Kett

Coating Thickness Tester

L-500

Operating Manual

Thank you for purchasing this product.
Please read the operating manual carefully and use this product properly.

For safety precautions

Improper use of the Coating Thickness Tester in violation of the following safety notes may result in death, injury or damage to property due to fire, etc. While the safety of the product has been given considerable attention, read the precautions in the operating manual and use the instrument properly.

■ Observe the safety precautions.

Read the precautions noted in the operating manual.
The safety measure of the unit may be impaired if instructions are ignored during use.

■ Do not use if broken.

If you suspect a problem or malfunction in the unit, make sure to contact the vendor.

■ Meaning of warning symbols

In order to prevent damage resulting from erroneously operating the equipment, the following symbols are indicated in the operating manual and on the product. These symbols have the following meanings.

	**Warning**	Failure to observe these items may lead to death or injury to the user.
	**Caution**	Failure to observe these items may lead to injury to the user or damage to property.
	**Note**	Items which the user should be aware of in order to use the unit safely.

- Do not use other than rated power supply voltage.
  If overvoltage is applied, the unit will be heated and it may cause malfunction, fire, or electric shock.

- Make sure to ground the power cable.
  With the 2P outlet, use a conversion plug to ground.
  In the case of 3P, it will be automatically grounded. If not grounded, it may cause a fire or an electric shock.

- If any of the cables including the power cable is damaged (broken), do not use it.
  Failure to observe this may cause a fire, an electric shock, and the like.
  For purchasing the spare parts, contact the vendor.

- Do not allow the unit to come in contact with water.
  This unit is not waterproof.
  Intrusion of water into the unit may cause an electric shock or a malfunction.

- Do not attempt to disassemble or modify the unit.
  Otherwise, it may cause malfunction, fire, or electric shock, etc.
  If the unit is assumed to be faulty, contact the vendor.

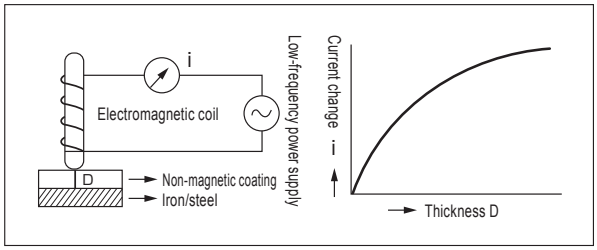
CONTENTS

1. Measuring Principles and Features

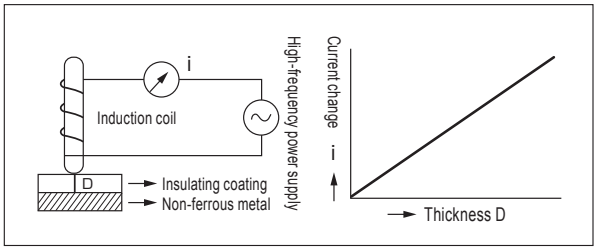
The Coating Thickness Tester L-500 is a coating thickness gauge that can measure in both electromagnetic type and eddy current type depending on the probe to be connected.

■ Measuring principle

- **Electromagnetic type (Fe probe)**
  Measurement of non-magnetic coatings on magnetic metals
  If an electromagnetic coil through which a constant low-frequency current flows is brought into the proximity of iron (magnetic metal), the number of magnetic flux lines through the coil varies with the approaching distance, which causes the variation of voltage between the ends of the coil. This change in voltage is detected by the current value and is calculated in terms of coating thickness.



- **Eddy current type (NFe probe)**
  Measurement of insulating coating on non-magnetic metals
  If an induction coil through which a constant high-frequency current flows is brought into the proximity of a metal, eddy currents are generated on the surface of the metal. Then these eddy currents fluctuate according to the distance between the coil and the metal surface and thus changes the voltage on each end of the coil. This change in voltage is detected by the current value and is calculated in terms of coating thickness.



	Electromagnetic type (Fe probe)													Eddy current type (NFe probe)							
Coating to be measured	Paint	Plastic	Lacquer	Resin	Rubber	Enamel	Lining	Zinc	Chrome	Tin	Copper	Aluminum	Other	Paint	Alumite (Anodic oxide coating)	Rubber	Plastic	Enamel	Lacquer	Resin	Other
Substrate	Iron/steel													Aluminum, Copper, Brass, etc.							

■ Features

- **The calibration curve memory function is integrated.**
  Up to 50 types can be calibrated and stored as an application for each probe. Thanks to this function, the measurement can be performed without troublesome calibration from the second time at the same measurement. A memorized application will not be erased even if the power is switched off.

- **Satisfactorily diversified functions are provided as a coating thickness gauge.**
  Various settings such as auto power-off function, backlight setting, upper/lower limit setting function, and statistics function are available.

- **Data can be outputted to the printer.**
  Measured values, statistical calculation results, and more can be printed with the built-in printer.

2. Specifications

- **Main unit specifications**

Display resolution	:	0.1μm (when less than 100μm), 1μm (when 100μm or more)
Display	:	Digital (backlit LCD)
Data memory	:	24,000 points
Number of application memories	:	50 (per probe)
External output	:	USB serial
Power supply	:	100-240V AC (50/60Hz) or battery 1.5V (AA alkaline) ×8 (main unit ×4, printer ×4)
Power consumption	:	25W
Battery life	:	70 hours (at turning off the printer and backlight)
Temperature/humidity operating range	:	0 to 40°C, 85% RH or less (no condensation)
Additional functions	:	Substrate calibration, foil calibration, application selection, upper/lower limit setting, unit switching, measurement mode switching, statistics calculation (block/group), data memory, auto power off, backlight, print density setting, date and time setting, display switching, etc.
Dimensions and weight	:	126mm (W) × 256mm (D) × 93mm (H), 750g
Accessories	:	Iron substrate (for Fe probe), aluminum substrate (for NFe probe), calibration foil x 6, battery 1.5V (AA alkali) ×8, AC adapter, power cable POC00, probe adapter, strap, printer paper ×2, surface protective sheet ×3, calibration foil case, carrying case, Easy Guide for Calibration, Operating Manual
Options	:	Calibration foils (thickness other than those supplied), Measuring Stand LW-990

- **Probe specifications**

Each probe is a required option. The probe you have selected will be included.

Model	:	EP-100	HP-100
Measurement method	:	Electromagnetic type (Fe probe)	Eddy current type (NFe probe)
Applications	:	Non-magnetic coating on magnetic metal	Insulation coating on non-magnetic metal
Measurement range	:	0-2,500μm or 99.0 mils	0-1,200μm or 47.0 mils
Measurement accuracy (according to our specified conditions)	:	± 0.3μm (when less than 15μm) ± 2% (when 15μm or more and less than 1,000μm) ± 3% (when 1,000μm or more)	± 1.0μm (when less than 50μm) ± 2% (when 50μm or more)

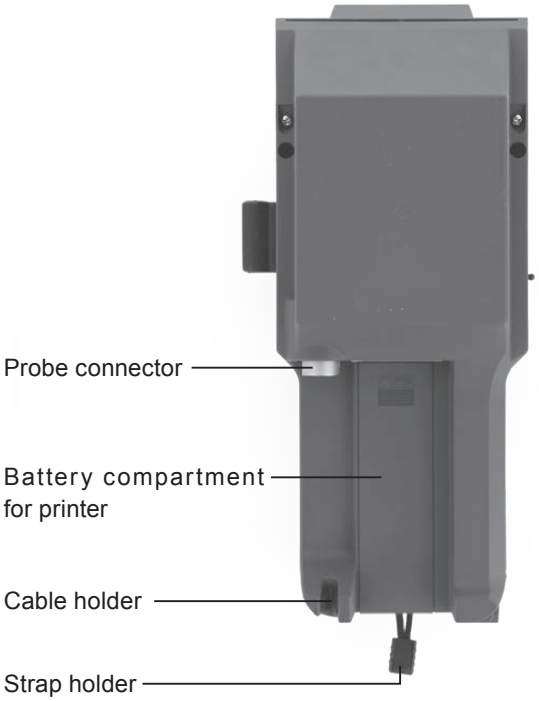
*** To improve the product, the specifications and external appearance may be changed without notice.**

3. Part names

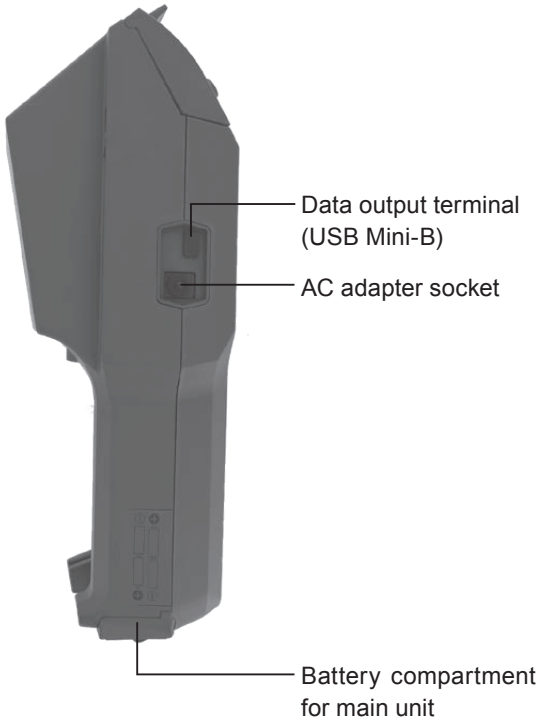
■ Parts of main unit

<Front>

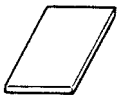
<Rear>



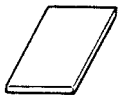
<Side>



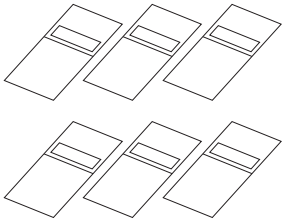
■ Accessories



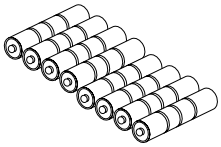
Iron substrate
For Fe probe



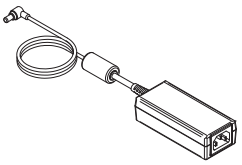
Aluminum substrate
For NFe probe



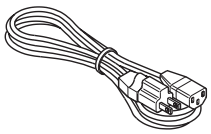
Calibration foils ×6



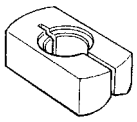
1.5 V batteries (AA alkaline) ×8



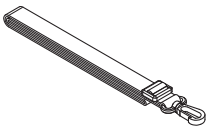
AC adapter



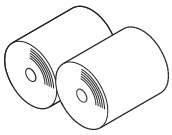
Power cable, POC00



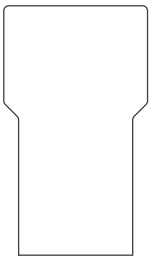
Probe adapter



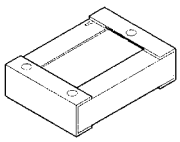
Strap



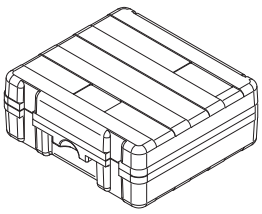
Printer paper ×2
At the time of shipment,
one roll is set in the main unit.



