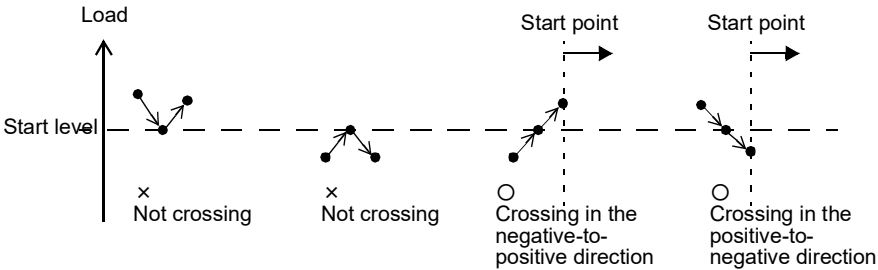
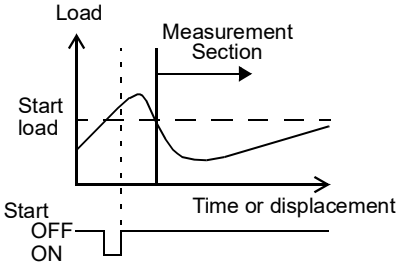
### ① Only External Input

Measurement starts when the external input signal "Start" turns OFF → ON → OFF. Setting of "2. Measurement Start Level" is disabled.



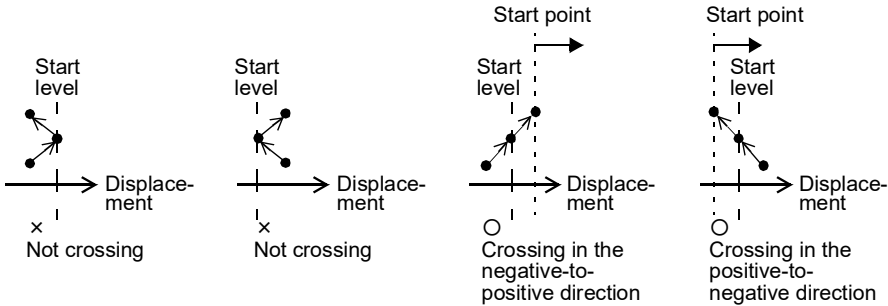
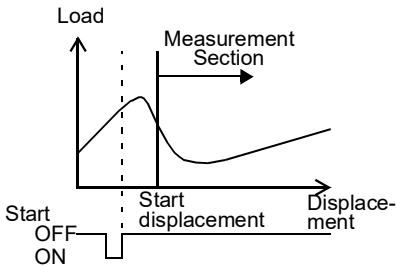
### ② External Input + Load

Measurement starts when the load crosses the Measurement Start Level after the external input signal "Start" turns OFF → ON → OFF.



③External Input + Displacement

Measurement starts when the displacement crosses the Measurement Start Level after the external input signal “Start” turns OFF → ON → OFF.



Point

The operation of turning the external input signal OFF → ON → OFF is the same as pressing **Start** on the Main screen.

2. Measurement Start Level

Set load or displacement when the Measurement Start Condition is “External Input + Load” or “External Input + Displacement.”

Setting range

External Input + Load (-9999 to +9999)

External Input + Displacement (-9999 to +32000)

Operation

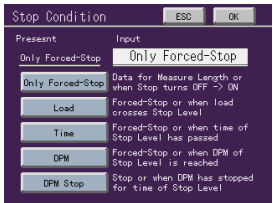


Main screen → Setting → Work Setting → Start Setting → Start Level

3. Measurement Stop Condition

Set the Measurement Stop Condition.

Operation



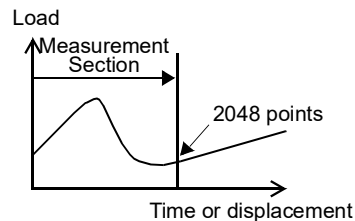
Main screen → Setting → Work Setting → Start Setting → Stop Condition

① Only Forced-Stop

Setting of “4. Measurement Stop Level” is disabled.

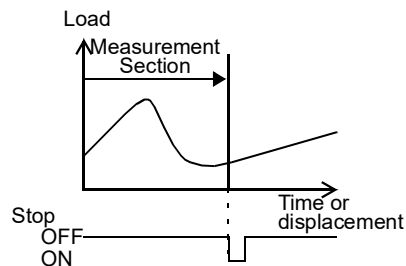
- 2048 points

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



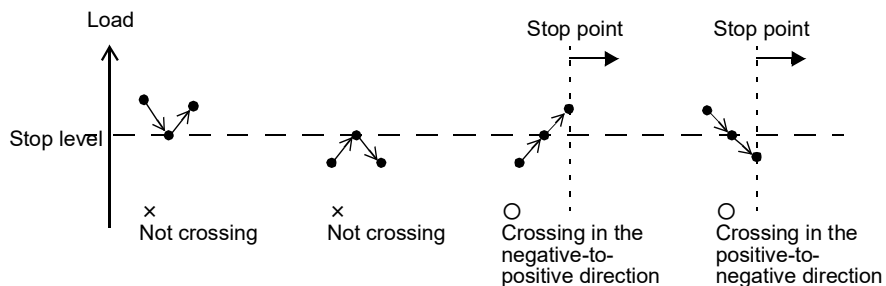
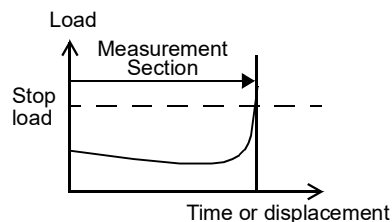
- External input

Measurement stops when the external input signal “Stop” turns OFF → ON.



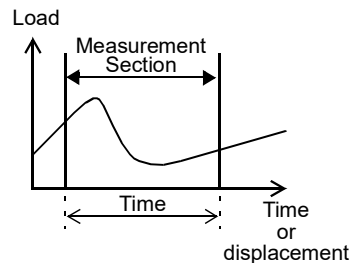
② Load

Measurement stops when the forced-stop or the load crosses the Measurement Stop Level.



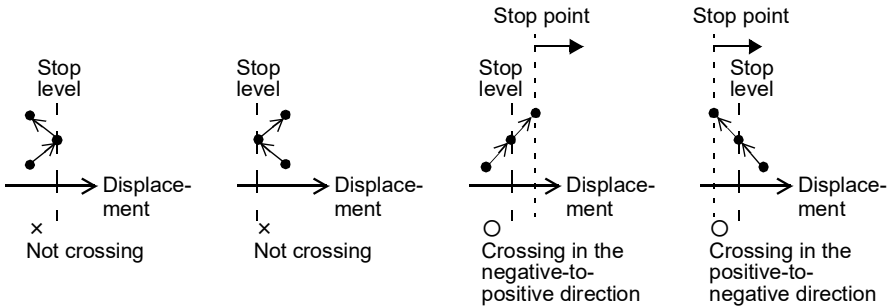
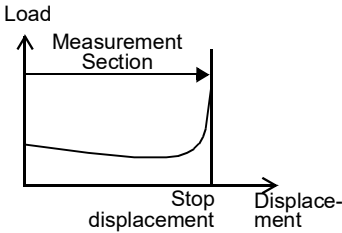
③ Time

Measurement stops when the forced-stop or the time specified under Measurement Stop Level has passed after measurement start.



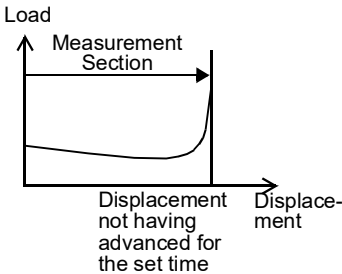
④ Displacement

Measurement stops when the forced-stop or the displacement reaches the Measurement Stop Level.



⑤ Displacement Stop

Measurement stops when the forced-stop or the displacement stops advancing to the time specified under Measurement Stop Level.



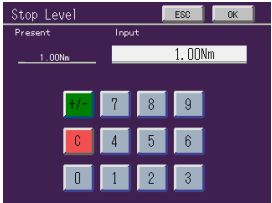
4. Measurement Stop Level

Set load, time or displacement when the Measurement Stop Condition is “Load,” “Time,” “Displacement” or “Displacement Stop.”

Setting range

Load	(-9999 to +9999)
Time	(0.1 to 10.0 sec.)
Displacement	(-9999 to +32000)
Displacement Stop	(0.1 to 10.0 sec.)

Operation



Main screen → Setting → Work Setting → Start Setting → Stop Level

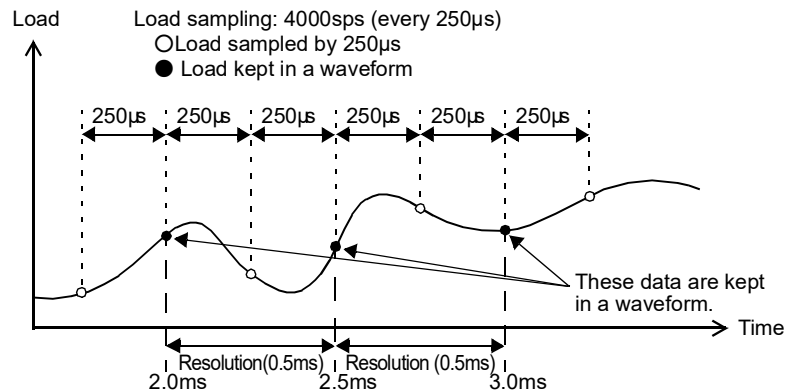
## ■ Measurement data

- The sampling rate is fixed at 4000sps (samples per second).
  - Measurement is carried out at 4000sps, but the data kept in a waveform is 2000 pieces per the Measurement Length. (Maximum data: 2048)
- Therefore, the waveform resolution is the Measurement Length/2000.

### When the Time/Displacement Change setting is Time

During measurement, the load is sampled at 4000sps, and after completion of the measurement, the load by resolution is kept in a waveform.

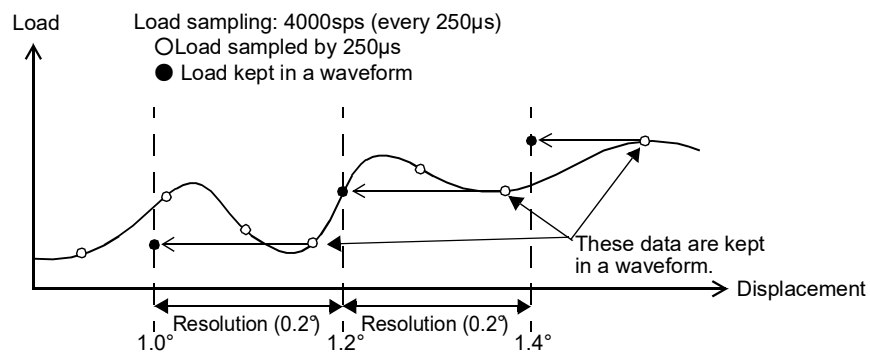
Example) When the Measurement Length is 1.0s



### When the Time/Displacement Change setting is Displacement

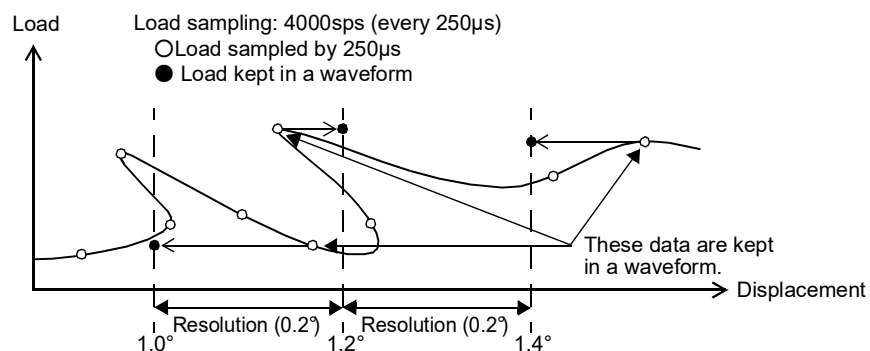
The load and displacement are sampled at 4000sps, and the load is kept in a waveform every time the displacement advances.

Example) When the Measurement Length is 400.0°



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

Example) When the displacement returns

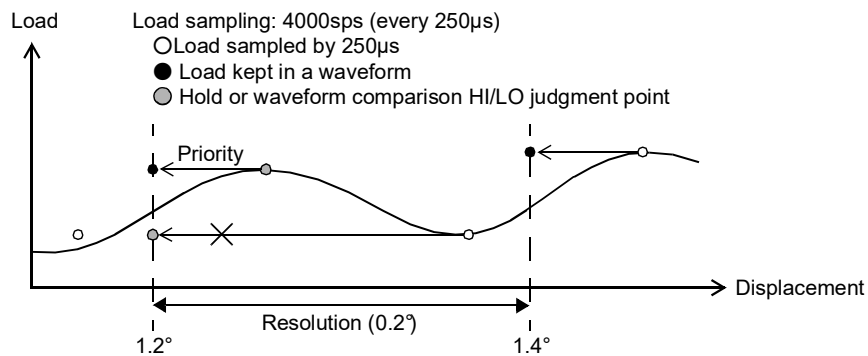




\* Out of the points not kept in a waveform, those meeting the following conditions are kept in the waveform by priority.

- ① Data kept as judgment points but not kept in a waveform when Peak Hold, Bottom Hold, Peak to Peak Hold, Relative Maximum Hold, Relative Minimum Hold, or Inflection Point Hold is used
- ② HI or LO result data not kept in a waveform when waveform comparisons are made

Example) When a hold or waveform comparison HI/LO judgment point does not fall into the data that should be kept in a waveform



### ■ When the displacement advances suddenly

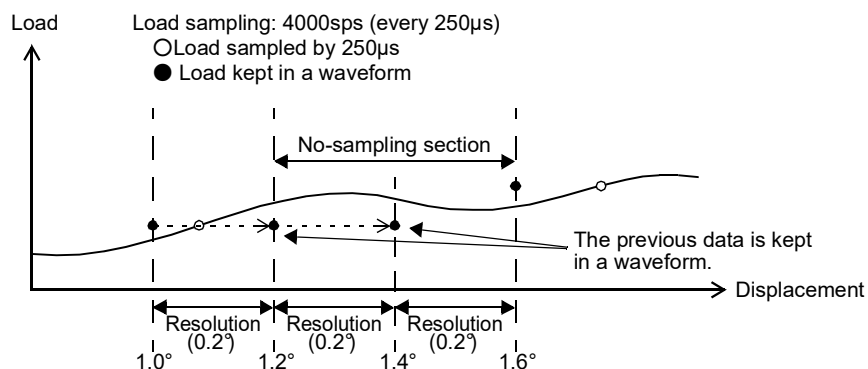
- When the displacement advances suddenly, a phenomenon occurs in which sampling is not performed in time and the data that should be kept in a waveform is dropped. In that case, the data of the immediately preceding displacement is kept in the waveform as the data of the dropped displacement. If 10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

\* Guide for the displacement pace

Displacement pace at which one piece of data is dropped: waveform resolution  $\times$  4000sps (/s)

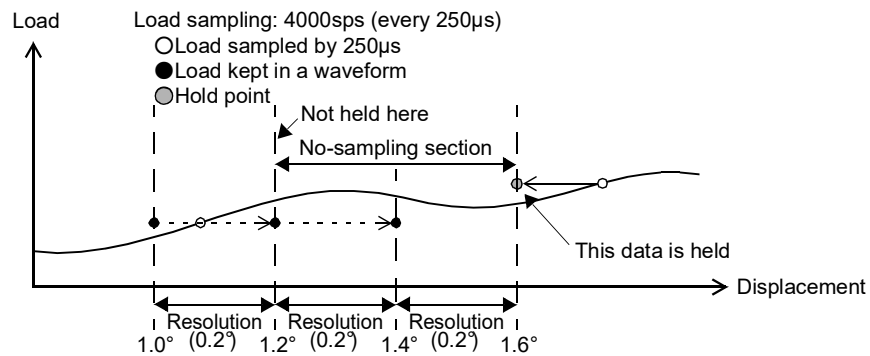
Example) When the Measurement Length is 400.0°  $\rightarrow$   $0.2 \times 400.0\text{sps} = 800.0\%$

Example) When the displacement advances suddenly



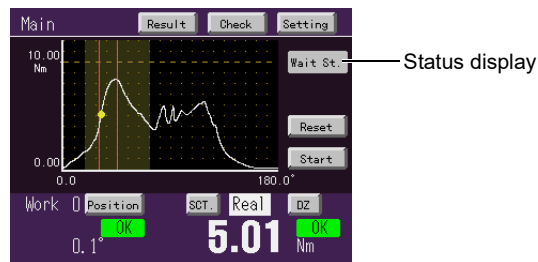
- If the displacement pace is fast, sampling may not be performed at the section start point. In that case, no load is held at the section start point, but the load in time for sampling near the section start point is held.

Example) When the section start point is 1.2° and Sample Hold is used



- \* When the section start point and end point are set identically, if the displacement pace is fast, no load may be held. Set the section start point and end point having a margin in consideration of the case where the displacement pace is fast.
- \* In the case of Waveform Reference at Back, where hold operation is performed with the waveform kept after completion of measurement, the above phenomenon will not occur.

## 4-6. Measurement

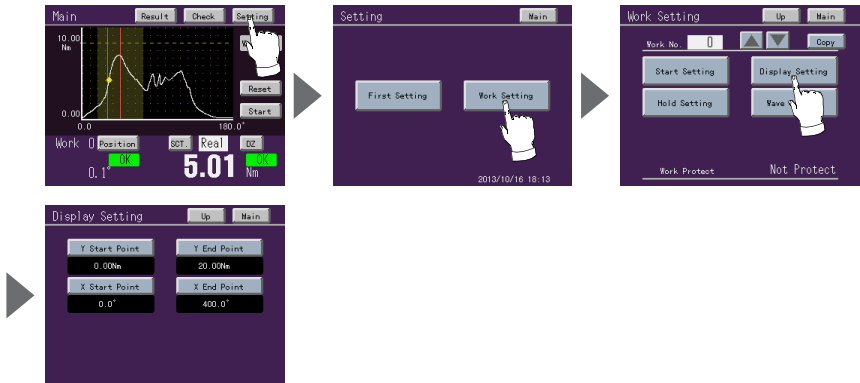


Carry out measurement according to the following procedure on the Main screen.

1. Check that the status display is "Wait St." or "Complete."  
If not, check that the Start signal is not input externally, and then press .
2. Satisfy the Measurement Start Condition, and start measurement.  
When measurement is started, the status display changes to "Sampling."  
  
\* If "Sampling" does not appear, check the following according to the status display.  
 Wait St.: The Start signal is not acknowledged. Input the Start signal or press .  
 Wait Off: The Start signal is not OFF. Turn OFF the Start signal.  
 Wait Lv.: After the Start signal is input, the load or displacement does not cross the Measurement Start Level. Change the Measurement Start Level or change the Start signal input timing.  
 Complete: Measurement is already stopped. See Step 4 onward.
3. Satisfy the Measurement Stop Condition, and stop measurement.  
Upon completion of measurement, the status display changes to "Complete."
4. As needed, press to check the waveform.

# 4-7. Adjustment of waveform display

Adjust the waveform display axis by Display Range Setting.



## Operation

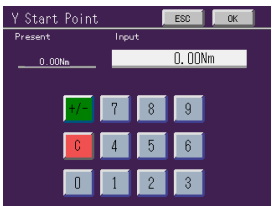
Main screen → Setting → Work Setting → Display Setting

### 1. Y-axis Start Point

Set the Y-axis start point of the waveform.

Setting range (-10000 to 10000)

Operation



Main screen → Setting → Work Setting → Display Setting → Y Start Point

### 2. Y-axis End Point

Set the Y-axis end point of the waveform.

Setting range

(Y-axis start point +  
25, 50, 100, 200, 300, 400, 500, 1000, 2000, 3000,  
4000, 5000, 10000, 20000)

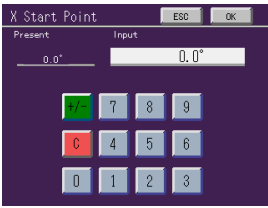
Operation



Main screen → Setting → Work Setting → Display Setting → Y End Point

### 3. X-axis Start Point

Set the X-axis start point of the waveform.  
The setting range differs according to the setting of Wave Reference and Measurement Length.



Setting range

Time or displacement (Front) (0 to 2000 × Measurement Length/2000)

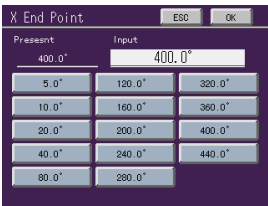
Displacement (Back) (-2000 to 0 × Measurement Length/2000)

Operation

Main screen → Setting → Work Setting → Display Setting → X Start Point

### 4. X-axis End Point

Set the X-axis end point of the waveform.  
The setting range differs according to the setting of Wave Reference and Measurement Length.



Setting range

Time or displacement (Front)

(X-axis start point + 25, 50, 100, 200, 400, 600, 800, 1000, 1200, 1400, 1600, 1800, 2000, 2200 × Measurement Length/2000)

Displacement (Back)

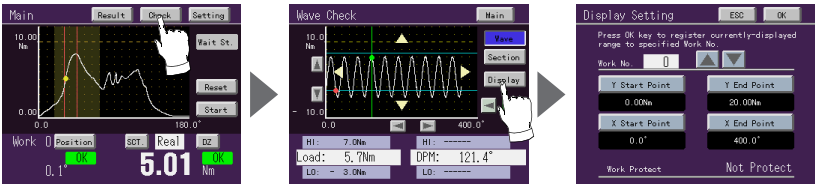
(X-axis start point + -25, -50, -100, -200, -400, -600, -800, -1000, -1200, -1400, -1600, -1800, -2000, -2200 × Measurement Length/2000)

Operation

Main screen → Setting → Work Setting → Display Setting → X End Point

### Setting from Waveform Check

The waveform display axis can also be adjusted by the following operation.



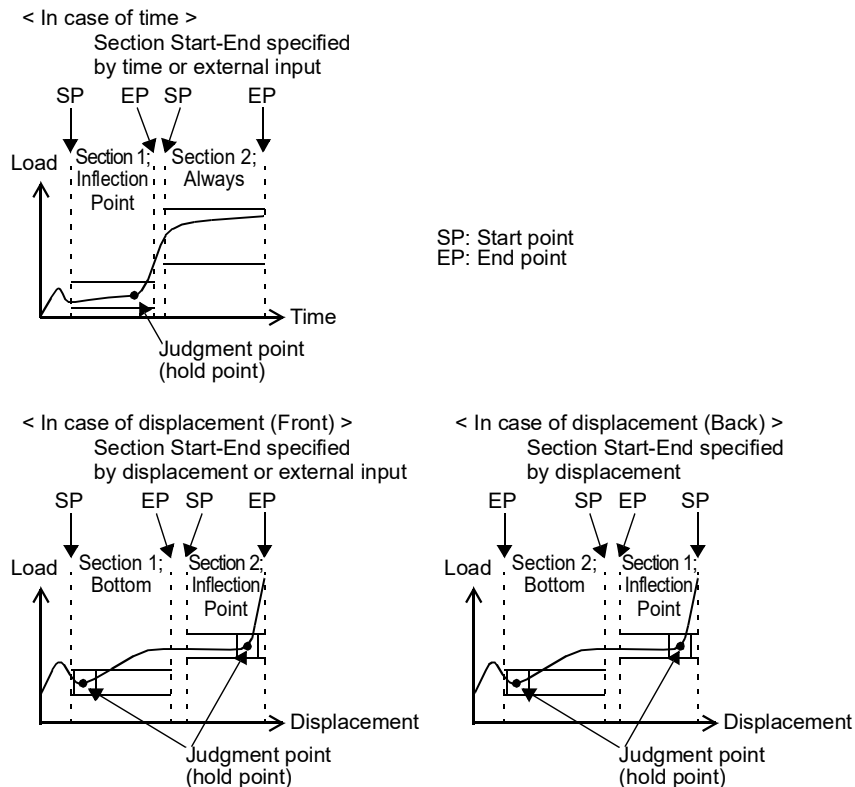
Operation

Main screen → Check → Display

## 4-8. Hold setting

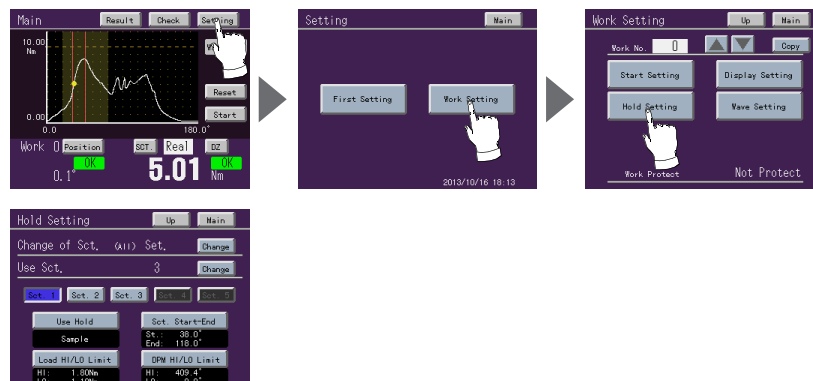
### ■ What is the hold function?

- By dividing a measurement waveform into up to five sections and specifying the HI limit, LO limit and the method of judgment for each section, the waveform can be judged on each section.
- The method of judgment can be changed by selection under “Use Hold.”
- Judgment point(s) can be kept depending on the selection under “Use Hold.”
- Make Change of Section by the external input signal “Hold” or Setting.



### ■ Section control setting

Set each section by Hold Setting.



#### Operation

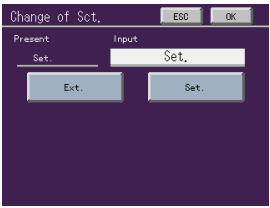
Main screen → Setting → Work Setting → Hold Setting

### - Change of Section

Select whether Change of Section is made by External Input or Setting.

Setting range (External Input or Setting)

Operation



Main screen → Setting → Work Setting → Hold Setting → Change (Change of Sct.)



Point

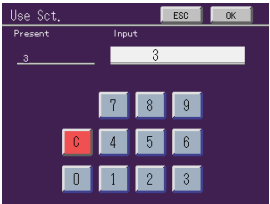
When the Waveform Reference is set at Back, Change of Section cannot be made externally.

### - Number of Use Sections

Set the number of sections to take hold.

Setting range (1 to 5)

Operation



Main screen → Setting → Work Setting → Hold Setting → Change (Use Sct.)

### - Section No.

Select the section(s) to set. Selection can be made by the number of sections set under "Number of Use Sections."

Setting range (Sct. 1, Sct. 2, Sct. 3, Sct. 4, Sct. 5)

Operation



Main screen → Setting → Work Setting → Hold Setting → Sct. 1 to Sct. 5

### - Use Hold

Set the hold to detect judgment point(s).

\* End displacement can be set only final section among the sections set by "Number of Use Sections" when X-axis of wave form is displacement.

Setting range

(Always, Sample, Peak, Bottom, Peak to Peak, Relative Maximum, Relative Minimum, Inflection Point, Average, End Displacement)

Operation



Main screen → Setting → Work Setting → Hold Setting → Use Hold

If Sample is selected to Hold, the setting items of the right screen are displayed.

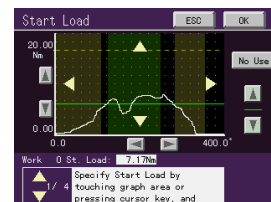


#### - Detection Start Load

Set the load to judge displacement while regarding a load as a trigger.

It is convenient for judging displacement with respect to the initial torque.

Press **No Use** for Sample Hold of the section start point.



Setting range (-9999 to 9999)

Operation

Main screen → Setting → Work Setting → Hold Setting → Use Hold → Sample → Start Load

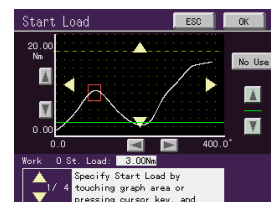
If Relative Minimum or Relative Maximum is selected to Hold, the setting items of the right screen are displayed.



#### - Detection Start Load

Set the load to start the detection of Relative Maximum (Relative Minimum).

If you do not use Detection Start Load, press **No Use**.



Setting range (-9999 to 9999)

Operation

Main screen → Setting → Work Setting → Hold Setting → Use Hold  
→ Rel. Max. (or Rel. Min.) → Start Load

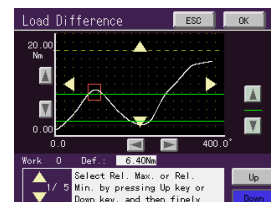
#### - Detection Load Difference

Set the load difference of Relative Maximum or Relative Minimum.

Select with the Up key for the Relative Maximum, and with the Down key for the Relative Minimum.

Setting range (1 to 19998)

Operation



Main screen → Setting → Work Setting → Hold Setting → Use Hold  
→ Rel. Max. (or Rel. Min.) → Load Difference

### - Detection Rate

Set the rate to detect Relative Maximum (Relative Minimum).

Relative Maximum (Relative Minimum) is detected when the detection rate is exceeded based on the relative minimum.

#### Setting range

(1/4, 1/2, 3/4, 1, 1.25, 1.5, 1.75, 2, 3, 4 Times)

#### Operation

Main screen → Setting → Work Setting → Hold Setting → Use Hold  
→ Rel. Max. (or Rel. Min.) → Rate



### - Detection Ordinal

Set the number of points to be counted before judgment of Relative Maximum (Relative Minimum).

#### Setting range (1 to 15 Times)

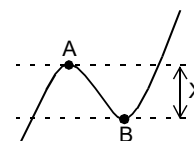
#### Operation

Main screen → Setting → Work Setting → Hold Setting → Use Hold  
→ Rel. Max. (or Rel. Min.) → Ordinal

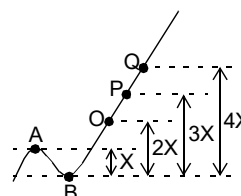


## How to detect Relative Maximum and Relative Minimum

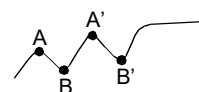
First, when Difference X between Point A and Point B exceeds Detection Load Difference, Point A is judged to be Relative Maximum, and Point B is judged to be Relative Minimum.



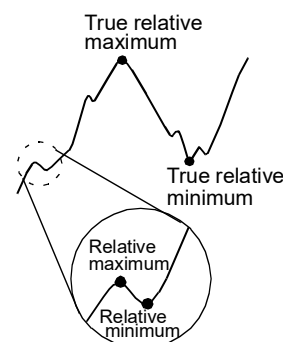
When Relative Maximum A and Relative Minimum B are detected, and Difference X between them exceeds Detection Rate (1/4 to 4 Times), at each point (Point Q if the Rate is 4 Times for example), A and B are displayed and held when the settings of “Use Hold” are Relative Maximum and Relative Minimum, respectively.



In the case where Relative Maximum and Relative Minimum appear more than once on a waveform, Relative Maximum and Relative Minimum are held after counting the number of times set under “Detection Ordinal.” For example, if the setting is “2,” A' and B' are held as Relative Maximum and Relative Minimum, respectively.



If the value of Detection Load Difference is too small, noise in the waveform as shown at the right may be regarded as Relative Maximum and Relative Minimum so that correct values may not be able to be held. Set an appropriate value by checking the input waveform on the screen.





If Inflection Point is selected to Hold, the setting items of the right screen are displayed.

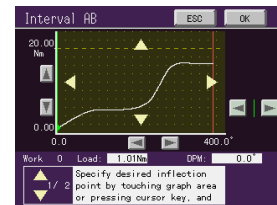


#### - Detection Interval AB

Set Detection Interval A and Detection Interval B.

