User's Manual
No. 99MAH034B1
SERIES No. 543

ID-C112RX

Calculation type
ABS Digimatic Indicator

User's Manual

Read this User's Manual thoroughly
before operating the instrument. After reading,
retain it close at hand for future reference.

Mitutoyo

CONVENTIONS USED IN THIS MANUAL

Safety Precautions

To ensure that instruments are operated correctly and safely, Mitutoyo manuals use various safety symbols (Signal Words and Safety Alert Symbols) to identify and warn against hazards and potential accidents.
The following signs indicate **general** warnings:

WARNING

Indicates a potentially hazardous situation which, if not avoided, could result in serious injury or death.

Types of Notes

The following types of **notes** are used in this manual to help the operator obtain reliable measurement data through correct instrument operation.

IMPORTANT

An important note provides information essential to use the product. You cannot disregard this note.
An important note is a type of precaution, which if neglected could result in degraded performance or accuracy, or instrument malfunction/failure.

NOTE

A note provides information to be especially noted or supplemented to use the product.
A note also supplies information to be noted for specific operations.

TIP

A *tip* is a type of note that helps the user apply the techniques and procedures described in the text to his or her specific needs.
It also provides reference information associated with the topic being discussed.

Battery-related Warnings

WARNING

If the battery is misused or abused, leakage or, in extreme causes, explosion and/or fire can result. Observe the following precautions to avoid instrument failure or malfunction.

- Do not disassemble, deform, short-circuit, charge, or heat the battery to 100°C or over, or throw the battery into a fire.
- Always insert the battery correctly with regard to the polarities (+ and –) marked on the battery and the instrument.
- Always use the recommended battery.
- If the instrument will not be used for more than three months, remove the battery and store it separately.
- When discarding or storing the battery, cover the positive (+) and negative (–) terminals with insulating tape to prevent contact with other metals. When disposing of it, follow the ordinances or regulations of the local government.
- Keep the battery away from direct sunlight, high temperature, high humidity and out of the reach of children.
- Do not swallow the battery. If swallowed, consult a physician immediately.
- Should the content contact an eye or skin, or enter the mouth, rinse with water immediately and consult a physician. Should it adhere to clothing, wash the clothing with water.

Disposal Warnings

WARNING

- A liquid crystal display and a lithium metal battery are used in this product. When disposing of the instrument, follow the ordinances or regulations of the local government.
- The liquid crystal display contains an irritating substance. Should the liquid content contact an eye or skin, flush with clean, flowing water. If the substance enters the mouth, immediately rinse the mouth, drink plenty of water, induce vomiting, and then consult a physician.

Cautions on use

Observe the following precautions to avoid instrument failure or malfunction.

IMPORTANT

- Do not strike the instrument or allow it to be struck.
- Do not drop it or apply excessive force to it.
- Do not disassemble or modify the instrument.
- Do not press the keys with a pointed object (such as screwdriver or ballpoint pen).
- Do not use or store the instrument under direct sunlight, or in an excessively hot or cold environment.
- Be alert for malfunction due to material deterioration if it is used in an environment with low or high atmospheric pressure.
- Do not store the instrument in a high-humidity environment. Do not use the instrument where it could be splashed with coolant.
- Do not use high-voltage equipment, such as an electric marking pen, near the instrument. Electronic parts may be damaged by such equipment. Be alert for malfunction if it is used in the vicinity of electric noise.
- Secure the instrument with a fixture such as a dial gage stand in a vibration-free environment.
- Do not subject the spindle to a vertical load or torsion.
- Wipe stains from the instrument panel by using a soft cloth or a cotton swab that is dry or moistened with diluted neutral detergent. Do not use an organic solvent such as thinner and benzene, which may cause the instrument panel to deform or malfunction.
- The contaminated spindle may cause malfunction. Wipe them off with a cloth damped with alcohol.

NOTE

- Be alert for measurement errors caused by thermal expansion of the component parts and the fixtures, resulting from a significant temperature fluctuation. Use the instrument in a temperature-controlled room that has minimum temperature fluctuation. Allow sufficient time for the instrument to thermally stabilize if it is moved to an environment with a different temperature.

Warranty

In the event that this product should prove defective in workmanship or material, within one year from the date of original purchase for use, it will be repaired or replaced, at Mitutoyo's option, free of charge upon its prepaid return to Mitutoyo

If the product fails or is damaged for any of the following reasons, it will be subject to a repair charge, even if it is still under warranty.

(a) Failure or damage owing to fair wear and tear.
(b) Failure or damage owing to inappropriate handling, maintenance or repair, or to unauthorized modification.
(c) Failure or damage owing to transport, dropping, or relocation of the instrument after purchase.
(d) Failure or damage owing to fire, salt, gas, abnormal voltage, lightning surge, or natural disaster.
(e) Failure or damage owing to use in combination with hardware or software other than those designated or permitted by Mitutoyo.
(f) Failure or damage owing to use in ultra-hazardous activities.

This warranty is effective only where the instrument is properly installed and operated in conformance with the instructions in this manual within the original country of the installation.

EXCEPT AS SPECIFIED IN THIS WARRANTY, ALL EXPRESS OR IMPLIED CONDITIONS, REPRESENTATIONS, AND WARRANTIES OF ANY NATURE WHATSOEVER INCLUDING, WITHOUT LIMITATION, ANY IMPLIED WARRANTY OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, NONINFRINGEMENT OR WARRANTY ARISING FROM A COURSE OF DEALING, USAGE, OR TRADE PRACTICE, ARE HEREBY EXCLUDED TO THE MAXIMUM EXTENT ALLOWED BY APPLICABLE LAW.

You assume all responsibility for all results arising out of its selection of this product to achieve its intended results.

Export Control Compliance

This Product falls into the Catch-All-Controlled Goods and/or Catch-All-Controlled Technologies (including Programs) under Category 16 of Appended Table 1 of Export Trade Control Order or under Category 16 of Appended Table of Foreign Exchange Control Order, based on Foreign Exchange and Foreign Trade Law of Japan.

If you intend re-exporting the product from a country other than Japan, re-selling the product in a country other than Japan, or re-providing the technology (including program), you shall observe the regulations of your country.

Contents

1 OVERVIEW

This chapter describes overview of this instrument including names and functions of each part, external dimensions, and details of the display unit.

1.1 Overview

This special instrument supports measurements described in the accompanying manual (No.99MAH035B) by calculation function which uses the formula $f(x)=Ax+B+Cx^{-1}$ ("x" is a spindle displacement)
To use the calculation function, set up this instrument referring to the accompanying manual and "3.3.3 CALC: Calculation function" and "3.2.1 Origin point (Calculation reference point)" in this document.

Measurement and Setup mode are available with this instrument.

- Measurement mode
  - ・Normal mode : Dynamically displays measurement data
  - ・Peak detection mode :
    - ・Run-out detection mode: Detects run-out of the measurement data
    - ・Maximum value detection mode: Detects maximum value of the measurement data
    - ・Minimum value detection mode: Detects minimum value of the measurement data
- Setup mode: Enables each setting

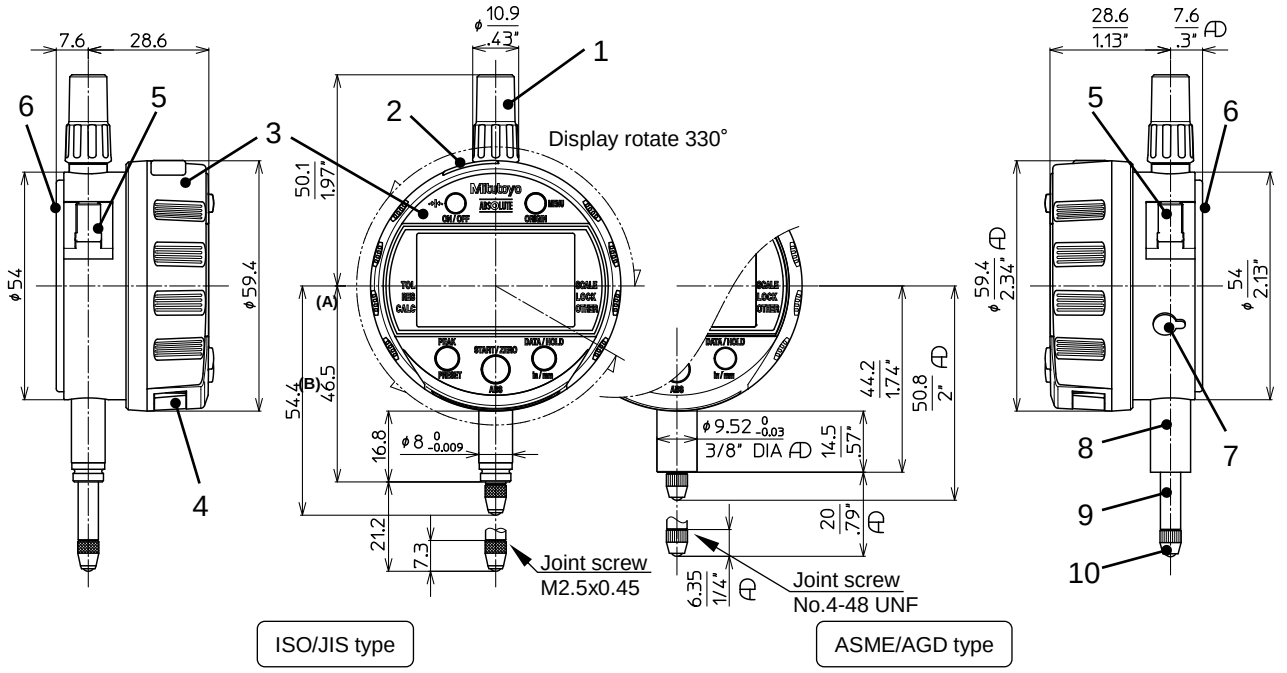
There are two measuring systems, ABS (Preset) system and INC (Comparison) system in measurement mode.

- Measuring system
  - ・ABS system: Absolute value measurement which measures distance (displacement) from a preset position .
  - ・INC system: Comparative measurement which measures distance (displacement) from the zero-set position .