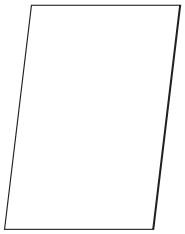
Protective sheets ×3



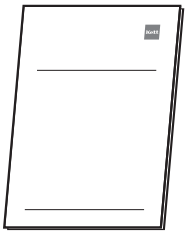
Calibration foil case



Carrying case



Easy Guide for Calibration



Operating Manual

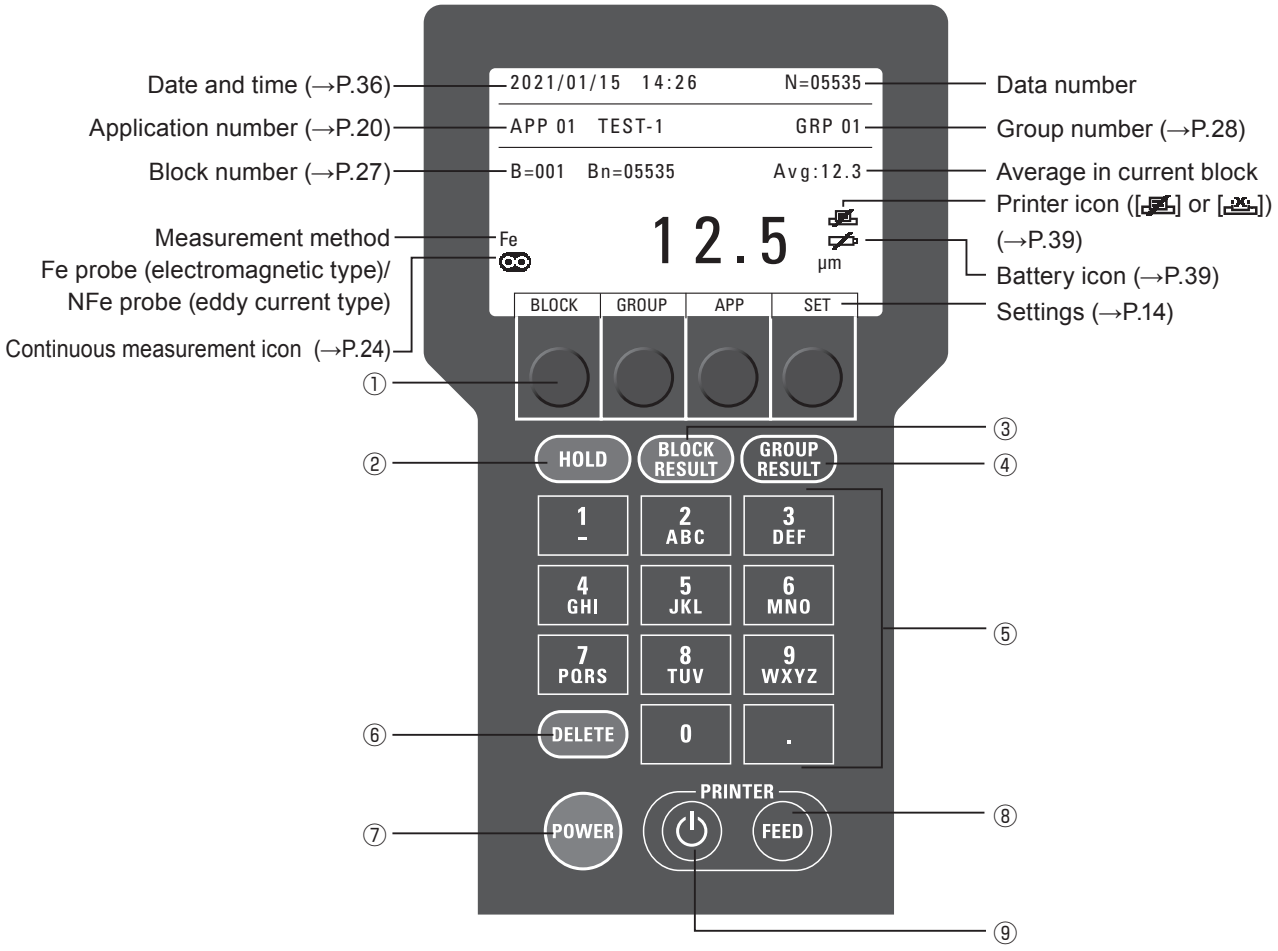
- **Probe (required option)**

  Each probe is a required option. The probe you have selected will be included.

Electromagnetic type
(Fe probe) EP-100

Eddy current type
(NFe probe) HP-100

■ Description of display and operation keys



* **When the screen displays all items**

	Operation keys	Functions
①	Function key	Used to operate an item on the display. It is used as a [▲] [▼], [BACK], [ENTER] key, etc.
②	[HOLD] key	Records measured data at continuous measurement.
③	[BLOCK RESULT] key	Displays the calculation result in the current block.
④	[GROUP RESULT] key	Displays the calculation result in the current group.
⑤	[0] to [9] [.] keys	Used to enter values and characters. The [1], [3], [5], and [9] keys can be used as shortcut keys by holding down them. Pressing the [7] key displays the list of the shortcut keys.
⑥	[DELETE] key	Erases the measured data from memory. This key is also used to erase the entered values and characters at entry of them.
⑦	[POWER] key	Turns on/off the power of the main unit. To turn off the power, hold down the key.
⑧	[FEED] key	Feeds printer paper.
⑨	[PRINTER POWER] key	Turns on/off the power of the printer.

4. Measurement Preparation

(1) Power supply preparation

This unit can be used with 100-240 VAC (50/60Hz) or batteries.

* **Use the supplied power cord POC00 for a 100 VAC power supply.**

- **When 100-240 VAC is used**
  Connect the supplied power cord and AC adapter, and insert the plug of the AC adapter into the AC adapter socket on the side of the main unit.
  Then, connect the AC adapter to a 100-240 VAC power outlet.

* **Please use this product in an electromagnetic noise-free environment. Electromagnetic noise may cause differences in measurements.**

- **When batteries are used**
  Install batteries in the main unit and printer, respectively.

<Installation of batteries for main unit>

Slide the lid of the battery compartment for the main unit to open it. Install four 1.5-V AA alkaline batteries with attention to the plus and minus directions.

* **Be careful not to damage the lug of the battery case lid when opening or closing the lid. When this tester is not used for a long period of time, be sure to remove the batteries. Failure to observe this may cause a malfunction such as liquid leakage.**

<Installation of batteries for printer>

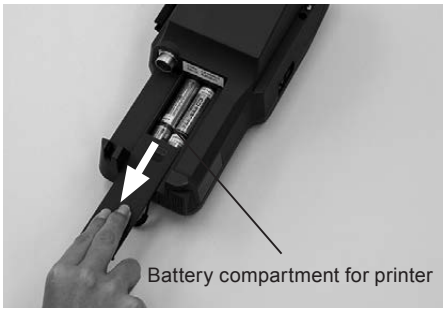
Slide the lid of the printer battery compartment to open it.
Install four 1.5-V AA alkaline batteries with attention to the plus and minus directions.

- **When both AC power and batteries are used**
  If the AC adapter is connected with batteries installed in the main unit, power is automatically supplied from the AC power supply side.

* **When AC power is used, it is recommended to remove the batteries.**

<Installation of batteries for main unit>

<Installation of batteries for printer>



(2) Probe selection

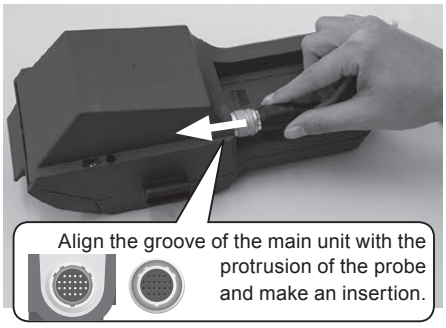
There are two types of probes: electromagnetic type (Fe probe) and eddy current type (NFe probe). Select the probe according to the material of the substrate to be measured.

- **Electromagnetic (Fe probe) cable is black**
  →For measuring non-magnetic coating on magnetic metals
- **Eddy current (NFe probe) cable is gray**
  →For measuring insulating coating on non-magnetic metals

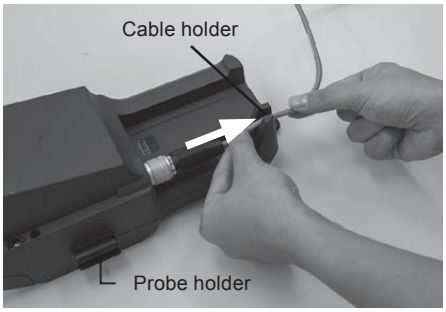
(3) Probe attaching/detaching

Make sure that the power is turned off before attaching or detaching the probe.

- **Probe attaching**
  Align the groove of the probe connector on the rear side of the main unit with the protrusion of the joint part of the probe and make an insertion. The probe is properly secured with a sound of "click."

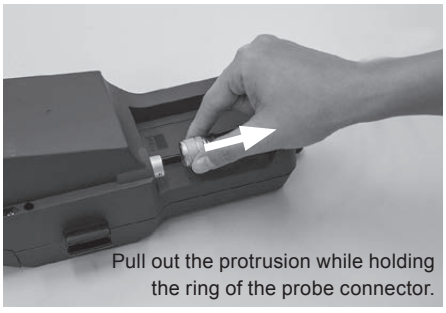


  Secure the probe cable to the cable holder.



* **The probe grip can be secured to the probe holder.**

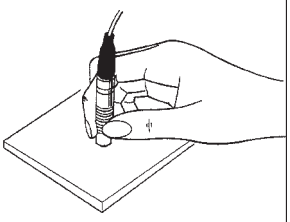
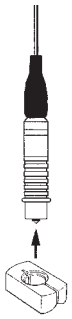
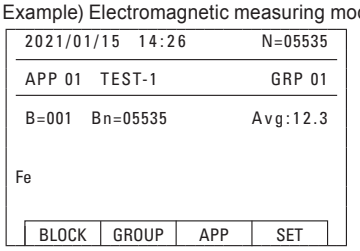
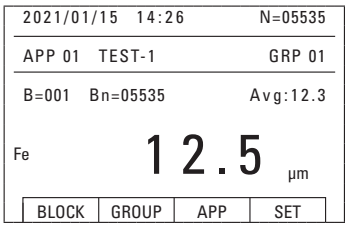
- **Probe detaching**
  The probe can be detached by sliding it in the pulling out direction while the ring of the probe connector is held.



(4) Attaching of surface protection sheet and strap

Attachment of a surface protection sheet allows the display and operation keys to be protected from being dirty or damged. In addition, attachment of a strap allows this product to be hung from user's neck or shoulder at use. Use the strap as necessary.

5. Measurement Mode

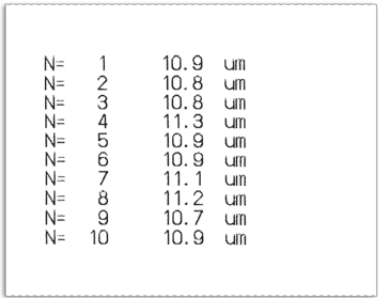
Procedure	Display
1. Turn on the power switch. Press the [POWER] key of the main unit.	
2. Perform foil calibration and substrate calibration. For an object to be measured for the first time, perform foil calibration and substrate calibration, and register the application (→P.20). ● Foil calibration is always required to obtain correct measured values with the coating thickness tester. (→P.16) ● It is recommended to perform substrate calibration on a regular basis, for example substrate calibration is performed before the start of measurement on a daily basis, in order to perform accurate measurement (→P.15).	
3. Measurement As shown in the figure, hold the probe by pinching the grip part near the measuring part. By holding the grip part and pressing it, the pressure at the time of measurement becomes constant. At measurement, quickly press the probe guide so that it is perpendicular to the measurement surface. When a beep sound is heard and the reading is displayed, disconnect the probe from the measurement surface.  The next measurement should be performed after the tip of the probe is separated from the measurement surface by 10 mm or more. ● To measure a pipe-shaped object or a flat surface continuously, a probe adapter can be used for stable measurement. ● If you drag the probe while pressing it against the measurement surface, the tip of the probe may wear and you may not be able to make accurate measurements. Dragging the probe while pressing it against a measurement surface may cause wear to the probe tip, which may disable accurate measurement.  Attach the probe adapter to the tip of the probe and tighten the screw to fix it.	Example) Electromagnetic measuring mode  Measurement results 

● When enabling the printer

*** When the power of the printer is turned on, the battery consumption will be accelerated. It is recommended to turn off the power of the printer when the printer is not in use.**

To use the printer, press the [PRINTER POWER] key to let the printer icon ([ ] or [ ]) disappear from the display (if the printer icon does not disappear, see page 39).