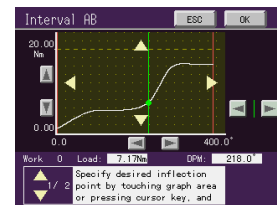
Setting range (The range is the same for A and B.)  
(1 to 999 × Measurement Length/2000)

#### Operation

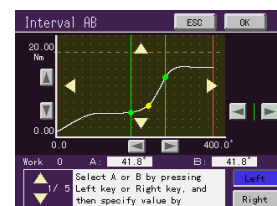


Main screen → Setting → Work Setting → Hold Setting → Use Hold → Inflect.  
→ Interval AB

- ① Set the inflection point you want to take. Touch the graph area or specify with the cursor keys, and then press **OK**.



- ② To set Detection Interval A, press **Left**, and to set Detection Interval B, press **Right**, and then set a value. After setting A and B, press **OK**.

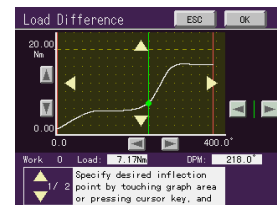


#### - Detection Load Difference

Set the load difference between Load A and Load B.

Setting range (1 to 19998)

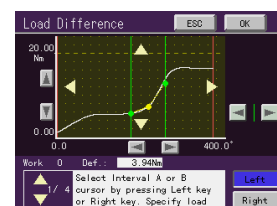
#### Operation



Main screen → Setting → Work Setting → Hold Setting → Use Hold → Inflect.  
→ Load Difference

- ① Set the inflection point you want to take. Touch the graph area or specify with the cursor keys, and then press **OK**.

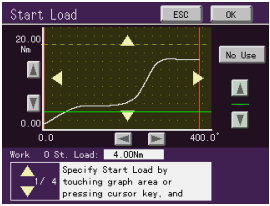
- ② To set Load A, press **Left**, and to set Load B, press **Right**, and then set a value. After setting A and B, press **OK**.



### - Detection Start Load

Set the load to start the detection of Inflection Point.

Start detecting the Inflection Point after the load crosses the Detection Start Load in the section. If you do not use Detection Start Load, press **No Use**. Inflection Point will be detected since the load crosses the start point of the section.



Setting range (-9999 to 9999)

Operation

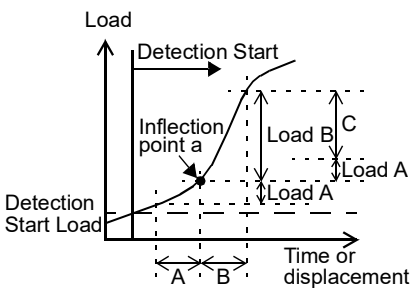
Main screen → Setting → Work Setting → Hold Setting → Use Hold → Inflect.  
→ Start Load

### How to detect an inflection point

The amount of change in the indicated value at Detection Interval A (load A) and the amount of change in the indicated value at Detection Interval B (load B) are compared, and when Difference C between these loads exceeds the Detection Load Difference set value, point a is held as an inflection point.

If there are two or more inflection points in the hold section, the point with a larger amount of change is held.

Normally  $A=B$ , but if  $A < B$  with a gradual inclination, it becomes easy to detect the inflection point.

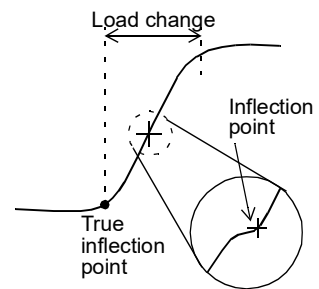


A: Detection Interval A  
B: Detection Interval B  
C: Load Difference  
Held as an inflection point  
if  $C > \text{Detection Load Difference}$ .

### Point

If the setting of Detection Interval AB is too short, fine changes in load are detected so that a correct value may not be able to be held.

In this case, set Detection Interval B large as close to the load change time as possible, and also set Detection Load Difference large according to the amount of change, by which an inflection point is held in the correct position.



## - Section Start-End

(only when Change of Section is made by Setting)

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

## Setting range

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

Time or displacement (Front)

(0 to  $2047 \times \text{Measurement Length}/2000$ )

\* Setting the start point &gt; the end point is unacceptable.

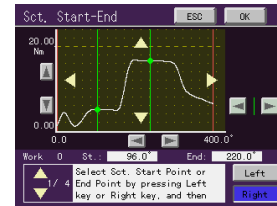
Displacement (Back)

(-2047 to  $0 \times \text{Measurement Length}/2000$ )

\* Setting the start point &lt; the end point is unacceptable.

## Operation

Main screen → Setting → Work Setting → Hold Setting → Sct. Start-End



## Point

- If the section start point and end point of two sections are set identically  
Front reference: The start point of the next section becomes valid.  
Back reference: The end point of the previous section becomes valid.  
Example) If the setting is the end point (section 1) = start point (section 2) = X  
Front reference: The X point falls on section 2.  
Back reference: The X point falls on section 1.
- If the displacement pace is fast, sampling may not be performed in time and no load may be held at the section start point. In that case, the load in time for sampling near the section start point is held.  
Also, when the section start point and end point are set identically, if the displacement pace is fast, no load may be held. Set the section start point and end point having a margin in consideration of the case where the displacement pace is fast.  
It is preferable to have a margin of the  $\text{Measurement Length}/2000 \times 10$  or more.

## - Load HI/LO Limit

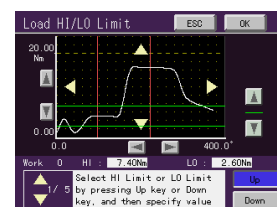
Set the range of load in which the judgment point is judged to be OK.

Setting range (-9999 to +9999: The range is the same for the HI limit and LO limit.)

\* Setting the HI limit &lt; the LO limit is unacceptable.

## Operation

Main screen → Setting → Work Setting → Hold Setting → Load HI/LO Limit





## Point

About the Load HI and LO Limit set values for “Peak to Peak”

“Peak to Peak” judgment is made by the maximum value – minimum value. Therefore, the judgment value will never be negative. So, set the Load HI/LO Limit in the range of 0 to 9999.

On the Main screen, the Load HI/LO Limit is offset-displayed (red line) on the basis of the minimum value (=0).

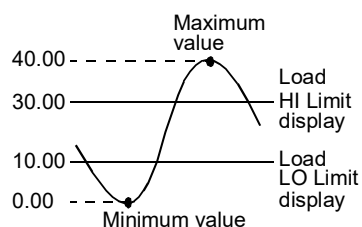
Value of Load HI Limit display = Load HI Limit set value + minimum value

Value of Load LO Limit display = Load LO Limit set value + minimum value

Example) When Load HI Limit is 30.00kN, and Load LO Limit is 10.00kN,

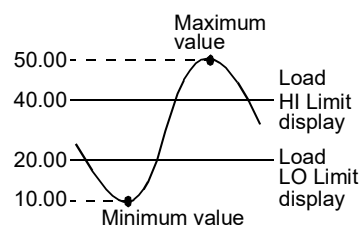
## [Measurement 1]

When the detected minimum value is 0.00kN, and the detected maximum value is 40.00kN



## [Measurement 2]

When the detected minimum value is 10.00kN, and the detected maximum value is 50.00kN



## - Displacement HI/LO Limit

(only when the X-axis represents displacement)

Set the range of displacement in which the judgment point is judged to be OK.

## Setting range

Displacement (Front): (0 to  $2047 \times \text{Measurement Length}/2000$ )

Displacement (Back): ( $-2047$  to  $0 \times \text{Measurement Length}/2000$ )

\* Setting the HI limit < the LO limit is unacceptable.

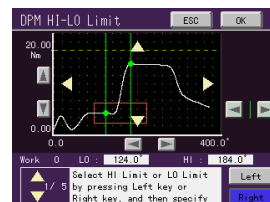
\* When End Displacement in Use Hold is selected, the screen of Displacement HI/LO becomes a numeric keypad.

Moreover, the setting range changes too.

Setting range (-9999 to 32000)

## Operation

Main screen → Setting → Work Setting → Hold Setting → DPM HI/LO Limit



## Types of holds

All holds are to carry out detection in each valid section.

The valid section is as follows:

When the setting of Change of Section is External Input: As long as the Hold input is ON

When the setting of Change of Section is Setting: Between the start point and end point of the set section

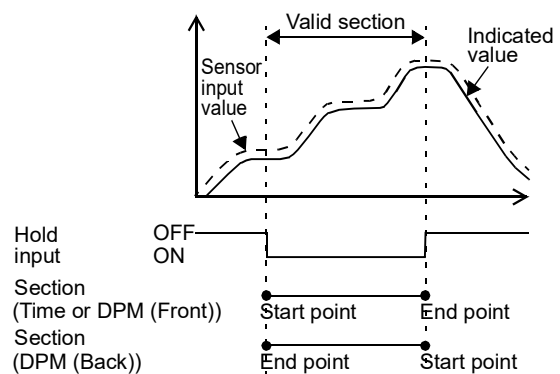
### - Always

The indicated value and the HI and LO

Limit set values are always compared in the valid section.

Judgment points are all data in the valid section.

No judgment points are kept.

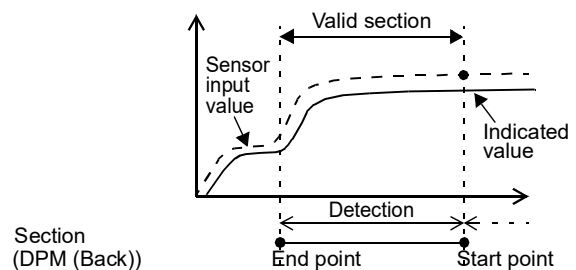
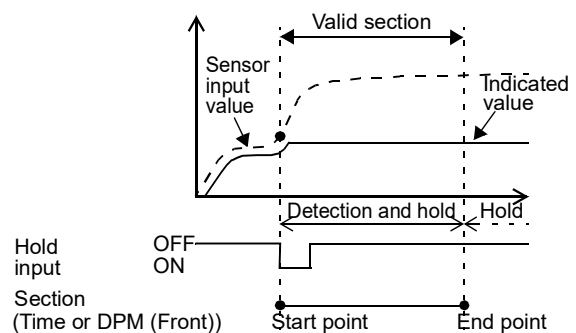


### - Sample

The load at the start point of the valid section is held.

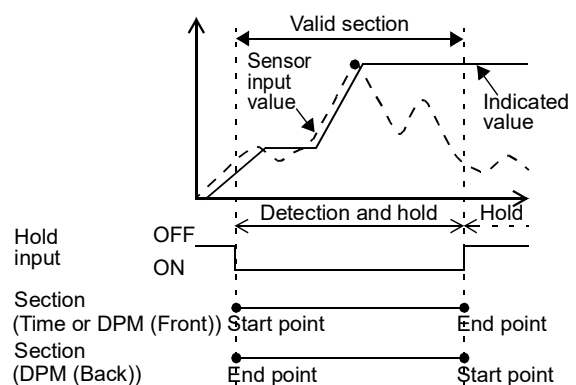
\* It is not necessary to make the section start point and end point identical.

\* When the Waveform Reference is set at Back, it detects a judgment point when the measurement ends.



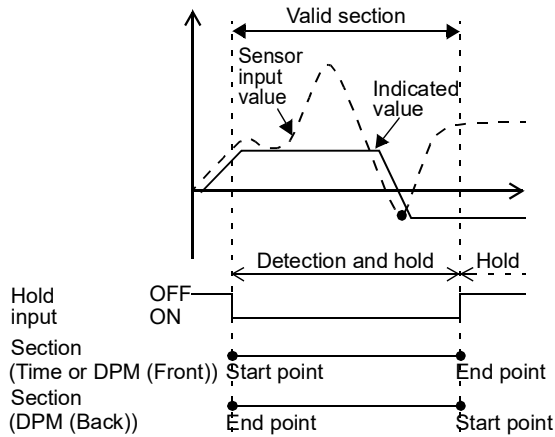
### - Peak

The maximum value (peak value) is held.



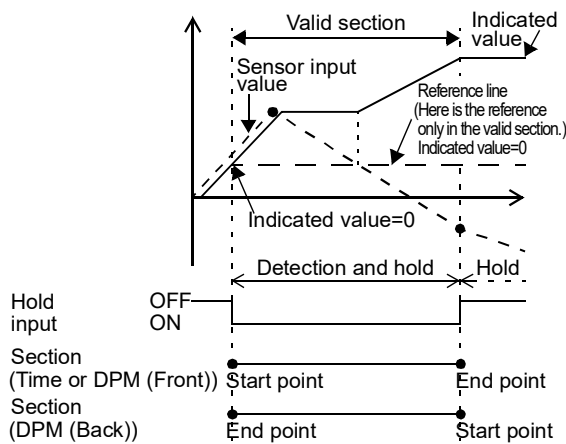
### - Bottom

The minimum value (bottom value) is held.



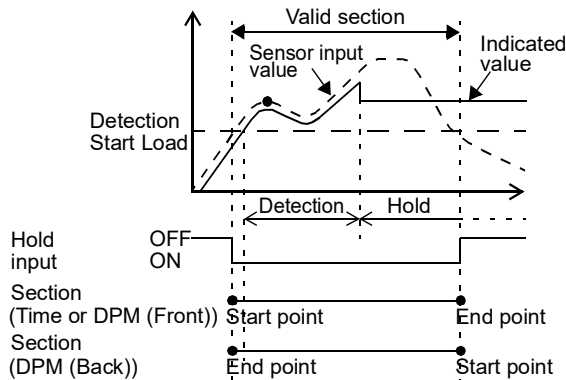
### - P-P (Peak to Peak)

The difference between the peak value and the bottom value is held.



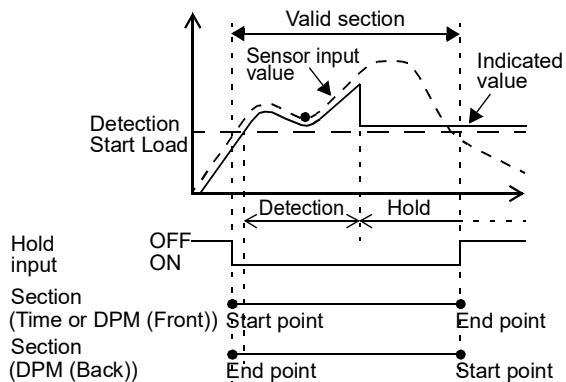
### - Relative Maximum

Detection is carried out from the point at which the Detection Start Load is crossed, and when the relative maximum detection conditions are met, the relative maximum is held.



### - Relative Minimum

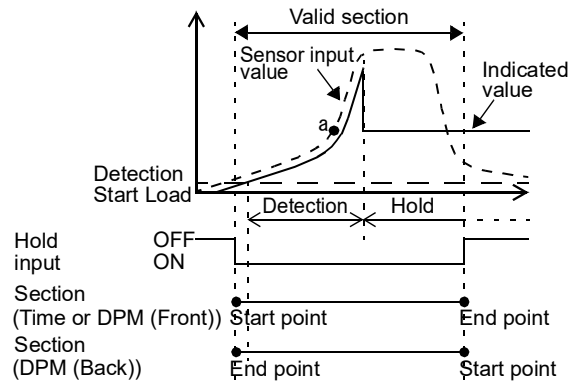
Detection is carried out from the point at which the Detection Start Load is crossed, and when the relative minimum detection conditions are met, the relative minimum is held.



**- Inflection Point**

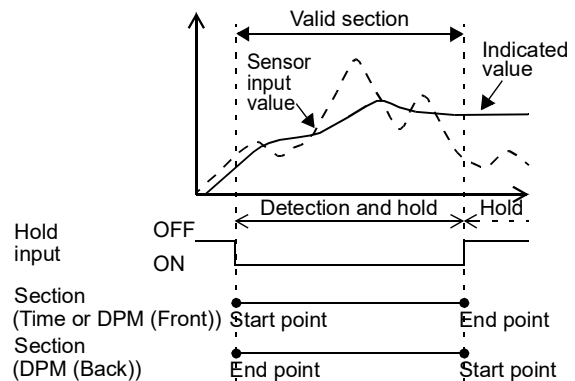
The point at which the load changes drastically is held.

Detection is carried out from the point at which the Detection Start Load is crossed, and when the inflection point detection conditions are met, the inflection point is held.

**- Average**

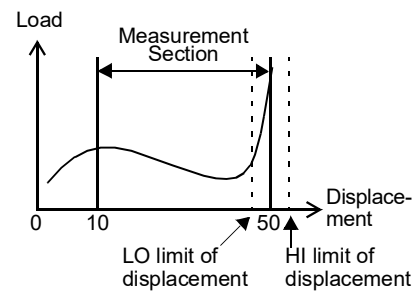
Average is calculated and held.

Average is calculated and held when X-axis represents displacement upon completion of measurement.

**- End Displacement**

The position of the measurement completion can be judged by using the End Displacement for the Use Hold.

The End Displacement is different from other hold types, so it judges not based on a wave starting point but based on an original point of the displacement.

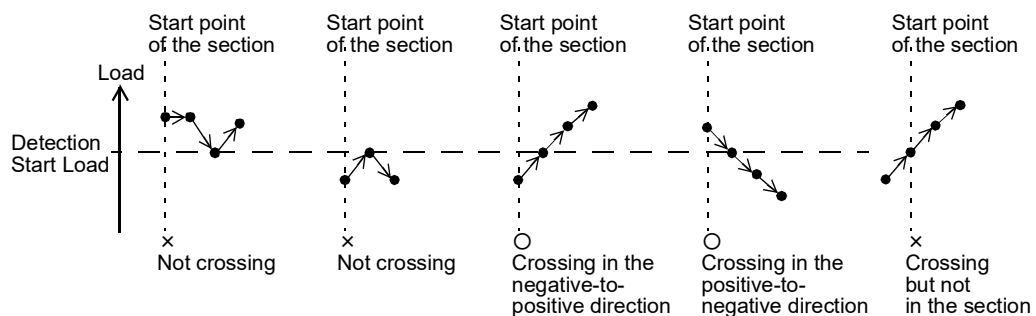


- \* It is not necessary to input Change of Sct. and to set Sct. Start-End of Hold.
- \* End displacement can be set only final section among the sections set by "Number of Use Sec." when X-axis of wave form is displacement.
- \* The line of DPM HI/LO Limit is not displayed on the actual measurement screen.

**What is "crossing" the Detection Start Load?**

Load's passing the detection start load in the positive-to-negative or negative-to-positive direction is called "crossing."

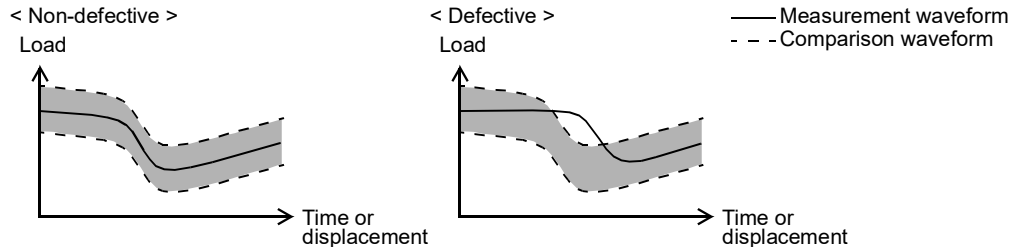
If detection is not started, check again the setting of Detection Start Load and the change of load in the section referring to the following examples.



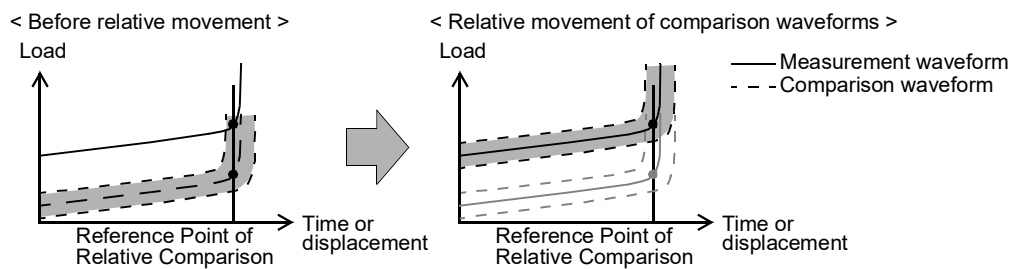
## 4-9. Waveform comparison setting

### ■ What is the waveform comparison function?

- Whether or not a measurement waveform is between comparison waveforms is judged by preparing the comparison waveforms in advance.



- If Relative Comparison is selected, waveforms fluctuating up and down with each measurement can relatively be compared.
- By this function, comparison waveforms are relatively moved according to the load at the Reference Point of Relative Comparison, which should previously be set by time or displacement, on a measurement waveform.
- If the measurement does not reach the Reference Point, no judgment is made. (All Wave Result outputs are OFF.)



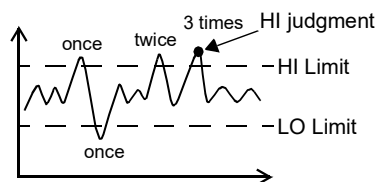
#### Point

- Relative movement can only be made in the Y-axis direction.
- In continuous mode, relative comparison function is invalid.

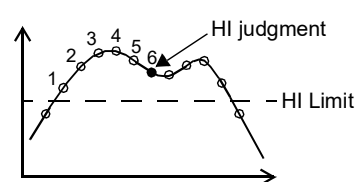
### ■ Waveform comparison in continuous mode

- Waveforms are judged with respect to the number of times they deviate from HI/LO limit of comparison waveforms created.
- Waveforms are also judged with respect to continuation range of deviation condition.

< HI limit: twice and LO limit: once >



< HI limit range 5 >

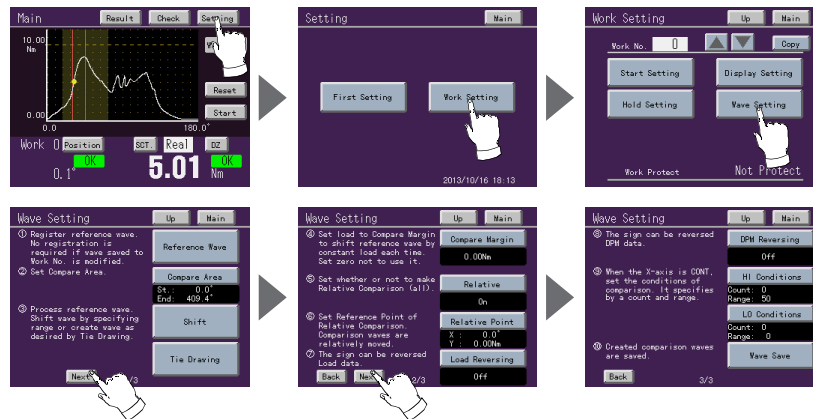


Range monitors the amount of waveform data.



## ■ Waveform Comparison Setting

Set the waveform comparison function by Wave Comparison Setting. Set each item according to the setting order. Skip unnecessary setting items.

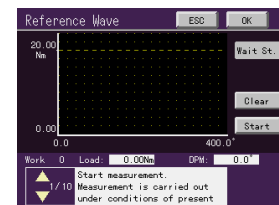


### Operation

Main screen → Setting → Work Setting → Wave Setting (→ Next → Next)

#### 1. Registration of Reference Waveform.

Input and register reference waveform(s).



### Operation

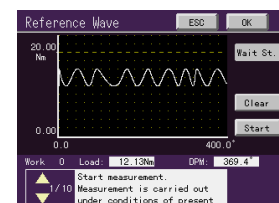
Main screen → Setting → Work Setting → Wave Setting → Reference Wave

- ① Not to use the currently-registered waveform(s), press **Clear**, and select **All Wave**.



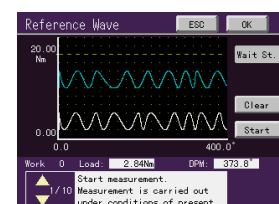
- ② Satisfy the Measurement Start Condition, and start measurement.

- ③ Satisfy the Measurement Stop Condition, and stop measurement.



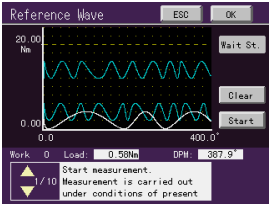
- ④ A measurement waveform is displayed.

Now, to delete the measurement waveform, press **Clear**, and select **Last Wave**.

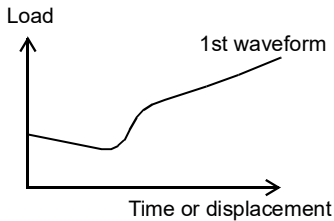


⑤ To input a waveform again, repeat ② to ④.

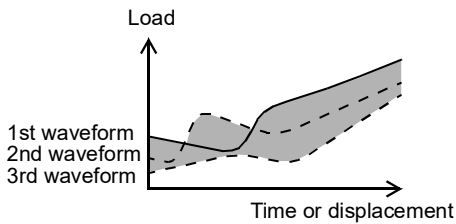
⑥ Pressing **OK** registers the reference waveform(s).



In the case of one reference waveform, it is recognized that the HI limit waveform and LO limit waveform are the same.



If two or more waveforms are input, the upper limit of all waveforms becomes the HI limit waveform, and the lower limit of all waveforms becomes the LO limit waveform.



## 2. Compare Area

Set the waveform comparison target.

Setting range (start point, end point)

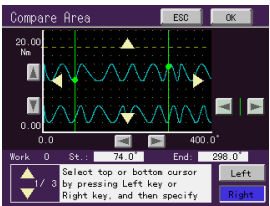
Time or displacement (Front)

(0 to 2047 × Measurement Length/2000)

Displacement (Back)

(-2047 to 0 × Measurement Length/2000)

Operation



Main screen → Setting → Work Setting → Wave Setting → Compare Area

- ① To change the start point of the area, press **Left** (Displacement (Back): **Right**), and then move the cursor to specify it.
- ② To change the end point of the area, press **Right** (Displacement (Back): **Left**), and then move the cursor to specify it.
- ③ To register the specified area, press **OK**.
- ④ After the registration of the area, the background color outside the area becomes gray on the waveform processing screens set later so that the boundaries of the area become clear.

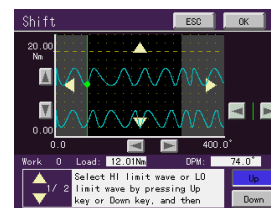
### 3. Shift

This is one of the waveform processing methods.

A part of waveform can be shifted up/down.

Setting range (range set under “Compare Area”)

Operation



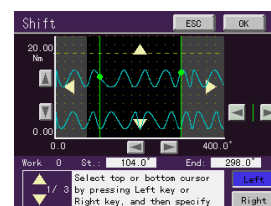
Main screen → Setting → Work Setting → Wave Setting → Shift

- ① To shift the HI limit waveform, press **Up**, and to shift the LO limit waveform, press **Down** to select each waveform, and then press **OK**.

- ② Determine the range you want to shift. To specify the left of the range, press **Left**, and then move the cursor.

To specify the right of the range, press **Right**, and then move the cursor.

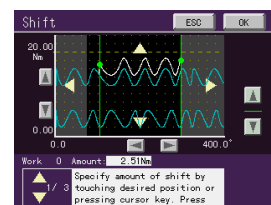
After specifying the range, press **OK**.



- ③ Determine the amount of shift.

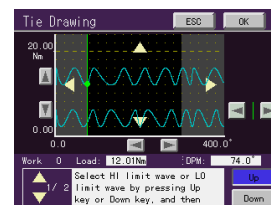
Touch the desired position, or specify the amount of shift

with **Up/Down**, and then press **OK**.



### 4. Tie Drawing

A waveform can be created or processed as desired by preparing one or more points and tying the point(s) by straight lines. If there is only one point, a spine-like waveform will result as passing that point.



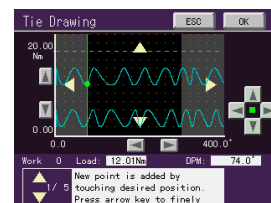
Setting range (1 to 10 points)

Operation

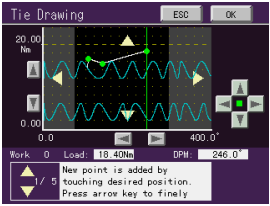
Main screen → Setting → Work Setting → Wave Setting → Tie Drawing

- ① To create/process the HI limit waveform, press **Up**, and to create/process the LO limit waveform, press **Down** to select each waveform, and then press **OK**.

- ② Touching a desired position creates a point. To finely adjust the point position, press the arrow key to move the point to the target position.



- ③ To add point(s), repeat the operation in ②.  
To correct already-created point(s), touch the left side of the point(s) you want to correct.  
All the points on the right side from the touched place are erased, and a new point is created at the touched place.



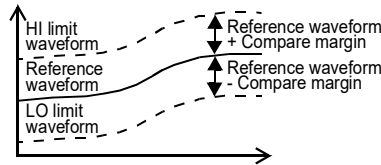
- ④ After specifying all points, press **OK**.

## 5. Compare Margin

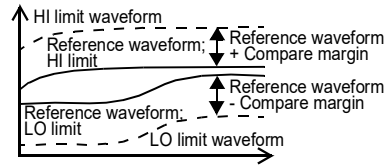
Entire waveforms are shifted by the set value. Use this when it is required to simply shift reference waveform(s) by the set load. If the Compare Margin is set in advance, comparison waveforms can be created by simply inputting and saving reference waveform(s).



<In the case of one reference waveform>



<In the case of two reference waveforms>



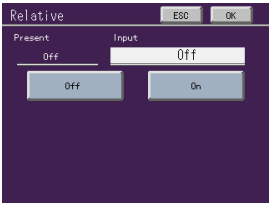
Setting range (0 to 9999)

Operation

Main screen → Setting → Work Setting → Wave Setting → Compare Margin

## 6. Relative Comparison

Select whether waveform comparison is made as standard or by relative value. The comparison is invalid in continuous mode.



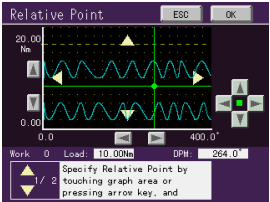
Setting range (Off, On)

Operation

Main screen → Setting → Work Setting → Wave Setting → Relative

## 7. Reference Point of Relative Comparison

Set the reference point for making waveform comparison by relative movement. This setting can be made only when the setting of Relative Comparison is On.



Setting range

X-axis:

Time or displacement (Front) (0 to 2047 × Measurement Length/2000)

Displacement (Back) (-2047 to 0 × Measurement Length/2000)

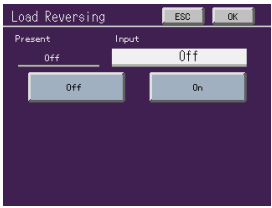
Y-axis: (-9999 to 9999)

Operation

Main screen → Setting → Work Setting → Wave Setting → Relative Point

### 8. Load Reversing

When measuring, reverse load sign before acquiring data.  
Waveform data is reversed without change in the indicated value display during measurement.

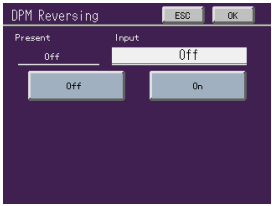


Setting range (Off, On)  
Operation

Main screen → Setting → Work Setting → Wave Setting → Next → Load Reversing

### 9. Displacement Reversing

When measuring, reverse displacement direction before acquiring data. When returning from one displacement point, this point can be set as a measurement start point. There is no change in the indicated value display and waveform data during measurement.