1.2 Features (what you can do)

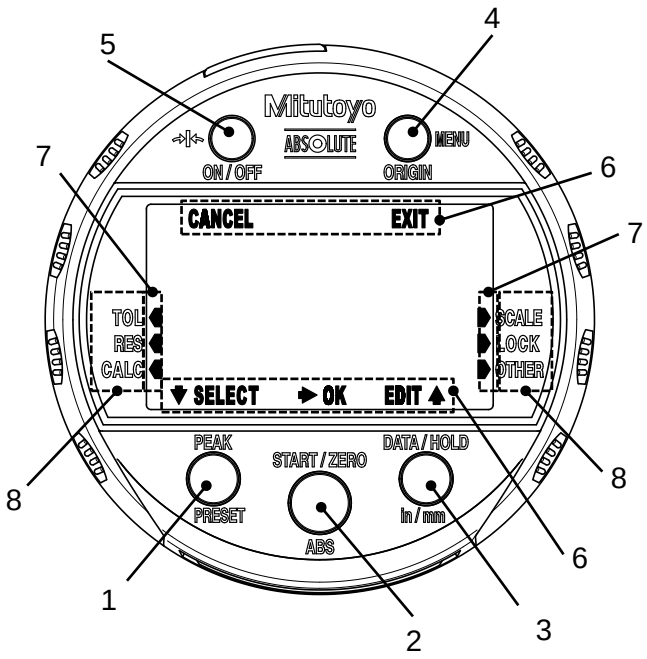
The following can be achieved with this instrument:

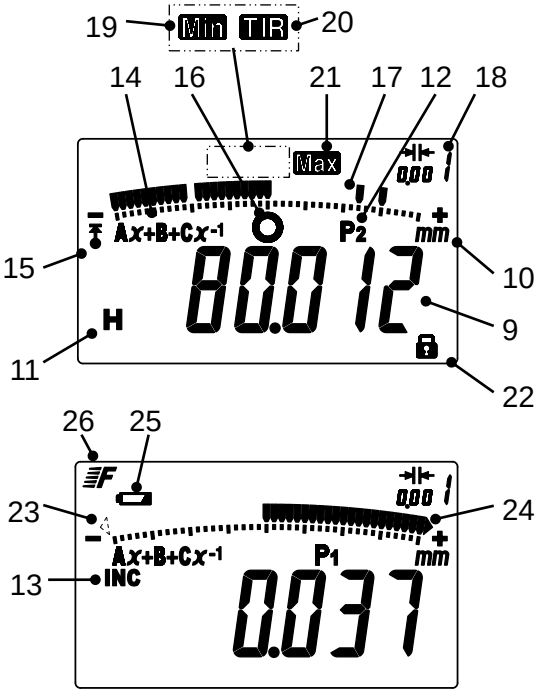
1.3 Part Names and Dimensions



1	Cap
2	Output connector (with rubber cap)
3	Display unit
4	Battery holder
5	Lever mounting position (left and right)
6	Flat back
7	Release mounting hole (with cap)
8	Stem
9	Spindle
10	Contact point ISO/JIS models : Part No.901312 ASME/AGD models : Part No.21BZB005

1.4 Details of the Display unit





1	Lower left key	11	Data hold	21	Maximum value detection measurement
2	Center key	12	Preset No.	22	Lock
3	Lower right key	13	Comparative measurement	23	Lower over-range
4	Upper right key	14	Calculation formula	24	Upper over-range
5	Upper left key	15	Origin offset	25	Low battery alarm
6	Key assist	16	Tolerance judgment	26	FAST
7	Cursor	17	Analog bar		
8	Parameter	18	Analog bar graduation		
9	Display value	19	Minimum value detection measurement		
10	Unit	20	Run-out detection measurement		

1.5 Specifications

Model name *1	ID-C112RXB	ID-C112RMXB	ID-C112REXB
Order No. *1	543-340B	543-341B	543-342B
Resolution *2	0.001 mm	.00005 “/0.001 mm	
Measuring range	12.7 mm	.5 “/12.7 mm	
Overall *3	Within 0.003 mm	Within ±.0001 “/0.003 mm	
Hysteresis *3	Within 0.002 mm	Within .0001 “/0.002 mm	
Repeatability *3	Within 0.002 mm	Within .0001 “/0.002 mm	
Stem diameter	ϕ8 mm		3/8 “ DIA
Contact point	Carbide (M2.5x0.45)		Carbide (No.4-48UNF)
Measuring force	≤1.5 N		
Measuring direction	Useful in all directions		
Protection level *4	IP42 (in factory shipment state)		
Power supply	Lithium battery CR2032 ×1pc.		
Battery life *5	Normal use :Approx. 1 year		
Scale	Electrostatic capacitance absolute encoder		
Response speed	Infinite		
Measurement frequency *6	Normal mode, Peak detection mode(FAST mode enabled):10 times/sec Peak detection mode(FAST mode disabled):50 times/sec		
CE marking	EMC Directive: EN61326-1 Immunity test requirements: Clause 6.2 Table 2 Emission limit: Class B		
Operating temperature	0 ℃~40 ℃		
Storage temperature	-10 ℃~60 ℃		
Net weight	170 g		

*1：All instruments in this series are of the flat-back type.

*2：Changeable by way of setting. Refer to “3.3.2 RES : Resolution”.

*3：20°C, normal measurement, the quantizing error (±1 count) is not included
The values are calculated with coefficients; A=1, B=0, C=0, and the resolution set to 0.001mm. They are subject to change depending on the coefficient settings.

*4：The protection level (IP: International Protection) is indicated according to IEC 60529 and JIS C 0920 standards.

*5：Battery life depends on use of the indicator. Use the above value as a guide.

*6：If the spindle speed exceeds following, the correct peak value may not be displayed.
Normal mode, Peak detection mode (FAST mode enabled):10µm/sec
Peak detection mode (FAST mode disabled):50µm/sec

1.6 Standard accessories

- Lithium battery CR2032(for monitor)
- No.99MAH034B User's Manual
- No.99MAH035B User's Manual (supplement)
- No.99MAH036B Quick Reference Manual
- No.99MAH042M EU Batteries Directive /EMC Directive/WEEE manual
- No.421RAC717 Precautions for Use
- Inspection certificate
- No.WA100 Warranty

1.7 Optional accessories

- No.905338 Connecting cable(1m)
- No.905409 Connecting cable (2m)
- No.21EZA313 Parameter Setup Kit
- No.21EZA198 Lifting lever(for ISO/JIS models)
- No.21EZA199 Lifting lever(for ASME/AGD models)
- No.21EZA105 Lifting knob(for ISO/JIS models)
- No.21EZA150 Lifting knob(for ASME/AGD models)
- No.540774 Lifting release
- Interchangeable contact points and extension rods for Mitutoyo dial indicators
- Color caps for Mitutoyo dial indicators (waterproof type)

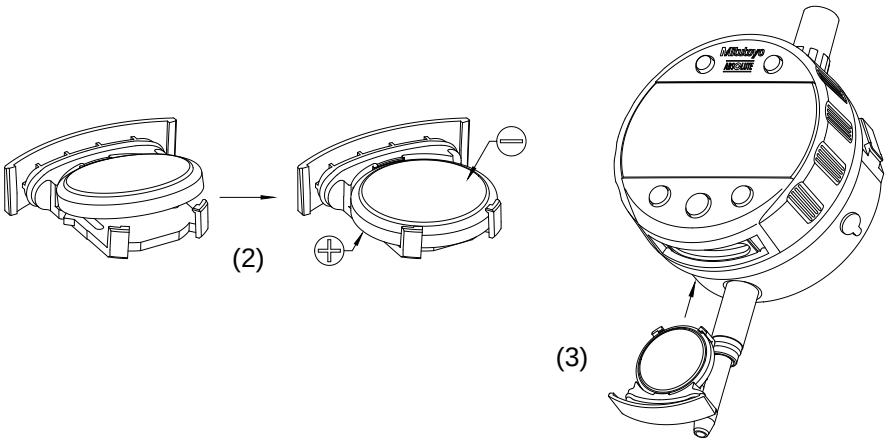
2 SETUP

This chapter describes installation of a battery, how to mount the stand or jigs, and the accessory replacement procedure.

2.1 Installation (replacement) of Battery and Initial Setting

A lithium battery (CR2032) is used with this instrument.
This instrument is not delivered with the battery set into position, so set the battery before use.

1. Remove the battery holder by using a flat-blade screwdriver or the like.
   (When replacing the battery, remove the spent battery.)
2. Set the battery into the battery holder as described in the figure below.
3. Set the battery holder into the original position. ([------] is displayed.)
4. To enter into the preset setting, press the center key.
5. Set up the preset values referring to "3.2.2 Preset setting".
6. Set up measurement mode and function which you want. (See section 3. Functions and Operating Procedure.)



IMPORTANT

- Do not use a sharp-pointed tool to remove the battery holder and not pry out the battery holder, to prevent damage to the battery holder.
- Note not to damage your nail when the battery holder is removed by hand.
- If the battery and battery holder is not set properly, a damage andmalfunction may result.
- If the Measurement mode is not entered after executing the above procedure, set the battery again.
- If the instrument will not be used for more than three months, remove the battery and store it separately to prevent damage by battery leakage.

NOTES

- The supplied battery is used only to check the functions and performance of the instrument, so it may not meet the battery life specification.

2.2 Adjusting Display Angle

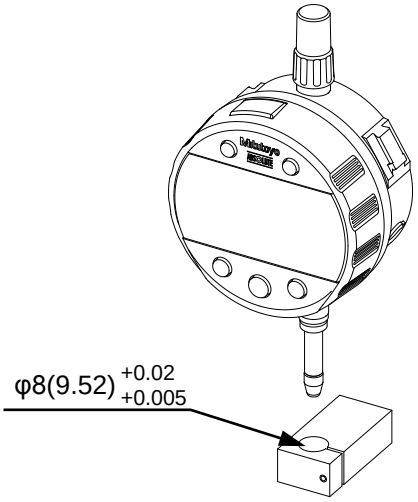
The display can be rotated 90° (to position A) clockwise or 240° (to position B) counterclockwise from the initial position. (For the rotating range, see 1. Part Names and Dimensions.)

IMPORTANT

- Stoppers are set at both positions A and B. Stop rotating the display at the stoppers, or the instrument may malfunction.
- Do not push in the display or pull it out. Doing so may cause the instrument to malfunction.

2.3 Securing Instrument

Secure the instrument to a stand, or fix it with a fixture or jig, when using it.



IMPORTANT

- Avoid using a lock screw to fix the stem directly. If fixed under a clamping torque of 150 N·cm or greater, the spindle may not move smoothly.

NOTES

- Set up the instrument with the spindle perpendicular to the reference plane or the surface to be measured. If the spindle axis is not perpendicular to the reference plane (measured surface), measurement errors will result.

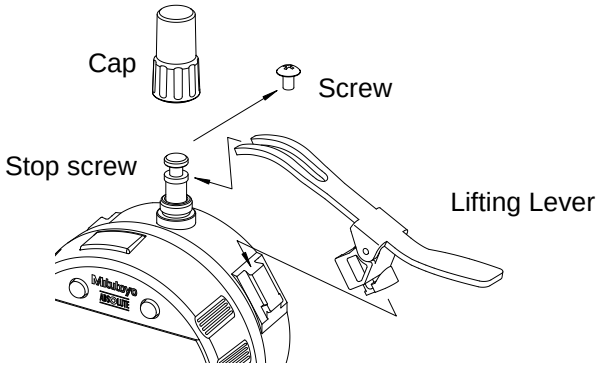
  →If the spindle axis is inclined ϕ from the perpendicular line to the reference plane, measurement error δ will be as follows for the measured length of 12 mm:

  ϕ = 1°: δ = 0.002mm
  ϕ = 2°: δ = 0.007mm
  ϕ = 3°: δ = 0.016mm
- If the instrument is to be secured with a fixture, fix it by the stem in a slotted hole of about ø8G7 (+0.005 to +0.02) or ø9.52 (+0.005 to +0.02).

2.4 Mounting Lifting Lever

A lifting lever (optional/ Parts No. 21EZA198 (mm), 21EZA199 (in)) is available for this instrument.

1. Rotate the cap counterclockwise to remove it from the instrument.
2. Hold the spindle with pliers protecting it with a rag to prevent it from rotating, remove the screw (M2.5 or No.4-48UNF) at the top of the spindle.
3. Attach the spindle stop provided with the lifting lever. Next, fix the lifting lever to the lever mounting part (dovetail) while applying its top to the spindle stop.



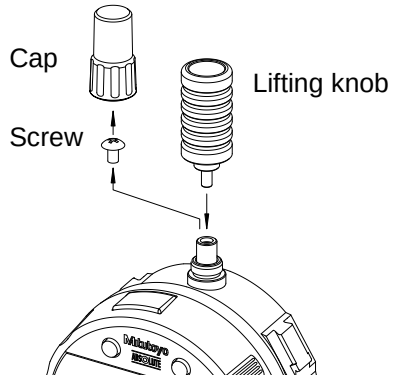
IMPORTANT

- Store the removed screw and cap, taking care to prevent loss.
- Using this instrument with the spindle stop loose may damage the internal parts or workpiece.
- When the spindle stop is not mounted, be sure to attach the removed screw to the top of the spindle. Failure to do so may damage the internal parts or workpiece.