<Printout example>



N=	1	10.9	um
N=	2	10.8	um
N=	3	10.8	um
N=	4	11.3	um
N=	5	10.9	um
N=	6	10.9	um
N=	7	11.1	um
N=	8	11.2	um
N=	9	10.7	um
N=	10	10.9	um

6. About Statistics Function

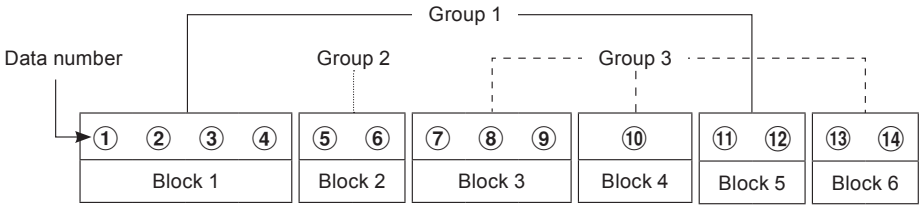
The product is equipped with the statistics function that calculates average values and so on.

- **Statistical contents**
  Calculates average values, standard deviations, maximum values, and minimum values.

- **Preparation for statistics**
  Measured data must be stored in memory for statistics.
  Set "Data memory" to "Enable" (→P.31).

- **Data Storage**
  When measured data is saved, a data number starting from 1 is assigned to each data in order. Each data belongs to a block and a group and is used as a statistical range.

<Image of data storage>



- Block
  A block is a smaller unit of measured data classification, and can store any consecutive numbers of measured data. Blocks are numbered from 1, and each time a block is updated, the number increases to block 2, block 3, and so on.
- Group
  A group is a larger unit of measured data classification, which is a data classification that stores arbitrary blocks together. Non-consecutive blocks can be grouped together because a group with which each block can be registered can be specified. Groups can be named up to 12 alphanumeric characters.

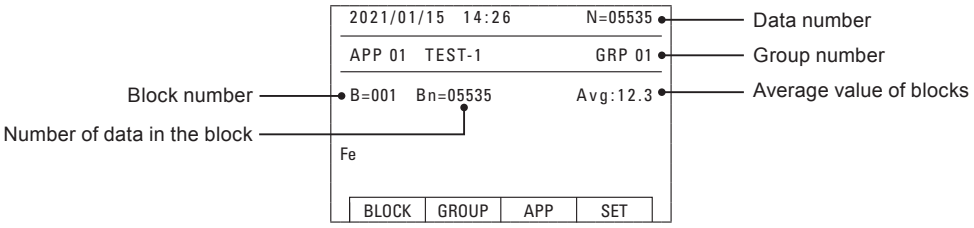
* **If a group whose blocks contain measured data is changed to another, the blocks are updated at the same time.**

* **The measured data is saved in the group and block specified before the measurement. It cannot be moved to another block or group after measurement.**

- **Statistical method**
  There are two methods to perform statistics; one is a method to specify data to be statistically calculated after measurement (data statistics), and the other is a method to specify the place (block and group) to which data is put before measurement and to statistically calculate the data therein (block statistics, group statistics). For further information, see page 25.

- **Screen information about statistics**

<When the screen displays all items>



- **Data deletion**

  Data can be deleted when the data is measured by mistake, the number of saved data reaches the upper limit, or the like (→P.30).

  • [DELETE] key

  The data immediately after measurement can be deleted with the [DELETE] key. This key is used when the data is found to be incorrect immediately after measurement.

  • Deletion of specified data

  A list of measured data can be displayed after measurement, and the data that is not suitable for statistical calculation can be deleted from the list. This deletion can be used when obviously abnormal data is deleted by viewing the list afterward.

  • Deletion of all data

  This deletion can be used when the number of saved data reaches the upper limit. All the blocks and groups will be deleted.

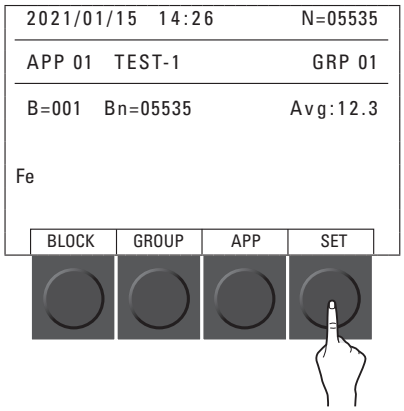
* **Be aware that the deleted data cannot be restored.**

7. Various settings

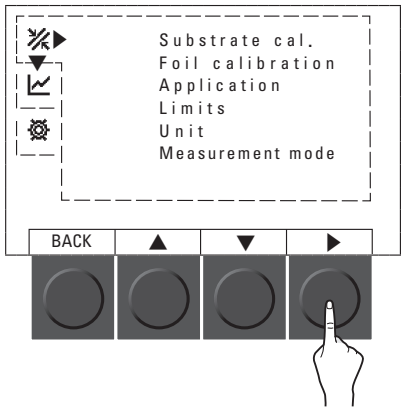
When the [SET] key is pressed on the measurement screen, the following menu screen will be displayed. For each function and operation method, refer to the reference page described as (P. ○○).

* **Once each function is set, the setting content will be kept intact even after the power is turned off until it is changed.**

<Measurement screen>



<Menu screen>



Use the function keys on the main unit to operate the display.

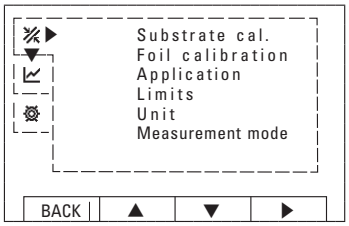
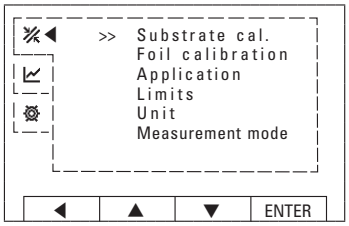
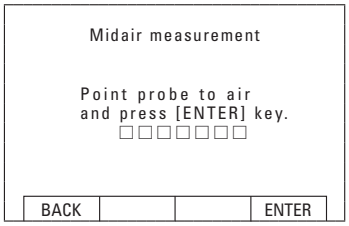
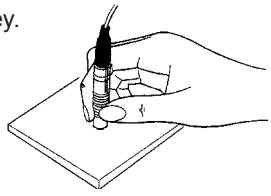
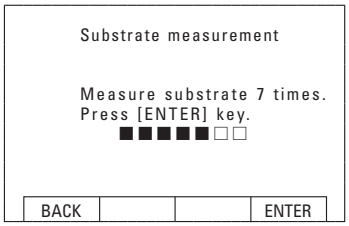
Icon of each item	Functions	Ref. page
Measurement menu	① Substrate calibration	P.15
	② Foil calibration	P.16
	③ Application	P.20
	④ Upper and lower limits	P.22
	⑤ Unit	P.23
	⑥ Measurement mode	P.24
Statistics menu	⑦ Statistics	P.25
	⑧ New block	P.27
	⑨ Group function	P.28
	⑩ Delete data	P.30
	⑪ Data memory	P.31
	⑫ Data output	P.32
Setting menu	⑬ Auto power off	P.33
	⑭ Backlight	P.34
	⑮ Change print density	P.35
	⑯ Date and time setting	P.36
	⑰ Display setting	P.37
	⑱ Software version	P.38
	Service menu (not used)	–

① Substrate calibration

<u>At the time of measurement, even if the type of coating is the same, the measurement value may be affected by the material and shape of the substrate (the same as the one to be measured, with no coating such as plating or painting on the surface).</u>

Perform a substrate calibration to correct the effect of the substrate before measurement. Once the substrate calibration is registered, it will be stored in the application (→P.20).

* **For the object to be measured for the first time, foil calibration using a calibration foil is required (→ P.16). Please carry out after the substrate calibration.**

Operating procedure	Display	Precautions
1. Press the [SET] key on the measurement screen (→P.14).		* **Press and hold the [3] key on the measurement screen to move to step 4.**
2. Select the icon [%]. Select the measurement menu icon [%] with the [▲] and [▼] keys, and then press the [►] key.		
3. Select "Substrate calibration". Select "Substrate calibration" with the [▲] and [▼] keys, and then press the [ENTER] key.		
4. Perform measurement in the air. When pointing the probe in the air and pressing the [ENTER] key, measurement will automatically be performed 7 times. 		* **When pressing the [BACK] key during the measurement, the current substrate calibration not be memorized.**
5. Perform measurement of substrate. Measure the substrate prepared in advance 7 times and press the [ENTER] key. 		
6. The screen will return to the screen of step 2.		

② Foil calibration

Foil calibration is always required before measurement to obtain correct measurement values with the coating thickness tester. First, prepare a "substrate" that has the same material, shape and thickness as the object to be measured, and to which no coating such as plating or painting is applied. Then, prepare four "calibration foils (samples whose thickness is known)" according to the thickness of the coating to be measured. Refer to the table below for combinations of "calibration foils".

- **Example of combination of substrate and calibration foil**

  Determine the calibration range slightly wider than the measurement range you want to use. Then, select calibration foils so that they are as evenly spaced as possible.

Measurement range	Calibration point				
0 to 50μm	Substrate (0μm)	12μm	25μm	38μm	50μm
50～500μm	Substrate (0μm)	50μm	100μm	300μm	500μm
500～2,000μm	Substrate (0μm)	500μm	1,000μm	1,500μm	2,000μm*1

***1 For 2,000μm, stack 500μm and 1,500μm calibration foils (The eddy current type is not used because the measurement range is up to 1,200μm).**

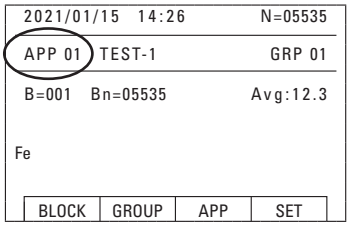
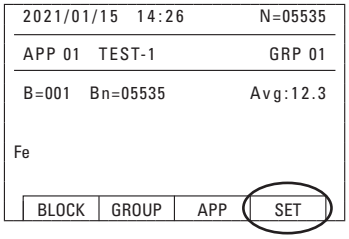
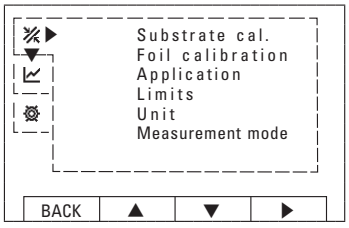
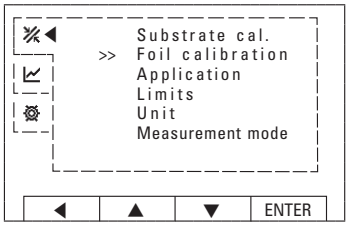
*** Use the attached substrate to easily check the accuracy of the instrument.**

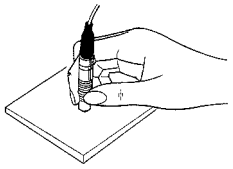
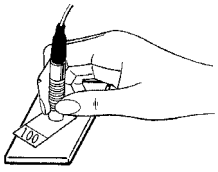
*** Values of the provided calibration foils are not the exactly same as the values described in the table but approximations of the actual measurement values. In addition, a calibration foil with a thickness other than the provided foils is available as an option. Please contact us for further information.**

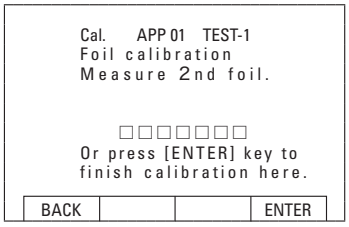
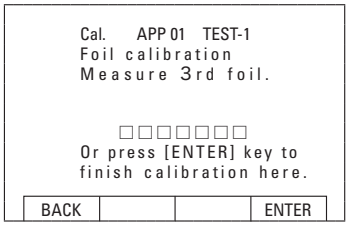
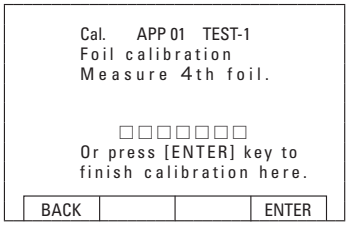
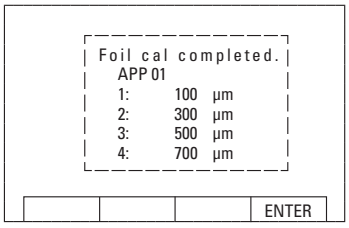
*** Even if the measurement target is the same, the calibration content stored in the application may deviate from the measurement value due to wear of the probe tip or changes in the surrounding environment (temperature, humidity, etc.). Perform a substrate calibration and foil calibration on a regular basis to ensure accurate measurement. The same applies when the object to be measured is changed or the probe is replaced with a new one.**

- **When the measurement method is electromagnetic and the substrate and 4 calibration foils (100/300/500/700µm) are used for calibration**

  For the foil calibration method, also refer to the "Easy Adjustment Guide" included with this unit.