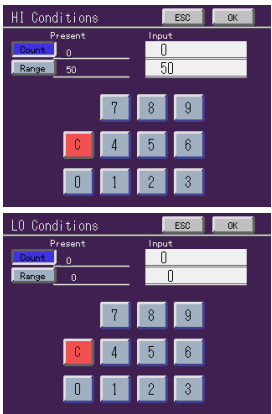
Setting range (Off, On)  
Operation

Main screen → Setting → Work Setting → Wave Setting → Next → Next → DPM Reversing

### 10. HI/LO Conditions

Waveform comparison condition in continuous mode is set.  
Comparison is made with respect to every acquisition.

Counts of HI/LO limit <  
Counts where HI/LO limit was exceeded or  
HI/LO limit range <  
Data range where HI/LO limit was exceeded  
⇒ HI or LO

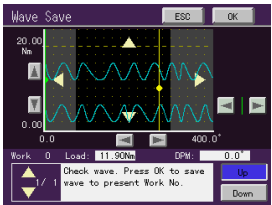


Setting range  
Count (0 to 99)  
Range (0 to 999)  
Operation

Main screen → Setting → Work Setting → Wave Setting → Next → Next  
→ HI conditions/LO conditions

### 11. Waveform Save

Check and save the waveform.  
If there is no problem, press .  
The present waveform is not saved until is pressed.



Operation

Main screen → Setting → Work Setting → Wave Setting → Wave Save



Point

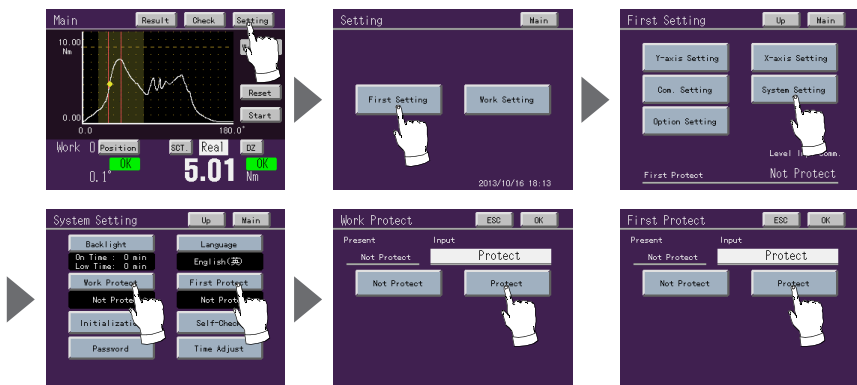
Upon completion of creation/processing of a waveform, be sure to check and save it by Waveform Save.

When not using comparison waveforms ...

1. Press **Clear** on the Registration of Reference Waveform screen, and select **All Wave**.
2. Since the Registration of Reference Waveform screen is restored, press **OK**.
3. If the setting of Relative Comparison is On, set it to Off.
4. Press Wave Save, and press **OK**.

## 4-10. Parameter protection

Protect set values from being changed by mistake.



### Work Setting Parameter Protection

#### Operation

Main screen → Setting → First Setting → System Setting → Work Protect → Protect

### First Setting Parameter Protection

#### Operation

Main screen → Setting → First Setting → System Setting → First Protect → Protect

## 4-11.Measuring work specification

Up to 16 types of work set values can be stored in the TM500, and the work No. (measuring work) used for measurement must be specified.

For this, the external input signals “Work 1 to Work 8” are used.

Normally, if there is no input to “Work 1 to Work 8,” the Work 0 set value is selected, while if “Work 1 to Work 8” are in the following conditions, each work is selected.

Measuring Work No. can be selected by using RS-232C command.

\* These data are only effective when "Communication" is selected at Priority of level input signal.

Work 8	Work 4	Work 2	Work 1	Main work display (measuring work)
0	0	0	0	0
0	0	0	1	1
0	0	1	0	2
0	0	1	1	3
0	1	0	0	4
0	1	0	1	5
0	1	1	0	6
0	1	1	1	7
1	0	0	0	8
1	0	0	1	9
1	0	1	0	10
1	0	1	1	11
1	1	0	0	12
1	1	0	1	13
1	1	1	0	14
1	1	1	1	15

(0:Open, 1:ON)

Control connector

A9, A10 B9, B10	COM (Input)
B1	Work 1
B2	Work 2
B3	Work 4
B4	Work 8



Point

Measuring work is accepted when the Start input signal is turned ON.

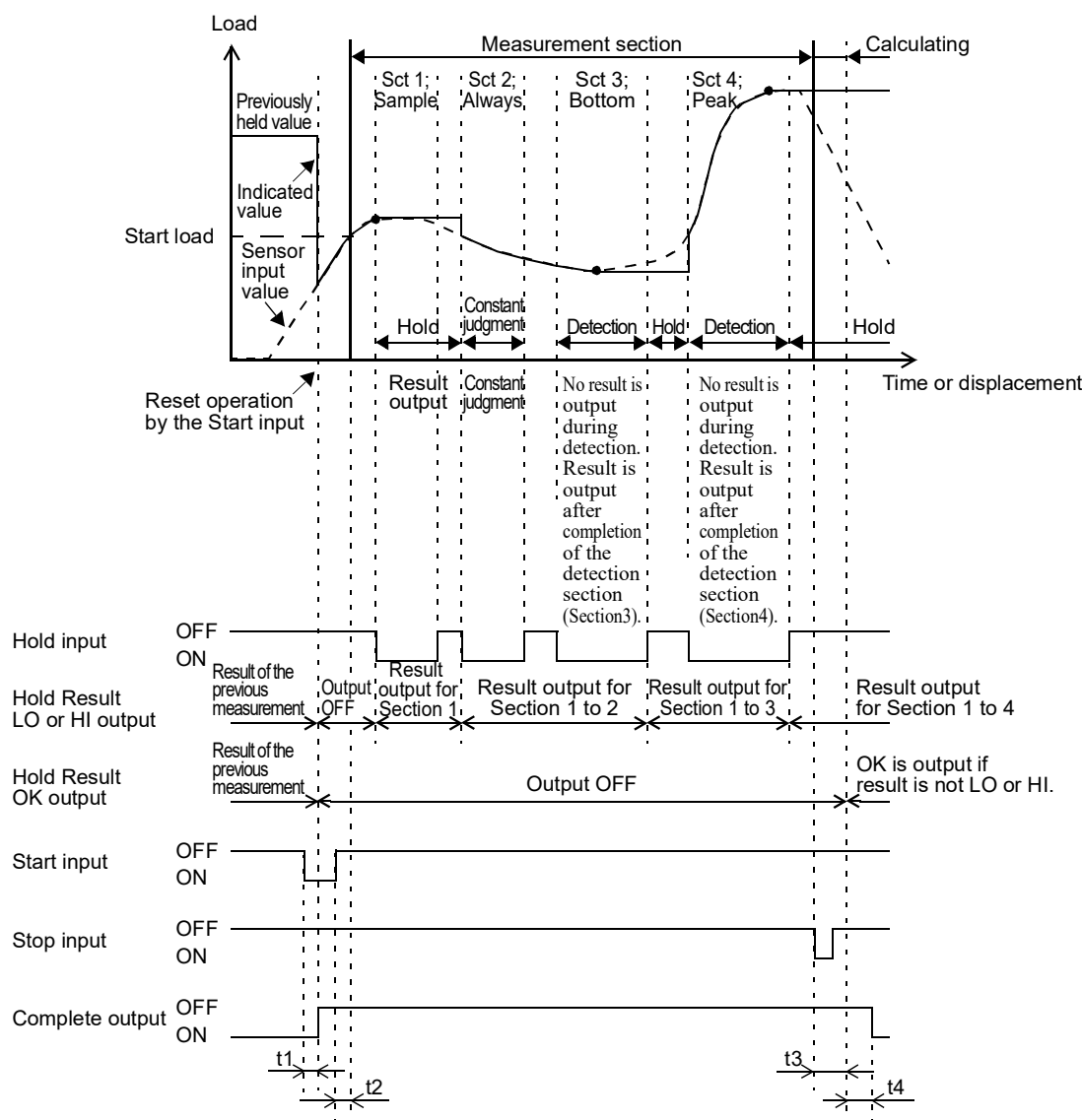
Even if the measuring work is changed during measurement, it is ignored.

## 4-12. Judgment timing chart

Here, some example timing charts using the hold function and waveform comparison function are given.

### ■ Example timing chart by the hold function

- External control (only time or displacement (Reference; Front))



t1: Delay time between the instant when the Start input is turned ON and the instant when all outputs but Run are turned OFF ... Approx. 5ms

t2: Delay time between the instant when the Start input is turned OFF and the instant when the measurable section is started. It varies depending on the time of crossing the Start Load.

t3: Delay time between the instant when the measurement is stopped (the Stop input is turned ON) and the instant when the Result output is turned ON ... Approx. 50ms (However, there are differences between measurements.)

t4: Delay time between the instant when the Result output is turned ON and the instant when the Complete output is turned ON ... Approx. 30ms



- Turning OFF → ON the external input signal “Start” releases the hold, and turns OFF all outputs but Run. (Reset operation by the Start input)
- Turning OFF → ON the external input signal “Hold” changes the section and gets the start point of the section.
- Turning ON → OFF the external input signal “Hold” gets the end point of the section.
- If Always or Sample is specified under “Use Hold,” the result (except OK) is output from the start point of the section. If any of the other holds is specified, the result is not output until the end of the section but the result (except OK) of the last section is output.
- Once the judgment of output becomes LO or HI, the output is maintained.
- The OK signal is output when it is confirmed that judgment has been made at all sections and the results are not HI or LO upon completion of measurement.  
OK will not result if judgment is not made for the Number of Use Sections.

Example 1: Failure in hold detection when Relative Maximum, Relative Minimum, or Inflection Point hold is used.

Example 2: Sections not changed for the Number of Use Sections.

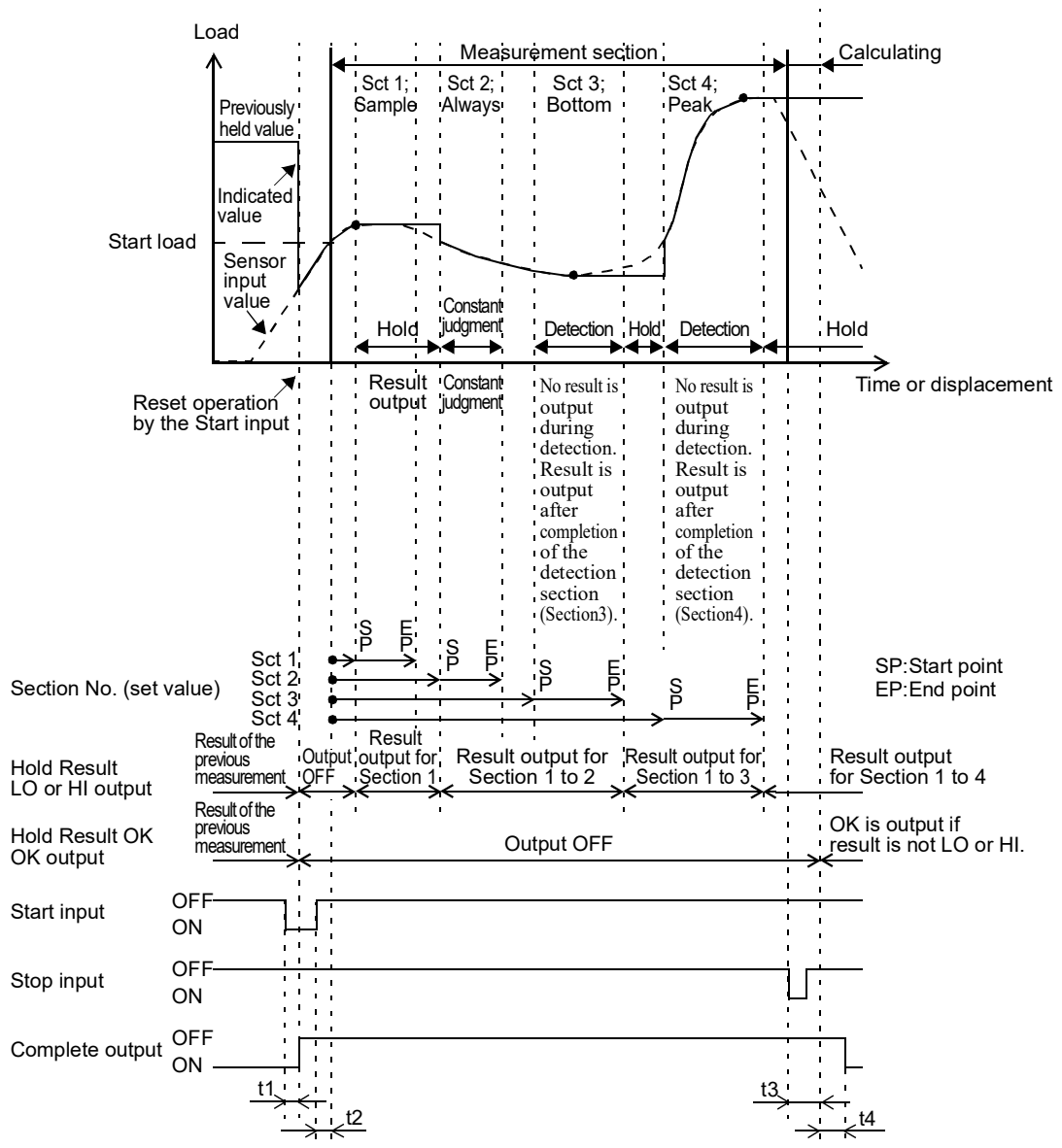
- Turning OFF → ON the Stop signal or taking data of 2048 points turns ON the Complete signal.
- When the X-axis of the waveform represents displacement, the relative maximum, relative minimum, inflection point, and average are judged upon completion of measurement.



#### Point

To start a section from the start of measurement, turn ON the external input signal “Hold” before the start of measurement.

## - Internal setting control (time or displacement (Reference; Front))



t1: Delay time between the instant when the Start input is turned ON and the instant when all outputs but Run are turned OFF ... Approx. 5ms

t2: Delay time between the instant when the Start input is turned OFF and the instant when the measurable section is started. It varies depending on the time of crossing the Start Load.

t3: Delay time between the instant when the measurement is stopped (the Stop input is turned ON) and the instant when the Result output is turned ON ... Approx. 50ms (However, there are differences between measurements.)

t4: Delay time between the instant when the Result output is turned ON and the instant when the Complete output is turned ON ... Approx. 30ms

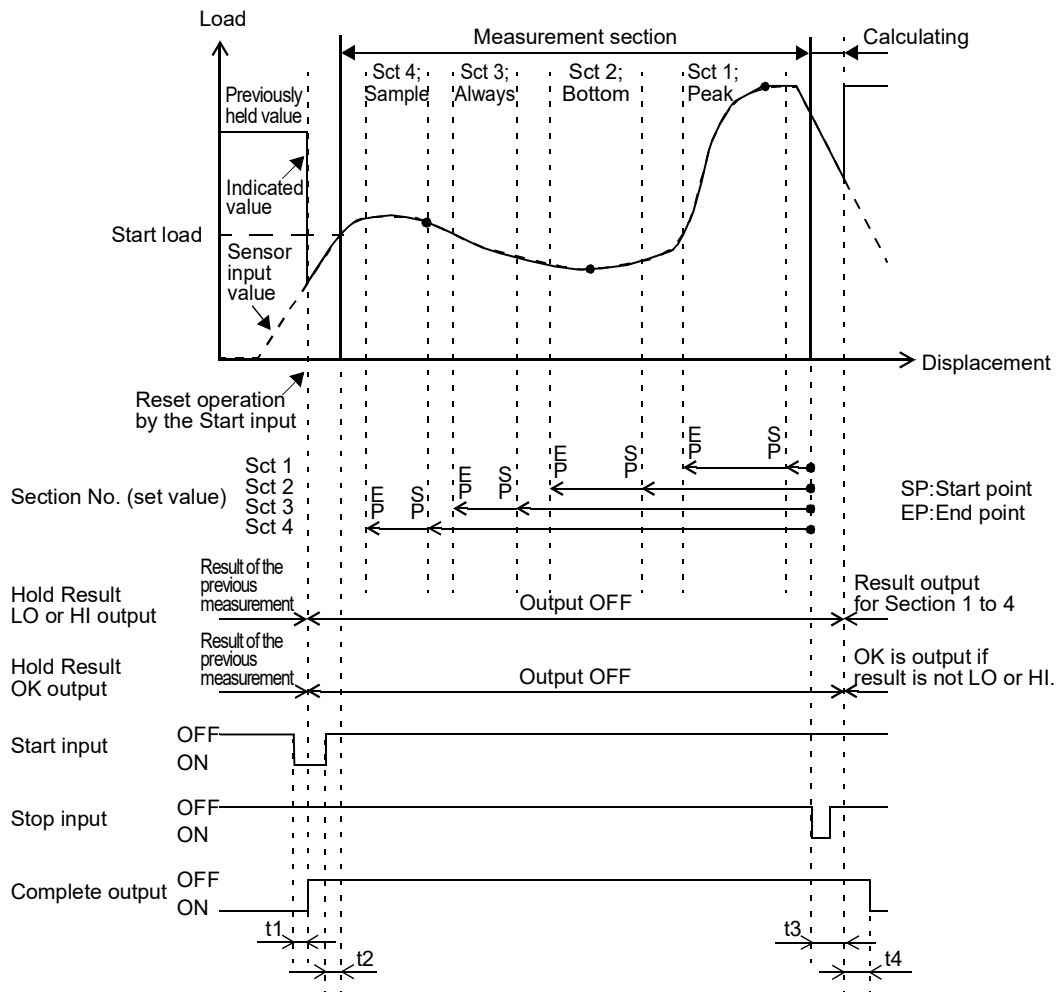
- Specify the start point and end point of the section by time or displacement.
- During measurement, each hold operation is performed by the set Section Start-End.
- Turning OFF → ON the external input signal “Start” releases the hold, and turns OFF all outputs but Run. (Reset operation by the Start input)
- If Always or Sample is specified under “Use Hold,” the result (except OK) is output from the start point of the section. If any of the other holds is specified, the result is not output until the end of the section but the result (except OK) of the last section is output.
- Once the judgment of output becomes LO or HI, the output is maintained.
- The OK signal is output when it is confirmed that judgment has been made at all sections and the results are not HI or LO upon completion of measurement.  
OK will not result if judgment is not made for the Number of Use Sections.

Example 1: Failure in hold detection when Relative Maximum, Relative Minimum, or Inflection Point hold is used.

Example 2: Sections not changed for the Number of Use Sections.

- Turning OFF → ON the Stop signal or taking data of 2048 points turns ON the Complete signal.
- When the X-axis of the waveform represents displacement, the relative maximum, relative minimum, inflection point, and average are judged upon completion of measurement.

## - Internal setting control (displacement (Reference; Back))



t1: Delay time between the instant when the Start input is turned ON and the instant when all outputs but Run are turned OFF ... Approx. 5ms

t2: Delay time between the instant when the Start input is turned OFF and the instant when the measurable section is started. It varies depending on the time of crossing the Start Load.

t3: Delay time between the instant when the measurement is stopped (the Stop input is turned ON) and the instant when the Result output is turned ON ... Approx. 50ms (However, there are differences between measurements.)

t4: Delay time between the instant when the Result output is turned ON and the instant when the Complete output is turned ON ... Approx. 30ms

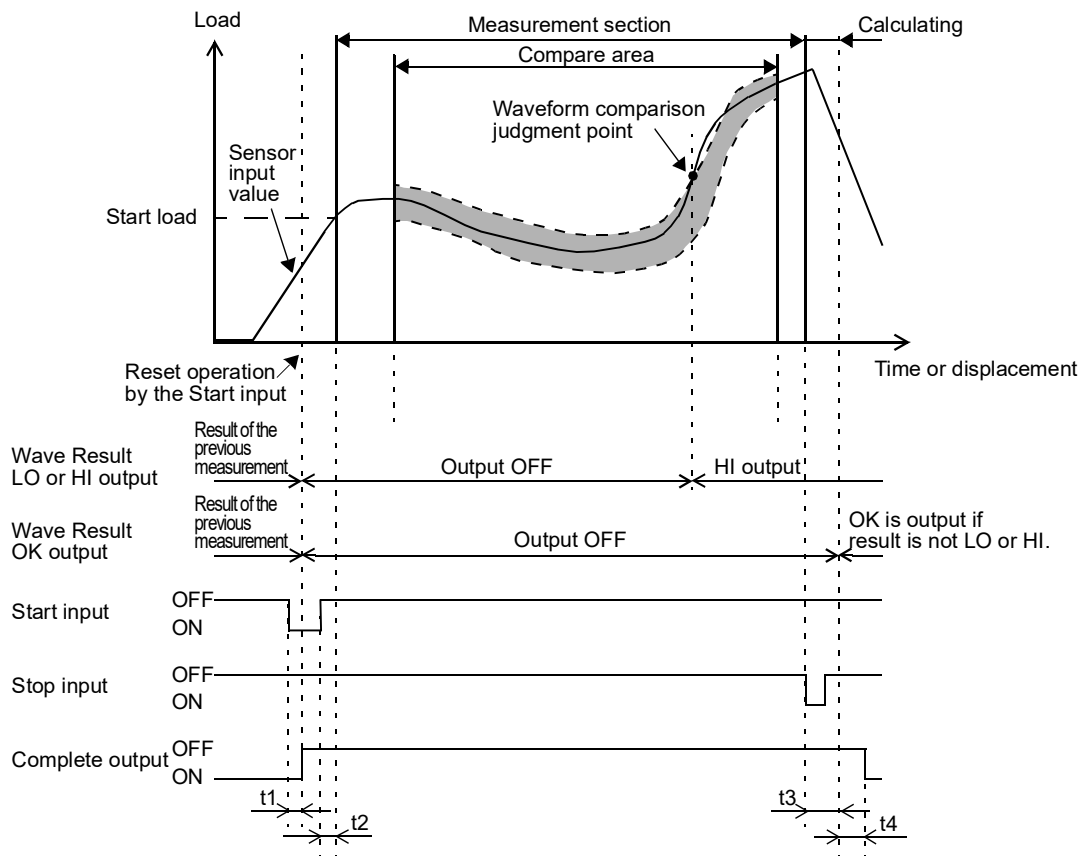
- Specify the start point and end point of the section by displacement.
- After completion of measurement, the waveform is scanned from the front, and each hold operation is performed by the set Section Start-End.
- Turning OFF → ON the external input signal “Start” releases the hold, and turns OFF all outputs but Run. (Reset operation by the Start input)
- Turning OFF → ON the Stop signal or taking data of 2048 points turns ON the Complete signal.
- All results are output after completion of measurement.
- The OK signal is output when it is confirmed that judgment has been made at all sections and the results are not HI or LO upon completion of measurement.  
OK will not result if judgment is not made for the Number of Use Sections.

Example 1: Failure in hold detection when Relative Maximum, Relative Minimum, or Inflection Point hold is used.

Example 2: Sections not changed for the Number of Use Sections.

## ■ Example timing chart using the waveform comparison function

- Reference; Front (Relative Comparison not in use)



t1: Delay time between the instant when the Start input is turned ON and the instant when all outputs but Run are turned OFF ... Approx. 5ms

t2: Delay time between the instant when the Start input is turned OFF and the instant when the measurable section is started. It varies depending on the time of crossing the Start Load.

t3: Delay time between the instant when the measurement is stopped (the Stop input is turned ON) and the instant when the Result output is turned ON ... Approx. 50ms (However, there are differences between measurements.)

t4: Delay time between the instant when the Result output is turned ON and the instant when the Complete output is turned ON ... Approx. 30ms

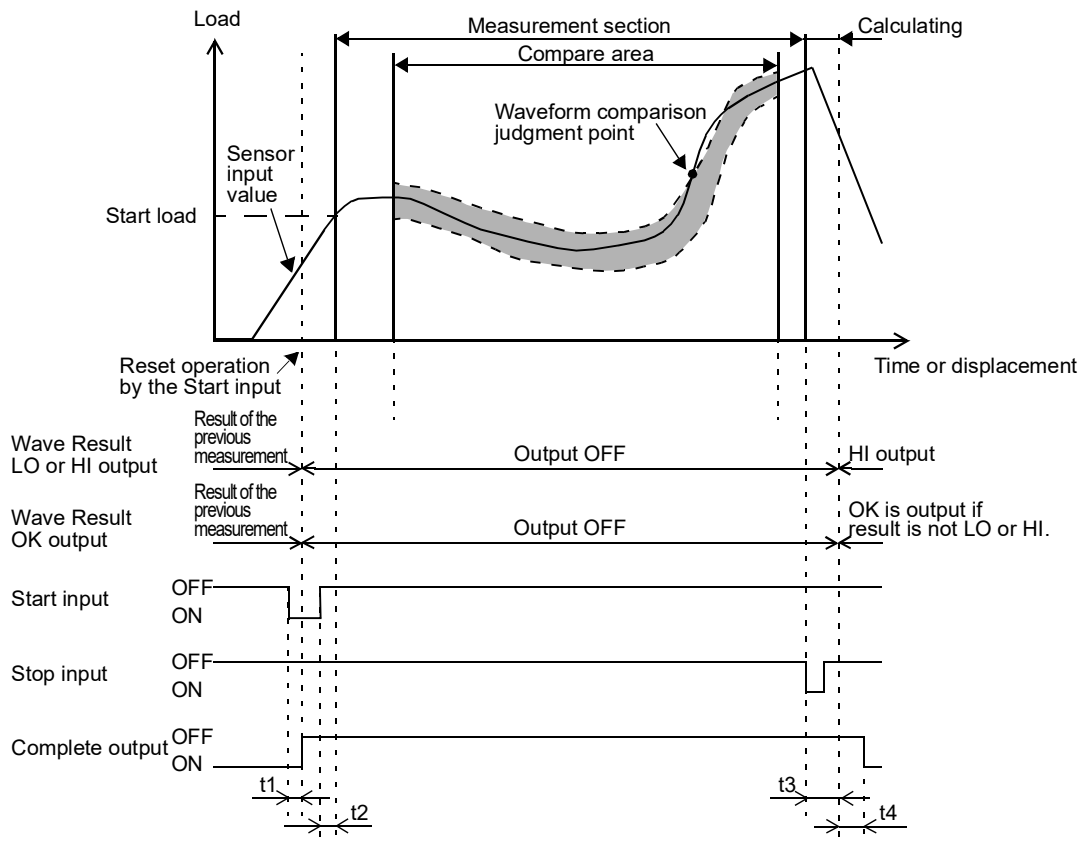
- Turning OFF → ON the external input signal “Start” releases the hold, and turns OFF all outputs but Run. (Reset operation by the Start input)
- Turning OFF → ON the Stop signal or taking data of 2048 points turns ON the Complete signal.
- Once the judgment of output becomes LO or HI, the output is maintained.
- OK turns ON if the Compare Area is passed through during measurement and the result is not LO or HI after completion of measurement.



### Point

If the measurement does not reach the Compare Area, all Wave Result outputs turn OFF.

## - Reference; Back, or Relative Comparison in use



t1: Delay time between the instant when the Start input is turned ON and the instant when all outputs but Run are turned OFF ... Approx. 5ms

t2: Delay time between the instant when the Start input is turned OFF and the instant when the measurable section is started. It varies depending on the time of crossing the Start Load.

t3: Delay time between the instant when the measurement is stopped (the Stop input is turned ON) and the instant when the Result output is turned ON ... Approx. 50ms (However, there are differences between measurements.)

t4: Delay time between the instant when the Result output is turned ON and the instant when the Complete output is turned ON ... Approx. 30ms

- Turning OFF → ON the external input signal “Start” releases the hold, and turns OFF all outputs but Run. (Reset operation by the Start input)
- Turning OFF → ON the Stop signal or taking data of 2048 points turns ON the Complete signal.
- After completion of measurement, judgment is made by scanning the waveform from its front, and HI or LO or OK turns ON.
- OK turns ON if the Compare Area is passed through during measurement and the result is not LO or HI after completion of measurement.



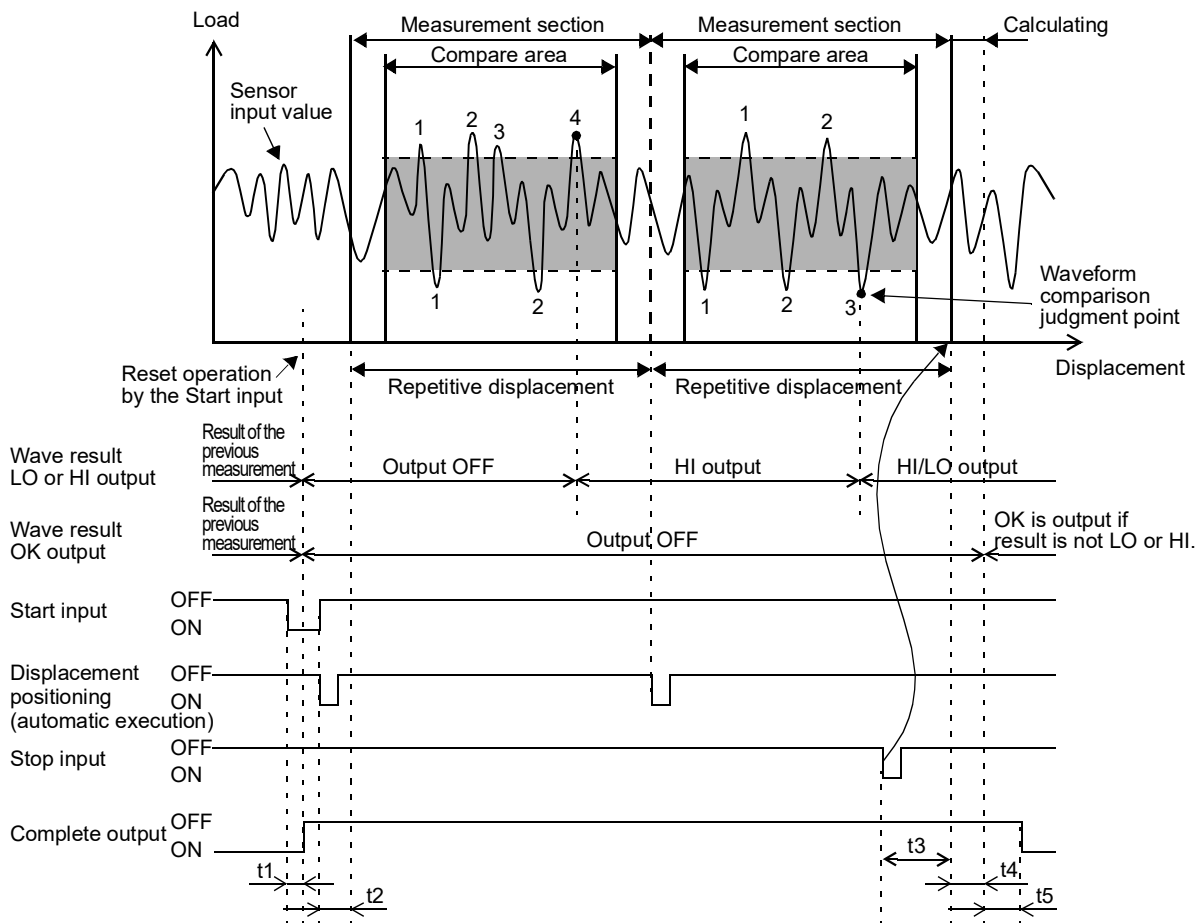
## Point

If the measurement does not reach the Compare Area, all Wave Result outputs turn OFF.

When Relative Comparison is used, if the measurement does not reach the Reference Point, no judgment is made. (All Wave Result outputs are OFF.)