2.5 Mounting Lifting Knob

A lifting knob (optional/ Parts No. 21EZA105 (mm), 21EZA150 (in)) is available.

1. Rotate the cap counterclockwise to remove it from the instrument.
2. Hold the spindle with pliers while protecting it with a rag to prevent rotation, remove the screw (M2.5 or No.4-48UNF) at the top of the spindle.
3. Fix the lifting knob to the top of the spindle.



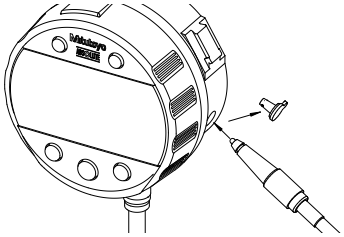
IMPORTANT

- Store the removed screw and cap, taking care to prevent loss.
- Using this instrument with the lifting knob loose may damage the internal parts or workpiece.
- When the lifting knob is not mounted, be sure to attach the removed screw to the top of the spindle. Failure to do so may damage the internal parts or workpiece.

2.6 Mounting Lifting Release

A release (optional/Parts No.540774) is available.

1. Remove the rubber cap from the release mounting hole.
2. Insert the release as far as possible into the hole.



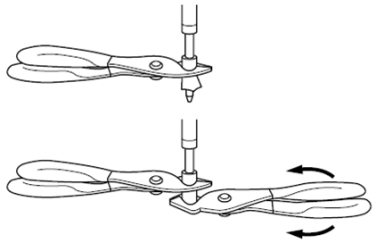
IMPORTANT

- Store the removed rubber cap, taking care to prevent loss.
- When attaching the rubber cap, screw it into the hole.
- When the release is not mounted, be sure to keep the rubber cap inserted.
- Inserting any object other than the release or applying an excess force to the hole may cause instrument malfunction.
- Moving the spindle up or down while the release is loose may damage the internal parts.

2.7 Replacing Contact Point

Interchangeable contact points and extension rods for Mitutoyo dial indicators are available.

1. Use two pliers (One is for holding the spindle and the other is for holding the contact point.) and a rag in the figure below. Rotate the plier which is holding the contact point clockwise to remove the contact point.
2. In a similar way, rotate the plier which is holding a contact point or an extension rod counterclockwise to mount.



IMPORTANT

- When replacing the contact point hold the spindle and turn the contact point. Otherwise, the indicator may be damaged.
- Changing the contact point also may change the external dimensions, measuring force, and limitation of the measuring direction. Contact point errors such as the non-perpendicularity of a flat contact point and run-out of the roller point add to the measurement error.

MEMO

3 FUNCTIONS AND OPERATIONS

This chapter describes functions and their operations of this instrument.

Each key function will change as follows depending on the operation mode.

●Measurement mode

* "Press and hold" means pressing and holding the key for 2 seconds or more.

Keys	Press	Press and hold
Lower left	PEAK (3.2.6)	PRESET (3.2.2)
Center	START (3.2.6) ZERO (3.2.5)	ABS (3.2.4)
Lower right	DATA (3.2.8) HOLD (3.2.7)	in/mm (3.2.10)
Upper left	→|← (3.2.9)	ON/OFF (3.1)
Upper right	MENU (3.3)	ORIGIN (3.2.1)

●Setup mode/Numerical values setting

Keys	Press	Press and hold
Lower left	**SELECT** / ▼	–
Center	**OK** / ▶	–
Lower right	**EDIT**/ ▲	–
Upper left	**CANCEL**	–
Upper right	**EXIT**	–

3.1 Power ON/OFF

Power ON: Press the upper left key.
Power OFF: Press and hold the upper left key

NOTE

- If the power is turned off right after the battery is installed before completing preset setting, "------" will be displayed when the power is turned on again.
- When the power is turned off while the instrument is holding the display value, and then the power is turned on again, the held display value will be released.

3.2 Measurement mode

The following describes each setting and operation of the measurement mode of this instrument. Refer to "1.1 Overview" for details of the measurement mode.

3.2.1 Origin point setting(Calculation reference point)

Origin point setting is required in order to measure using calculation function.
The origin point is a spindle position at which variable "x" in formula : $f(x)=Ax+B+Cx^{-1}$ becomes "0" (x=0). If the origin point is not set properly, a correct value may not be displayed depending on the calculation coefficients.
The origin point can be set only in the normal mode of ABS system.

1. Press and hold the upper right key. ("origin" will be displayed)
2. Press the center key at the appropriate spindle position (to be designated as the origin point).
3. The value to be displayed right after the origin point is set should be a calculation result with "x=0".

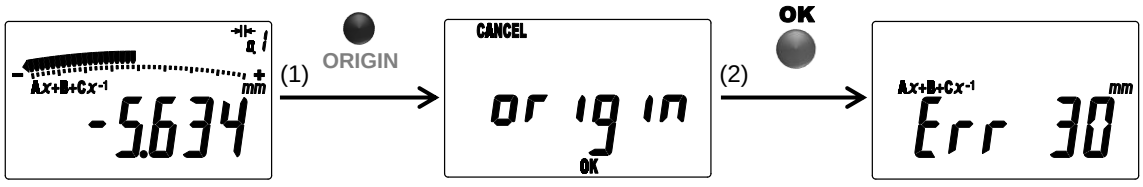
IMPORTANT

- This instrument internally calculates assuming spindle displacement as variable "x" which is based on the origin point(x=0). Unless the origin point that meets various jigs has been set, a correct calculation result may not be displayed.
- The origin point will be held even after the power is turned off. However, if the battery is replaced, set the origin point again.
- When setting the origin point, the preset position will be cleared (Preset No. will be disappeared.). However the preset value can be called, as it is being registered.

NOTE

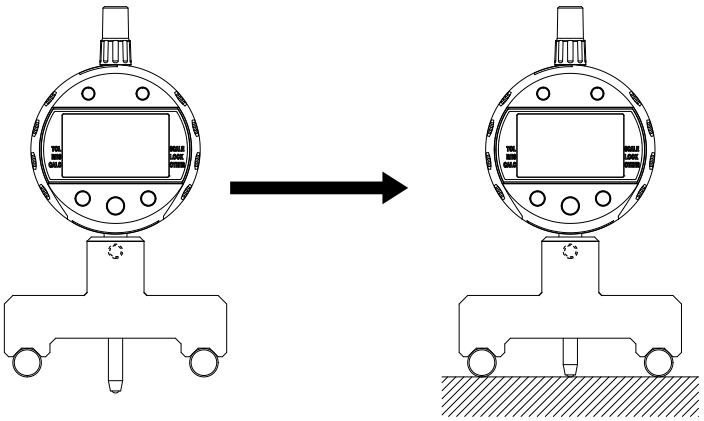
- If calculation function is not required, this setting is not necessary.
- The origin point cannot be set in the peak detection mode or INC system. So set it after changing the normal mode of ABS system.
- The origin point cannot be completed while the spindle is moving. So complete it after the spindle stops.
- When set the origin point while the calculation coefficient “C” is not being set to 0, overflow error of display value (Err30) is occurring. It is not unusual. A measurement data will be displayed when the spindle moves and the data will be in the digit number which can be displayed.
- The origin point can be offset by setting a desired origin offset value. Refer to "3.3.6.3 OFFSET(3): Origin offset".

Origin point setting



(When calculation coefficient “C” is not being set to 0.)

Example of origin point setting



3.2.2 Preset setting

Set up the preset when performing master setting.
Three settings; P1, P2, P3 are available as preset values.

1. Starting the preset setting
   Press and hold the lower left key in the measurement mode. "P☐" (☐ indicates Preset No.) starts blinking and the previously set value will be displayed. If the value does not need to be changed, skip to step 4.
2. Selecting preset No.
   Press the lower left key and select the preset No. to be set. Pressing the lower left key, the display changes in the following order: P1→P2→P3.
3. Editing the preset value.
   Press the lower right key to move the numerical value editing. Refer to "3.2.3 Numerical value editing" for details of the setting.
4. Completing the preset setting
   Lift up the spindle and position the contact point in the desired preset position. Next, press the center key. The preset setting is completed and the measurement in the ABS system will be ready.
   In the peak detection mode, the spindle position of maximum or minimum value will be set as the preset position.

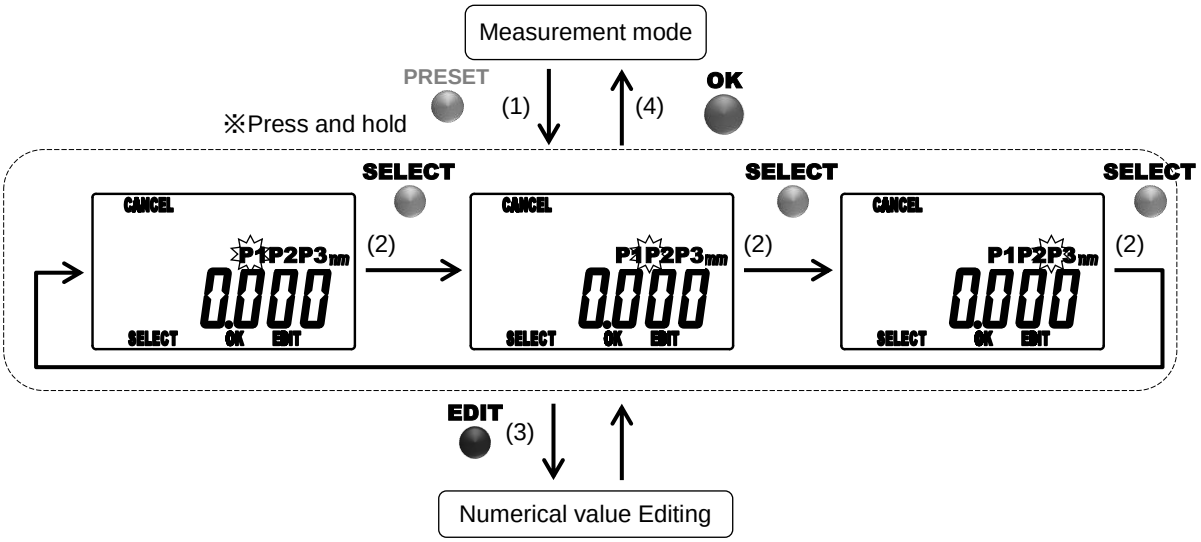
IMPORTANT

- Repeatability in the range of 0.2 mm (.0079”) from the bottom of the stroke is not guaranteed for this indicator. When setting the origin, be sure to lift the spindle at least 0.2 mm (.0079”) from the bottom of the stroke.
- The preset value will be calculated automatically according to the unit or the resolution. Check the preset value when the resolution is changed since the conversion error may occur.