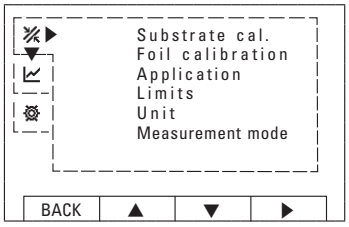
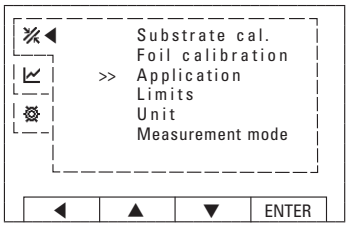
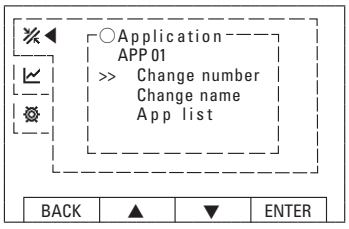
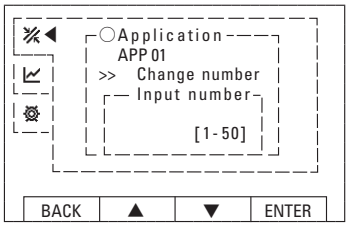
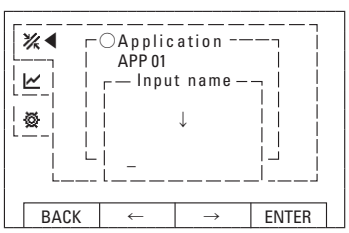
Operating procedure	Display	Precautions
1. Check the application number. Before making calibrations, check which application number to set (→P.20).		
2. Perform substrate calibration (→P.15).		
3. Press the [SET] key on the measurement screen (→P.14).		* **Press and hold the [9] key on the measurement screen to move to step 6.**
4. Select the icon [⚒]. Select the measurement menu icon [⚒] with the [▲] and [▼] keys, and then press the [►] key.		
5. Select “Foil calibration”. Select "Foil calibration" with the [▲] and [▼] keys, and then press the [ENTER] key.		

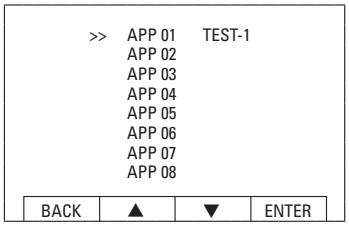
Operating procedure	Display	Precautions
6. Perform measurement of substrate. Measure a substrate without any coating about 5 times. If you make a measurement error, you can delete the previous value by pressing the [DELETE] key. When the measurement is completed, press the [ENTER] key.	Cal. APP 01 TEST-1 Substrate measurement Measure substrate. □□□□□□□ BACK Measure the prepared substrate about 5 times.  Cal. APP 01 TEST-1 Substrate measurement Measure substrate. ■■■■■□□ Mea. 0.1µm Avg. 0.2µm BACK ENTER	* **Prepare and use a substrate according to the object to be measured such as a magnetic metal substrate for the electromagnetic measurement method or a non-magnetic metal substrate for the eddy current measurement method.** * **Measuring about 5 times is an operation to take the average value.**
7. Measure the calibration foil (1st foil). Place the calibration foil (100µm) on the substrate and measure about 5 times. Measure in order from the thinnest calibration foil to be used. If you make a measurement error, you can delete the previous value by pressing the [DELETE] key. When the measurement is completed, press the [ENTER] key. Input the thickness described on the measured foil using the [0] to [9] [.] keys. If you make an input error, you can delete the input value by pressing the [DELETE] key. Determine with the [ENTER] key.	Cal. APP 01 TEST-1 Foil calibration Measure 1st foil. Press [ENTER] key when finishing measurement. □□□□□□□ BACK ENTER Place a calibration foil on the substrate and measure about 5 times  Cal. APP 01 TEST-1 Foil calibration Measure 1st foil. Press [ENTER] key when finishing measurement. ■■■■■□□ Mea. 103µm Avg. 101µm BACK ENTER Cal. APP 01 TEST-1 Foil calibration Measure 1st foil. Input thickness of foil and press [ENTER] key. [100] µm BACK ENTER	* **When the [BACK] key is pressed during operation of steps 7 to 10, the calibration at that point will be effective.** * **The measurement can be performed up to 7 times.**

Operating procedure	Display	Precautions
8. Measure the calibration foil (2nd foil). Place the calibration foil (300µm) on the substrate and measure about 5 times. Perform operations in the same manner as step 7.		*** If you want to finish the calibration with 1 or up to 3 calibration foils, enter the thickness of a calibration foil and press the [ENTER] key before measuring the next calibration foil. The calibration up to the calibration foil for which the thickness was input last will be saved.** *** Press the [BACK] key to return to the screen of step 5.**
9. Measure the calibration foil (3rd foil). Place the calibration foil (500µm) on the substrate and measure about 5 times. Perform operations in the same manner as step 7.		
10. Measure the calibration foil (4th foil). Place the calibration foil (700µm) on the substrate and measure about 5 times. Perform operations in the same manner as step 7.		
11. The calibration is complete. When the [ENTER] key is pressed, the calibration will be completed and the screen will return to the screen of step 5.		

③ Application

The probe can store 50 different applications.
Calibration result, application name (up to 12 alphanumeric characters) and the upper and lower limits (→ P.22) can be saved in each application.

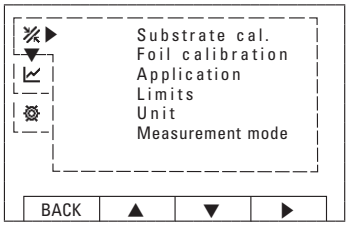
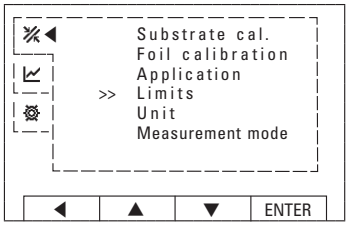
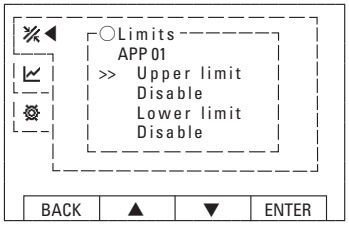
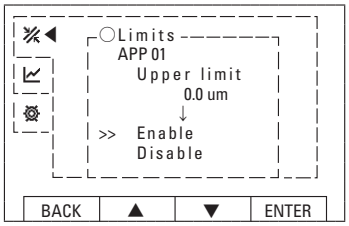
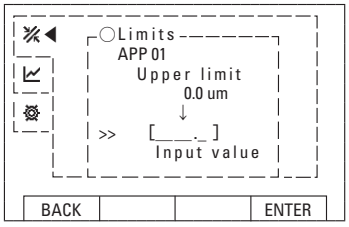
Operating procedure	Display	Precautions
1. Press the [SET] key on the measurement screen (→P.14).		* **Select [App] on the function key on the measurement screen to move to step 4.**
2. Select the icon []. Select the measurement menu icon [] with the [▲] and [▼] keys, and then press the [►] key.		
3. Select “Application”. Select "Application" with the [▲] and [▼] keys, and then press the [ENTER] key.		
4. Select an item to set. Select an item to set with the [▲] and [▼] keys, and then press the [ENTER] key.		* **The application number is set to "01" at the time of shipment. The current application number is displayed as "APP 01".** * **The set application number will be kept intact even after the power is turned off until it is changed.**
<When selecting "Change number"> Enter a number using the [0] to [9] keys and then press the [ENTER] key. If it is not necessary to change it, press the [BACK] key.		* **If you make an input error, you can delete the number by pressing the [DELETE] key.**
<When selecting "Input name"> Operate the [0] to [9] keys and enter a name (up to 12 alphanumeric characters). After entering the name, press the [ENTER] key.		* **P.16 "② Foil calibration" and name (up to 12 alphanumeric characters) can be set for each application number.**

Operating procedure	Display	Precautions
<When selecting "App list"> Select any application number with the [▲] and [▼] keys, and then press the [ENTER] key.		* **By pressing the [DELETE] key during selection of application number, you can delete the saved name, calibration result and the upper and lower limits.**
5. The screen will return to the screen of step 3.		* **If any of the function keys is used, the screen will return to the measurement screen.**

④ Upper and lower limits

It is a function to set the upper limit or lower limit and notify on the screen with a buzzer sound when a measurement value exceeds it.

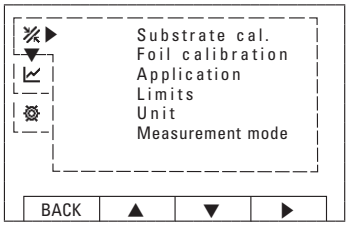
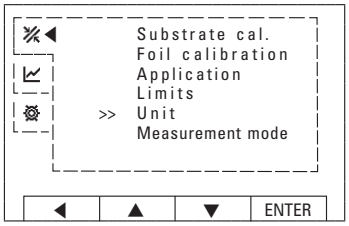
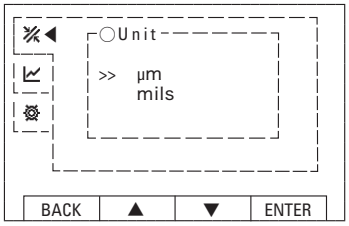
* **The screen display will be displayed on the left side of the measurement value and the upper limit will be displayed with "▲" and the lower limit with "▼". When printed, "!" will be displayed on the right side of the measurement value.**

Operating procedure	Display	Precautions
1. Press the [SET] key on the measurement screen (→P.14).		
2. Select the icon [⚒]. Select the measurement menu icon [⚒] with the [▲] and [▼] keys, and then press the [►] key.		
3. Select "Limits". Select "Limits" with the [▲] and [▼] keys, and then press the [ENTER] key.		
4. Select the upper or lower limit. Select "Upper limit" or "Lower limit" with the [▲] and [▼] keys, and then press the [ENTER] key.		* **It is not set at the shipment.**
The explanations about the upper limit display are provided here but operation of the lower limit can be done in the same manner. Select "Enable" or "Disable" with the [▲] and [▼] keys, and then press the [ENTER] key. If you select "Set", enter the upper and lower limits with the [0] to [9] and [.] keys and then press the [Enter] key. If it is not necessary to change it, press the [BACK] key.	 	* **If you make an input error, you can delete the input value by pressing the [DELETE] key.**
5. Press the [BACK] key to return to the screen of step 3.		