### - Continuous mode

When repeated twice at HI limit: three times and LO limit: twice



t1: Delay time between the instant when the Start input is turned ON and the instant when all outputs but Run are turned OFF ... Approx. 5ms

t2: Delay time between the instant when the Start input is turned OFF and the instant when the measurable section is started... 0.25ms  
Displacement positioning is automatically executed, and measurement starts as a measurement start point.

t3: Minimum time required for measurement completion at the next repetitive displacement... 0.5ms

t4: Delay time between the instant when the measurement is stopped and the instant when the Result output is turned ON ... Approx. 50ms (However, there are differences between measurements.)

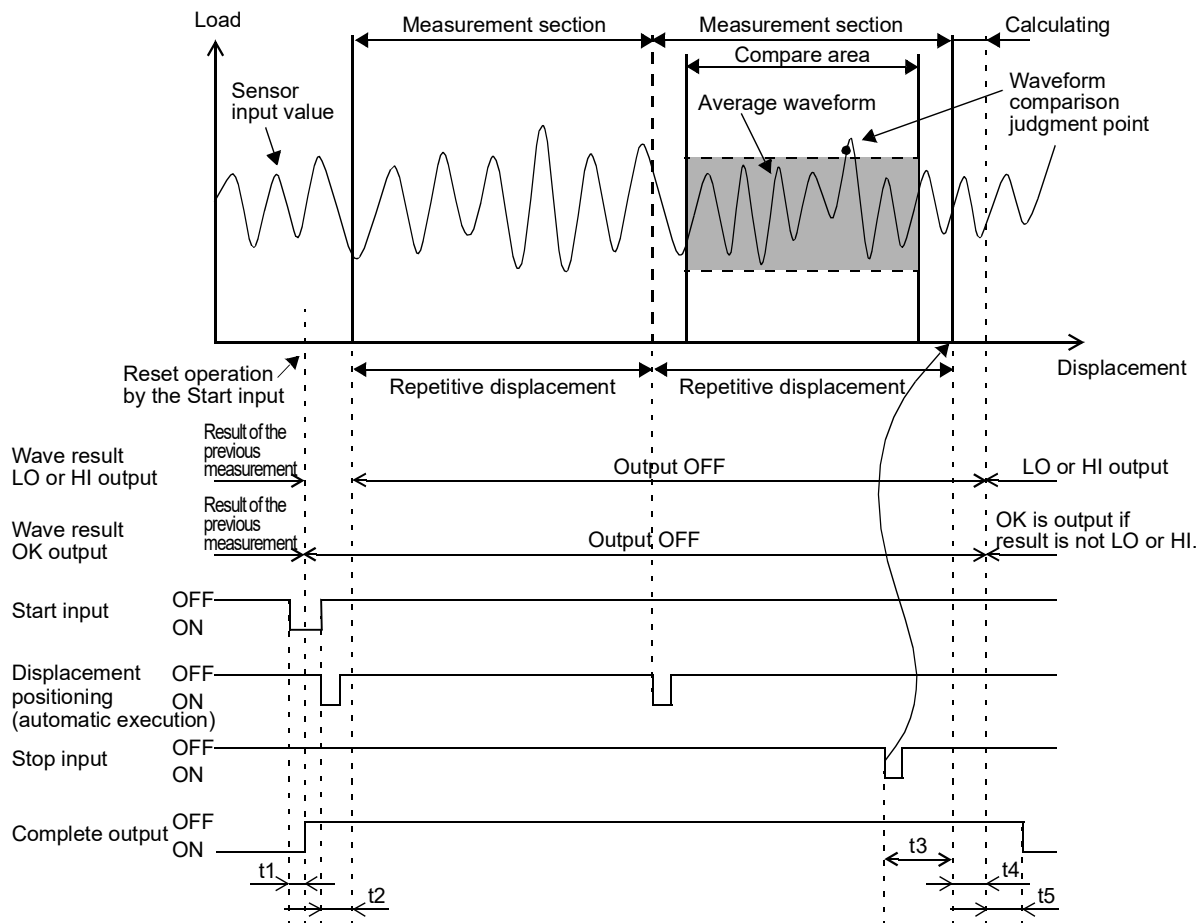
t5: Delay time between the instant when the Result output is turned ON and the instant when the Complete output is turned ON ... Approx. 30ms

- Turning OFF → ON the external input signal “Start” releases the hold, and turns OFF all outputs but Run. (Reset operation by the Start input)
- After turning “Measurement completion” from OFF to ON, “Complete” turns ON if either measured until repetitive displacement or measurement completion condition is satisfied.
- Once the judgment of output becomes LO or HI, the output is maintained.
- OK turns ON if the Compare Area is passed through during measurement and the result is not LO or HI after completion of measurement.
- The point where HI or LO was detected at the last acquired waveform is a judgment point.



## - Average mode

When repeated twice



t1: Delay time between the instant when the Start input is turned ON and the instant when all outputs but Run are turned OFF ... Approx. 5ms

t2: Delay time between the instant when the Start input is turned OFF and the instant when the measurable section is started... 0.25ms  
Displacement positioning is automatically executed, and measurement starts as a measurement start point.

t3: Minimum time required for measurement completion at the next repetitive displacement... 0.5ms

t4: Delay time between the instant when the measurement is stopped and the instant when the Result output is turned ON ... Approx. 50ms (However, there are differences between measurements.)

t5: Delay time between the instant when the Result output is turned ON and the instant when the Complete output is turned ON ... Approx. 30ms

- Turning OFF → ON the external input signal “Start” releases the hold, and turns OFF all outputs but Run. (Reset operation by the Start input)
- After turning “Measurement completion” from OFF to ON, “Complete” turns ON if either measured until repetitive displacement or measurement completion condition is satisfied.
- After completion of measurement, judgment is made by scanning the Average waveform from its front, and HI or LO or OK turns ON.
- OK turns ON if the Compare Area is passed through during measurement and the result is not LO or HI after completion of measurement.

# 5 COMMUNICATIONS

## 5-1. RS-232C

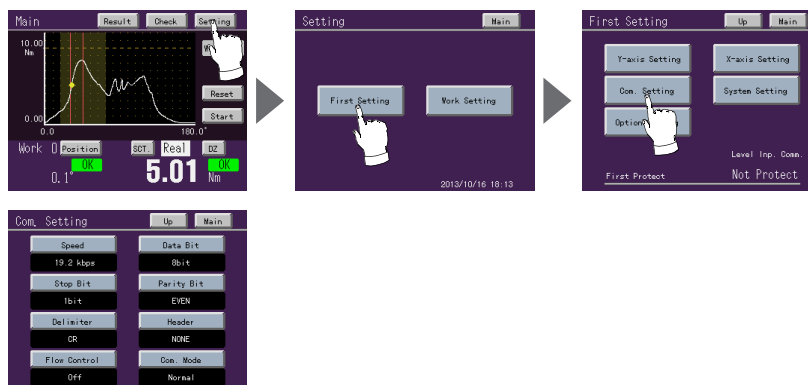
### ■ Outline

- Results can be read.
- Hold results can be read.
- Measurement waveforms can be read.
- Comparison waveforms can be read and written.
- Set values can be read and written.
- Wave Nos. can be read and written.
- Hold results can be automatically output upon completion of measurement.
- The communication check function is included.

(See "■ Communication establishment procedure" on page 19 (2-4.RS-232C Connection))

### ■ RS-232C setting

Make RS-232C communication settings by Communication Setting.



### Operation

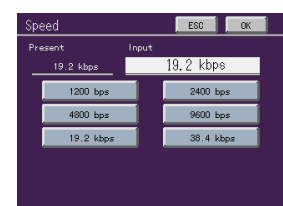
Main screen → Setting → First Setting → Com. Setting

#### - Transmission Speed

Setting range

(1200, 2400, 4800, 9600, 19.2k, 38.4k bps)

Operation

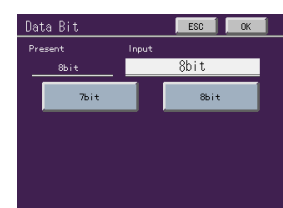


Main screen → Setting → First Setting → Com. Setting → Speed

#### - Data Bit

Setting range (7, 8 bit)

Operation



Main screen → Setting → First Setting → Com. Setting → Data Bit

- Stop Bit

Setting range (1, 2 bit)  
Operation



Main screen→Setting→First Setting→Com. Setting→Stop Bit

- Parity Bit

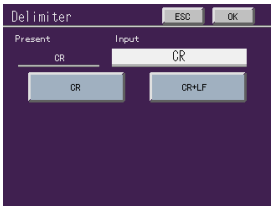
Setting range (None, Even, Odd)  
Operation



Main screen→Setting→First Setting→Com. Setting→Parity Bit

- Delimiter

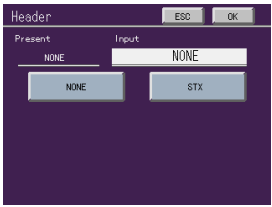
Setting range (CR, CR+LF)  
Operation



Main screen→Setting→First Setting→Com. Setting→Delimiter

- Header

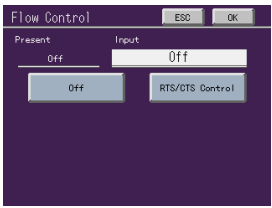
Setting range (None, STX)  
Operation



Main screen→Setting→First Setting→Com. Setting→Header

- Flow Control

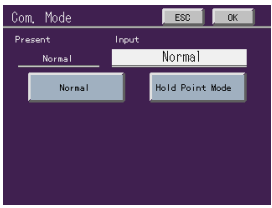
Setting range (Off, RTS/CTS Control)  
Operation



Main screen→Setting→First Setting→Com. Setting→Flow Control

- Communication Mode

Setting range (Normal, Hold Point Mode)  
Operation



Main screen→Setting→First Setting→Com. Setting→Com. Mode

## ■ Communication method (when the Communication Mode is Normal)

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

### -List of items that can be communicated

Item group		Set value, operation, display item	Read	Write	Cal.	Reference
Main		Load (display)	○	×	×	Display read command
		DPM (display)	○	×	×	Display read command
		Work No. (display)	○	×	×	Display read command
		Measurement status display	○	×	×	Display read command
		Waveform update check	○	×	×	Waveform update check/ equipment ID read command
		Measurement waveform	○	×	×	Waveform read command
		Equipment ID	○	×	×	Waveform update check/ equipment ID read command
Result		Result (display)	○	×	×	Hold result read command
		Result	○	×	×	Result read command
		Wave No.	○	○	×	Wave No. read/wave No. write command
First Setting	Y-axis Setting	Unit	○	○	×	Set value read/ set value write command
		Decimal Place	○	○	×	Set value read/ set value write command
		Zero Cal.	○	×	○	Set value read/ Zero cal. command
		Equiv. Cal. (rated output)	○	○	○	Set value read/ set value write command
		Equiv. Cal. (rated capacity)	○	○	○	Set value read/ set value write command
		Actual Cal.	×	×	○	Actual cal. command
		Overload	○	○	×	Set value read/ set value write command
		Increment	○	○	×	Set value read/ set value write command
		Analog Filter	○	○	×	Set value read/ set value write command
		Digital LPF	○	○	×	Set value read/ set value write command
		Digital Filter	○	○	×	Set value read/ set value write command
		DZ Limit	○	○	×	Set value read/ set value write command

Item group		Set value, operation, display item	Read	Write	Cal.	Reference
First Setting	X-axis Setting	Time/DPM Change	○	○	×	Set value read/ set value write command
		Phase Select	○	○	×	Set value read/ set value write command
		Wave Reference	○	○	×	Set value read/ set value write command
		Unit	○	○	×	Set value read/ set value write command
		Decimal Place	○	○	×	Set value read/ set value write command
		Zero Cal.	○	×	○	Set value read/ Zero cal. command
		Equiv. Cal. (number of pulses)	○	○	○	Set value read/ set value write command
		Equiv. Cal. (displacement value)	○	○	○	Set value read/ set value write command
		Actual Cal.	×	×	○	Actual Cal. command
		Measure Length	○	○	×	Set value read/ set value write command
		DPM Positioning	○	○	×	Set value read/ set value write command
		Digital Filter	○	○	×	Set value read/ set value write command
		Repetitive DPM	○	○	×	Set value read/ set value write command
	Communication Setting	Speed	○	○	×	Set value read/ set value write command
		Data Bit	○	○	×	Set value read/ set value write command
		Parity Bit	○	○	×	Set value read/ set value write command
		Stop Bit	○	○	×	Set value read/ set value write command
		Delimiter	○	○	×	Set value read/ set value write command
		Header	○	○	×	Set value read/ set value write command
		Flow Control	○	○	×	Set value read/ set value write command
		Com. Mode	○	○	×	Set value read/ set value write command
First Setting	System Setting	Backlight (ON Time)	○	○	×	Set value read/ set value write command
		Backlight (bright→dark)	○	○	×	Set value read/ set value write command
		Language	○	○	×	Set value read/ set value write command
		Work Protect	○	○	×	Set value read/ set value write command
		First Protect	○	○	×	Set value read/ set value write command
		Time adjust	○	○	×	Time read/ time write command
	Option Setting					

## COMMUNICATIONS

Item group		Set value, operation, display item	Read	Write	Cal.	Reference
Settings by work [Work 0 to 15]	Waveform Comparison Setting	Relative	○	○	×	Set value read/ set value write command
		Compare Area (start point)	○	○	×	Set value read/ set value write command
		Compare Area (end point)	○	○	×	Set value read/ set value write command
		Compare Margin	○	○	×	Set value read/ set value write command
		Relative Point (X-axis)	○	○	×	Set value read/ set value write command
		Relative Point (Y-axis)	○	○	×	Set value read/ set value write command
		Comparison Wave	○	○	×	Waveform read/ Waveform write command
		Load Reversing	○	○	×	Set value read/ set value write command
		DPM Reversing	○	○	×	Set value read/ set value write command
		HI Conditions Count	○	○	×	Set value read/ set value write command
		HI Conditions Range	○	○	×	Set value read/ set value write command
		LO Conditions Count	○	○	×	Set value read/ set value write command
		LO Conditions Range	○	○	×	Set value read/ set value write command
Other		Measurement Work No. (for RS-232C communications)	○	○	×	Set value read/ set value write command
		Priority of Level Input Signal	○	○	×	Set value read/ set value write command
		Load Digital Zero (for RS-232C communications)	×	×	○	Commanding command
		DPM Positioning (for RS-232C communications)	×	×	○	Commanding command
		Start (for RS-232C communications)	×	×	○	Commanding command
		Stop (for RS-232C communications)	×	×	○	Commanding command
		Hold (for RS-232C communications)	×	×	○	Commanding command
		Reset (for RS-232C communications)	×	×	○	Commanding command
		Backlight On (for RS-232C communications)	×	×	○	Commanding command
		Prohibit Touch Panel (for RS-232C communications)	×	×	○	Commanding command

## - Set value read command (First Setting)

Example: Reading Input Selection, Y-axis Setting, First Setting

Host  
(Transmission to the TM500)

R	0	1	0	0	Delimiter
---	---	---	---	---	-----------

Item No. (See the list of set value commands.)

Input Selection in the example

Item group (See the list of set value commands.)

Y-axis Setting in the example

TM500's return  
(In normal processing)

(STX)	R	0	1	0	0	+	0	0	0	0	0	0	1	Delimiter
-------	---	---	---	---	---	---	---	---	---	---	---	---	---	-----------

Data of the specified set value

Command received by the TM500

Header (If there is no header, no data will result.)

TM500's return  
(In abnormal condition)

(STX)	N	G	1	Delimiter
-------	---	---	---	-----------

NG No.

1: Receipt of a statement different from the command format

Header (If there is no header, no data will result.)

## - Set value read command (Work Setting)

Example: Reading Y-axis Start Point, Display Range Setting, Work No. 10, Work Setting

① Writing "10" to Work No.

Host  
(Transmission to the TM500)

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

Data to write

The amount of data varies depending on the set value.

Item No. (See the list of set value commands.)

Work No. in the example

Item group (See the list of set value commands.)

Work Setting in the example

TM500's return  
(In normal processing)

(STX)	W	1	0	0	0	+	0	0	0	0	0	1	0	Delimiter
-------	---	---	---	---	---	---	---	---	---	---	---	---	---	-----------

Command received by the TM500

Header (If there is no header, no data will result.)

TM500's return  
(In abnormal condition)

(STX)	N	G	1	Delimiter
-------	---	---	---	-----------

NG No.

1: Receipt of a statement different from the command format

2: Attempt to write a set value outside the setting range

4: Attempt to write a set value through communications during measurement

5: Attempt to write while protecting

Header (If there is no header, no data will result.)



## ② Reading Y-axis Start Point after Work No. is written normally

Host  
(Transmission to the TM500)

R	1	2	0	0	Delimiter
---	---	---	---	---	-----------

Item No. (See the list of set value commands.)

Y-axis Start Point in the example

Item group (See the list of set value commands.)

Display Range Setting in the example

TM500's return  
(In normal processing)

(STX)	R	1	2	0	0	+	0	0	0	1	0	0	0	Delimiter
-------	---	---	---	---	---	---	---	---	---	---	---	---	---	-----------

Data of the specified set value

Command received by the TM500

Header (If there is no header, no data will result.)

TM500's return  
(In abnormal condition)

(STX)	N	G	1	Delimiter
-------	---	---	---	-----------

NG No.

1: Receipt of a statement different from the command format

Header (If there is no header, no data will result.)

## - Set value write command (First Setting)

Example: Writing 1:±20mA to Input Selection, Y-axis Setting, First Setting

Host  
(Transmission to the TM500)

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

Data to write

"1" in the example

Item No. (See the list of set value commands.)

Input Selection in the example

Item group (See the list of set value commands.)

Y-axis Setting in the example

TM500's return  
(In normal processing)

(STX)	W	0	1	0	0	+	0	0	0	0	0	0	1	Delimiter
-------	---	---	---	---	---	---	---	---	---	---	---	---	---	-----------

Command received by the TM500

Header (If there is no header, no data will result.)

TM500's return  
(In abnormal condition)

(STX)	N	G	1	Delimiter
-------	---	---	---	-----------

NG No.

1: Receipt of a statement different from the command format

2: Attempt to write a set value outside the setting range

4: Attempt to write a set value through communications during measurement

5: Attempt to write while protecting

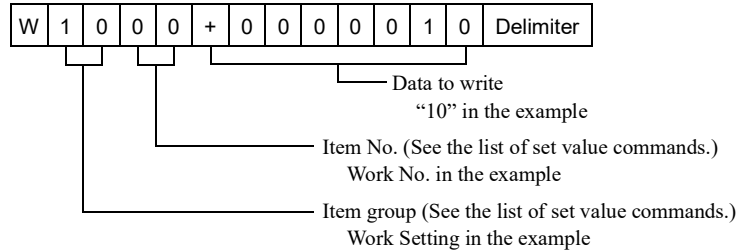
Header (If there is no header, no data will result.)

## - Set value write command (Work Setting)

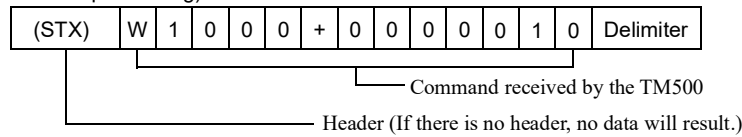
Example: Writing "1000" to Y-axis Start Point, Display Range Setting, Work No. 10, Work Setting

### ① Writing "10" to Work No.

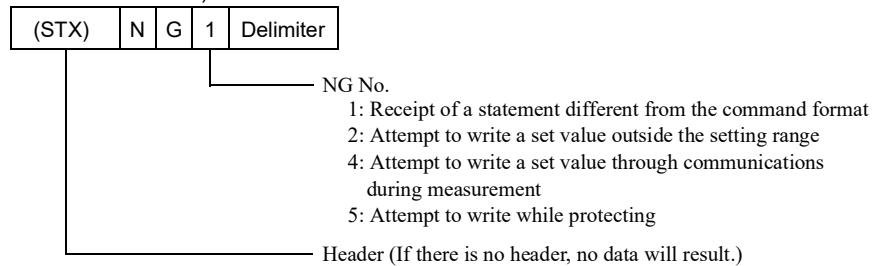
Host  
(Transmission to the TM500)



TM500's return  
(In normal processing)

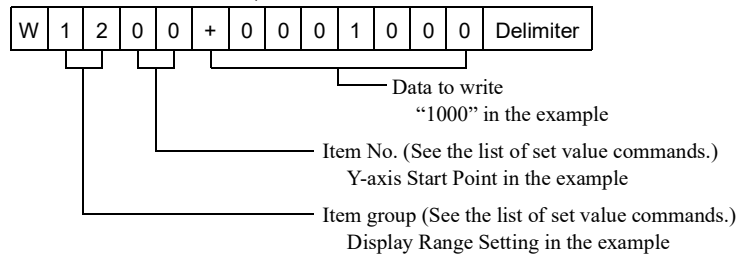


TM500's return  
(In abnormal condition)

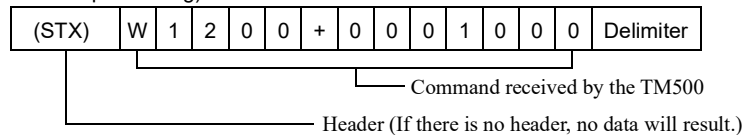


### ② Writing "1000" to Y-axis Start Point after Work No. is written normally

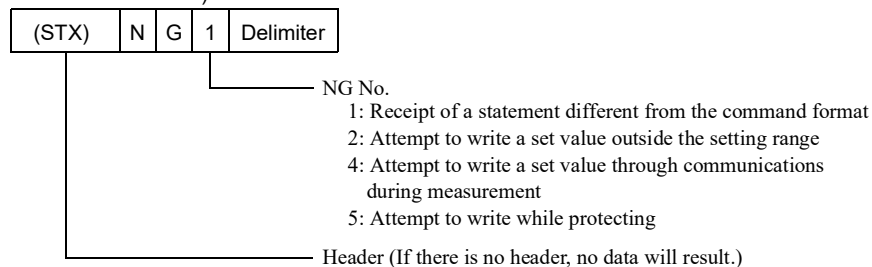
Host  
(Transmission to the TM500)



TM500's return  
(In normal processing)



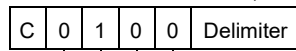
TM500's return  
(In abnormal condition)



## - Zero calibration command

Example: To perform zero calibration (load)

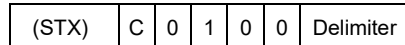
Host  
(Transmission to the TM500)



Item No. (See the list of Zero Calibration commands.)  
Zero Calibration in the example

Item group (See the list of Zero Calibration commands.)  
Y-axis Setting in the example

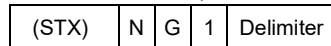
TM500's return  
(In normal processing)



Command received by the TM500

Header (If there is no header, no data will result.)

TM500's return  
(In abnormal condition)



NG No.

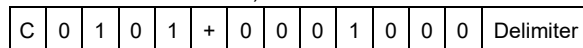
- 1: Receipt of a statement different from the command format
- 2: Attempt to write a set value outside the setting range
- 3: Attempt to perform calibration with actual load outside the calibration range
- 4: Attempt to write a set value through communications during measurement
- 5: Attempt to write while protecting

Header (If there is no header, no data will result.)

## - Actual load calibration command

Example: To perform actual load calibration (load)

Host  
(Transmission to the TM500)

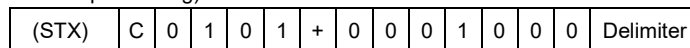


Load-applied value  
"1000" in the example

Item No. (See the list of Actual Calibration commands.)  
Actual Calibration in the example

Item group (See the list of Actual Calibration commands.)  
Y-axis Setting in the example

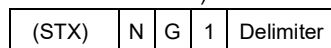
TM500's return  
(In normal processing)



Command received by the TM500

Header (If there is no header, no data will result.)

TM500's return  
(In abnormal condition)



NG No.

- 1: Receipt of a statement different from the command format
- 2: Attempt to write a set value outside the setting range
- 3: Attempt to perform calibration with actual load outside the calibration range
- 4: Attempt to write a set value through communications during measurement
- 5: Attempt to write while protecting

Header (If there is no header, no data will result.)

## - Hold result read command

Example: Reading the hold results of Section 1 to 3.

① Check to see if measurement is finished

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

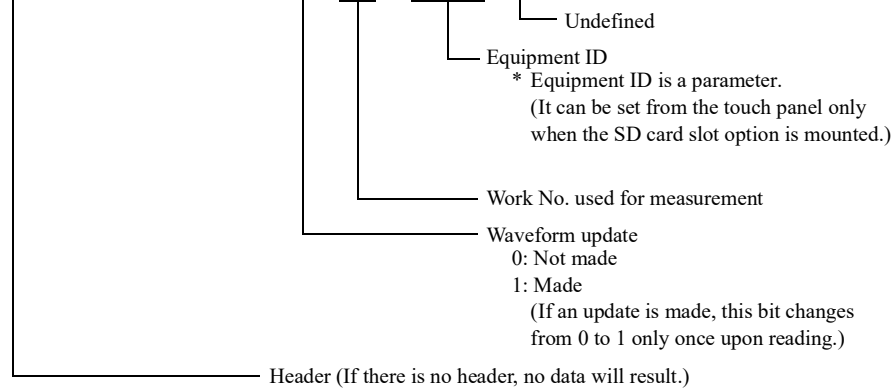
(For transmitting the SAMPLE command continuously, do it at intervals of 100ms or more.)

Host  
(Transmission to the TM500)

S	A	M	P	L	E	Delimiter
---	---	---	---	---	---	-----------

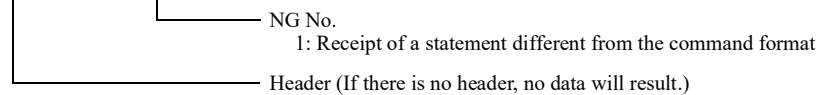
TM500's return  
(In normal processing)

(STX)	S	A	M	P	L	E	1	1	3	8	1	5	0	Delimiter
-------	---	---	---	---	---	---	---	---	---	---	---	---	---	-----------



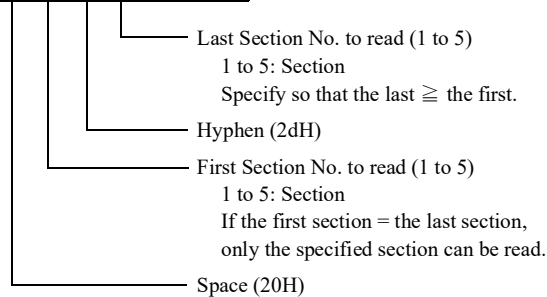
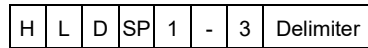
TM500's return  
(In abnormal condition)

(STX)	N	G	1	Delimiter
-------	---	---	---	-----------

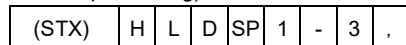


② Read the hold results.

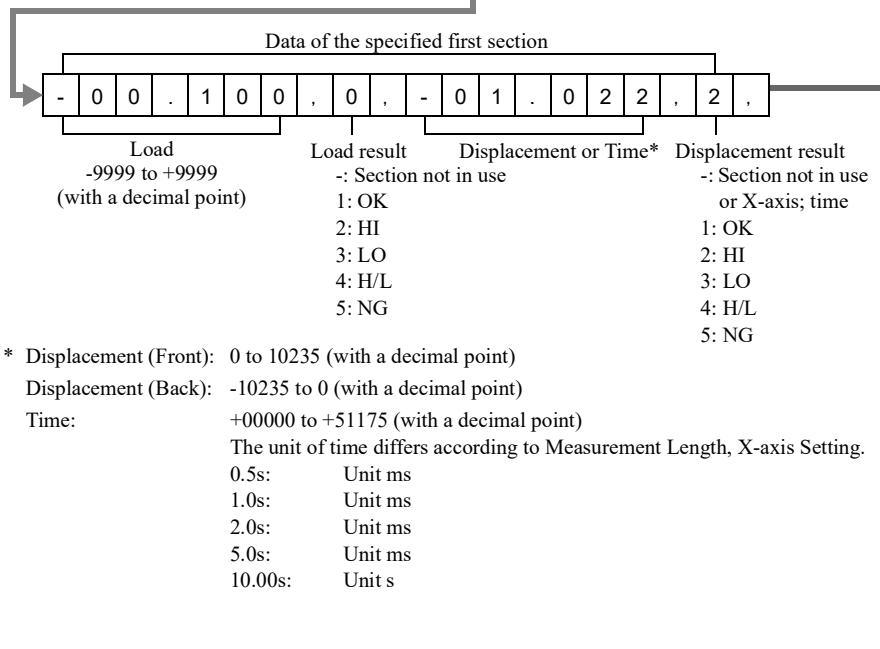
Host  
(Transmission to the TM500)



TM500's return  
(In normal processing)



Command received by the TM500

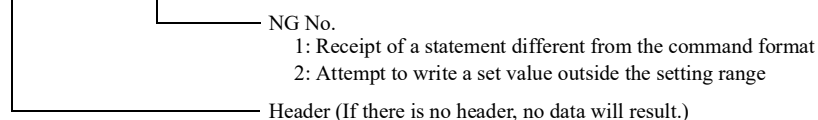
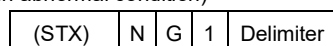


\* Displacement (Front): 0 to 10235 (with a decimal point)  
Displacement (Back): -10235 to 0 (with a decimal point)  
Time:  
The unit of time differs according to Measurement Length, X-axis Setting.  
0.5s: Unit ms  
1.0s: Unit ms  
2.0s: Unit ms  
5.0s: Unit ms  
10.00s: Unit s



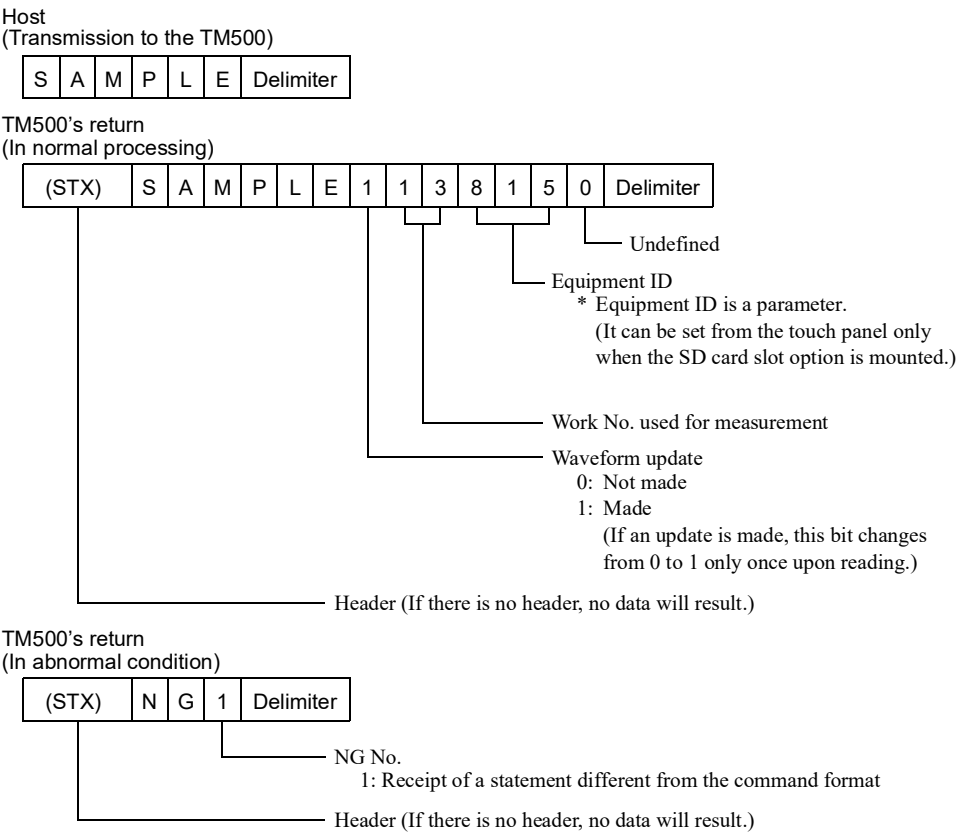
If there is no hold point in the specified section, hyphens (2dH) enter into Load and Displacement (Time), and if "Always" is set in the specified section, hyphens (2dH) also enter into Load and Displacement (Time).