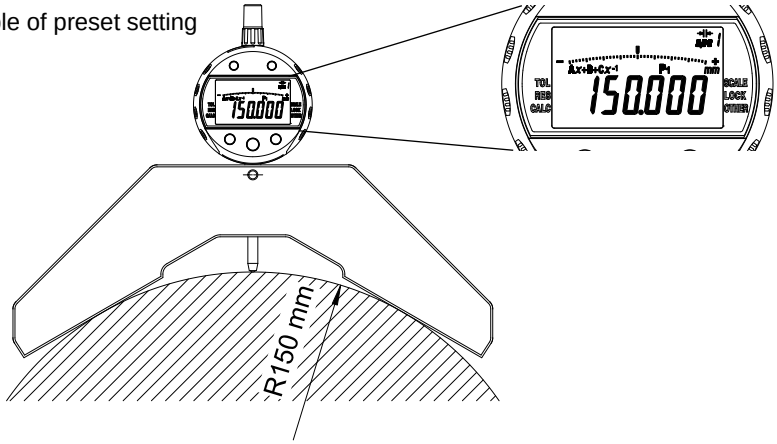
NOTE

- Press the upper left key to cancel the setting,
- The preset setting cannot be completed while the spindle is moving. So complete it after the spindle stops.
- The setup preset values and position will be held after the power is turned off. However, when the battery is replaced, the preset position will be cleared. Set up the position again.
- The power supply cannot be turned off with the upper left key in the preset setting.
- The preset setting may not be completed, when the calculation coefficient “C” is not being set to 0 and Overflow error of display value (Err30) is occurring. If it occurs, complete the preset setting after moving the spindle to an appropriate position.
- The preset setting cannot be completed if Overflow error of preset value (Err95) is occurring for the selected preset number. Reset the preset value.
- A rubber damper has been attached to the spindle in this indicator as a shock absorber. The elasticity of the damper may cause the indicated value to not stabilize at the bottom of the stroke, but this will not cause any operational problems.
- Also, the spindle may feel heavy at the bottom of the stroke when this indicator is first used, but this can be resolved by pushing the spindle up once.

Preset setting (Master setting)



Example of preset setting



3.2.3 Numerical value Editing

Numerical value for "Preset", "Tolerance judgment", "Calculation" can be edit by same key operation.

Items that requires numerical value editing

Functions	Editing items
Preset	P1, P2, P3
Tolerance judgment	Upper limit, Lower limit
Calculation function	Calculation coefficients: A, B, C Origin offset value

●Moving signs (+/-) and digits

Press the center key to move the sign or digit.

●Changing signs (+/-) and numerical values

Press the lower left key or lower right key to change the sign (+/-) or numerical value.

For signs (+/-)

Press the lower left or lower right key to switch the signs "+" ⇔ "-".

For numerical values

Pressing the lower left key, the display changes in the following order:
0→9→8→… →1→0.

Pressing the lower left key, the display changes in the following order:
0→1→2→… →9→0.

●Completing the numerical value editing

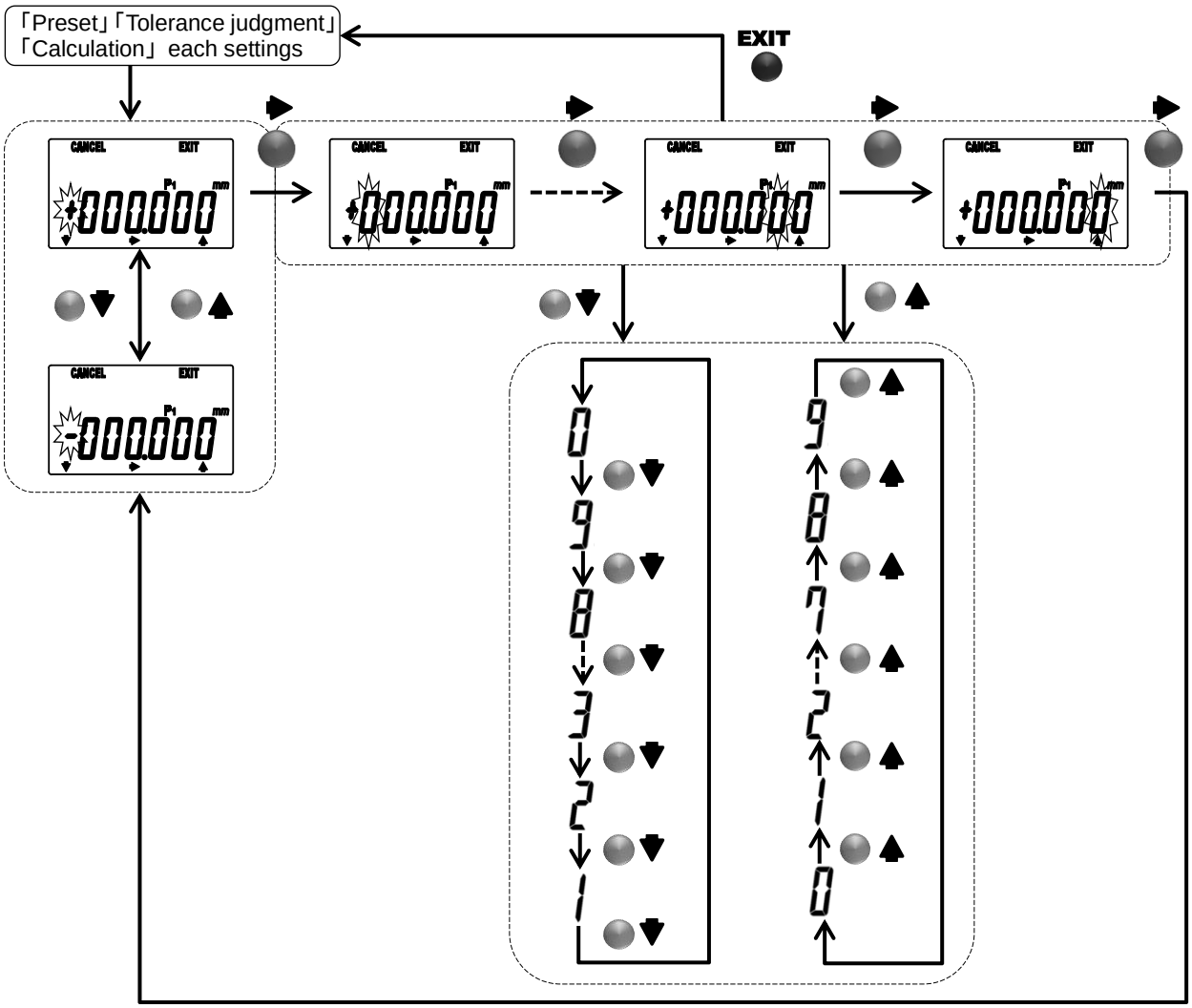
Press the upper right key to complete the numerical value editing.

After editing the numerical values, the previous setup widow will be restored.

NOTE

- If the last digit of resolution is "5", that of the numerical value changes in the order of "0 →5→0". Similarly if "2", in the order of "0→2→4→6→8→0".
- Press the upper left key to cancel the setting.
- The value is temporarily saved until completing each setting before moving the numerical value editing. If canceled, it will be deleted.

Numerical value Editing

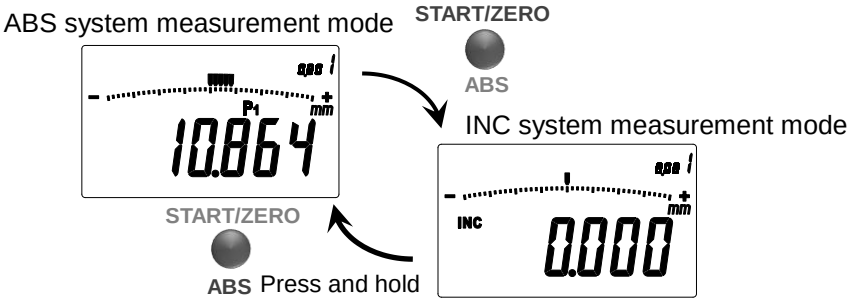


3.2.4 Switching measuring system (ABS/INC)

This can be operated only in the normal mode, not in the peak detection mode.
Press the center key to switch from ABS to INC.
Press and hold the center key to switch from INC to ABS.

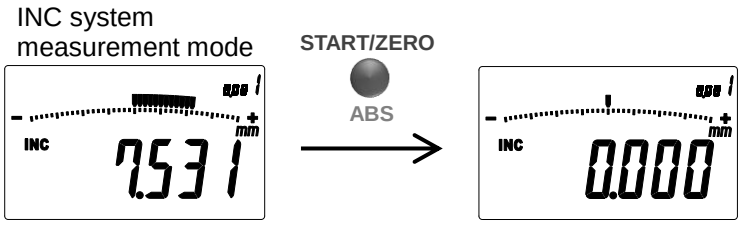
NOTE

- When the system is switched from ABS to INC, also display value will be set to the zero.
- It cannot switch from ABS to INC while the spindle is moving. So switch from ABS to INC after stopping the spindle.
- If switching is required in the peak detection mode, press the lower left key a few times to change the mode to the normal, and then switch the system.
- It may not switch from ABS to INC when the calculation coefficient “C” is not being set to 0 and Overflow error of display value (Err30) is occurring. If it occurs, switch from ABS to INC after moving the spindle to an appropriate position.



3.2.5 Zero-setting display value

Press the center key in the normal mode, the display value is set to zero.

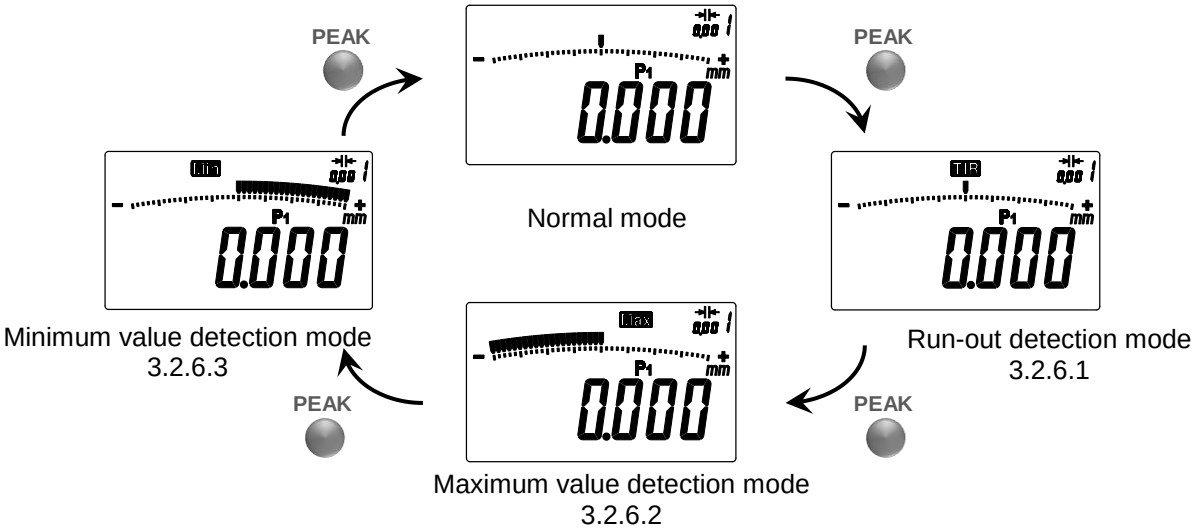


NOTE

- It cannot set to zero while the spindle is moving. So set to zero after stopping the spindle.
- It may not set to zero when the calculation coefficient “C” is not being set to 0 and Overflow error of display value (Err30) is occurring. If it occurs, set to zero after moving the spindle to an appropriate position.

3.2.6 Changing to peak detection mode

Press the lower left key to switch the mode between the normal mode and peak detection mode.
Pressing the lower left key to check each peak value by changing the display "TIR", "Max", and "Min" while the run-out, maximum and minimum value are held.



NOTE

- In the peak detection mode, start measuring while the contact point is contacting the measuring target.
- Note that the displacement caused by vibration, impact, etc. is detected.
- Detecting the peak will be being continued until changing to the normal mode.
- Holding the display value is possible in the peak detection mode. (Refer to "3.2.7 Holding display value".)
- The run-out, maximum value and minimum value can be confirmed to change the operation mode during holding the display value.
- The operation mode cannot be changed from peak detection to the normal mode while the display value is held.