⑤ Unit

You can set the display unit (μm, mils) of measurement value.

* **Saved measurement data will also be displayed in the selected unit.**

Operating procedure	Display	Precautions
1. Press the [SET] key on the measurement screen (→P.14).		
2. Select the icon [🔧]. Select the measurement menu icon [🔧] with the [▲] and [▼] keys, and then press the [►] key.		
3. Select "Unit". Select "Unit" with the [▲] and [▼] keys, and then press the [ENTER] key.		
4. Select the unit to display. Select the unit to be displayed with the [▲] and [▼] keys and then press the [ENTER] key. If it is not necessary to change it, press the [BACK] key.		* **"μm" is set at the time of shipment.**
5. The screen will return to the screen of step 3.		

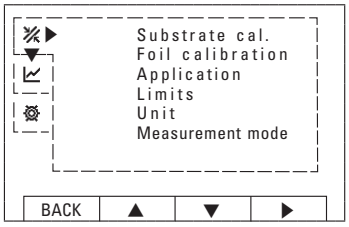
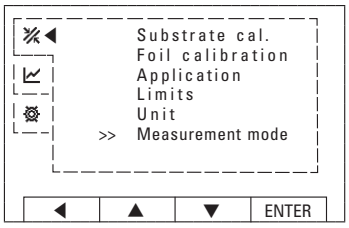
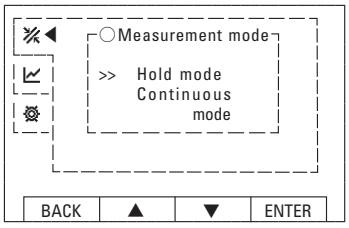
⑥ Measurement Mode

Either of "Hold mode" that fixedly displays a measurement value and "Continuous mode" that displays measurement value by continuous monitoring can be set.

* **The measurement mode at the time of calibration is fixed to "Hold mode".**

* **In "Continuous mode", press the tip of the probe against the measurement point and press the [HOLD] key when the measurement value is stabilized. The displayed value at this time will be stored as measurement data and will be printed when the power of the printer is on.**

This is useful when measuring a complex shape where measurement values tend to be unstable.

Operating procedure	Display	Precautions
1. Press the [SET] key on the measurement screen (→P.14).		
2. Select the icon []. Select the measurement menu icon [] with the [▲] and [▼] keys, and then press the [►] key.		
3. Select "Measurement mode". Select "Measurement mode" with the [▲] and [▼] keys, and then press the [ENTER] key.		
4. Select an item to set. Select a measurement mode to be set with the [▲] and [▼] keys, and then press the [ENTER] key. If it is not necessary to change it, press the [BACK] key.		* **At the time of shipment, it is set to "Hold mode".** * **When "Hold mode" is set, the icon () will appear on the display.**
5. The screen will return to the screen of step 3.		

⑦ Statistics

You can display the average value, standard deviation, maximum value and minimum value and also can set data range to be calculated. "Group statistics", "Block statistics" and "Data statistics" can be selected for data range to be calculated.

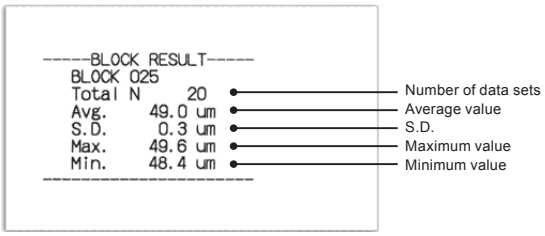
* **When performing statistical calculations, set “Data memory” to "Enable" before starting a measurement (→ P.31).**

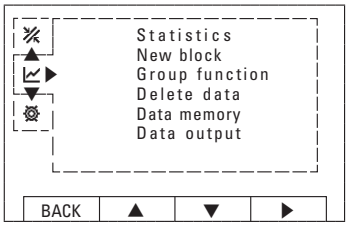
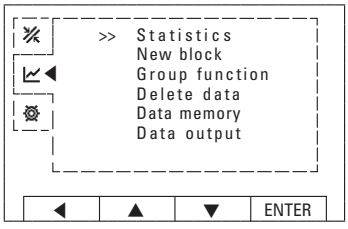
* **For details on “Group statistics” and “Block statistics”, refer to "6. Statistics Functions” on page 12.**

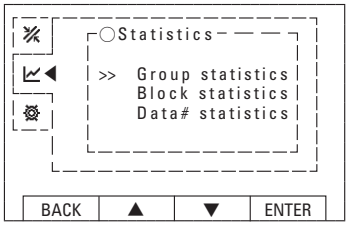
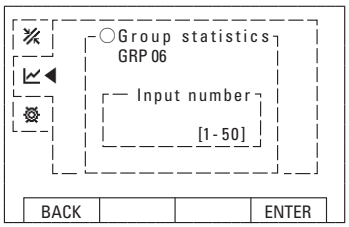
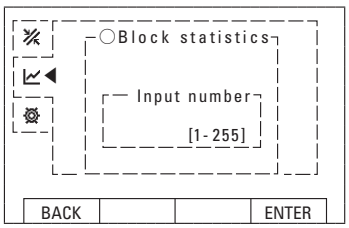
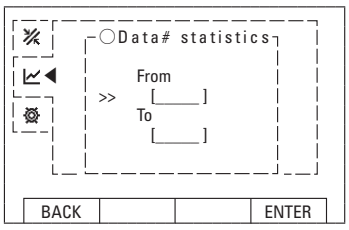
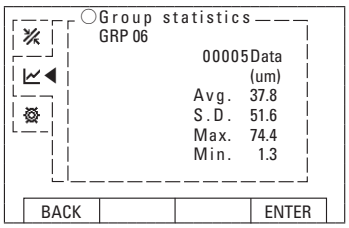
- **Group statistics**
  Statistical calculation results for data in each group can be displayed on the screen and printing of them is available.
  You can also display the results by pressing the [GROUP RESULT] key.
- **Block statistics**
  Statistical calculation results for data in each block can be displayed on the screen and printing of them is available.
  You can also display the results by pressing the [BLOCK RESULT] key.
- **Data statistics**
  Statistical calculation results for data between the specified data numbers can be displayed on the screen and printing of them is available.

* **Any deleted data will not be included in the statistical calculation results (→P.30).**

<Printout example>

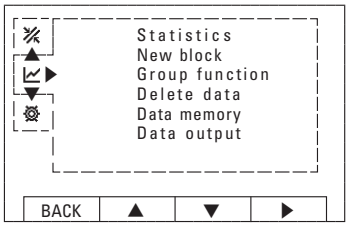
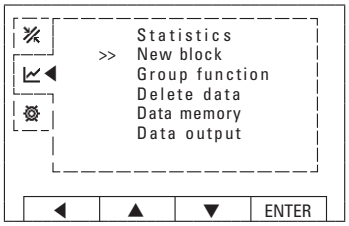
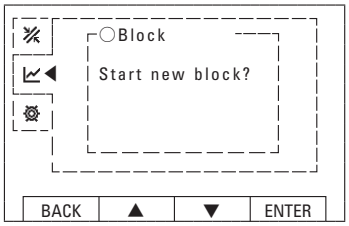
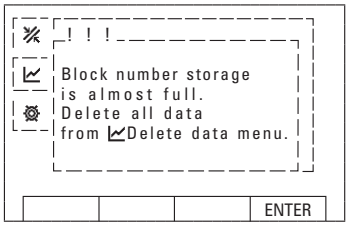


Operating procedure	Display	Precautions
1. Press the [SET] key on the measurement screen (→P.14).		
2. Select the icon [📈]. Select the statistics menu icon [📈] with the [▲] and [▼] keys, and then press the [►] key.		
3. Select “Statistics”. Select "Statistics" with the [▲] and [▼] keys, and then press the [ENTER] key.		

Operating procedure	Display	Precautions
4. Select an item to display. Select an item to display with the [▲] and [▼] keys, and then press the [ENTER] key. If it is not necessary to display it, press the [BACK] key.		
5. Set each item. Enter a number with the [0] to [9] keys and press the [Enter] key. If it is not necessary to set it, press the [BACK] key.	  	* **The current group number will be displayed on the group function screen.** * **If you make an input error, you can delete the number by pressing the [DELETE] key.**
The explanations about the group statistics result are provided here but operation can be done in the same manner when “Block statistics” or “Data statistics” is selected. Press the [Output] key to print statistical results.		
6. Press the [BACK] key to return to the screen of step 3.		

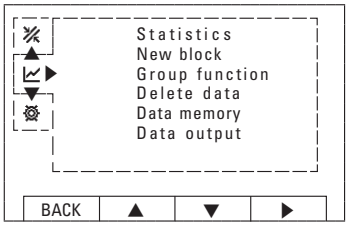
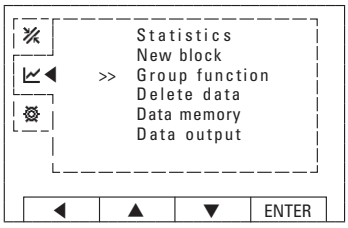
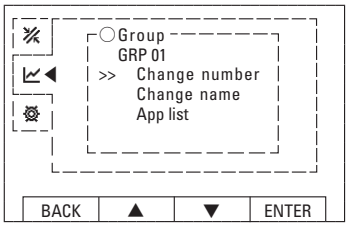
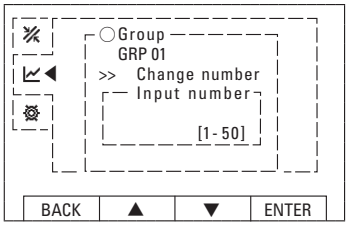
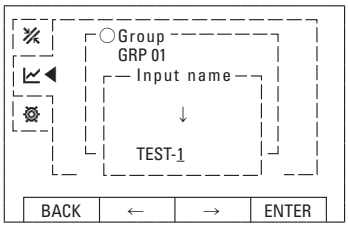
⑧ Block update

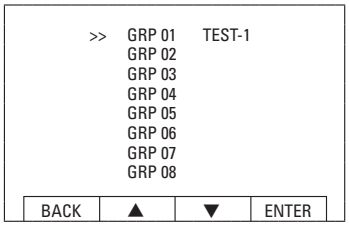
You can create a block that summarizes the measurement data. When the block number is updated, a new number will be assigned and the old number will become unavailable.
You can create up to 255 blocks. If you have used up to 255, delete all the measurement data and block data (→P.30).
Up to 24,000 measurement data can be stored in one block. However, updating of the block will become unavailable when the memory reaches the upper limit.

Operating procedure	Display	Precautions
1. Press the [SET] key on the measurement screen (→P.14).		* **Select [Block] of the function key on the measurement screen to move to step 4.**
2. Select the icon [📈]. Select the statistics menu icon [📈] with the [▲] and [▼] keys, and then press the [►] key.		
3. Select [Block update]. Select [Block update] using the [▲] and [▼] keys, and then press the [Enter] key.		
4. Update the block number. Press the [Enter] key to update the block number. If it is not necessary to update it, press the [BACK] key.		* **The current block number will be displayed as "B = XXX" on the measurement screen.**
When the block number approaches 255, a screen like the one on the right will be displayed. Delete all the measurement data (→P.30).		
5. The screen will return to the screen of step 3.		* **If any of the function keys is used, the screen will return to the measurement screen.**

⑨ Group function

You can set groups to which each block belongs.
By setting groups, statistical calculation can be performed across multiple blocks.
Groups are numbered 1 through 50 and different names can be saved for each number.