TM500's return  
(In abnormal condition)



- Result read command

- ① Check to see if measurement is finished
- If "1" is read to Waveform update, go to step ②, and if "1" is not read, repeat step ①.
- (For transmitting the SAMPLE command continuously, do it at intervals of 100ms or more.)



## ② Read the measurement results.

Host  
(Transmission to the TM500)

R	E	S	U	L	T	Delimiter
---	---	---	---	---	---	-----------

TM500's return  
(In normal processing)

(STX)	R	E	S	U	L	T	4	4	,	1	3	,	2	4	,	3	1	,
Command received by the TM500							Displacement Load		Displacement Load		Displacement Load		Displacement Load					
							Total result		Section1 Judgment		Section2 Judgment		Section3 Judgment					

Header (If there is no header, no data will result.)

3	3	,	1	3	,	2	4	Delimiter
Displacement Load		Displacement Load		Displacement Load				
Section4 Judgment		Section5 Judgment		Waveform Comparison Judgment				

Load result	Displacement result
-: Section not in use	-: Section not in use
1: OK	or X-axis; time
2: HI	1: OK
3: LO	2: HI
4: H/L	3: LO
5: NG	4: H/L
	5: NG

TM500's return  
(In abnormal condition)

(STX)	N	G	1	Delimiter
-------	---	---	---	-----------

NG No.

1: Receipt of a statement different from the command format

Header (If there is no header, no data will result.)

## - Waveform update check/equipment ID read command

Host  
(Transmission to the TM500)

S	A	M	P	L	E	Delimiter
---	---	---	---	---	---	-----------

TM500's return  
(In normal processing)

(STX)	S	A	M	P	L	E	1	1	3	8	1	5	0	Delimiter
Header (If there is no header, no data will result.)							Work No. used for measurement		Equipment ID		Waveform update		Undefined	
							0: Not made		* Equipment ID is a parameter. (It can be set from the touch panel only when the SD card slot option is mounted.)		0: Not made			
							1: Made				1: Made			
							(If an update is made, this bit changes from 0 to 1 only once upon reading.)							

TM500's return  
(In abnormal condition)

(STX)	N	G	1	Delimiter
-------	---	---	---	-----------

NG No.

1: Receipt of a statement different from the command format

Header (If there is no header, no data will result.)

## - Waveform read command

Example: Reading a measurement waveform.

① Check to see if measurement is finished

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

(For transmitting the SAMPLE command continuously, do it at intervals of 100ms or more.)

Host

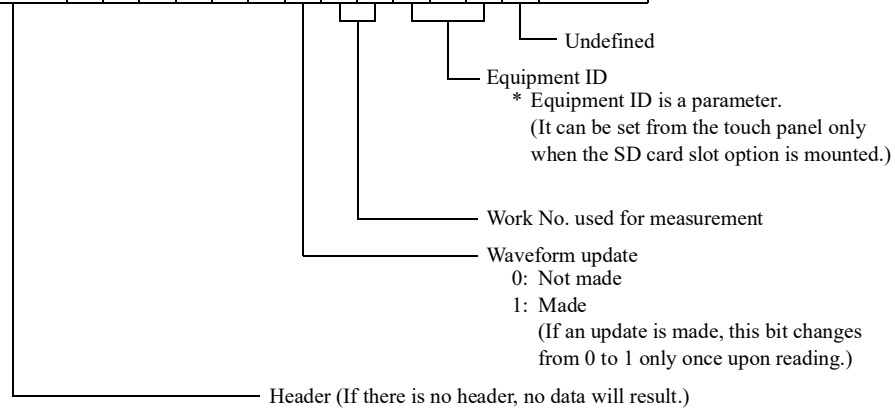
(Transmission to the TM500)

S	A	M	P	L	E	Delimiter
---	---	---	---	---	---	-----------

TM500's return

(In normal processing)

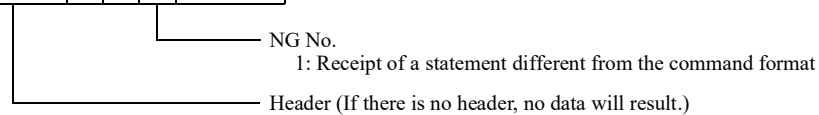
(STX)	S	A	M	P	L	E	1	1	3	8	1	5	0	Delimiter
-------	---	---	---	---	---	---	---	---	---	---	---	---	---	-----------



TM500's return

(In abnormal condition)

(STX)	N	G	1	Delimiter
-------	---	---	---	-----------





② Reading the measurement range

Host  
(Transmission to the TM500)

W	A	V	Delimiter
---	---	---	-----------

TM500's return  
(In normal processing)

(STX)	W	A	V	SP	0	0	0	0	-	2	0	4	7	Delimiter
-------	---	---	---	----	---	---	---	---	---	---	---	---	---	-----------

Start of the range  
(Data No.)  
When the X-axis  
represents  
time/displacement  
(Front):  
fixed at 0000  
displacement (Back):  
0000 to 2047  
Space (20H)  
End of the range  
(Data No.)  
When the X-axis represents  
time/displacement (Front):  
0000 to 2047  
displacement (Back):  
fixed at 2047  
Hyphen(2dH)  
Command received by the TM500  
Header (If there is no header, no data will result.)

TM500's return  
(In abnormal condition)

(STX)	N	G	1	Delimiter
-------	---	---	---	-----------

NG No.  
1: Receipt of a statement different from the command format  
Header (If there is no header, no data will result.)

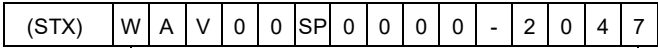
③ Reading the measurement waveform

Host  
(Transmission to the TM500)

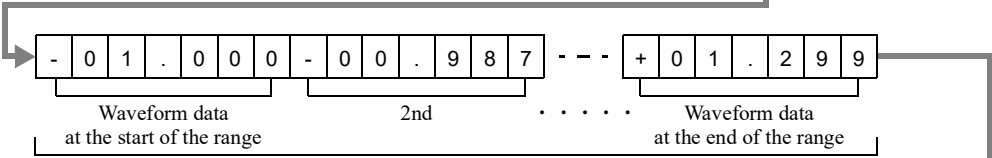
W	A	V	0	0	SP	0	0	0	0	-	2	0	4	7	Delimiter
---	---	---	---	---	----	---	---	---	---	---	---	---	---	---	-----------

Start of the range  
(Data No.)  
0000 to 2047  
End of the 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: Measurement 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 Work No. for RS-232C.

TM500's return  
(In normal processing)



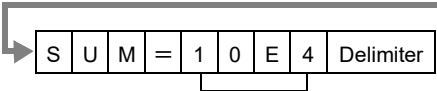
Command received by the TM500



Waveform data  
Amount of data: Data for the specified range “the end of the range – the start of the range + 1”  
2048 data in the example (2048 × 7 bytes)  
\* If the same data No. is specified for the start and the end of the range, only one data is read.

0: Load: -09999 to +09999 (with a decimal point)  
1: Displacement (Front): 0 to 10235 (with a decimal point)  
Displacement (Back): -10235 to 0 (with a decimal point)  
Time: +00000 to +51175 (with a decimal point)  
The unit of time differs according to Measurement Length, X-axis Setting.

0.5s: Unit ms  
1.0s: Unit ms  
2.0s: Unit ms  
5.0s: Unit ms  
10.00s: Unit s

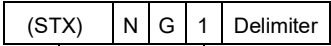


Checksum of the waveform data  
All the read waveform data is totaled by ignoring respective decimal points, and the two low-order bytes of the result are expressed in 4-digit hexadecimal.

Example) Checksum of three waveform data

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

TM500's return  
(In abnormal condition)



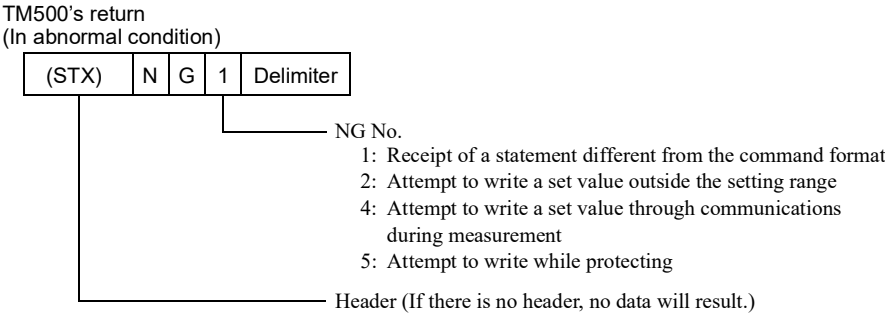
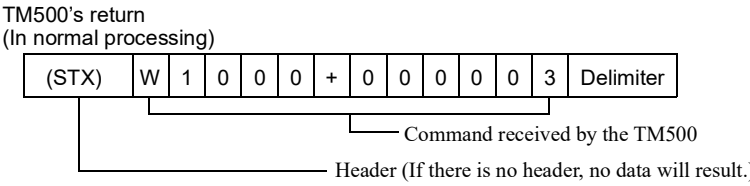
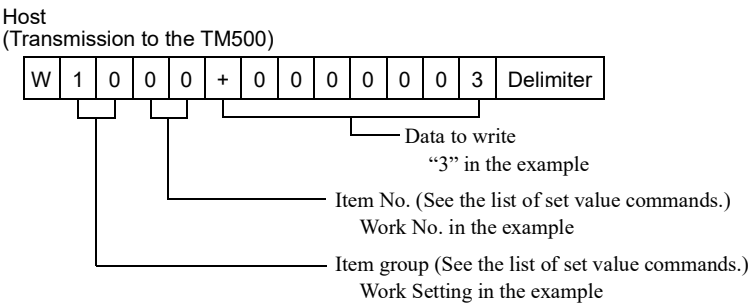
NG No.  
1: Receipt of a statement different from the command format  
2: Attempt to write a set value outside the setting range

Header (If there is no header, no data will result.)

- Waveform write command

Example: Writing to Comparison Waveform (LO limit) of Work No. 3

① Writing “3” to Work No.



## ② Writing Comparison Waveform (LO limit)

Host

(Transmission to the TM500)

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

Data No.  
0000 to 2047Load data  
-9999 to +9999

The decimal place should be the same  
as that of load calibration.  
If different, the decimal point is ignored.

Example) When the decimal place is 0.000,  
if +23.42 is specified,  
it is handled as +2.342.

Hyphen(2dH)

Space (20H)

Fixed at 0

Waveform selection

- 1: Comparison Waveform (HI limit)
- 2: Comparison Waveform (LO limit)

TM500's return

(In normal processing)

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

Command received by the TM500

Host

(Transmission to the TM500)

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

- Repeated for 2047 data by adding "1" to Data No. after confirmation of normal processing to change all the waveform data.
- Repeated for desired data by specifying Data No. to change part of the waveform.



TM500's return

(In abnormal condition)

(STX)	N	G	1	Delimiter
-------	---	---	---	-----------

NG No.

- 1: Receipt of a statement different from the command format
- 2: Attempt to write a set value outside the setting range
- 4: Attempt to write a set value through communications during measurement
- 5: Attempt to write while protecting

Header (If there is no header, no data will result.)

## - Wave No. read command

Host  
(Transmission to the TM500)

A	Delimiter
---	-----------

TM500's return  
(In normal processing)

(STX)	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)

Header (If there is no header, no data will result.)

TM500's return  
(In abnormal condition)

(STX)	N	G	1	Delimiter
-------	---	---	---	-----------

NG No.

1: Receipt of a statement different from the command format

Header (If there is no header, no data will result.)

## - Wave No. write command

Host  
(Transmission to the TM500)

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)

TM500's return  
(In normal processing)

(STX)	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 TM500

Header (If there is no header, no data will result.)

TM500's return  
(In abnormal condition)

(STX)	N	G	1	Delimiter
-------	---	---	---	-----------

NG No.

1: Receipt of a statement different from the command format

2: Attempt to write a set value outside the setting range

Header (If there is no header, no data will result.)

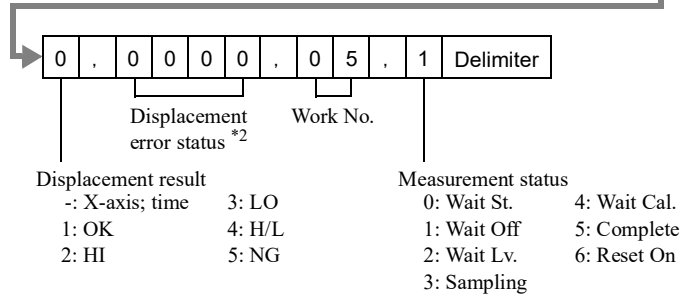
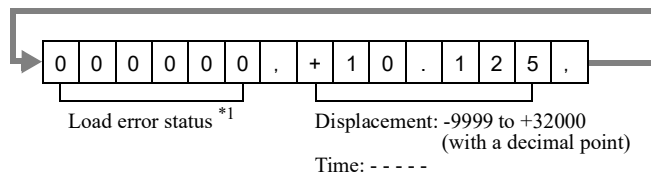
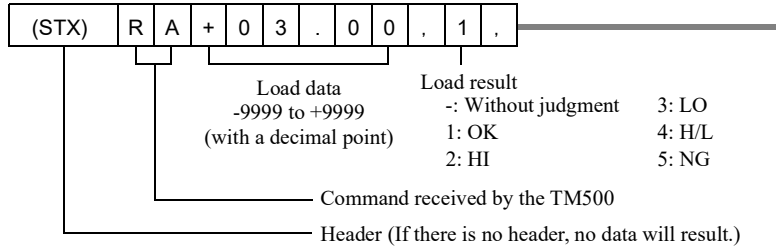
\* The wave No. is accepted when the Start signal is turned from OFF to ON.

## - Display read command

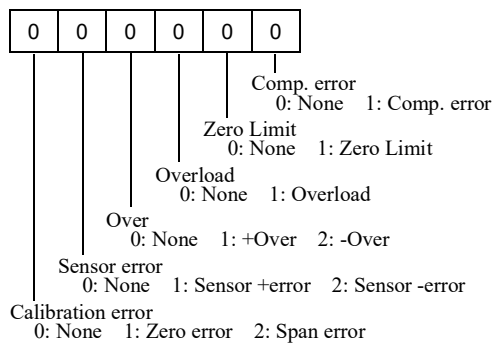
Host  
(Transmission to the TM500)

R	A	Delimiter
---	---	-----------

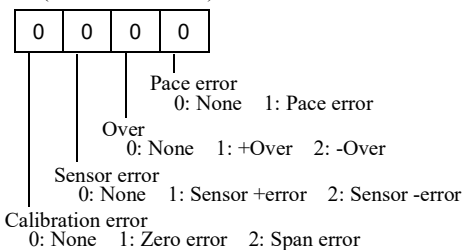
TM500's return  
(In normal processing)



\*1



\*2 ( - - - - for time)



TM500's return  
(In abnormal condition)

(STX)	N	G	1	Delimiter
-------	---	---	---	-----------

NG No.  
1: Receipt of a statement different from the command format

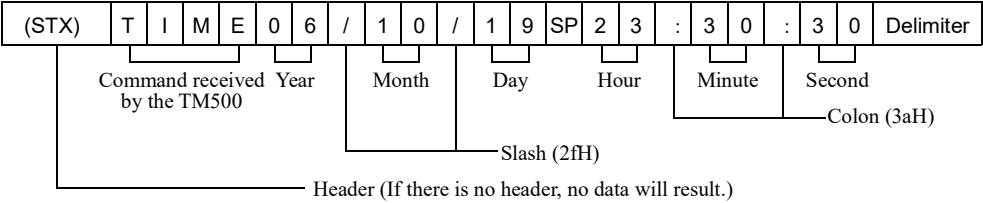
Header (If there is no header, no data will result.)

- Time read command

Host  
(Transmission to the TM500)

T	I	M	E	Delimiter
---	---	---	---	-----------

TM500's return  
(In normal processing)



The example is 23:30:30 October 19, 2006.

TM500's return  
(In abnormal condition)

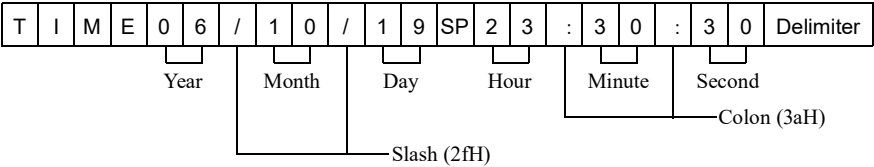
(STX)	N	G	1	Delimiter
-------	---	---	---	-----------

NG No.  
1: Receipt of a statement different from the command format

Header (If there is no header, no data will result.)

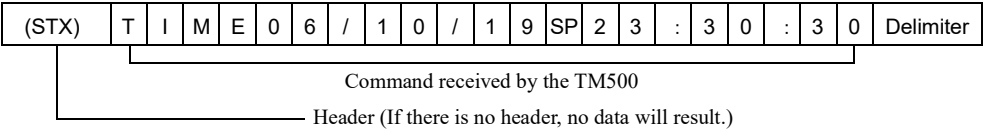
- Time write command

Host  
(Transmission to the TM500)



The example is 23:30:30 October 19, 2006.

TM500's return  
(In normal processing)



TM500's return  
(In abnormal condition)

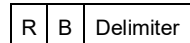
(STX)	N	G	1	Delimiter
-------	---	---	---	-----------

NG No.  
1: Receipt of a statement different from the command format  
2: Attempt to write a set value outside the setting range  
4: Attempt to write a set value through communications during measurement  
5: Attempt to write while protecting

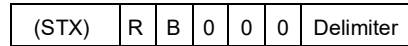
Header (If there is no header, no data will result.)

## - Status read command

Host  
(Transmission to the TM500)



TM500's return  
(In normal processing)



SD OK  
0: OFF  
1: ON

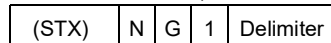
DPM OK  
0: OFF  
1: ON

Load OK  
0: OFF  
1: ON

Command received by the TM500

Header (If there is no header, no data will result.)

TM500's return  
(In abnormal condition)



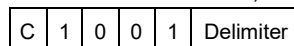
NG No.

1: Receipt of a statement different from the command format

Header (If there is no header, no data will result.)

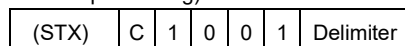
## - Commanding command

Host  
(Transmission to the TM500)



Item No. (See the list of Commanding commands.)

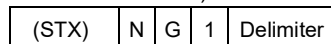
TM500's return  
(In normal processing)



Command received by the TM500

Header (If there is no header, no data will result.)

TM500's return  
(In abnormal condition)



NG No.

1: Receipt of a statement different from the command format

6: Tried to execute the command which unsatisfies the usage conditions.

Header (If there is no header, no data will result.)



## - List of commands to read set values

Item group		Setting item	Command (transmission to the TM500)							
First Setting	Y-axis Setting	Unit	R	0	1	0	1	Delimiter (CR,CR+LF)	R	0
		Decimal Place	R	0	1	0	2	Delimiter (CR,CR+LF)	R	0
		Zero Calibration	R	0	1	0	3	Delimiter (CR,CR+LF)	R	0
		Equiv. Cal. (rated output)	R	0	1	0	4	Delimiter (CR,CR+LF)	R	0
		Equiv. Cal. (rated capacity)	R	0	1	0	5	Delimiter (CR,CR+LF)	R	0
		Overload	R	0	1	0	6	Delimiter (CR,CR+LF)	R	0
		Increment	R	0	1	0	7	Delimiter (CR,CR+LF)	R	0
		Analog Filter	R	0	1	0	8	Delimiter (CR,CR+LF)	R	0
		Digital Filter	R	0	1	0	9	Delimiter (CR,CR+LF)	R	0
		DZ Limit	R	0	1	1	0	Delimiter (CR,CR+LF)	R	0
		Digital LPF	R	0	1	1	1	Delimiter (CR,CR+LF)	R	0
	X-axis Setting	Time/DPM Change	R	0	2	0	0	Delimiter (CR,CR+LF)	R	0
		Phase Select	R	0	2	0	1	Delimiter (CR,CR+LF)	R	0
		Wave Reference	R	0	2	0	2	Delimiter (CR,CR+LF)	R	0
		Unit	R	0	2	0	3	Delimiter (CR,CR+LF)	R	0
		Decimal Place	R	0	2	0	4	Delimiter (CR,CR+LF)	R	0
		Zero Calibration	R	0	2	0	5	Delimiter (CR,CR+LF)	R	0
		Equiv. Cal. (number of pulses)	R	0	2	0	6	Delimiter (CR,CR+LF)	R	0
		Equiv. Cal. (displacement value)	R	0	2	0	7	Delimiter (CR,CR+LF)	R	0
		Measure Length	R	0	2	0	8	Delimiter (CR,CR+LF)	R	0
		DPM Positioning	R	0	2	0	9	Delimiter (CR,CR+LF)	R	0
		Digital Filter	R	0	2	1	1	Delimiter (CR,CR+LF)	R	0
		Repetitive DPM	R	0	2	1	2	Delimiter (CR,CR+LF)	R	0

Return (by the TM500)											Input range (display range)
1	0	1	±	0	0	0	0	10 <sup>2</sup>	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF) See"9-3 Unit setting list"on page 153.
1	0	2	±	0	0	0	0	0	0	10 <sup>0</sup>	Delimiter (CR,CR+LF) 0: 0 1: 0.0 2: 0.00 3: 0.000
1	0	3	±	0	0	0	10 <sup>3</sup>	10 <sup>2</sup>	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF) -5.555~5.555 [V]
1	0	4	±	0	0	0	10 <sup>3</sup>	10 <sup>2</sup>	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF) -9.999~9.999 [V]
1	0	5	±	0	0	0	10 <sup>3</sup>	10 <sup>2</sup>	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF) -9999 to 9999
1	0	6	±	0	0	0	10 <sup>3</sup>	10 <sup>2</sup>	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF) 0 to 9999
1	0	7	±	0	0	0	0	0	0	10 <sup>0</sup>	Delimiter (CR,CR+LF) 0: 1 1: 2 2: 5 3: 10
1	0	8	±	0	0	0	0	0	0	10 <sup>0</sup>	Delimiter (CR,CR+LF) 0: 30 1: 100 2: 300 3: 1k [Hz]
1	0	9	±	0	0	0	0	10 <sup>2</sup>	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF) 0, 2 to 999 [Times]
1	1	0	±	0	0	0	10 <sup>3</sup>	10 <sup>2</sup>	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF) 0 to 9999
1	1	1	±	0	0	0	0	0	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF) 0 to 30 [Hz]
2	0	0	±	0	0	0	0	0	0	10 <sup>0</sup>	Delimiter (CR,CR+LF) 0: Time 1: Displacement 2: Continuous 3: Average
2	0	1	±	0	0	0	0	0	0	10 <sup>0</sup>	Delimiter (CR,CR+LF) 0: A/B-Phase 1: Only A-Phase
2	0	2	±	0	0	0	0	0	0	10 <sup>0</sup>	Delimiter (CR,CR+LF) 0: Front 1: Back
2	0	3	±	0	0	0	0	10 <sup>2</sup>	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF) See"9-3 Unit setting list"on page 153.
2	0	4	±	0	0	0	0	0	0	10 <sup>0</sup>	Delimiter (CR,CR+LF) 0: 0 1: 0.0 2: 0.00 3: 0.000
2	0	5	±	10 <sup>6</sup>	10 <sup>5</sup>	10 <sup>4</sup>	10 <sup>3</sup>	10 <sup>2</sup>	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF) 0 to 1000000
2	0	6	±	10 <sup>6</sup>	10 <sup>5</sup>	10 <sup>4</sup>	10 <sup>3</sup>	10 <sup>2</sup>	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF) 1 to 1000000
2	0	7	±	0	0	10 <sup>4</sup>	10 <sup>3</sup>	10 <sup>2</sup>	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF) -99999 to 99999
2	0	8	±	0	0	0	0	0	0	10 <sup>0</sup>	Delimiter (CR,CR+LF) Time/Displacement Change; Time 0: 0.5 1: 1.0 2: 2.0 3: 5.0 4: 10.0 [s] Time/Displacement Change; Displacement, Continuous, Average 0: 2000 1: 4000 2: 6000 3: 8000 4: 10000
2	0	9	±	0	0	10 <sup>4</sup>	10 <sup>3</sup>	10 <sup>2</sup>	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF) -9999 to 32000
2	1	1	±	0	0	0	0	10 <sup>2</sup>	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF) 0, 2 to 999 [Times]
2	1	2	±	0	0	0	0	0	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF) 0: 720 1: 810 2: 900 3: 990 4: 1080 5: 1170 6: 1260 7: 1350 8: 1440 9: 1530 10: 1620 11: 1710 12: 1800 13: 2000 (× Measurement Length/2000)

Item group		Setting item	Command (transmission to the TM500)							
First Setting	Commu- nication Setting	Speed	R	0	3	0	0	Delimiter (CR,CR+LF)	R	0
		Data Bit	R	0	3	0	1	Delimiter (CR,CR+LF)	R	0
		Parity Bit	R	0	3	0	2	Delimiter (CR,CR+LF)	R	0
		Stop Bit	R	0	3	0	3	Delimiter (CR,CR+LF)	R	0
		Delimiter	R	0	3	0	4	Delimiter (CR,CR+LF)	R	0
		Header	R	0	3	0	5	Delimiter (CR,CR+LF)	R	0
		Flow Control	R	0	3	0	6	Delimiter (CR,CR+LF)	R	0
	System Setting	Backlight (ON Time)	R	0	4	0	0	Delimiter (CR,CR+LF)	R	0
		Language	R	0	4	0	1	Delimiter (CR,CR+LF)	R	0
		Work Protect	R	0	4	0	2	Delimiter (CR,CR+LF)	R	0
		First Protect	R	0	4	0	3	Delimiter (CR,CR+LF)	R	0
		Undefined	R	0	4	0	4	Delimiter (CR,CR+LF)	R	0
		Backlight (bright→dark)	R	0	4	0	5	Delimiter (CR,CR+LF)	R	0
	OptionSetting									

Return (by the TM500)											Input range (display range)
3	0	0	±	0	0	0	0	0	0	10 <sup>0</sup>	Delimiter (CR,CR+LF) 0: 1200 1: 2400 2: 4800 3: 9600 4: 19.2k 5: 38.4k [bps]
3	0	1	±	0	0	0	0	0	0	10 <sup>0</sup>	Delimiter (CR,CR+LF) 0: 7 1: 8 [bit]
3	0	2	±	0	0	0	0	0	0	10 <sup>0</sup>	Delimiter (CR,CR+LF) 0: None 1: Even 2: Odd
3	0	3	±	0	0	0	0	0	0	10 <sup>0</sup>	Delimiter (CR,CR+LF) 0: 1 1: 2 [bit]
3	0	4	±	0	0	0	0	0	0	10 <sup>0</sup>	Delimiter (CR,CR+LF) 0: CR 1: CR+LF
3	0	5	±	0	0	0	0	0	0	10 <sup>0</sup>	Delimiter (CR,CR+LF) 0: None 1: STX
3	0	6	±	0	0	0	0	0	0	10 <sup>0</sup>	Delimiter (CR,CR+LF) 0: Off 1: RTS/CTS Control
4	0	0	±	0	0	0	0	0	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF) 0 to 99 [minute]
4	0	1	±	0	0	0	0	0	0	10 <sup>0</sup>	Delimiter (CR,CR+LF) 0: Japanese 1: English
4	0	2	±	0	0	0	0	0	0	10 <sup>0</sup>	Delimiter (CR,CR+LF) 0: Not Protect 1: Protect
4	0	3	±	0	0	0	0	0	0	10 <sup>0</sup>	Delimiter (CR,CR+LF) 0: Not Protect 1: Protect
4	0	4	±	0	0	0	0	10 <sup>2</sup>	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF) 100 to 170
4	0	5	±	0	0	0	0	0	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF) 0 to 99 [minute]

Item group		Setting item	Command (transmission to the TM500)						
Settings by work [Work 0 to 15]	Work Setting	Work No. (for RS-232C)	R	1	0	0	0	Delimiter (CR,CR+LF)	R 1
	Measurement Start Condition Setting	Start Condition	R	1	1	0	0	Delimiter (CR,CR+LF)	R 1
		Start Level	R	1	1	0	1	Delimiter (CR,CR+LF)	R 1
		Stop Condition	R	1	1	0	2	Delimiter (CR,CR+LF)	R 1
		Stop Level	R	1	1	0	3	Delimiter (CR,CR+LF)	R 1
	Display Range Setting	Y Start Point	R	1	2	0	0	Delimiter (CR,CR+LF)	R 1
		Y End Point	R	1	2	0	1	Delimiter (CR,CR+LF)	R 1
		X Start Point	R	1	2	0	2	Delimiter (CR,CR+LF)	R 1
		X End Point	R	1	2	0	3	Delimiter (CR,CR+LF)	R 1

Return (by the TM500)												Input range (display range)
0	0	0	±	0	0	0	0	0	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF)	0 to 15
1	0	0	±	0	0	0	0	0	0	10 <sup>0</sup>	Delimiter (CR,CR+LF)	0: Only External Input 1: External Input + Load 2: External Input + Displacement (2 can be set only when the X-axis of the waveform represents displacement.)
1	0	1	±	0	0	10 <sup>4</sup>	10 <sup>3</sup>	10 <sup>2</sup>	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF)	External Input + Load : -9999 to +9999 External Input + Displacement : -9999 to +32000
1	0	2	±	0	0	0	0	0	0	10 <sup>0</sup>	Delimiter (CR,CR+LF)	0: Only Forced-Stop 1: Load 2: Time 3: Displacement 4: Displacement Stop (3 and 4 can be set only when the X-axis of the waveform represents displacement.)
1	0	3	±	0	0	10 <sup>4</sup>	10 <sup>3</sup>	10 <sup>2</sup>	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF)	Load: -9999 to +9999 Time: 0.1 to 10.0[second] Displacement: -9999 to +32000 Displacement Stop : 0.1 to 10.0[second]
2	0	0	±	0	0	0	10 <sup>3</sup>	10 <sup>2</sup>	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF)	-10000 to 10000
2	0	1	±	0	0	0	0	0	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF)	Y-axis Start Point + 0: 25 1: 50 2: 100 3: 200 4: 300 5: 400 6: 500 7: 1000 8: 2000 9: 3000 10: 4000 11: 5000 12: 10000 13: 20000
2	0	2	±	0	0	0	10 <sup>3</sup>	10 <sup>2</sup>	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF)	Time or displacement (Front) 0 to 2000 (× Measurement Length/2000)  Displacement (Back) -2000 to 0 (× Measurement Length/2000)
2	0	3	±	0	0	0	0	0	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF)	Time or displacement (Front) X-axis Start Point + 0: 25 1: 50 2: 100 3: 200 4: 400 5: 600 6: 800 7: 1000 8: 1200 9: 1400 10: 1600 11: 1800 12: 2000 13: 2200 (× Measurement Length/2000)  Displacement (Back) X-axis Start Point + 0: 25 1: 50 2: 100 3: 200 4: 400 5: 600 6: 800 7: 1000 8: 1200 9: 1400 10: 1600 11: 1800 12: 2000 13: 2200 (× Measurement Length/2000)