3.2.6.1 Run-out detection mode ”TIR”

Hold the run-out of fluctuating measurement data (maximum value - minimum value). When the tolerance judgment condition has been set, the instrument displays the result of tolerance judgment for the run-out.

1. Press the lower left key a few times until "TIR" is displayed.
2. Press the center key. Run-out detection measurement is started.
3. When the measurement data exceeds either the maximum or minimum value, the display value will be updated.
   During update, "Max" or "Min" will blink.
4. The detected run-out will be held until the center key is pressed next time. Press the center key to restart run-out measurement.

NOTE

- When either a maximum or minimum value pointer of the analog bar is out of displayable range, the analog bar graduation automatically change by selecting the “Auto”.
- The tolerance judgment in the run-out detection mode is made by comparing the actual run-out value with the tolerance value (upper limit - lower limit).

3.2.6.2 Maximum value detection mode ”Max”

Hold the maximum value of fluctuating measurement data. When the tolerance judgment condition has been set, the instrument displays the result of tolerance judgment for the maximum value.

1. Press the lower left key a few times until "Max" is displayed.
2. Press the center key. Maximum value detection measurement is started.
3. When the measurement data exceeds the maximum value, "Max" starts blinking and the value is updated.
4. The detected maximum value will be held until the center key is pressed next time. Press the center key to restart maximum value measurement.

NOTE

- The maximum point can be edited into a desired value. So this instrument can measure based on this point. Refer to "3.2.2 Preset setting" to set the preset.
- When a maximum value pointer of the analog bar is out of displayable range, the pointer automatically moves to the center.

3.2.6.3 Minimum value detection mode ”Min”

Hold the minimum value of fluctuating measurement data. When the tolerance judgment condition has been set, the instrument displays the result of tolerance judgment for the minimum value.

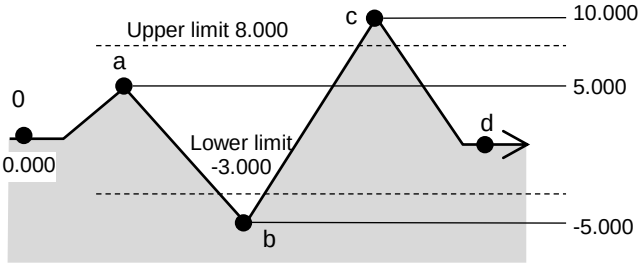
1. Press the lower left key a few times until "Min" is displayed.
2. Press the center key. Minimum value detection measurement is started.
3. When the measurement data falls below the minimum value, "Min" starts blinking and the value is updated.
4. The detected minimum value will be held until the center key is pressed next time. Press the center key to restart minimum value measurement.

NOTE

- The minimum point can be edited into a desired value. So this instrument can measure based on this point. Refer to "3.2.2 Preset setting" to set the preset.
- When a minimum value pointer of the analog bar is out of displayable range, the pointer automatically moves to the center.

TIP

- The following describes examples of display value and tolerance judgment in each measurement mode.



Example of display value in each measurement mode

	0	→	a	→	b	→	c	→	d
Normal	0.000	↗	5.000	↘	-5.000	↗	10.000	↘	0.000
TIR	0.000	↗	5.000	↗	10.000	↗	15.000		
Max	0.000	↗	5.000			↗	10.000		
Min	0.000			↘	-5.000				

Example of tolerance judgment (upper limit 8.000, Lower limit-3.000)

	0	a	b	c	d
Normal	○		◀	▶	○
TIR	○			◀ ▶	
Max	○			▶	
Min	○		◀		

3.2.7 Holding display value (when a data processor is not connected)

Press the lower right key in the measurement mode. "H" is displayed and the display value will be held. Press the lower right key again to release the hold.

NOTE
- If a data processor is connecting to this instrument during “H” is displayed, the held value will be output to it and then be released.
- The spindle position is being detected while “H” is displayed.

3.2.8 Display value output (when a data processor is connected)

The display value can be output to the data processor.
Press the lower right key in the measurement mode to output the display value to the data processor.
Refer to "4 Data Output" for cable connections, pin assignment, output format, and timing chart.

NOTE
- To use the data output function properly, refer to the operation manual of the data processor to be connected.
- When inputting a data output request (REQ) from a data processor, the spindle must be stopped. Otherwise, this instrument may output wrong data or may not output.
- If this instrument receives data output request (REQ) signals repeatedly at short intervals, it may not output a data.

3.2.9 Centering pointer of analog bar

When the pointer of the analog bar is out of displayable range, move the pointer to the center by setting up the graduation of the bar. It is same as in the case of mechanical dial indicator, shifting the bezel to a desired scale position.
Press the upper left key in each measurement mode in order to center the pointer of analog bar.

- Normal mode : Current measuring position
- Run-out detection mode : Center of the run-out
  : Center of the tolerance value, when enabling the tolerance judgment function.
- Maximum value detection mode : Maximum value
- Minimum value detection mode : Minimum value

NOTE
- It cannot center the pointer of analog bar when enabling the tolerance judgment function except Run-out detection mode. Because setting to the center of the tolerance value at all time.

3.2.10 Switching units (in/mm)

Press and hold the lower right key to switch the display unit between inch and metric.

NOTE
- When the unit is switched, the following will be converted accordingly: display value, preset values, tolerance value, resolution, calculation coefficients (B, C), origin offset value, and analog bar graduation.
  If it causes the overflow error of display value (Err 30), set the proper resolution.
  Also, it causes overflow error of each setting values or conversion error, it is recommended to check the values of each setting after switching unit.
- The display unit can be switched only in the normal mode. So if switching is required in the peak detection mode, press the lower left key a few times to change the mode to the normal, and then switch.

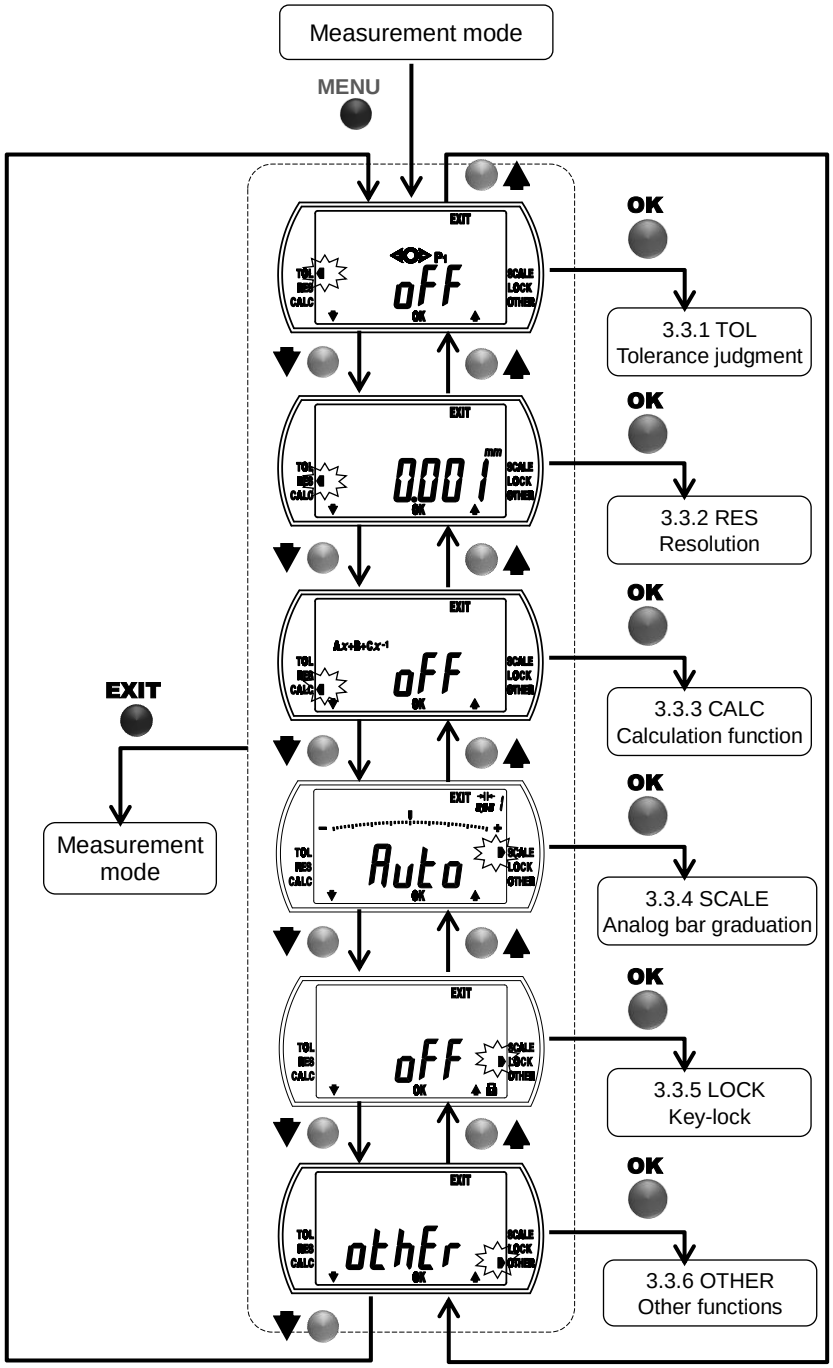
3.3 Setup Mode

The following parameters can be checked or set in the setup mode.

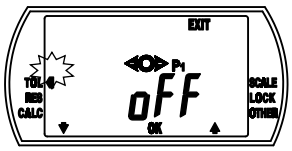
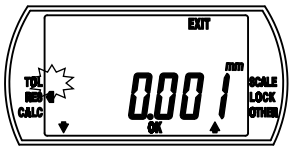
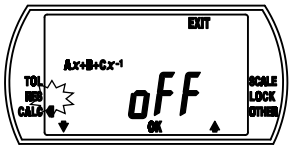
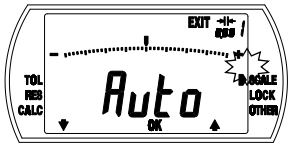
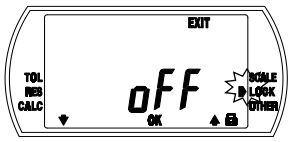
- Starting up the setup mode
  Press the upper right key in the measurement mode to move into the setup mode.
- Selecting parameters
  1. The blinking cursor indicates the currently selected parameter.
  2. Press the lower left or lower right key to display the current set parameter.
     - Pressing the lower left key, the cursor moves in the following order: TOL→RES → ... →OTHER→TOL.
     - Pressing the lower right key, the cursor moves in the following order: TOL→ OTHER→ ... →RES→TOL.
  3. Press the center key to move the parameter setting
- Completing the setup mode
  Press the upper right key to complete setup mode and return to the measurement mode,

NOTE

- During the setup mode, key assists which correspond to each key will be displayed. (Refer to "1.4 Details of Display Unit".)
- The setup parameters will be registered even after the battery is replaced or power is turned off. However, if the battery is replaced while the key-lock function is enabled, the key-lock function will be set off.
- The power supply cannot be turned off with the upper left key in the setup mode.