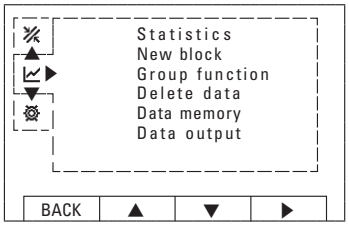
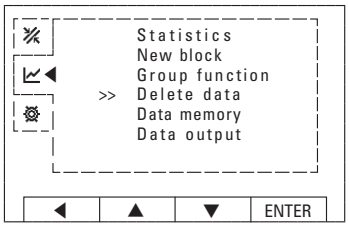
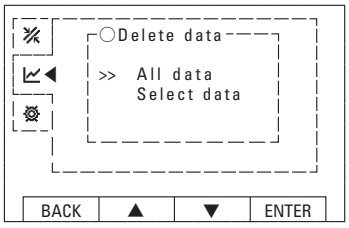
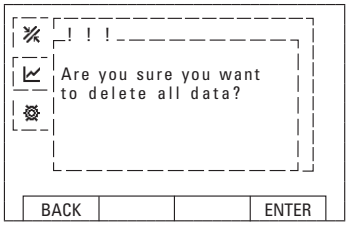
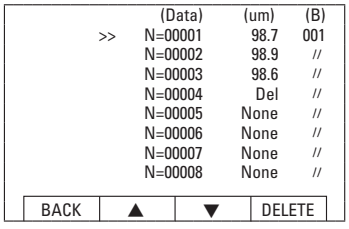
Operating procedure	Display	Precautions
1. Press the [SET] key on the measurement screen (→P.14).		*** Select [Group] of the function key on the measurement screen to move to step 4.**
2. Select the icon [📈]. Select the statistics menu icon [📈] with the [▲] and [▼] keys, and then press the [►] key.		
3. Select "Group function". Select "Group function" with the [▲] and [▼] keys, and then press the [ENTER] key.		
4. Select an item to set. Select an item to set with the [▲] and [▼] keys, and then press the [ENTER] key. If it is not necessary to change it, press the [BACK] key.		*** The current group number is displayed as "GRP 00".**
<When selecting "Change number"> After entering the number with the [0] to [9] keys, press the [ENTER] key. If it is not necessary to change it, press the [BACK] key.		*** If you make an input error, you can delete the number by pressing the [DELETE] key.**
<When selecting "Change name"> Enter the name using the [0] to [9] keys (up to 12 alphanumeric characters). After entering the name, press the [ENTER] key.		

Operating procedure	Display	Precautions
<When selecting "App list"> Select a desired group number with the [▲] and [▼] keys, and then press the [ENTER] key.		
5. The screen will return to the screen of step 3.		*** If any of the function keys is used, the screen will return to the measurement screen.**

⑩ Delete data

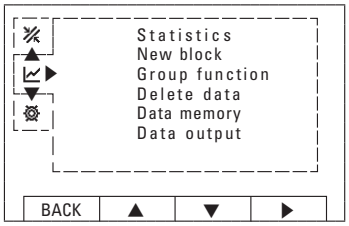
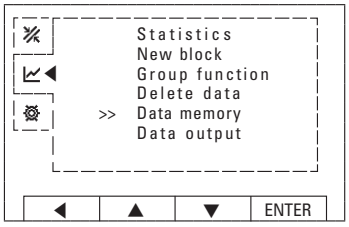
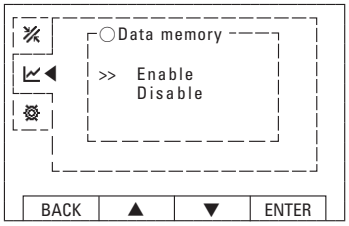
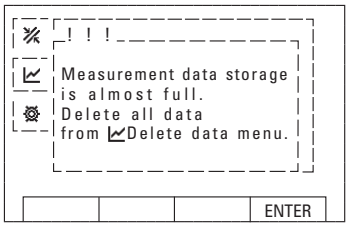
You can delete measurement data.

* **The measurement data obtained most recently can be deleted by pressing the [DELETE] key.**
* **Any deleted data will not be included in the statistical calculation results (→P.25).**

Operating procedure	Display	Precautions
1. Press the [SET] key on the measurement screen (→P.14).		* **Press and hold the [5] key on the measurement screen to move to <When selecting "Delete specified data">.**
2. Select the icon [📈]. Select the statistics menu icon [📈] with the [▲] and [▼] keys, and then press the [►] key.		
3. Select "Delete data". Select "Delete data" with the [▲] and [▼] keys, and then press the [ENTER] key.		
4. Select the item to delete. Select the item to delete with the [▲] and [▼] keys, and then press the [ENTER] key.		
<When selecting "Delete all data"> A confirmation message is displayed. Press the [ENTER] key to delete all data.		* **Once deleted, the data cannot be restored.**
<When selecting "Delete specified data"> A list of data will be displayed. Select a measurement data number to be deleted with the [▲] and [▼] keys, and then press the [ENTER] key. If it is not necessary to delete it, press the [BACK] key first.		* **If there is no corresponding measurement data, "None" will be displayed.** * **If all measurement data are not available, the screen will return to the screen of step 3.**
5. The screen will return to the screen of step 3.		

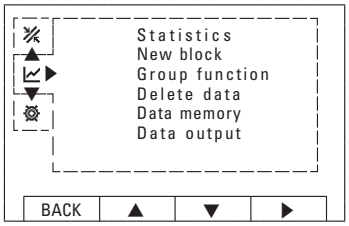
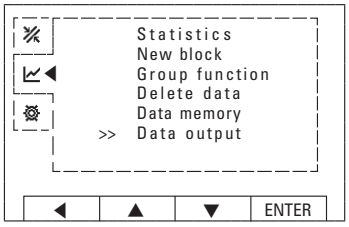
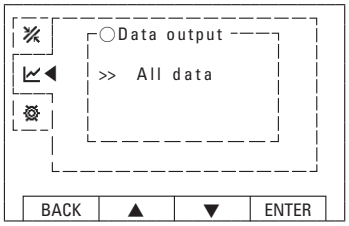
⑪ Data memory

You can set whether to save measurement data in the data memory.

Operating procedure	Display	Precautions
1. Press the [SET] key on the measurement screen (→P.14).		
2. Select the icon [📈]. Select the statistics menu icon [📈] with the [▲] and [▼] keys, and then press the [►] key.		
3. Select the icon "Data memory". Select "Data memory" with the [▲] and [▼] keys, and then press the [ENTER] key.		
4. Determine whether to save the measurement data. Select an item to set with the [▲] and [▼] keys, and then press the [ENTER] key. If it is not necessary to change it, press the [BACK] key.		* **At the time of shipment, "Enable" is set.** * **When "Enable" is selected, the measurement data will be saved in the memory.** * **When performing statistical calculation (→P.25), set it to "Enable" before measurement. If it is set after a measurement or if it is set to "Disable", statistical calculation of measurement data cannot be performed.**
When the remaining capacity of the memory is insufficient, the screen as shown on the right will be displayed. Delete all the measurement data (→P.30).		
5. The screen will return to the screen of step 3.		

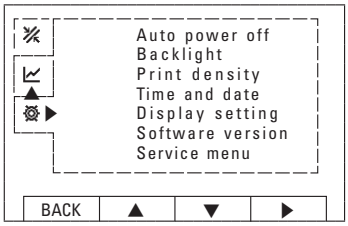
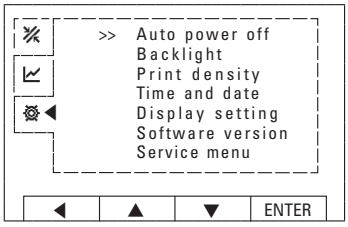
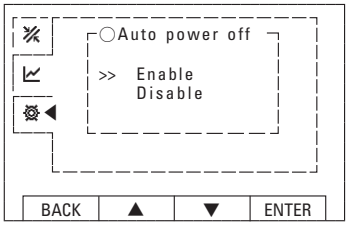
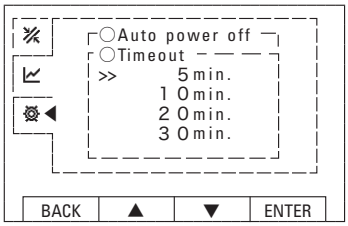
⑫ Data output

You can output measurement data to a PC.
Please check the required specifications to connect with a PC (→P.40).

Operating procedure	Display	Precautions
1. Press the [SET] key on the measurement screen (→P.14).		
2. Select the icon [📈]. Select the statistics menu icon [📈] with the [▲] and [▼] keys, and then press the [►] key.		
3. Select "Data output". Select "Data output" with the [▲] and [▼] keys, and then press the [ENTER] key.		
4. Output the measurement data. Select "All data" and then press the [ENTER] key. If it is not necessary to output it, press the [BACK] key.		
5. The screen will return to the screen of step 3.		

⑬ Auto power off

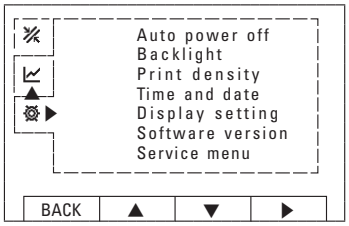
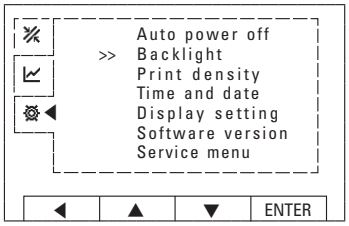
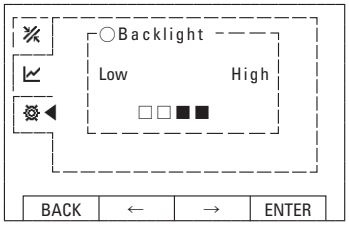
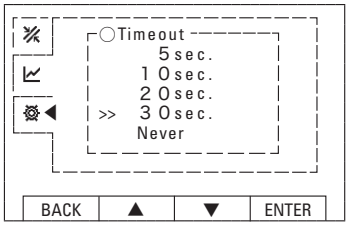
You can set the time to automatically turn off the power when no measurement or key operation is performed for a certain period of time.

Operating procedure	Display	Precautions
1. Press the [SET] key on the measurement screen (→P.14).		
2. Select the icon [⚙]. Select the setting menu icon [⚙] with the [▲] and [▼] keys, and then press the [►] key.		
3. Select "Auto power off". Select "Auto power off" with the [▲] and [▼] keys, and then press the [ENTER] key.		
4. Select whether to turn off the power automatically. Select an item to set with the [▲] and [▼] keys, and then press the [ENTER] key.		* **At the time of shipment, "Enable" is set.**
5 Set the time for auto power off. Select a setting time with the [▲] and [▼] keys, and then press the [ENTER] key. If it is not necessary to change it, press the [BACK] key.		* **At the time of shipment, "5 min." is set.**
6. The screen will return to the screen of step 3.		

⑭ Backlight

You can set the brightness and the lighting time of the backlight.
This is a convenient function to set when measuring in a dark place or when no operation is performed for a certain period of time.