Item group		Setting item	Command (transmission to the TM500)							
Settings by work [Work 0 to 15]	Hold Setting	Change of Sct. (common to all work)	R	1	3	0	0	Delimiter (CR,CR+LF)	R	1
		Use Sct.	R	1	3	0	1	Delimiter (CR,CR+LF)	R	1
		Sct. No. (for RS-232C communications)	R	1	3	0	2	Delimiter (CR,CR+LF)	R	1
		Use Hold	R	1	3	0	3	Delimiter (CR,CR+LF)	R	1
		Sct. Start-End (start point)	R	1	3	0	4	Delimiter (CR,CR+LF)	R	1
		Sct. Start-End (end point)	R	1	3	0	5	Delimiter (CR,CR+LF)	R	1
		Load HI/LO Limit (HI limit)	R	1	3	0	6	Delimiter (CR,CR+LF)	R	1
		Load HI/LO Limit (LO limit)	R	1	3	0	7	Delimiter (CR,CR+LF)	R	1
		DPM HI/LO Limit (HI limit)	R	1	3	0	8	Delimiter (CR,CR+LF)	R	1
		DPM HI/LO Limit (LO limit)	R	1	3	0	9	Delimiter (CR,CR+LF)	R	1
		Start Load	R	1	3	1	0	Delimiter (CR,CR+LF)	R	1
		Load Difference	R	1	3	1	1	Delimiter (CR,CR+LF)	R	1
		Rate	R	1	3	1	2	Delimiter (CR,CR+LF)	R	1
		Ordinal	R	1	3	1	3	Delimiter (CR,CR+LF)	R	1
		Interval AB (A)	R	1	3	1	4	Delimiter (CR,CR+LF)	R	1
		Interval AB (B)	R	1	3	1	5	Delimiter (CR,CR+LF)	R	1

Return (by the TM500)											Input range (display range)
3	0	0	±	0	0	0	0	0	0	10 <sup>0</sup>	Delimiter (CR,CR+LF) 0: External Input 1: Setting (0 can be set only when the time or displacement (Front))
3	0	1	±	0	0	0	0	0	0	10 <sup>0</sup>	Delimiter (CR,CR+LF) 1 to 5
3	0	2	±	0	0	0	0	0	0	10 <sup>0</sup>	Delimiter (CR,CR+LF) 0: Sct1 1: Sct2 2: Sct3 3: Sct4 4: Sct5
3	0	3	±	0	0	0	0	0	0	10 <sup>0</sup>	Delimiter (CR,CR+LF) 0: Always 1: Sample 2: Peak 3: Bottom 4: Peak to Peak 5: Relative Maximum 6: Relative Minimum 7: Inflection Point 8: Average 9: End Displacement
3	0	4	±	0	0	0	10 <sup>3</sup>	10 <sup>2</sup>	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF) Waveform Reference; Front 0 to 2047 (× Measurement Length/2000) Waveform Reference; Back -2047 to 0 (× Measurement Length/2000)
3	0	5	±	0	0	0	10 <sup>3</sup>	10 <sup>2</sup>	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF) Waveform Reference; Front 0 to 2047 (× Measurement Length/2000) Waveform Reference; Back -2047 to 0 (× Measurement Length/2000)
3	0	6	±	0	0	0	10 <sup>3</sup>	10 <sup>2</sup>	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF) -9999 to +9999
3	0	7	±	0	0	0	10 <sup>3</sup>	10 <sup>2</sup>	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF) -9999 to +9999
3	0	8	±	0	0	10 <sup>4</sup>	10 <sup>3</sup>	10 <sup>2</sup>	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF) Waveform Reference; Front 0 to 2047 (× Measurement Length/2000) Waveform Reference; Back -2047 to 0 (× Measurement Length/2000) * When End Displacement in Use Hold is selected; -9999 to 32000
3	0	9	±	0	0	10 <sup>4</sup>	10 <sup>3</sup>	10 <sup>2</sup>	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF) Waveform Reference; Front 0 to 2047 (× Measurement Length/2000) Waveform Reference; Back -2047 to 0 (× Measurement Length/2000) * When End Displacement in Use Hold is selected; -9999 to 32000
3	1	0	±	0	0	0	10 <sup>3</sup>	10 <sup>2</sup>	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF) -9999 to 9999
3	1	1	±	0	0	10 <sup>4</sup>	10 <sup>3</sup>	10 <sup>2</sup>	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF) 1 to 19998
3	1	2	±	0	0	0	0	0	0	10 <sup>0</sup>	Delimiter (CR,CR+LF) 0: 1/4 1: 1/2 2: 3/4 3: 1 4: 1.25 5: 1.5 6: 1.75 7: 2 8: 3 9: 4 [times]
3	1	3	±	0	0	0	0	0	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF) 1 to 15 [times]
3	1	4	±	0	0	0	0	10 <sup>2</sup>	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF) 1 to 999 (× Measurement Length/2000)
3	1	5	±	0	0	0	0	10 <sup>2</sup>	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF) 1 to 999 (× Measurement Length/2000)



Item group		Setting item	Command (transmission to the TM500)							
Settings by work [Work 0 to 15]	Waveform Comparison Setting	Relative	R	1	4	0	0	Delimiter (CR,CR+LF)	R	1
		Compare Area (start point)	R	1	4	0	1	Delimiter (CR,CR+LF)	R	1
		Compare Area (end point)	R	1	4	0	2	Delimiter (CR,CR+LF)	R	1
		Compare Margin	R	1	4	0	3	Delimiter (CR,CR+LF)	R	1
		Relative Point (X-axis)	R	1	4	0	4	Delimiter (CR,CR+LF)	R	1
		Relative Point (Y-axis)	R	1	4	0	5	Delimiter (CR,CR+LF)	R	1
		Load Reversing	R	1	4	0	6	Delimiter (CR,CR+LF)	R	1
		DPM Reversing	R	1	4	0	7	Delimiter (CR,CR+LF)	R	1
		HI Conditions Count	R	1	4	0	8	Delimiter (CR,CR+LF)	R	1
		HI Conditions Range	R	1	4	0	9	Delimiter (CR,CR+LF)	R	1
		LO Conditions Count	R	1	4	1	0	Delimiter (CR,CR+LF)	R	1
		LO Conditions Range	R	1	4	1	1	Delimiter (CR,CR+LF)	R	1
Other		Measurement Work No. (for RS-232C communications)	R	1	0	0	1	Delimiter (CR,CR+LF)	R	1
		Priority of Level Input Signal	R	1	0	0	2	Delimiter (CR,CR+LF)	R	1

Return (by the TM500)												Input range (display range)	
4	0	0	±	0	0	0	0	0	0	10 <sup>0</sup>	Delimiter (CR,CR+LF)	0: Off    1: On	
4	0	1	±	0	0	0	10 <sup>3</sup>	10 <sup>2</sup>	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF)	Time or displacement (Front) 0 to 2047 (× Measurement Length/2000) Displacement (Back) -2047 to 0 (× Measurement Length/2000)	
4	0	2	±	0	0	0	10 <sup>3</sup>	10 <sup>2</sup>	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF)	Time or displacement (Front) 0 to 2047 (× Measurement Length/2000) Displacement (Back) -2047 to 0 (× Measurement Length/2000)	
4	0	3	±	0	0	0	10 <sup>3</sup>	10 <sup>2</sup>	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF)	0 to 9999	
4	0	4	±	0	0	0	10 <sup>3</sup>	10 <sup>2</sup>	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF)	Time or displacement (Front) 0 to 2047 (× Measurement Length/2000) Displacement (Back) -2047 to 0 (× Measurement Length/2000)	
4	0	5	±	0	0	0	10 <sup>3</sup>	10 <sup>2</sup>	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF)	-9999 to 9999	
4	0	6	±	0	0	0	0	0	0	10 <sup>0</sup>	Delimiter (CR,CR+LF)	0: Off    1: On	
4	0	7	±	0	0	0	0	0	0	10 <sup>0</sup>	Delimiter (CR,CR+LF)	0: Off    1: On	
4	0	8	±	0	0	0	0	0	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF)	0 to 99	
4	0	9	±	0	0	0	0	10 <sup>2</sup>	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF)	0 to 999	
4	0	0	±	0	0	0	0	0	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF)	0 to 99	
4	0	1	±	0	0	0	0	10 <sup>2</sup>	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF)	0 to 999	
0	0	1	±	0	0	0	0	0	0	10 <sup>0</sup>	Delimiter (CR,CR+LF)	0 to 15	
0	0	2	±	0	0	0	0	0	0	10 <sup>0</sup>	Delimiter (CR,CR+LF)	0: External Input 1: Communication	

## - List of commands to write set values

Item group		Setting item	Command					
First Setting	Y-axis Setting	Unit	W	0	1	0	1	±
		Decimal Place	W	0	1	0	2	±
		Equiv. Cal. (rated output)	W	0	1	0	4	±
		Equiv. Cal. (rated capacity)	W	0	1	0	5	±
		Overload	W	0	1	0	6	±
		Increment	W	0	1	0	7	±
		Analog Filter	W	0	1	0	8	±
		Digital Filter	W	0	1	0	9	±
		DZ Limit	W	0	1	1	0	±
		Digital LPF	W	0	1	1	1	±
	X-axis Setting	Time/DPM Change	W	0	2	0	0	±
		Phase Select	W	0	2	0	1	±
		Wave Reference	W	0	2	0	2	±
		Unit	W	0	2	0	3	±
		Decimal Place	W	0	2	0	4	±
		Equiv. Cal. (number of pulses)	W	0	2	0	6	±
		Equiv. Cal. (displacement value)	W	0	2	0	7	±
		Measure Length	W	0	2	0	8	±
		DPM Positioning	W	0	2	0	9	±
		Digital Filter	W	0	2	1	1	±
		Repetitive DPM	W	0	2	1	2	±

(transmission to the TM500)								Input range (display range)
0	0	0	0	10 <sup>2</sup>	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF)	See "9-3 Unit setting list" on page 153.
0	0	0	0	0	0	10 <sup>0</sup>	Delimiter (CR,CR+LF)	0: 0                      1: 0.0 2: 0.00                3: 0.000
0	0	0	10 <sup>3</sup>	10 <sup>2</sup>	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF)	-9.999~9.999 [V]
0	0	0	10 <sup>3</sup>	10 <sup>2</sup>	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF)	-9999 to 9999
0	0	0	10 <sup>3</sup>	10 <sup>2</sup>	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF)	0 to 9999
0	0	0	0	0	0	10 <sup>0</sup>	Delimiter (CR,CR+LF)	0: 1                      1: 2 2: 5                      3: 10
0	0	0	0	0	0	10 <sup>0</sup>	Delimiter (CR,CR+LF)	0: 30                    1: 100 2: 300                  3: 1k [Hz]
0	0	0	0	10 <sup>2</sup>	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF)	0, 2 to 999 [Times]
0	0	0	10 <sup>3</sup>	10 <sup>2</sup>	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF)	0 to 9999
0	0	0	0	0	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF)	0 to 30 [Hz]
0	0	0	0	0	0	10 <sup>0</sup>	Delimiter (CR,CR+LF)	0: Time                1: Displacement 2: Continuous        3: Average
0	0	0	0	0	0	10 <sup>0</sup>	Delimiter (CR,CR+LF)	0: A/B-Phase        1: Only A-Phase
0	0	0	0	0	0	10 <sup>0</sup>	Delimiter (CR,CR+LF)	0: Front                1: Back
0	0	0	0	10 <sup>2</sup>	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF)	See "9-3 Unit setting list" on page 153.
0	0	0	0	0	0	10 <sup>0</sup>	Delimiter (CR,CR+LF)	0: 0                      1: 0.0 2: 0.00                3: 0.000
10 <sup>6</sup>	10 <sup>5</sup>	10 <sup>4</sup>	10 <sup>3</sup>	10 <sup>2</sup>	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF)	1 to 1000000
0	0	10 <sup>4</sup>	10 <sup>3</sup>	10 <sup>2</sup>	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF)	-99999 to 99999
0	0	0	0	0	0	10 <sup>0</sup>	Delimiter (CR,CR+LF)	Time/Displacement Change; Time 0: 0.5   1: 1.0   2: 2.0 3: 5.0   4: 10.0 [s] Time/Displacement Change; Displacement, Continuous, Average 0: 2000   1: 4000   2: 6000 3: 8000   4: 10000
0	0	10 <sup>4</sup>	10 <sup>3</sup>	10 <sup>2</sup>	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF)	-9999 to 32000
0	0	0	0	10 <sup>2</sup>	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF)	0, 2 to 999 [Times]
0	0	0	0	0	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF)	0: 720    1: 810    2: 900    3: 990 4: 1080   5: 1170   6: 1260   7: 1350 8: 1440   9: 1530   10: 1620   11: 1710 12: 1800   13: 2000 (× Measurement Length/2000)

Item group		Setting item	Command					
First Setting	Communication Setting	Speed	W	0	3	0	0	±
		Data Bit	W	0	3	0	1	±
		Parity Bit	W	0	3	0	2	±
		Stop Bit	W	0	3	0	3	±
		Delimiter	W	0	3	0	4	±
		Header	W	0	3	0	5	±
		Flow Control	W	0	3	0	6	±
		Com. Mode	W	0	3	0	7	±
	System Setting	Backlight (ON Time)	W	0	4	0	0	±
		Language	W	0	4	0	1	±
		Work Protect	W	0	4	0	2	±
		First Protect	W	0	4	0	3	±
		Undefined	W	0	4	0	4	±
		Backlight (bright→dark)	W	0	4	0	5	±
	Option Setting							

(transmission to the TM500)							Input range (display range)	
0	0	0	0	0	0	10 <sup>0</sup>	Delimiter (CR,CR+LF)	0: 1200 1: 2400 2: 4800 3: 9600 4: 19.2k 5: 38.4k [bps]
0	0	0	0	0	0	10 <sup>0</sup>	Delimiter (CR,CR+LF)	0: 7 1: 8 [bit]
0	0	0	0	0	0	10 <sup>0</sup>	Delimiter (CR,CR+LF)	0: None 1: Even 2: Odd
0	0	0	0	0	0	10 <sup>0</sup>	Delimiter (CR,CR+LF)	0: 1 1: 2 [bit]
0	0	0	0	0	0	10 <sup>0</sup>	Delimiter (CR,CR+LF)	0: CR 1: CR+LF
0	0	0	0	0	0	10 <sup>0</sup>	Delimiter (CR,CR+LF)	0: None 1: STX
0	0	0	0	0	0	10 <sup>0</sup>	Delimiter (CR,CR+LF)	0: Off 1: RTS/CTS Control
0	0	0	0	0	0	10 <sup>0</sup>	Delimiter (CR,CR+LF)	0: Normal 1: Hold Point Mode
0	0	0	0	0	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF)	0 to 99 [minute]
0	0	0	0	0	0	10 <sup>0</sup>	Delimiter (CR,CR+LF)	0: Japanese 1: English
0	0	0	0	0	0	10 <sup>0</sup>	Delimiter (CR,CR+LF)	0: Not Protect 1: Protect
0	0	0	0	0	0	10 <sup>0</sup>	Delimiter (CR,CR+LF)	0: Not Protect 1: Protect
0	0	0	0	10 <sup>2</sup>	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF)	100 (Bright) to 170 (Dark)
0	0	0	0	0	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF)	0 to 99 [minute]

Item group		Setting item	Command					
Settings by work [Work 0 to 15]	Work Setting	Work No. (for RS-232C communications)	W	1	0	0	0	±
		Start Condition	W	1	1	0	0	±
	Measurement Start Condition Setting	Start Level	W	1	1	0	1	±
		Stop Condition	W	1	1	0	2	±
		Stop Level	W	1	1	0	3	±
	Display Range Setting	Y Start Point	W	1	2	0	0	±
		Y End Point	W	1	2	0	1	±
		X Start Point	W	1	2	0	2	±
		X End Point	W	1	2	0	3	±
	Hold Setting	Change of Sct. (common to all work)	W	1	3	0	0	±
		Use Sct.	W	1	3	0	1	±
		Sct. No. (for RS-232C communications)	W	1	3	0	2	±

(transmission to the TM500)							Input range (display range)
0	0	0	0	0	$10^1$	$10^0$	Delimiter (CR,CR+LF) 0 to 15
0	0	0	0	0	0	$10^0$	Delimiter (CR,CR+LF) 0: Only External Input 1: External Input + Load 2: External Input + Displacement (2 can be set only when the X-axis of the waveform represents displacement.)
0	0	$10^4$	$10^3$	$10^2$	$10^1$	$10^0$	Delimiter (CR,CR+LF) External Input + Load: -9999 to +9999 External Input + Displacement: -9999 to +32000
0	0	0	0	0	0	$10^0$	Delimiter (CR,CR+LF) 0: Only Forced-Stop 1: Load 2: Time 3: Displacement 4: Displacement Stop (3 and 4 can be set only when the X-axis of the waveform represents displacement.)
0	0	$10^4$	$10^3$	$10^2$	$10^1$	$10^0$	Delimiter (CR,CR+LF) Load: -9999 to +9999 Time: 0.1 to 10.0 [second] Displacement: -9999 to +32000 Displacement Stop: 0.1 to 10.0 [second]
0	0	$10^4$	$10^3$	$10^2$	$10^1$	$10^0$	Delimiter (CR,CR+LF) -10000 to 10000
0	0	0	0	0	$10^1$	$10^0$	Delimiter (CR,CR+LF) Y-axis Start Point + 0: 25 1: 50 2: 100 3: 200 4: 300 5: 400 6: 500 7: 1000 8: 2000 9: 3000 10: 4000 11: 5000 12: 10000 13: 20000
0	0	0	$10^3$	$10^2$	$10^1$	$10^0$	Delimiter (CR,CR+LF) Time or displacement (Front) 0 to 2000 (× Measurement Length/2000) Displacement (Back) -2000 to 0 (× Measurement Length/2000)
0	0	0	0	0	$10^1$	$10^0$	Delimiter (CR,CR+LF) Time or displacement (Front) X-axis Start Point + 0: 25 1: 50 2: 100 3: 200 4: 400 5: 600 6: 800 7: 1000 8: 1200 9: 1400 10: 1600 11: 1800 12: 2000 13: 2200 (× Measurement Length/2000) Displacement (Back) X-axis Start Point + 0: -25 1: -50 2: -100 3: -200 4: -400 5: -600 6: -800 7: -1000 8: -1200 9: -1400 10: -1600 11: -1800 12: -2000 13: -2200 (× Measurement Length/2000)
0	0	0	0	0	0	$10^0$	Delimiter (CR,CR+LF) 0: External Input 1: Setting (0 can be set only when the time or displacement (Front))
0	0	0	0	0	0	$10^0$	Delimiter (CR,CR+LF) 1 to 5
0	0	0	0	0	0	$10^0$	Delimiter (CR,CR+LF) 0: Sct1 1: Sct2 2: Sct3 3: Sct4 4: Sct5



Item group		Setting item	Command					
Settings by work [Work 0 to 15]	Section 1 to 5	Use Hold	W	1	3	0	3	±
		Sct. Start-End (start point) Note1)	W	1	3	0	4	±
		Sct. Start-End (end point) Note1)	W	1	3	0	5	±
		Load HI/LO Limit (HI limit) Note1)	W	1	3	0	6	±
		Load HI/LO Limit (LO limit) Note1)	W	1	3	0	7	±
		DPM HI/LO Limit (HI limit) Note1)	W	1	3	0	8	±
		DPM HI/LO Limit (LO limit) Note1)	W	1	3	0	9	±
		Start Load	W	1	3	1	0	±
		Load Difference	W	1	3	1	1	±
		Rate	W	1	3	1	2	±
		Ordinal	W	1	3	1	3	±
		Interval AB (A)	W	1	3	1	4	±
		Interval AB (B)	W	1	3	1	5	±

(transmission to the TM500)							Input range (display range)	
0	0	0	0	0	0	10 <sup>0</sup>	Delimiter (CR,CR+LF)	0: Always 1: Sample 2: Peak 3: Bottom 4: Peak to Peak 5: Relative Maximum 6: Relative Minimum 7: Inflection Point 8: Average 9: End Displacement
0	0	0	10 <sup>3</sup>	10 <sup>2</sup>	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF)	Time or displacement (Front) 0 to 2047 (× Measurement Length/2000) * However, End point of the previous section ≤ Start point ≤ End point Displacement (Back) -2047 to 0 (× Measurement Length/2000) * However, End point of the previous section ≥ Start point ≥ End point
0	0	0	10 <sup>3</sup>	10 <sup>2</sup>	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF)	Time or displacement (Front) 0 to 2047 (× Measurement Length/2000) * However, Start point ≤ End point ≤ Start point of the next section Displacement (Back) -2047 to 0 (× Measurement Length/2000) * However, Start point ≥ End point ≥ Start point of the next section
0	0	0	10 <sup>3</sup>	10 <sup>2</sup>	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF)	-9999 to +9999 * Setting HI limit < LO limit is unacceptable.
0	0	0	10 <sup>3</sup>	10 <sup>2</sup>	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF)	-9999 to +9999 * Setting HI limit < LO limit is unacceptable.
0	0	10 <sup>4</sup>	10 <sup>3</sup>	10 <sup>2</sup>	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF)	Waveform Reference; Front 0 to 2047 (× Measurement Length/2000) Waveform Reference; Back -2047 to 0 (× Measurement Length/2000) * When End Displacement in Use Hold is selected; -9999 to 32000 * Setting HI limit < LO limit is unacceptable.
0	0	10 <sup>4</sup>	10 <sup>3</sup>	10 <sup>2</sup>	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF)	Waveform Reference; Front 0 to 2047 (× Measurement Length/2000) Waveform Reference; Back -2047 to 0 (× Measurement Length/2000) * When End Displacement in Use Hold is selected; -9999 to 32000 * Setting HI limit < LO limit is unacceptable.
0	0	0	10 <sup>3</sup>	10 <sup>2</sup>	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF)	-9999 to 9999
0	0	10 <sup>4</sup>	10 <sup>3</sup>	10 <sup>2</sup>	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF)	1 to 19998
0	0	0	0	0	0	10 <sup>0</sup>	Delimiter (CR,CR+LF)	0: 1/4 1: 1/2 2: 3/4 3: 1 4: 1.25 5: 1.5 6: 1.75 7: 2 8: 3 9: 4 [Times]
0	0	0	0	0	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF)	1 to 15 [Times]
0	0	0	0	10 <sup>2</sup>	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF)	1 to 999 (× Measurement Length/2000)
0	0	0	0	10 <sup>2</sup>	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF)	1 to 999 (× Measurement Length/2000)

Item group		Setting item	Command					
Settings by work [Work 0 to 15]	Waveform Comparison Setting	Relative	W	1	4	0	0	±
		Compare Area (start point) Note1)	W	1	4	0	1	±
		Compare Area (end point) Note1)	W	1	4	0	2	±
		Compare Margin	W	1	4	0	3	±
		Relative Point (X-axis)	W	1	4	0	4	±
		Relative Point (Y-axis)	W	1	4	0	5	±
		Load Reversing	W	1	4	0	6	±
		DPM Reversing	W	1	4	0	7	±
		HI Conditions Count	W	1	4	0	8	±
		HI Conditions Range	W	1	4	0	9	±
		LO Conditions Count	W	1	4	1	0	±
		LO Conditions Range	W	1	4	1	1	±
Other		Measurement Work No. (for RS-232C communications)	W	1	0	0	1	±
		Priority of Level Input Signal	W	1	0	0	2	±

(transmission to the TM500)								Input range (display range)
0	0	0	0	0	0	10 <sup>0</sup>	Delimiter (CR,CR+LF)	0: Off      1: On
0	0	0	10 <sup>3</sup>	10 <sup>2</sup>	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF)	Time or displacement (Front) 0 to 2047 (× Measurement Length/2000) * Setting Start point > End point is unacceptable. Displacement (Back) -2047 to 0 (× Measurement Length/2000) * Setting Start point < End point is unacceptable.
0	0	0	10 <sup>3</sup>	10 <sup>2</sup>	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF)	Time or displacement (Front) 0 to 2047 (× Measurement Length/2000) * Setting Start point > End point is unacceptable. Displacement (Back) -2047 to 0 (× Measurement Length/2000) * Setting Start point < End point is unacceptable.
0	0	0	10 <sup>3</sup>	10 <sup>2</sup>	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF)	0 to 9999
0	0	0	10 <sup>3</sup>	10 <sup>2</sup>	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF)	Time or displacement (Front) 0 to 2047 (× Measurement Length/2000) Displacement (Back) -2047 to 0 (× Measurement Length/2000)
0	0	0	10 <sup>3</sup>	10 <sup>2</sup>	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF)	-9999 to 9999
0	0	0	0	0	0	10 <sup>0</sup>	Delimiter (CR,CR+LF)	0: Off      1: On
0	0	0	0	0	0	10 <sup>0</sup>	Delimiter (CR,CR+LF)	0: Off      1: On
0	0	0	0	0	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF)	0 to 99
0	0	0	0	10 <sup>2</sup>	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF)	0 to 999
0	0	0	0	0	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF)	0 to 99
0	0	0	0	10 <sup>2</sup>	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR,CR+LF)	0 to 999
0	0	0	0	0	0	10 <sup>0</sup>	Delimiter (CR,CR+LF)	0 to 15
0	0	0	0	0	0	10 <sup>0</sup>	Delimiter (CR,CR+LF)	0: External Input 1: Communication

## Point

## Note1)

Please change other set values beforehand so that the setting range becomes the maximum when a set value to which other settings influence the setting range is written in.

Example 1 When you write the Load HI Limit value in.

Please write -9999 in the Load LO Limit value beforehand.

Example 2 When you change the Section Start-End.

Please write 2047(Time or Displacement (Front)) and -2047(Displacement (Back)) in at the start point and the end point in all sections beforehand in order of End Point of Section 5, Start Point of Section 5, End Point of Section 4, ..... End Point of Section 1 and Start Point of Section 1.

Please write in the value to be set in order of Start Point of Section 1, End Point of Section 1, Start Point of Section 2, ..... Start Point of Section 5 and End Point of Section 5.

## - List of zero calibration commands

Item group		Setting item	Command (transmission to the TM500)					
First Setting	Y-axis Setting	Zero Calibration	C	0	1	0	0	Delimiter (CR, CR+LF)
	X-axis Setting	Zero Calibration	C	0	2	0	0	Delimiter (CR, CR+LF)

## - List of actual load calibration commands

Item group		Setting item						
First Setting	Y-axis Setting	Actual Load Calibration	C	0	1	0	1	
	X-axis Setting	Actual Load Calibration	C	0	2	0	1	

## Command (transmission to the TM500)

±	0	0	0	10 <sup>3</sup>	10 <sup>2</sup>	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR, CR+LF)
±	0	0	10 <sup>4</sup>	10 <sup>3</sup>	10 <sup>2</sup>	10 <sup>1</sup>	10 <sup>0</sup>	Delimiter (CR, CR+LF)

## Input range

Actual Load Calibration (Y-axis Setting): -9999 to 9999

Actual Load Calibration (X-axis Setting): -9999 to 32000

## - List of zero calibration commands

Item group		Commanding	Command (transmission to the TM500)					
Other		Load Digital Zero	C	1	0	0	1	Delimiter (CR, CR+LF)
		DPM Positioning	C	1	0	0	2	Delimiter (CR, CR+LF)
		Start ON (*1)	C	1	0	0	3	Delimiter (CR, CR+LF)
		Start OFF (*1)	C	1	0	0	4	Delimiter (CR, CR+LF)
		Stop	C	1	0	0	5	Delimiter (CR, CR+LF)
		Hold ON (*2)	C	1	0	0	6	Delimiter (CR, CR+LF)
		Hold OFF (*2)	C	1	0	0	7	Delimiter (CR, CR+LF)
		Reset ON (*1)	C	1	0	0	8	Delimiter (CR, CR+LF)
		Reset OFF (*1)	C	1	0	0	9	Delimiter (CR, CR+LF)
		Backlight ON (*1)	C	1	0	1	0	Delimiter (CR, CR+LF)
		Backlight OFF (*1)	C	1	0	1	1	Delimiter (CR, CR+LF)
		Prohibit Touch Panel ON (*1)	C	1	0	1	2	Delimiter (CR, CR+LF)
		Prohibit Touch Panel OFF (*1)	C	1	0	1	3	Delimiter (CR, CR+LF)

\*1 These data are only effective when “Communication” is selected at Priority of level input signal.

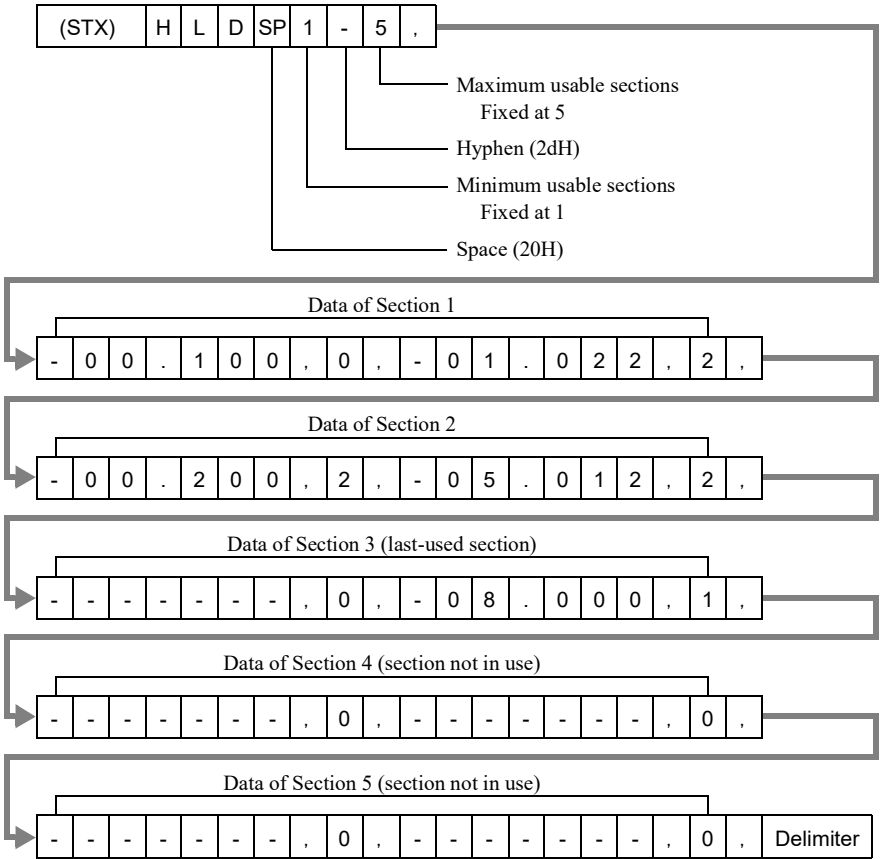
\*2 These data are only effective when “External Input” is selected at Change of Sct..

■ Communication method  
(when the Communication Mode is Hold Point Mode)

After completion of measurement, the Hold Result of each section is automatically transmitted to the host.

Example: When the hold function is used in Section 1 to 3 of a measurement waveform

TM500's transmission  
(In normal processing)



Data of the sections not in use are also returned  
but hyphens (2dH) enter into Load and Displacement (Time).

\* The format of section data is the same as that for reading hold results.

## ■ Cautions

### - Work No. for RS-232C communications

Once Work No. is written, it will be reflected afterward throughout reading and writing of settings by work. This work No. is just for RS-232C communications. The TM500's work is not changed. Also, the Work No. display in Work Setting is not changed.