Measurement mode
MENU
EXIT
OK
oFF
0.001
Ax+B+Cx-1
oFF
Auto
oFF
othEr
TOL
RES
CALC
SCALE
LOCK
OTHER
3.3.1 TOL
Tolerance judgment
3.3.2 RES
Resolution
3.3.3 CALC
Calculation function
3.3.4 SCALE
Analog bar graduation
3.3.5 LOCK
Key-lock
3.3.6 OTHER
Other functions
Measurement
mode

Parameters

Parameter	Example of display	Settings
TOL (Tolerance judgment)	 “ON” or ”OFF”	Selecting ON/OFF of tolerance judgment and tolerance value setting
RES (Resolution)	 Current resolution	Selecting resolution of the display
CALC (Calculation function)	 “ON” or ”OFF”	Selecting ON/OFF of calculation function and coefficients setting
SCALE (Analog bar graduation)	 Current analog bar graduation	Selecting analog bar graduation
LOCK (Key-lock)	 “ON” or ”OFF”	Selecting ON/OFF of key-lock function
OTHER (Other functions)	 “other”	Setting other functions (Refer to "3.3.6 OTHER: Other functions".)

3.3.1 TOL: Tolerance judgment

The tolerance judgment function compares measurement data (display value) with tolerance values (upper/lower limit) for OK/NG judgment. The tolerance values can be set in ABS system (P1, P2, P3) and INC system respectively.

- Enabling tolerance judgment. Changing tolerance values
  1. Press the upper right key in the measurement mode to move the setup mode.
  2. Press the lower left or lower right key to move the blinking cursor to "TOL".
  3. Press the center key to move the ON/OFF selection of the tolerance judgment function.
  4. Press the lower left key to select "ON".
  5. Press the center key to move the tolerance value setting (upper/lower limit). The upper limit sign is blinking, and currently set value will be displayed.
  6. When press the lower left key, the display switches to the lower limit. (Pressing the lower left key, the upper limit and the lower limit switch.) The lower limit sign (or the upper limit sign) is blinking, and the currently set lower limit (or the upper limit) will be displayed.
  7. To edit the tolerance value, select the target value and press the lower right key. The numerical value editing will be enabled. (Refer to "3.2.3 Numerical value editing".)
  8. Press the center key after checking or editing the tolerance values. The tolerance judgment is set "ON", and the mode returns to the parameter setting. (Refer to "3.3 Setup Mode".)
- Disabling tolerance judgment
  1. Press the upper right key in the measurement mode to move the setup mode.
  2. Press the lower left or lower right key to move the blinking cursor to "TOL".
  3. Press the center key to move the ON/OFF selection of the tolerance judgment function.
  4. Press the lower left key to select "OFF".
  5. Press the center key to set the tolerance judgment "OFF" and return to the parameter setting. (Refer to "3.3 Setup Mode".)

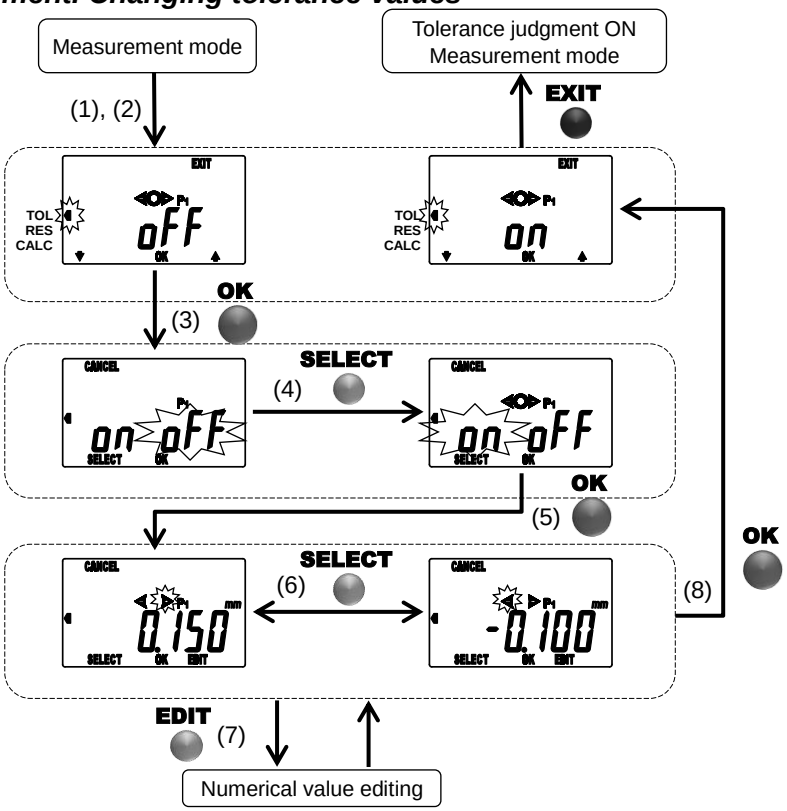
IMPORTANT

- The tolerance values will be set in the currently active system (ABS (P1, P2, P3) or INC). Check the desired measuring system is selected before setting the tolerance judgment function.
- The tolerance values will be calculated automatically according to the unit or the resolution. Check the tolerance values after the resolution is changed since the conversion error may occur.

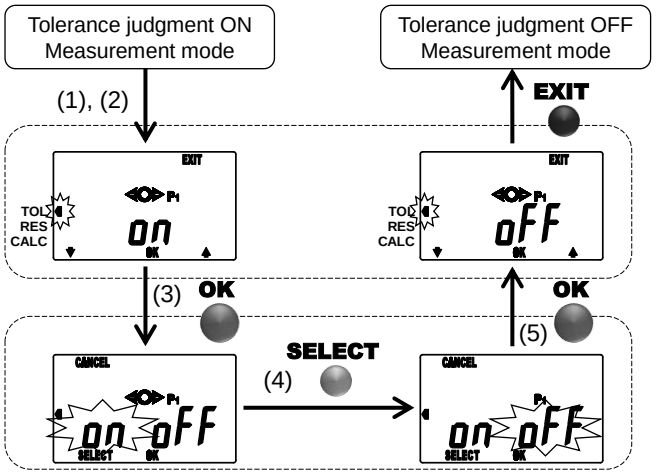
NOTE

- Press the upper left key to cancel the operation.
- The tolerance judgment in the run-out detection mode is made by comparing the actual run-out value with the tolerance value (upper limit - lower limit).
- If the upper limit is set lower than the lower limit, the tolerance upper/lower limit setting error (Err 90) will occur. Reset the values to be the upper limit is greater than the lower limit.
- The tolerance judgment setting cannot be completed if Overflow error of upper / lower limit value (Err95) is occurring. Reset the upper or lower limit value.

Enabling tolerance judgment. Changing tolerance values



Disabling tolerance judgment



3.3.2 RES: Resolution

The resolution of the display can be changed.

- Selecting the resolution
  1. Press the upper right key in the measurement mode to move the setup mode.
  2. Press the lower left or lower right key to move the blinking cursor to "RES".
  3. Press the center key to set the resolution.
  4. Press the lower left or lower right key to switch the resolution.
  5. Press the center key to set the resolution and the mode returns to the parameter setting. (Refer to "3.3 Setup Mode".)

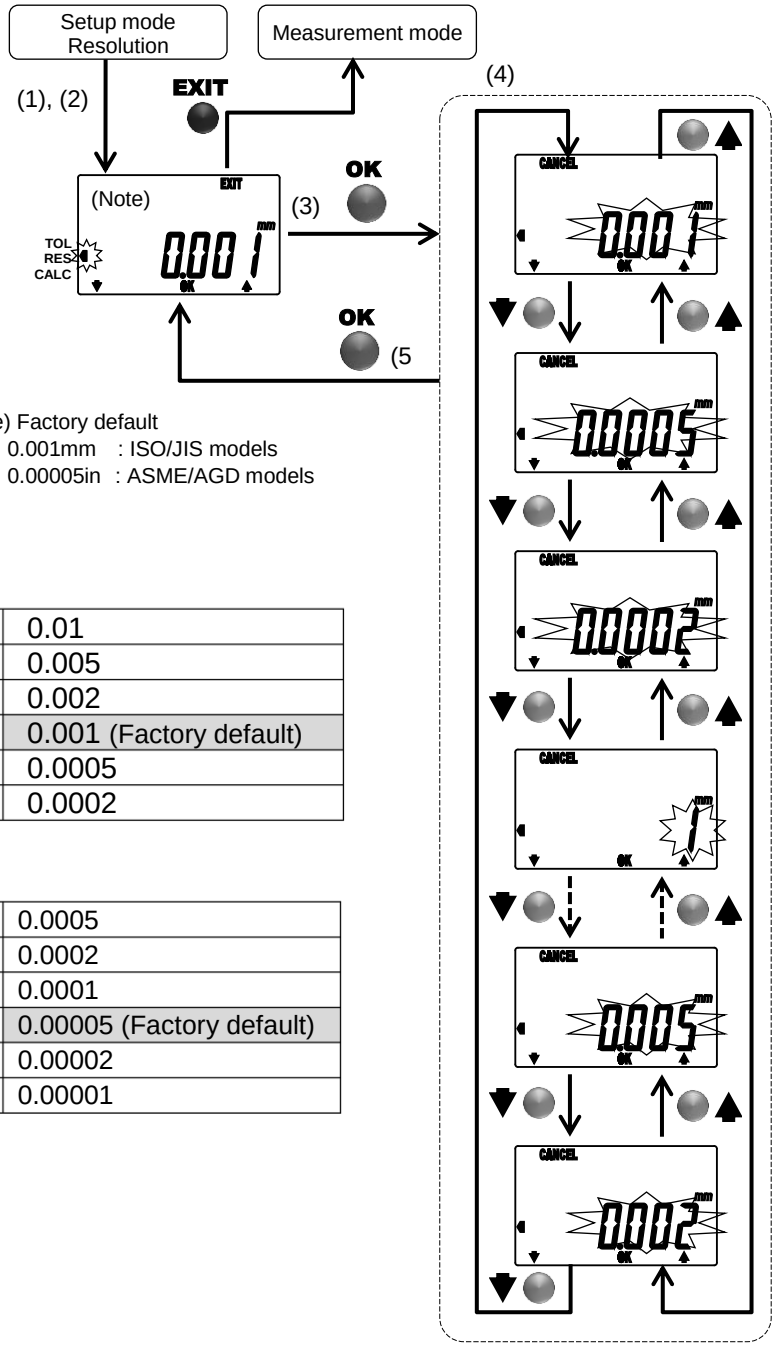
IMPORTANT

- The preset values (P1, P2, P3) and the tolerance values (upper and lower limits) will be calculated automatically according to the resolution. Check the values after changing the resolution, since the conversion error or overflow error (Err95) may occur.

NOTE

- Press the upper left key to cancel the operation.
- The coefficients (A, B, C) and the origin offset value will not be changed by changing the resolution.
- Set up a greater resolution than 0.001mm in disabling the calculation function. If 0.0005mm or 0.0002mm is set in this condition, a last digit will not be changed. Because the resolution of the spindle displacement "x" is "0.001mm".
- When the unit is switched, the resolution will be automatically changed accordingly. Check the resolution after switching the unit.
- When the unit is hidden (refer to "3.3.6.2 UNIT(2): Unit display"), the resolution will be same as the previously set unit.

Selecting the resolution



(Note) Factory default
0.001mm : ISO/JIS models
0.00005in : ASME/AGD models

Resolutions

Metric

(1)	1	(7)	0.01
(2)	0.5	(8)	0.005
(3)	0.2	(9)	0.002
(4)	0.1	(10)	0.001 (Factory default)
(5)	0.05	(11)	0.0005
(6)	0.02	(12)	0.0002

Inch

(1)	0.05	(7)	0.0005
(2)	0.02	(8)	0.0002
(3)	0.01	(9)	0.0001
(4)	0.005	(10)	0.00005 (Factory default)
(5)	0.002	(11)	0.00002
(6)	0.001	(12)	0.00001

3.3.3 CALC: Calculation function

This special instrument supports measurements by internal calculations using the formula $f(x)=Ax+B+Cx^{-1}$ (“x” is a spindle displacement). The calculation coefficients (A, B, C) can be set.