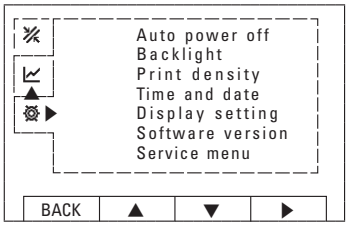
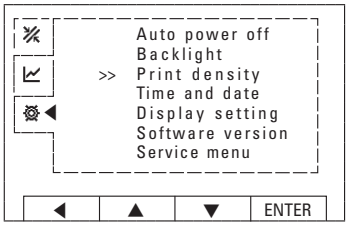
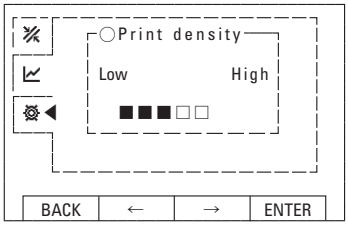
* **The brighter the backlight or the longer the lighting time, the greater the decrease in battery life.**

Operating procedure	Display	Precautions
1. Press the [SET] key on the measurement screen (→P.14).		
2. Select the icon [⚙]. Select the setting menu icon [⚙] with the [▲] and [▼] keys, and then press the [►] key.		
3. Select "Backlight". Select "Backlight" with the [▲] and [▼] keys, and then press the [ENTER] key.		
4. Set the brightness of the backlight. Select the brightness with the [←] and [→] keys, and then press the [ENTER] key.		* **At the time of shipment, "□□■■" is set.**
5. Specify the lighting time. Select "Timeout" with the [▲] and [▼] keys, and then press the [ENTER] key. If it is not necessary to change it, press the [BACK] key.		* **At the time of shipment, "30" is set.**
6. The screen will return to the screen of step 3.		

⑮ Change print density

You can set the print density for output from the printer.

* **Increasing the print density will greatly reduce the battery life.**
* **As the printer head wears out, the print density will become lighter. If the print density is thinner even when this setting is set to the maximum, contact your dealer or us.**

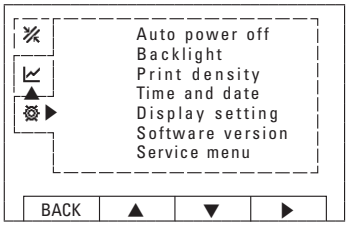
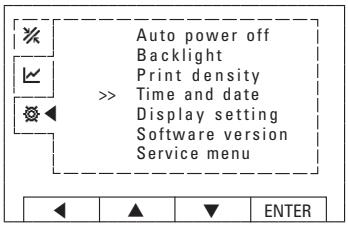
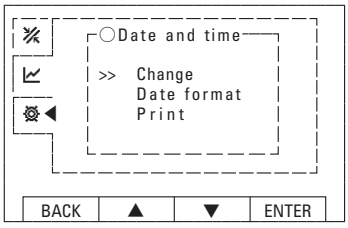
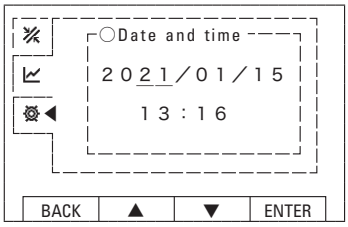
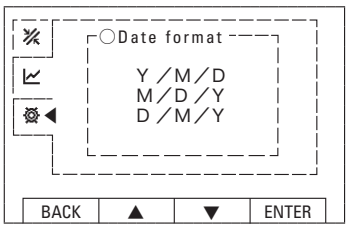
Operating procedure	Display	Precautions
1. Press the [SET] key on the measurement screen (→P.14).		
2. Select the icon [⚙]. Select the setting menu icon [⚙] with the [▲] and [▼] keys, and then press the [▶] key.		
3. Select "Print density". Select "Print density" with the [▲] and [▼] keys, and then press the [ENTER] key.		
4. Specify the print density. Select the print density with the [←] and [→] keys, and then press the [ENTER] key. If it is not necessary to change it, press the [BACK] key.		* **At the time of shipment, "■■■□□" is set.** * **When the power of the printer is on, a test print of "Density changed" will be output immediately when the [ENTER] key is pressed.**
5. The screen will return to the screen of step 3.		

⑯ Date and time setting

You can set the time and date.

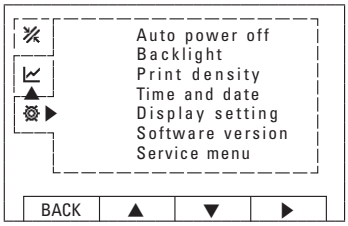
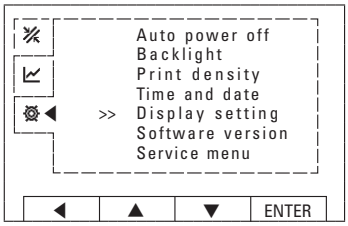
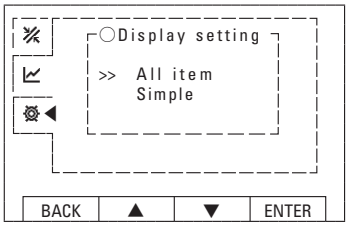
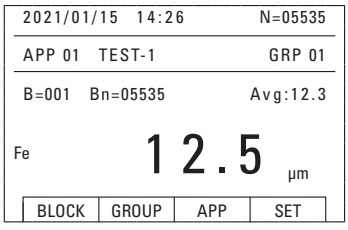
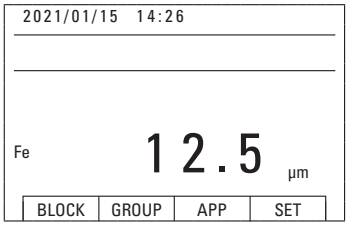
* **When a non-existent day such as February 30th or April 31st is entered, it will be set as the first day of the following month.**

Example) February 30 → March 1, April 31 → May 1

Operating procedure	Display	Precautions
1. Press the [SET] key on the measurement screen (→P.14).		* **When the [1] key on the measurement screen is pressed and held as a short-cut key, [Print] in step 4 will be executed.**
2. Select the icon [⚙]. Select the setting menu icon [⚙] with the [▲] and [▼] keys, and then press the [►] key.		
3. Select "Date and time". Select "Date and time" with the [▲] and [▼] keys, and then press the [ENTER] key.		
4. Select the setting item. Select an item to set with the [▲] and [▼] keys, and then press the [ENTER] key.		* **When selecting "Print", the time and date will be printed. If the power of the printer is off, no printing will be performed.**
<When selecting "Change"> Enter the time and date with the [▲] / [▼] keys and the [0] to [9] keys, and then press the [ENTER] key. If it is not necessary to change it, press the [BACK] key.		
<When selecting "Date format"> Select an item to set with the [▲] and [▼] keys, and then press the [ENTER] key. If it is not necessary to change it, press the [BACK] key.		
5. The screen will return to the screen of step 3.		

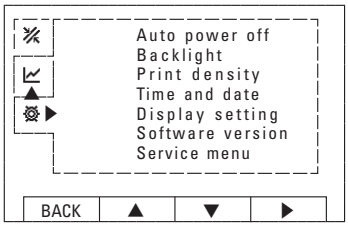
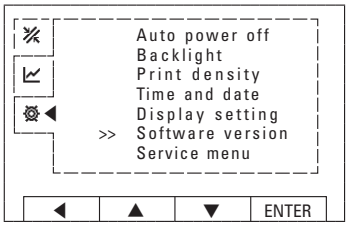
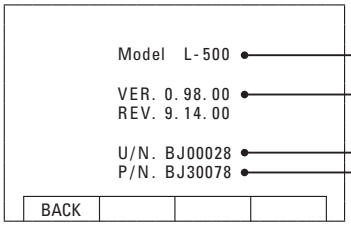
⑰ Display setting

The display of the measurement screen can be selected from "All items" or "Simple".
In the simple display, the date and time, measurement mode, unit, printer icon, and battery icon are displayed.

Operating procedure	Display	Precautions
1. Press the [SET] key on the measurement screen (→P.14).		
2. Select the icon [⚙]. Select the setting menu icon [⚙] with the [▲] and [▼] keys, and then press the [►] key.		
3. Select "Display setting". Select "Display setting" with the [▲] and [▼] keys, and then press the [ENTER] key.		
4. Select a display method on the measurement screen. Select an item to set with the [▲] and [▼] keys, and then press the [ENTER] key. If it is not necessary to change it, press the [BACK] key.		* **At the time of shipment, "All item" is set.**
When selecting "All item", the measurement screen will be displayed as shown on the right.		
When selecting "Simple", the measurement screen will be displayed as shown on the right.		
5. The screen will return to the screen of step 3.		

⑱ Software version

You can check information including the model, software version, serial number of the main unit and serial number of the probe.

Operating procedure	Display	Precautions
1. Press the [SET] key on the measurement screen (→P.14).		
2. Select the icon [⚙]. Select the setting menu icon [⚙] with the [▲] and [▼] keys, and then press the [►] key.		
3. Select "Software version". Select "Software version" with the [▲] and [▼] keys, and then press the [ENTER] key.		
4. The information of this unit is displayed. After confirming the information, press the [BACK] key.		
5. The screen will return to the screen of step 3.		

8. Battery/printer paper replacement

If the following icon is displayed, check by following the respective procedures.

Name	Icon	Description
Battery icon		The battery for the main unit is exhausted (⇒ P.39 "**■ Battery replacement**").
Printer icon		Displays the power status of the printer. When the icon is displayed, check the following. • The battery for the printer is exhausted (⇒ P.39 "**■ Battery replacement**"). • The printer battery is not set (⇒ P.9 "**(1) Power supply preparation**"). • The power of the printer is not on (⇒ P.11 "**● When enabling the printer**").
		The printer paper is out (⇒P.39 "**■ Printer paper replacement**").

■ Battery replacement

Replace the batteries with new four or eight batteries (1.5V AA alkaline batteries) by referring to P.9 "(1) Power supply preparation".

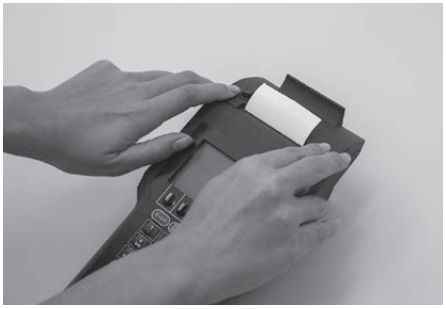
■ Printer paper replacement

If the printer icon ([ ]) is displayed, load new printer paper.

① Press the open/close button on the front of the main unit and load printer paper in the same orientation as the photo.

* **If the paper orientation is not set correctly, printing will not occur.**

② Close the printer paper cover with the tip of the printer paper sticking out as shown in the photo.



9. Data output

By connecting to a PC, this unit can output data such as measurement values and statistical calculation results. You can also use a USB port as a serial COM port by installing the driver before connecting. Please download and use the latest FTDI "Virtual COM port (VCP) driver".