### - About Section No. for RS-232C communications

Once Section No. is written (with the currently-specified Work No.), it will be reflected afterward throughout reading and writing of hold settings. This section No. is just for RS-232C communications. The TM500's section is not changed. Also, the Section display in Hold Setting is not changed.

### - About communications during measurement

During measurement, writing or calibration cannot be carried out through communications, where only reading can be carried out.

### ▪ About messages

Unless otherwise noted, all the messages are in ASCII code.

### ▪ About Priority of level input signal

Use communication interface to read/write this setting.

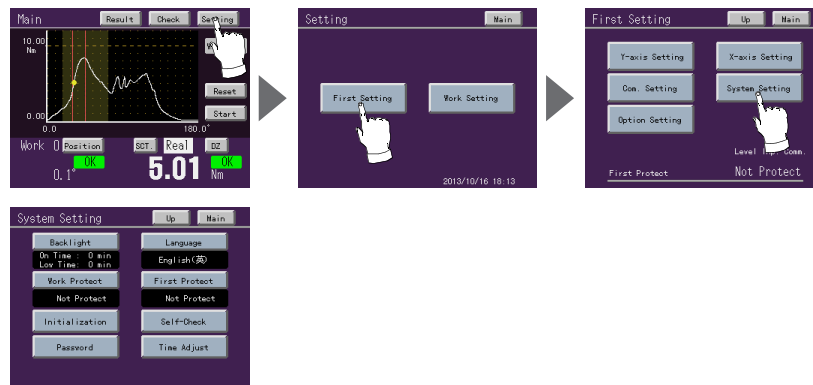




# 6 SYSTEM SETTINGS

## 6-1. System setting

Select language and adjust contrast, etc., by System Setting.



### Operation

Main screen→Setting→First Setting→System Setting

### - Backlight

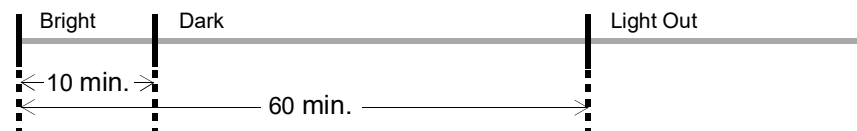
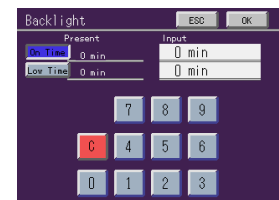
This function changes the brightness of the backlight when touch screen has not been used for certain period of time.

The ON time ( lighting time of the backlight) and the Low time ( bright →dark switching time of the backlight) are set up.

When you use it in the state which a display is always in sight, set the ON time to 0 minutes.

When you want the backlight always bright, set 0 minutes for both the ON time and the Low time. The backlight is turned bright by touching the panel when the backlight is turned off or it is dark.

Ex.) Set 60 minutes to ON time, 10 minutes to Low time.)



Setting range (0 to 99 minutes) (with both time)

### Operation

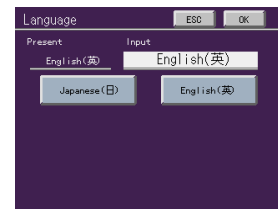
Main screen→Setting→First Setting→System Setting→Backlight

### - Language

Select language.

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

Operation



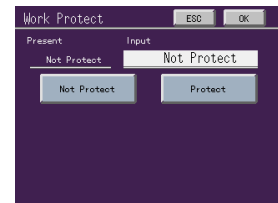
Main screen→Setting→First Setting→System Setting→Language

### - Work Setting Parameter Protection

Set whether or not work setting parameters can be changed.

Setting range (Not Protect, Protect)

Operation



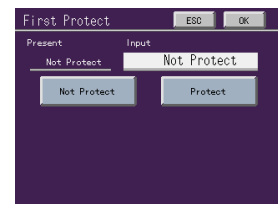
Main screen→Setting→First Setting→System Setting→Work Protect

### - First Setting Parameter Protection

Set whether or not first setting parameters can be changed.

Setting range (Not Protect, Protect)

Operation



Main screen→Setting→First Setting→System Setting→First Protect

### - Initialization

Parameters are brought back to factory defaults.

Setting range

First Setting: All the set values of the first setting parameters other than the equipment's specific settings

Work Setting: All work setting parameters

All: First Setting + Work Setting

(The TM500's specific settings are the set values marked with \* in "9-2 Setting item list" on p.148.)

Operation



Main screen→Setting→First Setting→System Setting→Initialization

### - Self-Check

Make self-checks.

Operation



Main screen→Setting→First Setting→System Setting→Self-Check

① LCD Check

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

The screen changes as red → green → blue → horizontal stripes → vertical stripes.

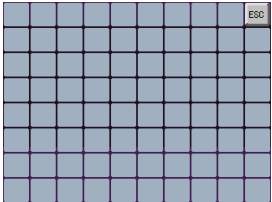
Touching the screen restores the original screen.

Operation

Main screen→Setting→First Setting→System Setting→Self-Check→LCD Check

② KEY Check

Check that the touch panel is free from unrecognizable places. When touched, each square changes to yellow. Pressing **ESC** at the upper right of the screen restores the original screen.

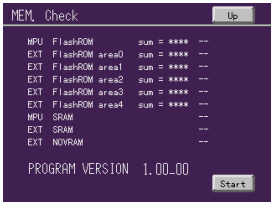


Operation

Main screen→Setting→First Setting→System Setting→Self-Check→KEY Check

③ MEM. Check

Check that the memory is free from defects. The results are displayed in a short time after **Start** at the lower right of the screen is pressed. Also, check the version here.



Operation

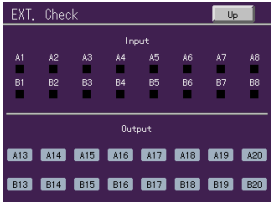
Main screen→Setting→First Setting→System Setting→Self-Check→MEM. Check

④ EXT. Check

Check that the external input/output signals operate.

On outputs, pressed pins turn ON.

On inputs, ON-recognized pins turn yellow.



Operation

Main screen→Setting→First Setting→System Setting→Self-Check→EXT. Check

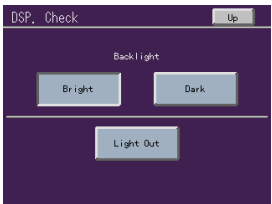
⑤ DSP. Check

Check the backlight and status indicator lamp.

The backlight turns bright by pressing **Bright**, and turns dark by pressing **Dark**.

The backlight goes out when **LightOut** is pressed, and after that, it recovers when the screen is touched.

The status indicator lamp lights in green and red alternately.



Operation

Main screen→Setting→First Setting→System Setting→Self-Check→DSP. Check

## ⑥ FLT. Check

Check the filter circuit.

## - Analog Filter

Voltage/current input (Load input):

When the input is changed from 0V to 10V or

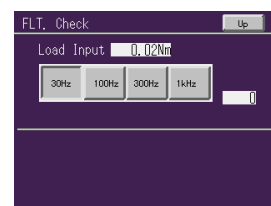
0mA to 10mA (step input), use the following values as a guide for normal.

30Hz: 23±2

100Hz: 7±2

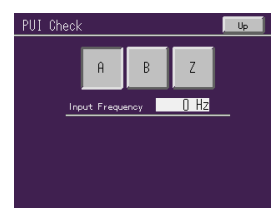
300Hz: 3±1

1kHz: 1±1



## ⑦ PUI Check

Check that the encoder input is recognized.



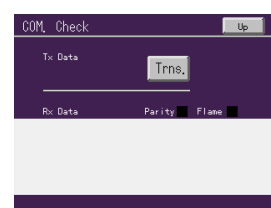
## Operation

Main screen→Setting→First Setting→System Setting→Self-Check→PUI Check

## ⑧ COM. Check

Check that RS-232C reception and transmission are in proper operation.

Press the Trns. Key, the same statement as in display read is transmitted, and the received data is displayed in the Rx Data section. Also, in the case of a parity error/framing error, the Parity/Frame lamp turns red.



## Operation

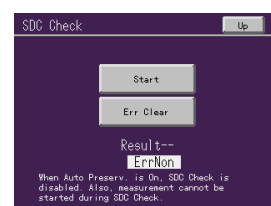
Main screen→Setting→First Setting→System Setting→Self-Check→COM. Check

## ⑨ SDC Check (Only when the SD card slot option is mounted)

Check the operation of the SD memory card.

Selectable range (Start, Err Clear)

## Operation



Main screen→Setting→First Setting→System Setting→Self-Check→SDC Check

**- Password**

This setting is for maintenance and inspection. Do not operate it.

Setting range (0 to 9999)

Operation



Main screen→Setting→First Setting→System Setting→Password

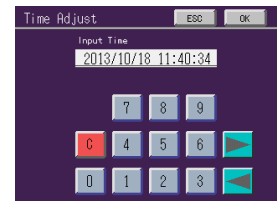
**- Time Adjust**

Set the present time displayed on the Setting screen.

Setting range



(2000/01/01 00:00:00 to 2079/12/31 23:59:59)

Operation



Main screen→Setting→First Setting→System Setting→Time Adjust

1. Press  /  on the numeric keypad to flash the place you want to set.

Each time you press  / , the flashing place changes as Year → Month → Day → Hour → Minute → Second → Year → ...

2 0 0 0 / 0 1 / 0 1 / 0 1 : 2 3 : 5 5  
 Year Month Day Hour Minute Second

2. Input a numeric value.

Input all of Year/Month/Day/Hour/Minute/Second in two digits.

Year: 00 to 79 (last two digits of year)  
 Month: 01 to 12  
 Day: 01 to 31 (The last day changes according to the set month.)  
 Hour: 00 to 23 (24-hour display)  
 Minute: 00 to 59  
 Second: 00 to 59

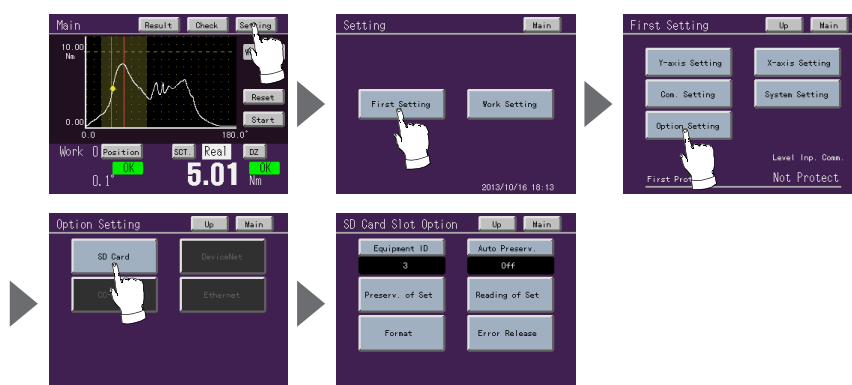
3. Press  .

# 7 OPTION

## 7-1. SD card slot option

### ■ Outline

- Set values and comparison waveform data can be preserved on an SD memory card.
- Settings can be reconstructed by reading the set values and comparison waveform data having been preserved on an SD memory card.
- Measurement waveform data and judgment points can be automatically preserved on an SD memory card upon completion of measurement.
- A wave No. can be set on each waveform.

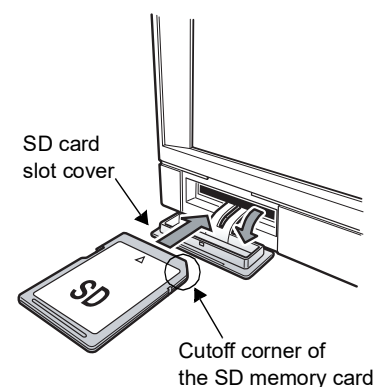


### Operation

Main screen → Setting → First Setting → Option Setting → SD Card

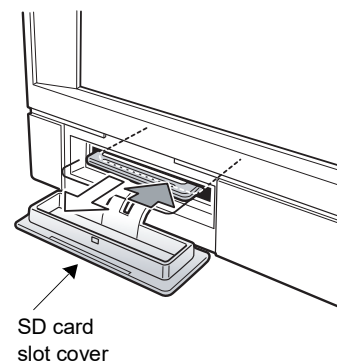
### ■ SD memory card insertion

1. Open the SD card slot cover of the main unit.
2. Insert an SD memory card paying attention to its cutoff corner as shown at the right.
3. Push in until you hear it click.
4. Close the SD card slot cover.



## ■SD memory card ejection

1. Check that the SD memory card is not in processing.
2. Open the SD card slot cover of the main unit.
3. Once push in the SD memory card, and then release it.  
You will hear it click, and the SD memory card will pop out slightly.
4. Pick the SD memory card, and draw it out frontward.
5. Close the SD card slot cover.



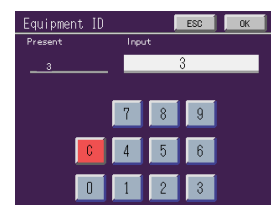
## ■Settings

### - Equipment ID

By setting its ID, an TM500 can be controlled to differentiate from other TM500s.

Setting range (0 to 999)

Operation



Main screen→Setting→First Setting→Option Setting → SD Card→ Equipment ID

### - Measurement Waveform Preservation by the Automatic Operation

This setting is to automatically preserve the present measurement waveform data and judgment point data on an SD memory card upon completion of measurement.

Setting range

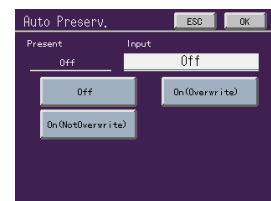
Off

On (Overwrite): The oldest file is erased and the present waveform is preserved, when SD memory card is full.

On (Not Overwrite): It does not overwrite, when SD memory card is full.

\* Setting "On" disables preservation and reading of set values, and formatting of an SD memory card.

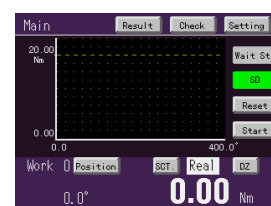
Operation



Main screen→Setting→First Setting→Option Setting →SD Card→ Auto Preserv.

If "On" is set, "SD" appears under the status display on the main screen, and upon completion of measurement, it changes to SD Busy.

Also, in the case of an error, the corresponding error number is displayed.



**Point**

It takes about 1s to write a measurement waveform on average.

(It varies depending on conditions.)

When Measurement Waveform Preservation by the Automatic Operation is “On (Overwrite)” and SD memory card is full, present waveform is preserved by overwriting on the oldest file. In this case, it is possible to take about several seconds to write in the waveform.

Approximately 80 waveforms can be stored in 1MB.

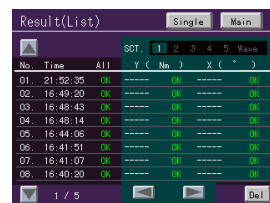
Measurement can be made in writing a waveform on an SD card, but upon termination of the measurement, if the writing of the previous measurement waveform is not completed, the next measurement cannot be started until the writing of the previous measurement waveform is completed. (The SD OK signal turns OFF. Do not start the next measurement while it is OFF. It is reset by starting measurement being saved in time.)

## ■ Setting a wave No. on a measurement waveform

Setting a wave No. allows control of the waveform stored on an SD card by number. Set the wave No. through communication (RS-232C). (For the setting method, see "5-1.RS-232C" on p.81.)

The wave No. of the measurement waveform can be confirmed on the Result screen.

\* At power-on, the wave No. is set at 0. “Wave No. :” is not displayed until a new wave No. is set and measurement is made.



### Operation

Main screen → Result

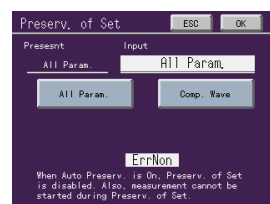
Chapter  
7

OPTION

## ■ Preservation of set values on an SD memory card

### 1. Press .

Select “All Parameter” to preserve first setting parameters, work setting (Work 0 to 15) parameters, and comparison waveform data (Work 0 to 15) on an SD memory card, and select “Comparison Wave” to preserve only comparison waveform data (Work 0 to 15) on an SD memory card.



Setting range (All Parameter, Comparison Wave)

### Operation

Main screen → Setting → First Setting → Option Setting → SD Card → Preserv. of Set

### 2. Press to start preservation.



## Files created on an SD memory card

When waveforms and set values are preserved, the following files are created on an SD memory card.

TM50SETT.500 (Set values other than comparison waveforms)  
 TMCOMP00.500 (Comparison waveforms)

All parameters

TM50DXXX.500 (Measurement waveforms) (XXX : 000 to 199)

Measurement waveform data are sequentially written in this file.

When the volume of the file in which the data are to be written exceeds approx. 10MB, the measurement waveform data are written in a new file.



### Point

These are UNIPULSE's original data.

To convert them into CSV files, dedicated PC software "FILE CONVERTER" is required.

Download it from our homepage.

## ■ Reading of set values from an SD memory card

1. Press .

### Setting range

Param. (Not In): The TM500's specific settings remain, but all the other parameters are restored.

Param. (In): The TM500's specific settings do not remain, and all the parameters are restored.

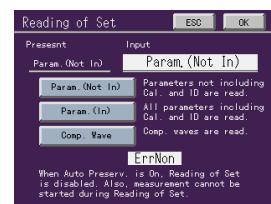
Comparison Wave: Only comparison waveform data are reconstructed.

(The TM500's specific settings are the set values marked with \* in "9-2 Setting item list" on p.148.)

### Operation

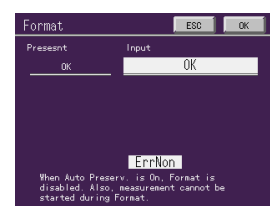
Main screen→Setting→First Setting→Option Setting →SD Card→Reading of Set

2. Press  to start reading.




## ■ Format of an SD memory card

1. Press  .



### Operation

Main screen→Setting→First Setting→Option Setting →SD Card→Format

2. To format, press  .

### CAUTION

- Format an SD memory card on the TM500 or with dedicated formatting software. Formatting it in other ways disables writing of measurement waveforms at an average of approximately 1s because the SD memory card processing speed becomes slow due to an inappropriate format for the TM500. In that case, reformat it on the TM500 before use.
- During preservation and reading of data and formatting of an SD memory card, a warning is displayed across the screen. Never eject the SD memory card or turn off the power. Also, measurement cannot be started.

## ■ Error messages

Error	Description
Error 01	No SD memory card is set to the main unit. Check again to see if an SD memory card is in the SD memory card slot, or if it is properly inserted.
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 TM500 format is FAT16.
Error 04	SD memory card processing is not ready.
Error 33	The SD memory card is write-protected.
Error 88	There is no file that can be read by the TM500.
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 preserved because the SD memory card has no free space.
Error 91	The data file is read-only.
Error BS	This error is displayed when a measurement waveform is not written in time and the measurement start input OFF→ON is ignored. It is reset by starting measurement with the error cleared or being saved in time.
Other Errors	The cause is an indefinite error. The noise and the breakdown of SD memory card, etc. are thought. It is necessary to review the working environment when frequently happening.

## ■ Error Release

When an error is displayed, release the error by this function.

If such an error is displayed, SD memory card processing cannot be performed until it is released.

Also, the SD memory card error cannot be released with **Reset** on the Main screen.

1. Press **Error Release**.

### Setting range

**Only Release:** Processing resumes if the SD memory card is in normal condition when the error is released during Measurement Waveform Preservation by the Automatic Operation.

**Annul Data:** The data that are about to be written on the present SD memory card are annulled to release the error when it occurs during Measurement Waveform Preservation by the Automatic Operation.

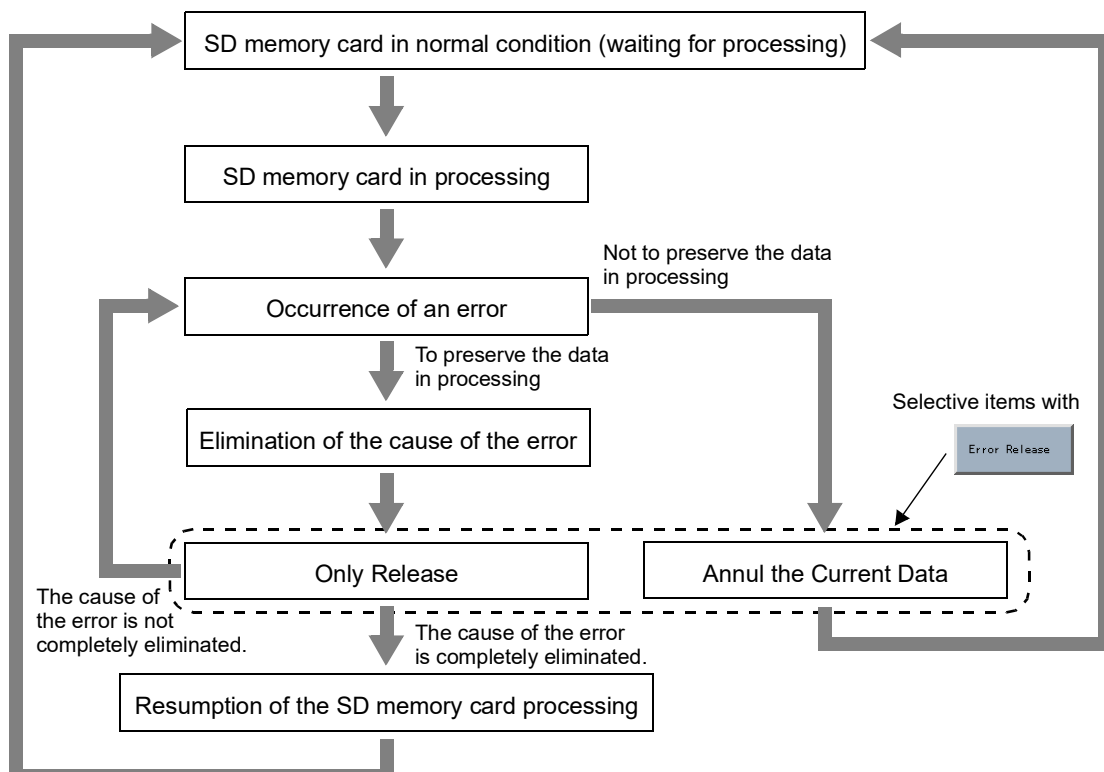


### Operation

Main screen → Setting → First Setting → Option Setting → SD Card → Error Release

2. Press **OK** to release the present error.

- SD memory card error release flow during Measurement Waveform Preservation by the Automatic Operation

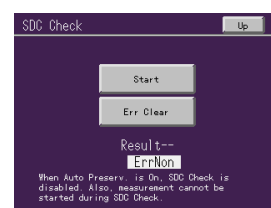


**Point**

The data in processing can also be annulled to release the error by turning the power off and then on again, or setting Measurement Waveform Preservation by the Automatic Operation to Off.

## ■ SD memory card self-check

1. Go to the SDC Check screen under Self-check.

**Operation**

Main screen→Setting→First Setting→System Setting→Self-Check→SDC Check

2. Press  .

SD memory card writing and reading are checked.

If there is any error, the error is displayed.

# 8 SPECIFICATIONS

## 8-1. Specifications

### ■ Analog section

#### Sensor input for torque (voltage input)

Input resistance	1MΩ
Signal input range	±5V
Non-linearity	0.02%/F.S.±1 digit
Zero drift	Within 0.2mV/°C RTI
Gain drift	Within 0.01%/°C
Analog filter	First-order low-pass filter (-6dB/oct) Selectable from 30, 100, 300, and 1k Hz.
Sampling speed	4000 times/sec.
A/D resolution	24bit binary Approx. 1/30000 with respect to 5V
Voltage output	This terminal is directly connected to the UTMII voltage output terminal (for input voltage confirmation). Use terminal: C-55-111A (manufactured by Miraial or an equivalent) ϕ 2, Depth: 6mm Compatible terminal: C-55-155B (manufactured by Miraial or an equivalent)

#### Drive power supply for UTMII

Power supply voltag	DC24V * One UTMII at the maximum
---------------------	----------------------------------

#### Sensor input for displacement

Maximum input frequency	50kHz
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 used. All pulses are counted as in the plus direction.) Output stage circuit specification; open collector (NPN type, Vceo=30V or more, Ic=30mA or more)

## ■ Display section

Display	3.5-inch TFT color LCD module
	Display area      71W×53H [mm]
	Dot configuration    320×240 [dot]
Indicated value	Load      -9999 to +9999
	Displacement      -9999 to +32000
	Decimal point;      The decimal place is to be input together with a value at the time of calibration. 0.000, 0.00, 0.0, 0
Number of display times	Fixed at 3 times/sec

## ■ Setting section

Setting method	Setting by analog type touch panel operation
Preservation of set values	Initial settings;    NOV RAM (nonvolatile RAM)
	Other settings;    Lithium-battery-backed-upC-MOS RAM (The preservation period is approx. 5 years or more, which varies depending on the operating condition and preservation environment.)
	* For the categories of parameters, see "9-2.Setting item list" on p.148.

## ■ Interface

RS-232C communication interface	Start/stop system
	Baud rate      1200, 2400, 4800, 9600, 19200, 38400 bps
	Data bit      7, 8 bit
	Parity bit      None, Even, Odd
	Stop bit      1, 2 bit
	Delimiter      CR, CR+LF
	Header      None, STX
	Flow Control    Off, RTS/CTS control
	All parameters can be read and written.
	All comparison waveforms can be read and written.
	Measurement waveforms and judgment points can be read.

### Input signals

Input type;            plus common/minus common shared

ON voltage; 12V or more

OFF voltage; 3V or less

At 24V load; approx. 5mA

Isolation; photocoupler

16 points

Output type;      sink type

Output transistor ON at signal ON.

To connect an input unit like a PLC, connect plus common.

Rated voltage; 30V

Rated current; 30mA

Isolation; photocoupler

## SD card slot [SDC]

All parameters can be preserved and reconstructed.

All comparison waveforms can be preserved and reconstructed.

Measurement waveforms and judgment points can automatically be preserved.

\* An SD card of 1GB is attached.

Approx. 80 waveforms can be preserved by 1MB.

## Power supply voltage

DC24V ( $\pm 15\%$ )

## Power consumption

20W max

Inrush current (Typ)

2A, 10msec (at ordinary temperature, cold-start)

### Operating conditions

Temperature; Operating temperature range -10°C to +40°C

Storage temperature range      -20°C to +60°C

Humidity; 85%RH or less (non-condensing)

### Outside dimensions

96W×96H×117.3D [mm] (not including projections)

### Panel-cut dimensions

 $92^{+1}_{-0} \times 92^{+1}_{-0} \text{ [mm]}$ 

Panel thickness

1.6 to 3.2 [mm]

Weight

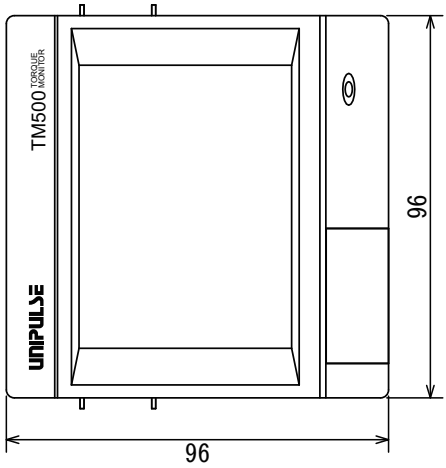
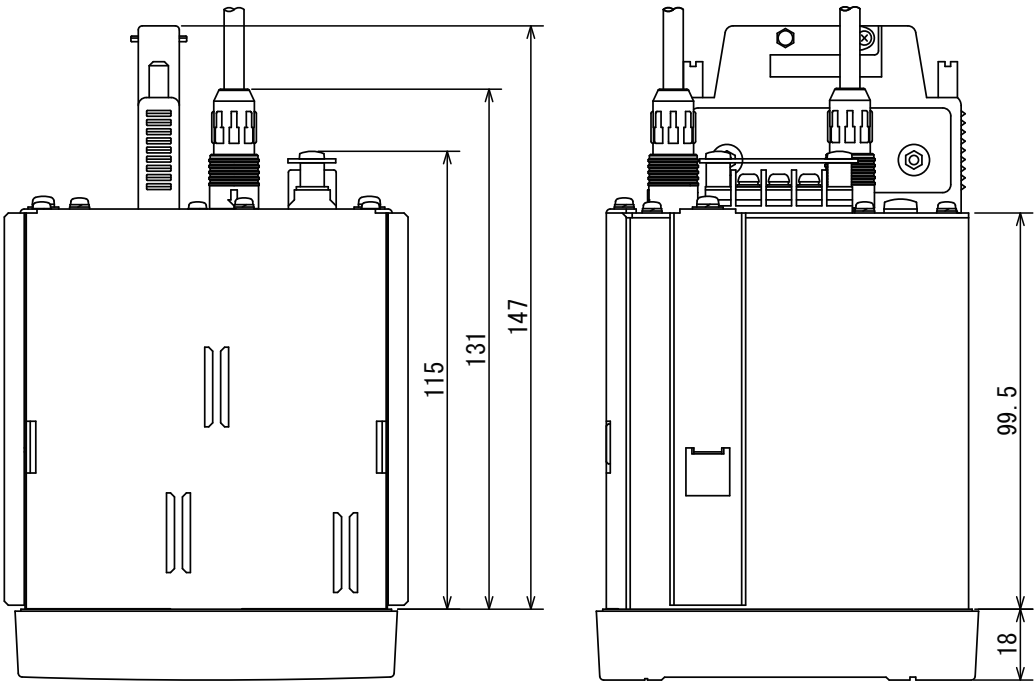
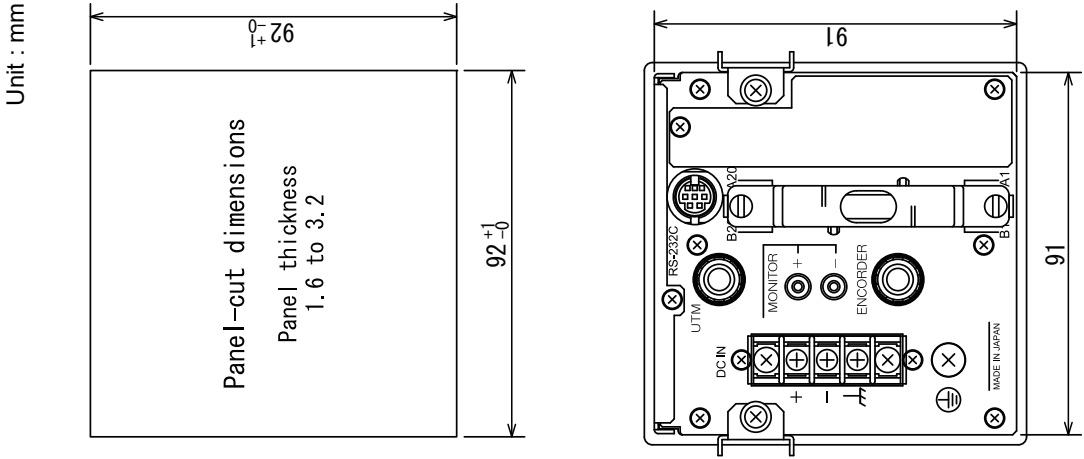
Approx. 1.0kg