- Enabling the calculation function. Checking or changing the calculation coefficients.
  1. Press the upper right key in the measurement mode to move the setup mode.
  2. Press the lower left or lower right key to move the blinking cursor to "CALC".
  3. Press the center key to move the ON/OFF selection of the calculation function.
  4. Press the lower left key to select "ON".
  5. Press the center key to move the calculation coefficient setting (A, B, C).
     The coefficient signs (A, B, C) will blink, and currently set value will be displayed.
  6. Press the lower left key to change the calculation coefficient.
  7. To change the calculation coefficient, select the target coefficient and press the lower right key. The numerical value editing will be enabled. (Refer to "3.2.3 Numerical value editing".)
  8. Press the center key after checking or changing the calculation coefficients. The calculation function is set "ON", and the mode returns to the parameter setting. (Refer to "3.3 Setup Mode".)
  9. Set up the origin point. (Refer to “3.2.1 Origin point setting”.)
- Disabling the calculation function
  1. Press the upper right key in the measurement mode to move the setup mode.
  2. Press the lower left or lower right key to move the blinking cursor to "CALC".
  3. Press the center key to move the ON/OFF selection of the calculation function.
  4. Press the lower left key to select "OFF".
  5. Press the center key to set the calculation function "OFF" and return to the parameter setting. (Refer to "3.3 Setup Mode".)

IMPORTANT

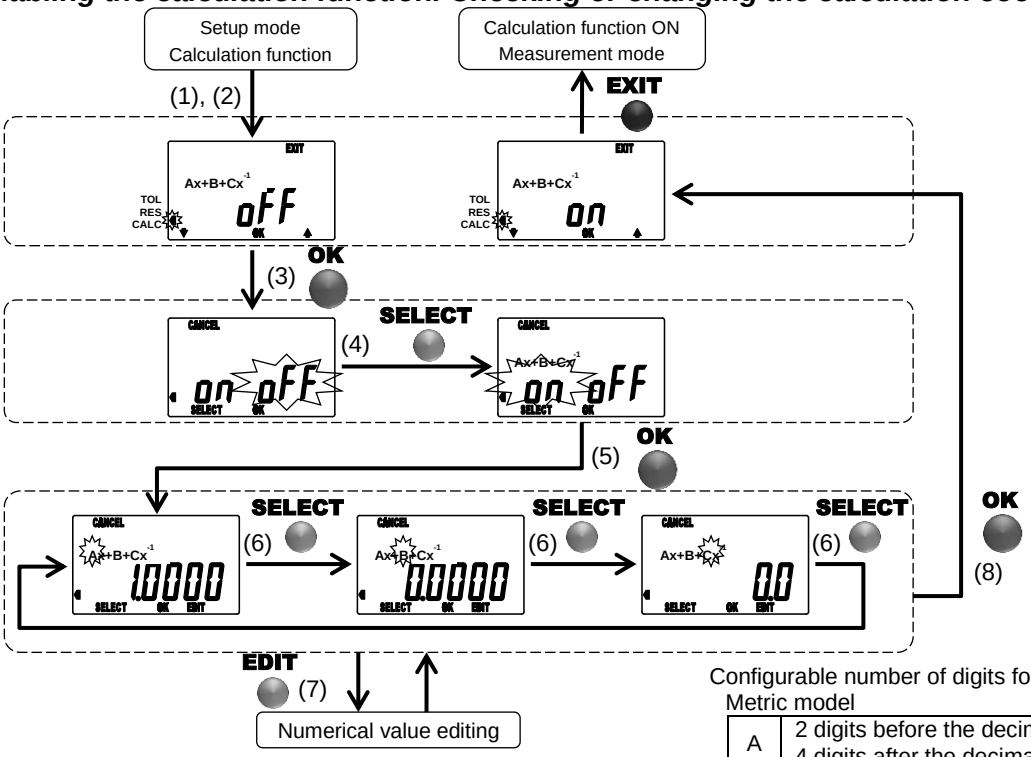
- When enabling the calculation function or changing the calculation coefficient in the ABS system, the preset position will be cleared (Preset No. will be disappeared.). However the preset value can be called, as it is being registered.
- When enabling the calculation function or changing the calculation coefficient in the INC system, the zero set position will be cleared (“INC” will be disappeared.). Set to zero after moving the spindle to an appropriate position. (Refer to "3.2.5 Zero-setting display value".)

NOTE

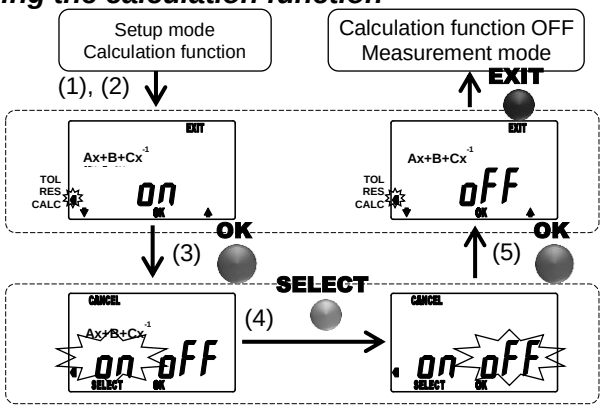
- Press the upper left key to cancel the operation.
- Overflow error of display value (Err30) may occur as a result of calculation. (Refer to "5 ERROR MESSAGES AND ACTION".)
- Set up the calculation coefficients and the resolution to be a proper combination. If this combination is not proper, a last digit will not be changed. Because the resolution of the spindle displacement "x" is "0.001mm".
  Example) Resolution=0.0002mm, Calculation coefficients: A=1, B=C=0
- The factory default of the calculation coefficients are A=1, B=C=0.
- The calculation function setting cannot be completed if the calculation coefficient A is set to zero. Reset the calculation coefficient A.
- The calculation coefficients (A, B, C) will not be converted by the resolution changing.

- The calculation coefficients (B, C) will be calculated automatically according to the unit. Check the calculation coefficients after the unit is changed since the conversion error or overflow error (Err95) may occur.
- Set up the origin offset to add an offset value to the spindle displacement "x". (Refer to "3.3.6.3 OFFSET(3): Origin offset".)
- The number of digits available for each calculation coefficient is described below.

Enabling the calculation function. Checking or changing the calculation coefficients.



Disabiling the calculation function



Configurable number of digits for calculation coefficient

Metric model

A	2 digits before the decimal point, 4 digits after the decimal point
B	2 digits before the decimal point, 4 digits after the decimal point
C	5 digits before the decimal point, 1 digits after the decimal point

Inch models

A	mm	2 digits before the decimal point, 4 digits after the decimal point
	inch	
B	mm	2 digits before the decimal point, 4 digits after the decimal point
	inch	1 digits before the decimal point, 5 digits after the decimal point
C	mm	5 digits before the decimal point, 1 digits after the decimal point
	inch	2 digits before the decimal point, 4 digits after the decimal point

3.3.4 SCALE: Analog bar graduation

The analog bar graduation (Display range: ±20) can be changed.

- Selecting a graduation of analog bar
  1. Press the upper right key in the measurement mode to move the setup mode.
  2. Press the lower left or lower right key to move the blinking cursor to "SCALE".
  3. Press the center key to set the analog bar graduation.
  4. Press the lower left or lower right key to switch the analog bar graduation.
  5. Press the center key to set the analog bar graduation and return to the parameter setting. (Refer to "3.3 Setup Mode".)

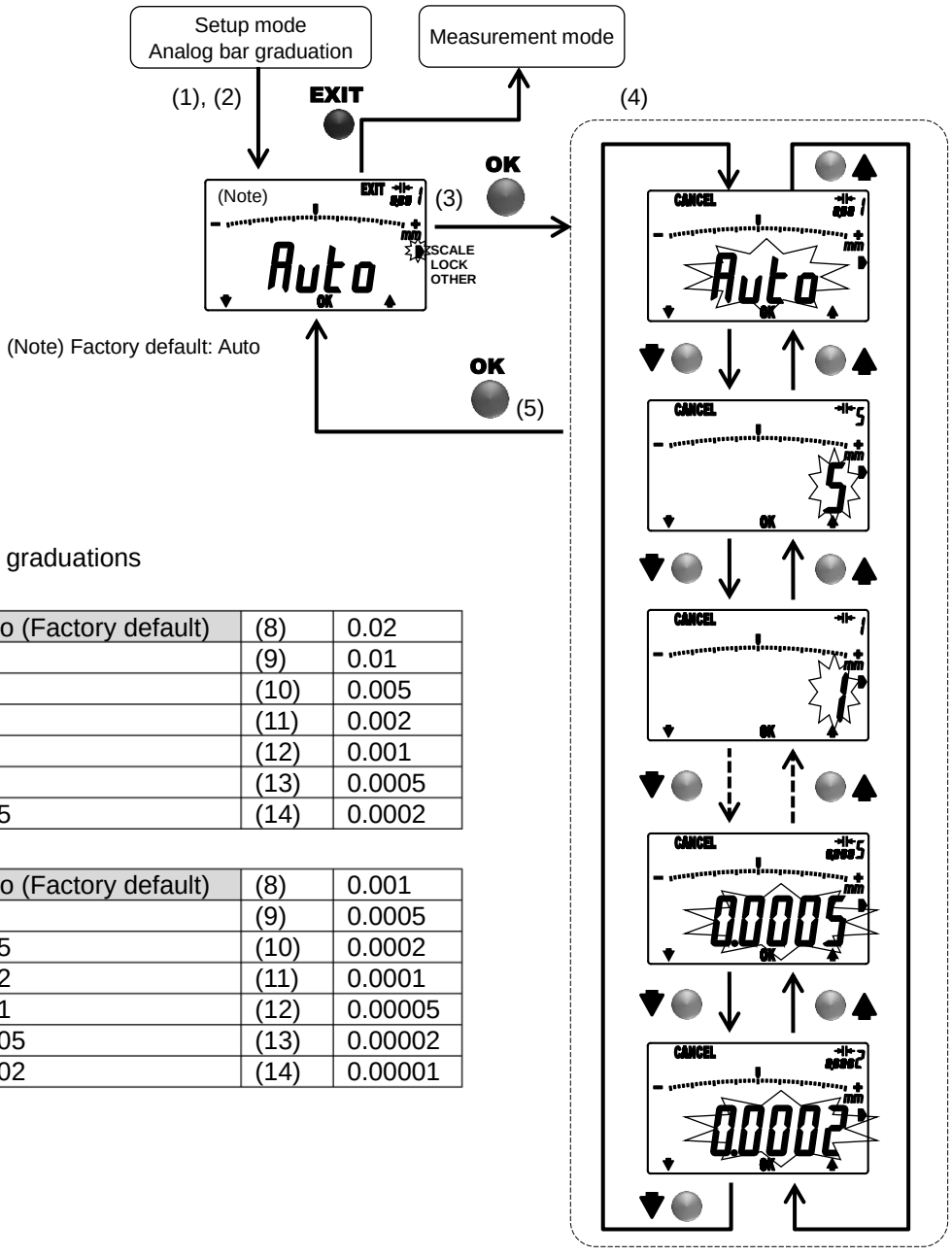
NOTE

- Press the upper left key to cancel the operation.
- The factory default of the analog bar graduation is "Auto". Change it as required.
- If the analog bar graduation is set to "0.0005mm" or "0.0002mm", the resolution will be "0.001mm". Because the resolution of the spindle displacement "x" is "0.001mm".
- The analog bar will be displayed based on the display value. If the analog bar graduation is selected lower than the resolution of display value, the analog bar will vary discontinuously.
- When the unit is switched, the graduation of the analog bar will be automatically changed accordingly. After switching the unit, check the graduation of the analog bar.
- When the unit is hidden (refer to "3.3.6.2 UNIT(2): Unit display"), the graduation will be same as the previously set unit.