- **Communication interface : USB2.0 Full Speed**

  USB I/F connector pinout

Pin number	Signal name	Functions
1	Vbus	Power supply
2	-Data (-D)	Data line
3	+Data (+D)	Data line
4	GND	GND

- **Virtual COM port data output specifications**

  Interface type : Asynchronous communication
  Baud rate : 15,200 bps
  Data bit : 8 bit
  Parity : Absent
  Stop Bit : 1 bit

Example) Measurement results

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	Output data
Character	N	=	0	0	0	0	1			1	2	3	4					u	m											N=00001 1234 um
ASCII code	4E	3D	30	30	30	30	31	20	20	31	32	33	34	20	20	20	20	75	6D	20	20	20	0A							
Character	N	=	0	0	0	0	2				5	6	7					u	m											N=00002 567 um
ASCII code	4E	3D	30	30	30	30	32	20	20	20	35	36	37	20	20	20	20	75	6D	20	20	20	0A							
Character	N	=	0	0	0	0	3					8	9	.	0			u	m											N=00003 89.0 um
ASCII code	4E	3D	30	30	30	30	33	20	20	20	20	38	39	2E	30	20	20	75	6D	20	20	20	0A							
Character	N	=	0	0	0	0	4						3	.	8			u	m											N=00004 3.8 um
ASCII code	4E	3D	30	30	30	30	34	20	20	20	20	20	33	2E	38	20	20	75	6D	20	20	20	0A							
Character	N	=	0	0	0	0	5			-			1	.	2			u	m											N=00005 - 1.2 um
ASCII code	4E	3D	30	30	30	30	35	20	20	2D	20	20	31	2E	32	20	20	75	6D	20	20	20	0A							
Character	N	=	0	0	0	0	6					1	2	.	3			m	i	l	s									N=00006 12.3 mils
ASCII code	4E	3D	30	30	30	30	36	20	20	20	20	31	32	2E	33	20	20	6D	69	6C	73	20	0A							

Example) Measurement result (when reached the limit)

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	Output data
Character	N	=	0	0	0	0	6					1	2	.	3			u	m			!								N=00006 12.3 um !
ASCII code	4E	3D	30	30	30	30	36	20	20	20	20	31	32	2E	33	20	20	75	6D	20	20	21	0A							

Example) Block statistical calculation result

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	Output data
Character	-	-	-	-	-	B	L	O	C	K		R	E	S	U	L	T	-	-	-	-	-								-----BLOCK RESULT-----
ASCII code	2D	2D	2D	2D	2D	42	4C	4F	43	4B	20	52	45	53	55	4C	54	2D	2D	2D	2D	2D	0A							
Character				B	L	O	C	K		1	2	3																		BLOCK 123
ASCII code	20	20	20	42	4C	4F	43	4B	20	31	32	33	0A																	
Character				T	o	t	a	l		N			2	3	4	5	6													Total N 23456
ASCII code	20	20	20	54	6F	74	61	6C	20	4E	20	20	32	33	34	35	36	20	0A											
Character				A	v	g	.					7	5	.	3		u	m												Avg. 75.3 um
ASCII code	20	20	20	41	76	67	2E	20	20	20	20	37	35	2E	33	20	75	6D	20	20	0A									
Character				S	.	V	.				1	5	9				u	m												S.V. 159 um
ASCII code	20	20	20	53	2E	56	2E	20	20	20	31	35	39	20	20	20	75	6D	20	20	0A									
Character				M	a	x	.			1	2	3	4				u	m												Max. 1234 um
ASCII code	20	20	20	4D	61	78	2E	20	20	31	32	33	34	20	20	20	75	6D	20	20	0A									
Character				M	i	n	.					5	6	.	7		u	m												Min. 56.7 um
ASCII code	20	20	20	4D	69	6E	2E	20	20	20	20	35	36	2E	37	20	75	6D	20	20	0A									
Character	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-								----------
□□□□□□□	2D	2D	2D	2D	2D	2D	2D	2D	2D	2D	2D	2D	2D	2D	2D	2D	2D	2D	2D	2D	2D	2D	0A							

Example) Group statistical calculation result

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	Output data
Character	-	-	-	-	-	G	R	O	U	P		R	E	S	U	L	T	-	-	-	-	-								-----GROUP RESULT-----
ASCII code	2D	2D	2D	2D	2D	47	52	4F	55	50	20	52	45	53	55	4C	54	2D	2D	2D	2D	2D	0A							
Character	G	R	O	U	P		5	0			G	R	O	U	P	N	A	M	E										GROUP 50 GROUPNAME
ASCII code	47	52	4F	55	50	20	35	30	20	20	47	52	4F	55	50	4E	41	4D	45	20	20	20	0A							
Character				T	o	t	a	l		N			2	3	4	5	6													Total N 23456
ASCII code	20	20	20	54	6F	74	61	6C	20	4E	20	20	32	33	34	35	36	20	0A											
Character				A	v	g	.					7	5	.	3		u	m												Avg. 75.3 um
ASCII code	20	20	20	41	76	67	2E	20	20	20	20	37	35	2E	33	20	75	6D	20	20	0A									
Character				S	.	D	.			□	1	5	9				u	m												S.D. □159 um
ASCII code	20	20	20	53	2E	44	2E	20	20	20	31	35	39	20	20	20	75	6D	20	20	0A									
Character				M	a	x	.			1	2	3	4				u	m												Max. 1234 um
ASCII code	20	20	20	4D	61	78	2E	20	20	31	32	33	34	20	20	20	75	6D	20	20	0A									
Character				M	i	n	.					5	6	.	7		u	m												Min. 56.7 um
ASCII code	20	20	20	4D	69	6E	2E	20	20	20	20	35	36	2E	37	20	75	6D	20	20	0A									
Character	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-								----------
ASCII code	2D	2D	2D	2D	2D	2D	2D	2D	2D	2D	2D	2D	2D	2D	2D	2D	2D	2D	2D	2D	2D	2D	0A							

Example) When setting a limit

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	Output data
Character				S	e	t		U	.	L	I	M				1	7	3	9					u	m					Set U.LIM 1739 um
ASCII code	20	20	20	53	65	74	20	55	2E	4C	49	4D	20	20	20	31	37	33	39	20	20	20	20	75	6D	20	20	0A		
Character				S	e	t		L	.	L	I	M						2	5	.	8			u	m					Set L.LIM 25.8 um
ASCII code	20	20	20	53	65	74	20	4C	2E	4C	49	4D	20	20	20	20	20	32	35	2E	38	20	20	75	6D	20	20	0A		

Example) When changing blocks

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	Output data
Character				S	e	t		B	L	O	C	K				1	1	1												Set BLOCK 111
ASCII code	20	20	20	53	65	74	20	42	4C	4F	43	4B	20	20	20	31	31	31	0A											

Example) When changing groups

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18											Output data
Character				S	e	t		G	R	O	U	P					2	2												Set GROUP 22
ASCII code	20	20	20	53	65	74	20	47	52	4F	55	50	20	20	20	20	32	32	0A											

Example) When changing the application

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18											Output data
Character				S	e	t		A	P	P							3	3												Set APP 33
ASCII code	20	20	20	53	65	74	20	41	50	50	20	20	20	20	20	20	33	33	0A											

Example) Date and time

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	Output data
Character	2	0	2	1	/	0	1	/	1	5		1	4	:	2	6														2021/01/15 14:26
ASCII code	32	30	32	30	2F	30	31	2F	32	33	20	31	35	3A	33	35	20	20	20	20	20	0A								
Character	0	1	/	1	5	/	2	0	2	1		1	4	:	2	6														01/15/2021 14:26
ASCII code	30	31	2F	32	33	2F	32	30	32	30	20	31	35	3A	33	35	20	20	20	20	20	0A								
Character	1	5	/	0	1	/	2	0	2	1		1	4	:	2	6														15/01/2021 14:26
ASCII code	32	33	2F	30	31	2F	32	30	32	30	20	31	35	3A	33	35	20	20	20	20	20	0A								

*** LF (0x0A) is added as a line feed code.**

10. Handling precautions

■ Storage

After use, clean it well, avoid direct sunlight and store it in a dry place. When not using for a long period of time, remove the power cord and the batteries. It is recommended to store it in a carrying case.

■ Notes regarding measurement

(1) Handle the probe carefully so as not to damage it.

Accurate measurement cannot be performed if the tip of the probe is damaged or dirt is present on it. Do not hit the probe against a surface to be measured or slide it sideways while pressing it. After measurement, clean the tip of the probe with benzine, alcohol, etc. using a soft cloth.

(2) Please handle the calibration foils carefully.

The calibration foils are precisely measured in thickness. If you make calibrations using damaged or bent foils, you will not be able to make accurate measurements. Pay particular attention to the wear of the thinnest 10μm calibration foil. If a calibration foil is damaged during use, specify the thickness of the calibration foil to the store where you purchased it or us, and purchase a new one. At that time, the thickness of the new calibration foil may be slightly different from that of the old calibration foil, but there is no inconvenience in calibration.

(3) Always be sure to perform substrate calibration before performing daily measurements.

Once the substrate calibration is registered, it will be stored in the application, but it is recommended to perform the substrate calibration every day before starting measurement in order to perform accurate measurement.

11. If you thought it was a malfunction

If any of the following symptom is observed, follow the respective procedures to check and take appropriate action. If the symptom cannot be solved even by following the procedures, contact your dealer or us.

Symptoms	Points to be checked	Check/Remedy
Cannot turn on the power	Power supply (main unit)	Is the AC adapter or the battery set correctly? Open the battery compartment on the side of the main unit and check (⇒P.9 "**(1) Power supply preparation**").
	Battery replacement (main unit)	Isn't the battery exhausted? If the battery for the main unit is exhausted, replace the four AA alkaline batteries with new ones (⇒ P.9 "**(1) Power supply preparation**").
No measurement value is displayed.	Probe selection	Is the probe selected correctly? Make sure you have selected the probe that matches the object to be measured (⇒P.10 "**(2) Probe selection**").
	Probe condition	Isn't the probe deformed? If the probe is deformed, please purchase a new probe.
		Isn't the probe tip or connector dirty? If dirt is present, clean it by wiping off the dirt with benzine, alcohol, etc. using a soft cloth.
Cannot measure correctly	Application	Is the correct application number selected? Check the application number (⇒P.20 "③ **Application**").
	Foil calibration	Is the foil calibration suitable for the measurement target? Make sure that the foil calibration is made according to the measurement target and the thickness you want to measure (⇒P.16 "② **Foil calibration**").
Cannot print	Power supply (printer)	Is the power of the printer on? Press the [PRINTER POWER] key. When the power is off, the printer icon ( ) will be displayed on the display (⇒P.39 "■ **Battery replacement**").
	Battery (printer)	Are the batteries set correctly? Open the battery compartment on the back of the main unit and check (⇒P.9 "**(1) Power supply preparation**").
		Isn't the battery exhausted? If the batteries for printer are exhausted, replace the four AA alkaline batteries with new ones (⇒ P.9 "**(1) Power supply preparation**").
	Printer paper	Is printer paper loaded properly? Check if the printer paper is properly loaded (⇒ P.39 "■ **Printer paper replacement**").
		Isn't the printer out of paper? Check if the printer paper is properly loaded (⇒ P.39 "■ **Printer paper replacement**").
The measurement value remains "----" and does not move	Substrate calibration or foil calibration	Is the substrate calibration or foil calibration done correctly? Perform the substrate calibration or foil calibration again according to P.15 "① **Substrate calibration**" or P.16 "② **Foil calibration**".

12. Error display

If any of the following error messages are displayed, follow the procedures described below to check for the cause of the error and take appropriate action to remove the error. If the symptom cannot be solved even by following the procedures, contact your dealer or us.

Display	Cause	Action to be taken
Probe Missing Error 101	The probe is not connected	Turn off the power of the main unit and then connect the probe.
Probe Broken Error 102	Disconnection of the probe and poor connection of the connector	Check if the connector is connected firmly and correctly(⇒P.10 “**(3) Probe attaching/detaching**”). If there is no problem with the connector connection, it may be due to disconnection (breaking of the wire). In this case, contact your dealer or us.
Under Range Error 104	Exceeding the lower limit of measurement range	Check the measurement range of the probe in use (⇒ Refer to the instruction manual provided with the probe). Check if the procedures on P.15 "① **Substrate calibration**" or P.16 "② **Foil calibration**” are correctly performed.
Over Range Error 105	Exceeding the upper limit of measurement range	

Notes

- Copying some or all of the contents of this user manual without prior written consent is strictly prohibited.
- The contents of this user manual may be changed at any time in the future without any prior notice.
- The appearance and/or representations of the products and parts depicted in this user manual may not appear exactly as their actual counterparts, but this does not affect their operation or functionality.
- This user manual was intended to be written as clearly and accurately as possible. However, if you are unclear about anything in this user manual or notice any missing information, please contact us directly.
- We cannot be held responsible for any actions or effects resulting from the execution of any operations outlined in this user manual.

KETT ELECTRIC LABORATORY Co. Ltd.

1-8-1 Minami-Magome, Ota-ku, Tokyo 143-8507, JAPAN

☎ +81-3-3776-1121 +81-3-3776-3001

https://www.kett.co.jp/english/ overseas@kett.co.jp

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