## ■ Optional accessories

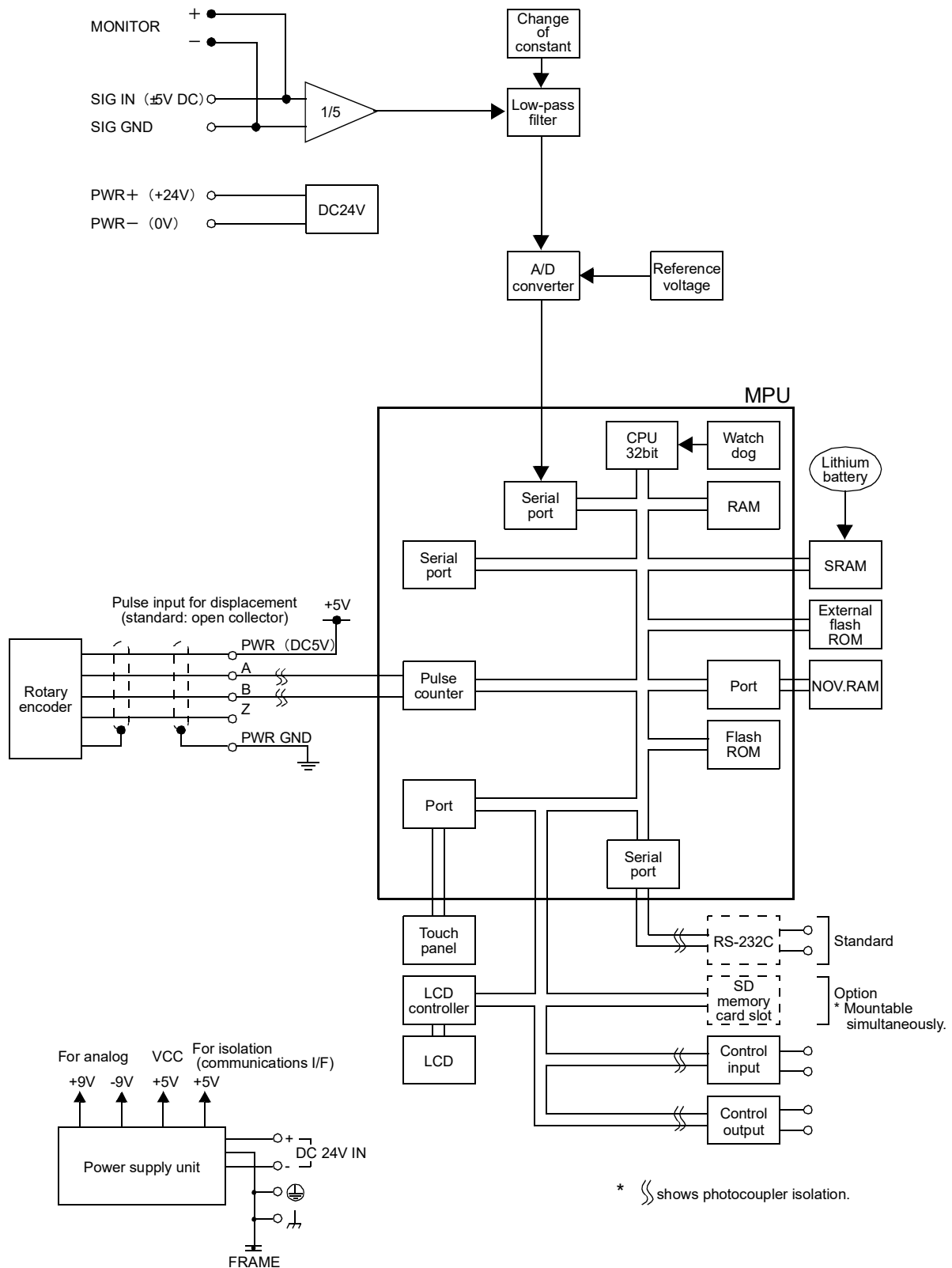
DTC1	Case for TM500 (with AC power supply)
SD1G	1GByte card
SD2G	2GByte card
CA81-232X	miniDIN-D-Sub9p cross cable 1.5m
CATM51-M	Cable for UTM II /UTMV connection 5m
CATM(R)51-M	Cable for UTM II rotary encoder connection 5m
CN52	FCN series I/O connector (with cover)
CN57	FCN series I/O connector (with diagonal cover)
CN60	Circular DIN 8p connector for RS-232C
CN90	Waterproof plastic connector for UTM II /UTMV connection
CN91	Waterproof plastic connector for UTM II rotary encoder connection
GMP96x96	Rubber packing



# 8-2. Outside dimensions

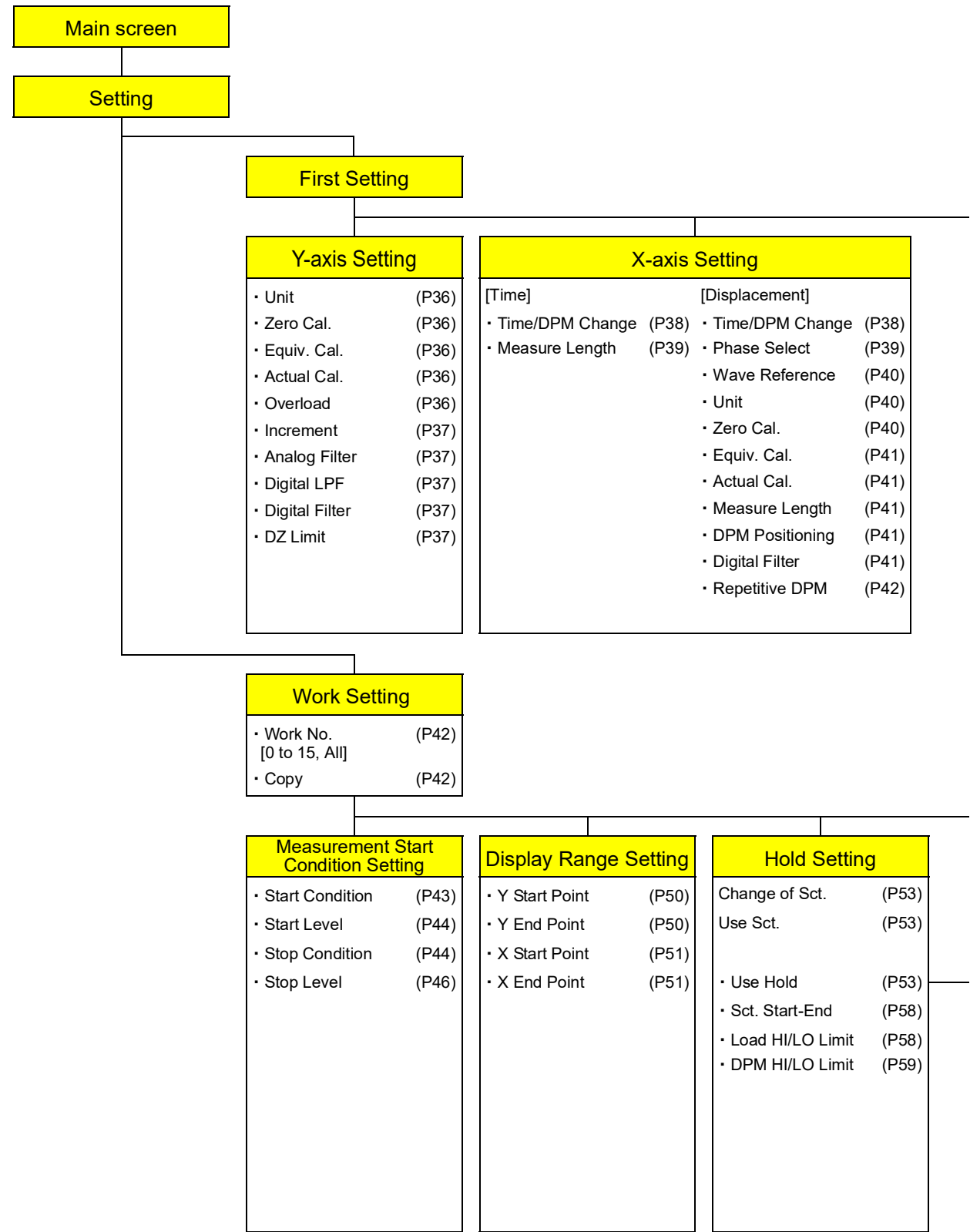


### 8-3. Block diagram



# 9 SUPPLEMENTS

## 9-1. Setting tree



Communication Setting	System Setting	Option Setting
<div><div>• Speed (P81)</div><div>• Data Bit (P81)</div><div>• Stop Bit (P82)</div><div>• Parity Bit (P82)</div><div>• Delimiter (P82)</div><div>• Header (P82)</div><div>• Flow Control (P82)</div><div>• Com. Mode (P82)</div></div>	<div><div>• Backlight (P128)</div><div>• Language (P129)</div><div>• Work Protect (P129)</div><div>• First Protect (P129)</div><div>• Initialization (P129)</div><div>• Self-Check (P129)</div><div>• Password (P132)</div><div>• Time Adjust (P132)</div></div>	<div><div>SD Card Slot Option (P133)</div><div>• Equipment ID (P134)</div><div>• Auto Preserv. (P134)</div><div>• Preserv. of Set (P135)</div><div>• Reading of Set (P136)</div><div>• Format (P137)</div><div>• Error Release (P138)</div></div>

Use Hold	Waveform Comparison Setting
<div><div>• Start Load (P54)</div><div>• Load Difference (P54)</div><div>• Rate (P55)</div><div>• Ordinal (P55)</div><div>• Interval AB (P56)</div></div>	<div><div>• Reference Wave (P64)</div><div>• Compare Area (P65)</div><div>• Shift (P66)</div><div>• Tie Drawing (P66)</div><div>• Compare Margin (P67)</div><div>• Relative (P67)</div><div>• Relative Point (P67)</div><div>• Load Reversing (P68)</div><div>• DPM Reversing (P68)</div><div>• HI Conditions (P68)</div><div>• LO Conditions (P68)</div><div>• Wave Save (P68)</div></div>

## 9-2. Setting item list

### ■ First Setting

Item	Set value	Input range (display range)	Initial value	Memory *2
Y-axis Setting	Unit*1	See "9-3 Unit setting list" on p.153	Nm	N
	Zero Cal.*1	-5.555~5.555 [V]	0.000V	N
	Equiv. Cal.*1 (rated output)	-9.999~9.999 [V]	5.000V	N
	Equiv. Cal.*1 (rated capacity)	-9999 to 9999	50.00Nm	N
	Actual Cal.*1 (Load value)	-9999 to 9999	50.00Nm	N
	Overload	0 to 9999	99.99Nm	N
	Increment*1	0 : 1    1 : 2    2 : 5    3 : 10	0.01Nm	N
	Analog Filter	0 : 30    1 : 100 2 : 300    3 : 1k [Hz]	300Hz	N
	Digital LPF	0 (OFF) to 30 [Hz]	0Hz	N
	Digital Filter	0, 2 to 999 [Times]	0 Times	N
	DZ Limit	0 to 9999	99.99Nm	N
X-axis Setting	Time/DPM Change	0 : Time    1 : Displacement 2 : Continuous    3 : Average	Displacement	N
	Phase Select	0 : A/B-Phase    1 : Only A-Phase	A/B-Phase	N
	Wave Reference	0 : Front    1 : Back	Front	N
	Unit*1	See "9-3 Unit setting list" on p.153	°	N
	Zero Cal.*1	0 to 1000000	0	N
	Equiv. Cal.*1 (number of pulses)	1 to 1000000	2000	N
	Equiv. Cal.*1 (displacement value)	-99999 to 99999	360.0°	N
	Actual Cal.*1 (displacement value)	-9999 to 32000	360.0°	N
	Measure Length	Time/Displacement Change: Time 0 : 0.5    1 : 1.0    2 : 2.0 3 : 5.0    4 : 10.0 [s]  Time/Displacement Change: Displacement, Continuous, Average 0 : 2000    1 : 4000    2 : 6000 3 : 8000    4 : 10000	2.0s  400.0°	N
	DPM Positioning	-9999 to 32000	0.00°	N
	Digital Filter	0, 2 to 999 [Times]	0 Times	N
	Repetitive DPM	0 : 720    1 : 810    2 : 900 3 : 990    4 : 1080    5 : 1170 6 : 260    7 : 1350    8 : 1440 9 : 1530    10 : 1620    11 : 1710 12 : 1800    13 : 2000 × Measurement Length/2000	360.0°	N

\*1 Function-specific set values (calibration values, etc.); currently set values remain even if initialization is executed.

\*2 [NOV RAM : N] [SRAM : S]

Item	Set value	Input range (display range)	Initial value	Memory *2
Option Setting	Equipment ID *1	0 to 999	0	N
	Auto Preserv.	0 : Off 1 : On (Overwrite) 2 : On (Not Overwrite)	Off	N
	Preserv. of Set	0 : All Parameter 1 : Comparison Waveform	All Parameter	
	Reading of Set	0 : All Parameter (Not Include) 1 : All Parameter (Include) 2 : Comparison Waveform	All Parameter (Not Include)	
	Format			
	Error Release	0 : Only Release 1 : Annul the Current Data	Only Release	
Communication Setting	Speed	0 : 1200      1 : 2400 2 : 4800      3 : 9600 4 : 19.2k      5 : 38.4k [bps]	19.2kbps	N
	Data Bit	0 : 7      1 : 8 [bit]	8bit	N
	Stop Bit	0 : 1      1 : 2 [bit]	1bit	N
	Parity Bit	0 : None      1 : Even 2 : Odd	Even	N
	Delimiter	0 : CR      1 : CR+LF	CR	N
	Header	0 : None      1 : STX	None	N
	Flow Control	0 : Off      1 : RTS/CTS Control	Off	N
	Com. Mode	0 : Normal      1 : Hold Point Mode	Normal	N
System Setting	Backlight (ON Time) (bright→dark)	0 to 9999	10 minutes (ON Time) 0 minutes (bright→dark)	N
	Language *1	0 : Japanese 1 : English	Japanese	N
	Work Protect	0 : Not Protect      1 : Protect	Not Protect	N
	First Protect	0 : Not Protect      1 : Protect	Not Protect	N
	Initialization	0 : First Setting Parameter 1 : Work Setting Parameter 2 : All Parameter		
	Self-Check			
	Password	0 to 9999	0	
	Time Adjust *1	2001/01/01 00:00:00 to 2079/12/31 23:59:59	2001/01/01 00:00:00	S

\*1 Function-specific set values (calibration values, etc.); currently set values remain even if initialization is executed.

\*2 [NOV RAM : N] [SRAM : S]

## ■ Settings by work [Work 0 to 15, All]

Item	Set value	Input range (display range)	Initial value	Memory *2
Settings by work	Work No.	0 to 15	0	
	Copy No.	0 to 15	0	
Measurement Start Condition Setting	Start Condition	0 : Only External Input 1 : External Input + Load 2 : External Input + Displacement (2 can be set only when the X-axis of the waveform represents displacement.)	External Input + Load	S
	Start Level	External Input + Load : -9999 to +9999 External Input + Displacement : -9999 to +32000	1.00Nm	S
	Stop Condition	0 : Only Forced-Stop 1 : Load 2 : Time 3 : Displacement 4 : Displacement Stop (3 and 4 can be set only when the X-axis of the waveform represents displacement.)	Only Forced-Stop	S
	Stop Level	Load: -9999 to +9999 Time: 0.1 to 10.0 [second] Displacement: -9999 to +32000 Displacement Stop: 0.1 to 10.0 [second]	1.00	S
Display Range Setting	Y Start Point	-10000 to 10000	0.00Nm	S
	Y End Point	Y-axis Start Point + 0 : 25      1 : 50 2 : 100     3 : 200 4 : 300     5 : 400 6 : 500     7 : 1000 8 : 2000    9 : 3000 10 : 4000   11 : 5000 12 : 10000   13 : 20000	20.00Nm	S

\*2 [NOV RAM : N] [SRAM : S]

Item	Set value	Input range (display range)	Initial value	Memory *2
Display Range Setting	X Start Point	Time or displacement (Front) 0 to 2000 × Measurement Length/2000  Displacement (Back) -2000 to 0 × Measurement Length/2000	0.00	S
	X End Point	Time or displacement (Front) X-axis Start Point + 0 : 25            1 : 50 2 : 100           3 : 200 4 : 400           5 : 600 6 : 800           7 : 1000 8 : 1200          9 : 1400 10 : 1600        11 : 1800 12 : 2000        13 : 2200 × Measurement Length/2000  Displacement (Back) X-axis Start Point + 0 : -25           1 : -50 2 : -100          3 : -200 4 : -400          5 : -600 6 : -800          7 : -1000 8 : -1200        9 : -1400 10 : -1600       11 : -1800 12 : -2000       13 : -2200 × Measurement Length/2000	400.0°	S
Hold Setting	Change of Sct. (common to all work)	0 : External Input    1 : Setting (0 can be set only when the time or displacement (Front))	Setting	S
	Use Sct.	1 to 5	1	S
	Sct. No. (for RS-232C communications)	0 : Sct1            1 : Sct2 2 : Sct3            3 : Sct4 4 : Sct5		S
Section 1 to 5	Use Hold	0 : Always        1 : Sample 2 : Peak           3 : Bottom 4 : Peak to Peak 5 : Relative Maximum 6 : Relative Minimum 7 : Inflection Point 8 : Average 9 : End Displacement	Always	S
	Sct. Start-End (start point,end point)	Time or displacement (Front) 0 to 2047 × Measurement Length/2000  Displacement (Back) -2047 to 0 × Measurement Length/2000	0.0 to 409.4°	S
	Load HI/LO Limit (HI limit, LO limit)	-9999 to +9999	-99.99 to 99.99Nm	S
	DPM HI/LO Limit (HI limit, LO limit)	Waveform Reference; Front 0 to 2047 × Measurement Length/2000  Waveform Reference; Back -2047 to 0 × Measurement Length/2000  * When End Displacement in Use Hold is selected; -9999 to 32000	0.0 to 409.4°	S

\*2 [NOV RAM : N] [SRAM : S]



Item	Set value	Input range (display range)	Initial value	Memory *2
Section 1 to 5	Start Load	-9999 to 9999	1.00Nm	S
	Load Difference	1 to 19998	1.00Nm	S
	Rate	0 : 1/4      1 : 1/2 2 : 3/4      3 : 1 4 : 1.25      5 : 1.5 6 : 1.75      7 : 2 8 : 3          9 : 4 [Times]	3/4 Times	S
	Ordinal	1 to 15 [Times]	1 Times	S
	Interval AB (Inflection PointA, Inflection PointB)	1 to 999 × Measurement Length/2000	20.0°, 20.0°	S
Waveform Comparison Setting	Reference Wave			
	Compare Area (start point,end point)	Time or displacement (Front) 0 to 2047 × Measurement Length/2000  Displacement (Back) -2047 to 0 × Measurement Length/2000	0.0 to 409.4°	S
	Shift	Range; Time or displacement (Front) 0 to 2047 × Measurement Length/2000  Displacement (Back) -2047 to 0 × Measurement Length/2000  Amount of movement : -19998 to +19998	0.0 to 409.4°    0.00Nm	
	Tie Drawing			
	Compare Margin	0 to 9999	0Nm	S
	Relative (common to all work)	0 : Off      1 : On	Off	S
	Relative Point	X-axis : Time or displacement (Front) 0 to 2047 × Measurement Length/2000  Displacement (Back) -2047 to 0 × Measurement Length/2000  Y-axis : -9999 to 9999	X-axis : 0.0° Y-axis : 0.00Nm	S
	Load Reversing	0 : Off      1 : On	Off	S
	DPM Reversing	0 : Off      1 : On	Off	S
	HI Conditions	Count : 0 to 99 Range : 0 to 999	Count : 0 Range : 50	S
	LO Conditions	Count : 0 to 99 Range : 0 to 999	Count : 0 Range : 50	S
	Wave Save			

\*2 [NOV RAM : N] [SRAM : S]

## 9-3. Unit setting list

\* Numbers are values in the RS-232C input range.

Also, "0" results in no unit.

Weight		Force		Pressure		Length		Angle		Other			
1	μg	11	μN	28	μPa	45	μm	52	None	55	g/cm <sup>3</sup>	89	l/s
2	mg	12	mN	29	mPa	46	mm	53	°	56	kg/m <sup>3</sup>	90	l/min
3	g	13	N	30	Pa	47	cm	54	deg	57	t/m <sup>3</sup>	91	l/h
4	kg	14	kN	31	hPa	48	m			58	g/l	92	μA
5	Mg	15	MN	32	kPa	49	km			59	g/ml	93	mA
6	t	16	μNm	33	MPa	50	in			60	mg/m	94	A
7	lb	17	mNm	34	GPa	51	ft			61	kg/m	95	kA
8	dyne	18	Nm	35	N/m <sup>2</sup>					62	kgm/s	96	μV
9	kdyne	19	kNm	36	μbar					63	kgm <sup>2</sup> /s	97	mV
10	oz	20	MNm	37	mbar					64	kgm <sup>2</sup>	98	V
		21	ftlb	38	bar					65	mPas	99	kV
		22	inlb	39	mmHg					66	Pas	100	Ω
		23	inoz	40	inH <sub>2</sub> O					67	m <sup>2</sup> /s	101	kΩ
		24	Ncm	41	ftH <sub>2</sub> O					68	mm/s	102	MΩ
		25	gcm	42	psia					69	m/s	103	W
		26	kgcm	43	psig					70	mm/min	104	kW
		27	kgm	44	atom					71	cm/min	105	MW
						72	m/min	106	VA				
						73	m/h	107	°C				
						74	km/h	108	F				
						75	m/s <sup>2</sup>	109	J				
						76	rpm	110	kJ				
						77	Hz	111	MJ				
						78	kHz	112	%RH				
						79	MHz	113	l				
						80	kg/s	114	m <sup>3</sup>				
						81	t/s	115	%				
						82	kg/min	116	‰				
						83	t/min	117	ppm				
						84	kg/h						
						85	t/h						
						86	m <sup>3</sup> /s						
						87	m <sup>3</sup> /min						
						88	m <sup>3</sup> /h						

## 9-4. Error messages

### ■ Load errors

Error	Description
<b>Zero Err</b>	The sensor input signal in performing zero calibration is outside the zero calibration range. Check that unwanted force is not applied to the sensor and that there is no break in the cables and there is no mistake in wiring, and then perform zero calibration again.
<b>Span Err</b>	[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 load in the actual load calibration range is applied to the sensor and that there is no break in the cables and there is no mistake in wiring, and then perform calibration again.  [During equivalent input calibration] The values input to the rated output and display value are outside the equivalent input calibration range. Or, "0" is input. Check that they are not different from the specifications of the sensor, and then perform calibration again.
<b>Sensor +</b>	The sensor input signal is beyond the signal input range. It is considered that excessive force is applied to the sensor. Remove the load. If such overload cannot be identified and the error cannot still be removed, break(s) in the cables, mistake(s) in wiring, or sensor failure is considered.
<b>Sensor -</b>	The sensor input signal is below the signal input range. It is considered that reversely-directed force is applied to the sensor. Check around the sensor. If such reversely-directed force cannot be identified and the error cannot still be removed, break(s) in the cables, mistake(s) in wiring, or sensor failure is considered.
<b>+ OVER</b>	A signal equivalent to a display value beyond +9999 is input. It is considered that unexpectedly excessive load is applied to the sensor. Perform calibration by setting so that the maximum value of measurement will not go beyond +9999.
<b>- OVER</b>	A signal equivalent to a display value below -9999 is input. It is considered that unexpectedly excessive reversely-directed load is applied to the sensor. Perform calibration by setting so that the minimum value of measurement will not drop below -9999.
<b>OVERLOAD</b>	A signal equivalent to a display value beyond the overload set value is input. It is considered that excessive force is applied to the sensor. Remove the load.
<b>DZ Limit</b>	The digital-zeroed load (load subjected to digital zero - zero calibration load) is beyond the range of the digital zero limit set value. It is considered that the sensor's zero point has deviated due to deterioration from aging, etc. Return the input signal to the setting range or increase the digital zero limit set value, and then perform digital zero again and input the Reset signal.
<b>Comp Err</b>	When the setting of Relative Comparison in Waveform Comparison Setting is "On," measurement has not been carried out to the set Reference Point of Relative Comparison. Carry out measurement to the Reference Point of Relative Comparison.

## ■ Displacement errors

Error	Description
<b>ZeroErr</b>	The sensor input signal in performing zero calibration is outside the zero calibration range. Check that unwanted force is not applied to the sensor and that there is no break in the cables and there is no mistake in wiring, and then perform zero calibration again.
<b>SpanErr</b>	[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 load in the actual load calibration range is applied to the sensor and that there is no break in the cables and there is no mistake in wiring, and then perform calibration again.  [During equivalent input calibration] The values input to the rated output and display value are outside the equivalent input calibration range. Or, "0" is input. Check that they are not different from the specifications of the sensor, and then perform calibration again.
<b>Sensor+</b>	The sensor output pulse count is beyond the TM500 internal count range. Set so that the sensor output pulse count will not go beyond the internal count range. Also, input the DPM Positioning signal at an appropriate time because inputting the DPM Positioning signal clears the internal count to zero.
<b>Sensor-</b>	The sensor output pulse count is below the TM500 internal count range. Set so that the sensor output pulse count will not drop below the internal count range. Also, input the DPM Positioning signal at an appropriate time because inputting the DPM Positioning signal clears the internal count to zero.
<b>+ OVER</b>	A signal equivalent to a display value beyond +32000 is input. It is considered that the displacement is moving beyond the maximum expected displacement. Perform calibration by setting so that the maximum value of measurement will not go beyond +32000.
<b>- OVER</b>	A signal equivalent to a display value below -9999 is input. It is considered that the displacement is moving below the displacement expected in the reverse direction. Perform calibration by setting so that the minimum value of measurement will not drop below -9999.
<b>PaceErr</b>	The displacement pace is too fast to perform sampling in time, and 10 or more measurement points of data are skipped. Adjust the displacement pace so that it will become 10 pieces of data/4000sps or less. One piece of data corresponds to the Measurement Length/2000.

## ■ Error release

- Common to load errors and displacement errors

Error	Error release
<b>Zero Err</b>	Perform zero calibration within the zero calibration range.
<b>Span Err</b>	Perform actual load calibration within the actual load calibration range. Or, perform equivalent input calibration within the equivalent input calibration range.
<b>Sensor + Sensor -</b>	Bring the sensor input into the signal input range/internal count range.
<b>+ OVER - OVER</b>	Load : Make the load indicated value -9999 to +9999. Displacement : Make the displacement indicated value -9999 to +32000.

- Load errors

Error	Error release
<b>OVERLOAD</b>	After the indicated value falls within the set Overload value, turn OFF → ON the Reset input, or press <b>Reset</b> on the Main screen.
<b>DZ Limit Comp Err</b>	Turn OFF → ON the Reset input, or press <b>Reset</b> on the Main screen. Or, turn the power off and then on again.

- Displacement error

Error	Error release
<b>PaceErr</b>	Turn OFF → ON the Reset input, or press <b>Reset</b> on the Main screen. Or, turn the power off and then on again.

## 9-5. Troubleshooting

Items	Questions	Answers
Torque meter	Does the indicated value display change according to the unit of the torque meter used?	The indicated value is not converted according to unit change. After change, perform actual load calibration or equivalent input calibration.
Wiring and connection	About the cables to be connected to the terminal block	For connection to the power input terminals, use 6mm or less crimp contacts.
	The power cannot be turned on.	Check to see if the power cord is connected properly. Connect the power cord properly. Check to see if the power supply is in the specified range. Use a power supply in the specified range, and make proper connection confirming plus and minus.
Setting and operation	How can the decimal place be changed?	The decimal place of HI limit, LO limit, etc., are in conjunction with the decimal place set at the time of actual load calibration or equivalent input calibration. Perform calibration again, and change the decimal place.
	No result/value is output, or a result/value is abnormal.	Check to see if the output cable is connected properly. Connect the output cable properly referring to the equivalent circuit diagram.
		Check to see if the power is on. External input/output signals require external power supply. Turn on the power.
	Are the set data erased when the power is turned off?	The set data are not erased even if the power is turned off.
	Are the set data erased if no power is applied for a long time?	The TM500 preserves the settings for approx. 5 years with the power off. However, the preservation period may become short depending on the operating condition and installation environment.
RS-232C	RS-232C communications cannot be carried out.	The maximum possible value in the setting range is set. Example) If "5" is selected for the item the setting range of which is "0," "1" and "2," "2" is set.
		Check to see if the communication cable is connected properly. Turn off the power, and then connect the communication cable properly.
		Check to see if the communication cable in use is proper. Check the wiring, and connect the communication cable properly.
	Is any special program needed for communications with a PC?	Check to see if the communication conditions between the TM500 and equipment connected are in agreement. Check the communication conditions, and make the settings consistent with the equipment connected. Programming is necessary. Create software to exchange commands by timing as required.

## 9-6. Conformity with EC directives

The TM500 Torque Monitor is a CE-marked EC-Directive-conforming product (by the Council of the European Union).

- EMC Directives;      EN61326-1
- EN55011
- EN61000-4-2
- EN61000-4-3
- EN61000-4-4
- EN61000-4-5
- EN61000-4-6
- EN61000-4-8



### Point

EMC Directive EN61000-4-5 (Lightning Surge Immunity) is met by the TM500 body in combination with a lightning surge protector.

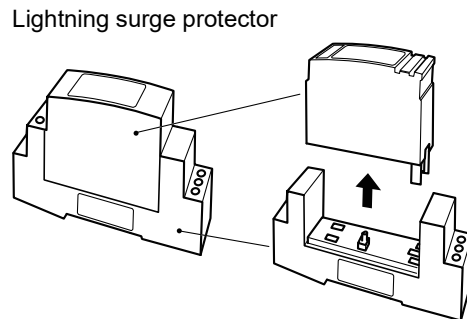
### CAUTION

- Since the TM500 is defined as open type (built-in equipment), be sure to use it as installed and fixed to a panel, etc.
- Use shielded cables (for encoder, RS-232C, external input/output, and UTM).

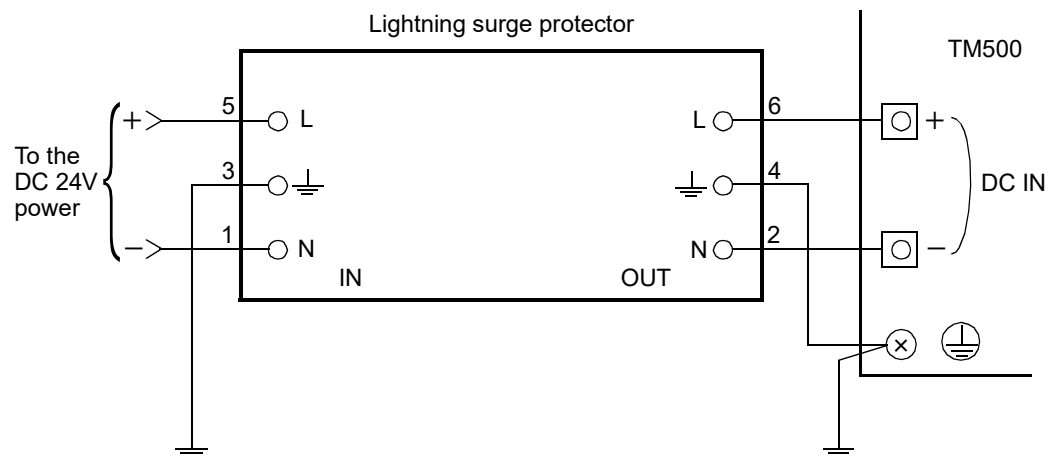
## ■ Connection of a lightning surge protector

Attach a lightning surge protector against lightning surge.

EMC Directive EN61000-4-5 (Lightning Surge Immunity) is met by the TM500 body in combination with a lightning surge protector.



<Connect>



### Attention

Be sure to ground  $\perp$  of the lightning surge protector.  
Without grounding, it will not function as a lightning surge protector.



### Point

No lightning surge protector is included as standard (optionally available).  
Our company carries an optional lightning surge protector (TSU03).  
Contact our sales department for details.



## Unipulse Corporation

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