TIP

- The graduation of the analog bar will change automatically in the following conditions:
  1. Run-out detection mode: Graduation will change run-out to be within the display range.
  2. Tolerance judgment ON: Graduation will change tolerance values to be within the display range.
  3. Changing resolution: Graduation will change same as resolution.

Selectiong a graduation of analog bar



Analog bar graduations

Metric

(1)	Auto (Factory default)	(8)	0.02
(2)	5	(9)	0.01
(3)	1	(10)	0.005
(4)	0.5	(11)	0.002
(5)	0.2	(12)	0.001
(6)	0.1	(13)	0.0005
(7)	0.05	(14)	0.0002

Inch

(1)	Auto (Factory default)	(8)	0.001
(2)	0.2	(9)	0.0005
(3)	0.05	(10)	0.0002
(4)	0.02	(11)	0.0001
(5)	0.01	(12)	0.00005
(6)	0.005	(13)	0.00002
(7)	0.002	(14)	0.00001

3.3.5 LOCK: Key-lock

Key operation can be partially disabled in order to avoid incorrect key operation.

- Enabling key-lock (disabling key operation)
  1. Press the upper right key in the measurement mode to move the setup mode.
  2. Press the lower left or lower right key to move the blinking cursor to "LOCK".
  3. Press the center key to move the ON/OFF selection of the key-lock function.
  4. Press the lower left key to select "ON".
  5. Press the center key to set the key-lock function "ON" and return to the parameter setting. (Refer to "3.3 Setup Mode".)
- Disabling key-lock (enabling key operation)
  1. Press the upper right key in the measurement mode to move the setup mode.
  2. Press the lower left or lower right key to move the blinking cursor to "LOCK".
  3. Press the center key to move the ON/OFF selection of the key-lock function.
  4. Press the lower left key to select "OFF".
  5. Press the center key to set the key-lock function "OFF" and return to the parameter setting. (Refer to "3.3 Setup Mode".)

NOTE

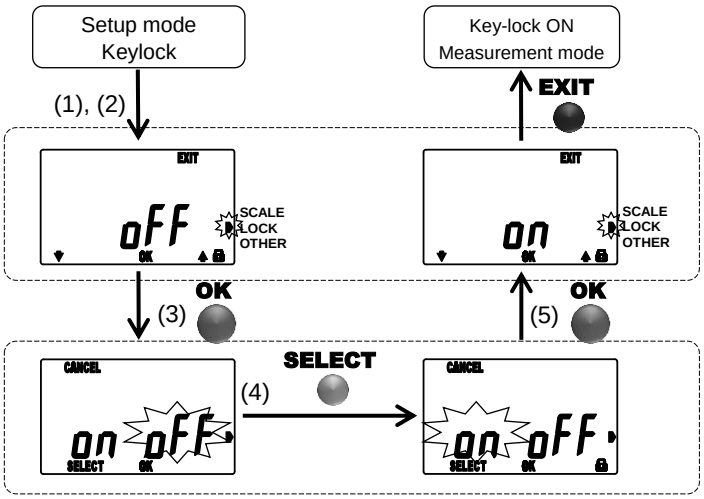
- Press the upper left key to cancel the operation.
- The key-lock function will not be disabled by turning off the power. However, it will be set off when the battery is replaced.
- When the key-lock is set on, other than key-lock cannot be selected in the setup mode.
- The key-lock items can be customized via PC communication. (Refer to "3.3.6.1 PC(1): PC communication".)

Functions to be disabled while key-lock is on

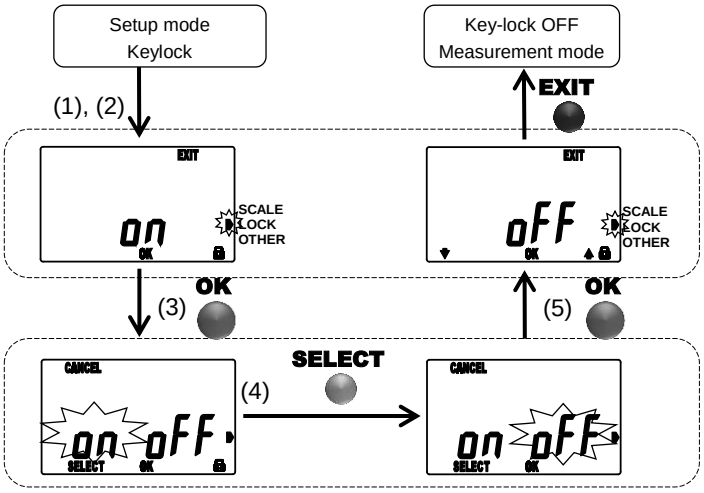
- Measurement mode

Keys	Operation	Key names		Disabled functions		Remarks
		Metric model	Inch models	Metric model	Inch models	
Lower left key	Press	PEAK		○		3.2.6
	Press and Hold	PRESET		○		3.2.2
Center key	Press	ZERO		○		3.2.5
	Press and Hold	ABS		○		3.2.4
Lower right key	Press	DATA/HOLD		—		3.2.7 3.2.8
	Press and Hold	—	in/mm	—	○	3.2.10
Upper left key	Press	→|←		○		3.2.9
	Press and Hold	ON/OFF		—		3.1
Upper right key	Press	MENU		—		3.3
	Press and Hold	ORIGIN		○		3.2.1

Enabling key-lock (disabling key operation)



Disabling key-lock (enabling key operation)

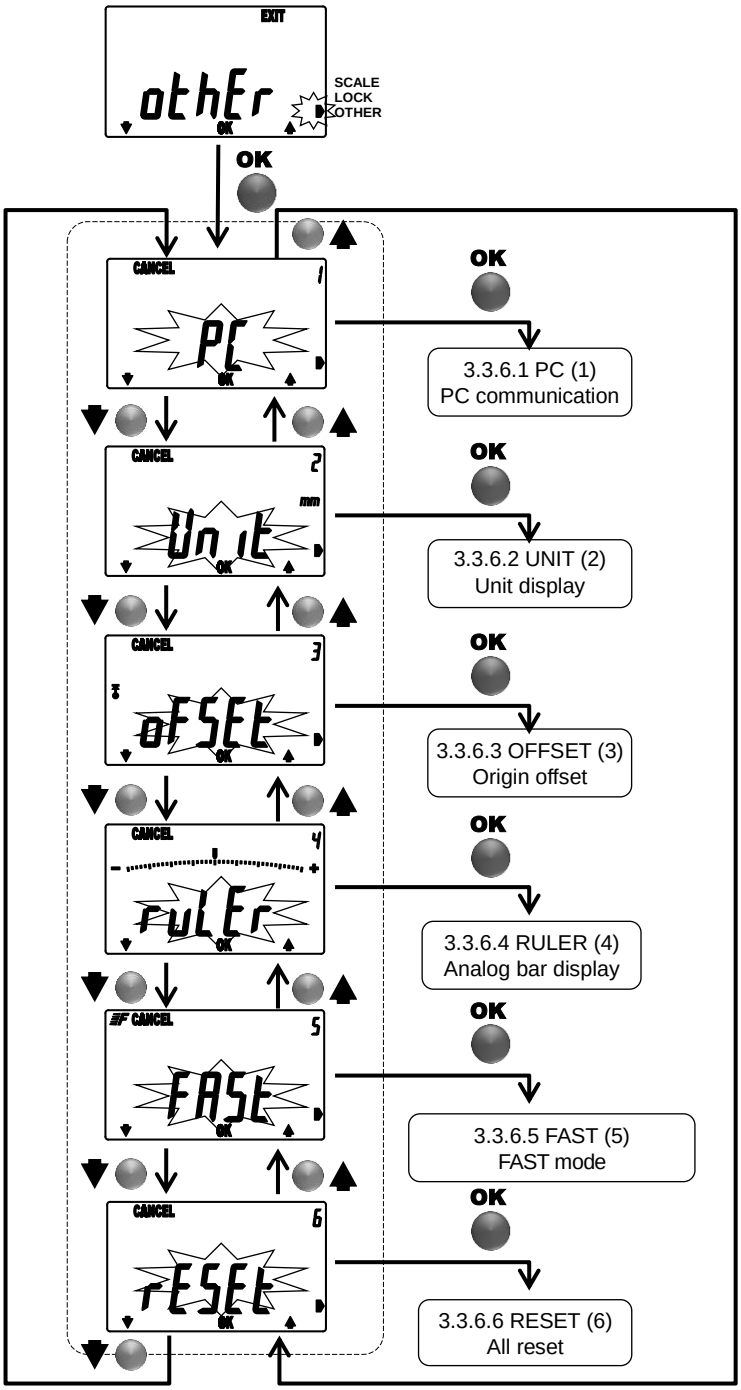


3.3.6 OTHER: Other functions

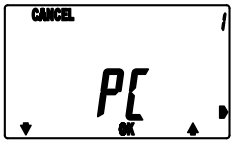
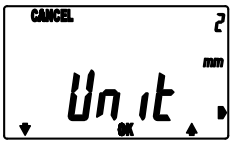
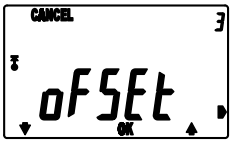
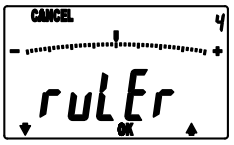
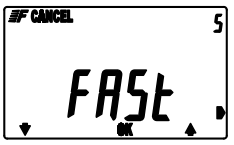
Check or set up the PC communication or the unit display.

- Selecting items available in OTHER functions
  1. Press the upper right key in the measurement mode to move the setup mode.
  2. Press the lower left or lower right key to move the blinking cursor to "OTHER".
  3. Press the center key to move the ON/OFF selection of OTHER functions.
  4. Press the lower left or lower right key to change the item in the other functions.
     ･Pressing the lower left key, the display changes in the following order:
     PC communication → Unit display →...→ All reset → PC communication
     ･Pressing the lower right key, the display changes in the following order:
     PC communication → All reset→...→ Unit display → PC communication.
  5. Press the center key to return to the parameter setting.

NOTE ･ Press the upper left key to cancel the operation.


EXIT
othEr
OK
SCALE
LOCK
OTHER
OK
CANCEL
1
PC
OK
3.3.6.1 PC (1)
PC communication
CANCEL
2
mm
Unit
OK
3.3.6.2 UNIT (2)
Unit display
CANCEL
3
oFSEt
OK
3.3.6.3 OFFSET (3)
Origin offset
CANCEL
4
rULEr
OK
3.3.6.4 RULER (4)
Analog bar display
CANCEL
5
FASt
OK
3.3.6.5 FAST (5)
FAST mode
CANCEL
6
rESEt
OK
3.3.6.6 RESET (6)
All reset

Items available in OTHERs

Other functions (Item No.)	Example of LCD display	Settings
PC(1) PC communication	 1, PC	Selecting ON/OFF of PC communication for each setting
UNIT(2) Unit display	 2, UNIT	Selecting ON/OFF of unit display
OFFSET(3) Origin offset	 3, OFFSET	Selecting ON/OFF of origin offset, and origin offset value setting
RULER(4) Analog bar display	 4, RULER	Selecting ON/OFF of analog bar display
FAST(5) FAST mode	 5, FAST	Selecting ON/OFF of FAST mode
RESET(6) All reset	 6, RESET	Executing all reset

3.3.6.1 PC(1): PC communication

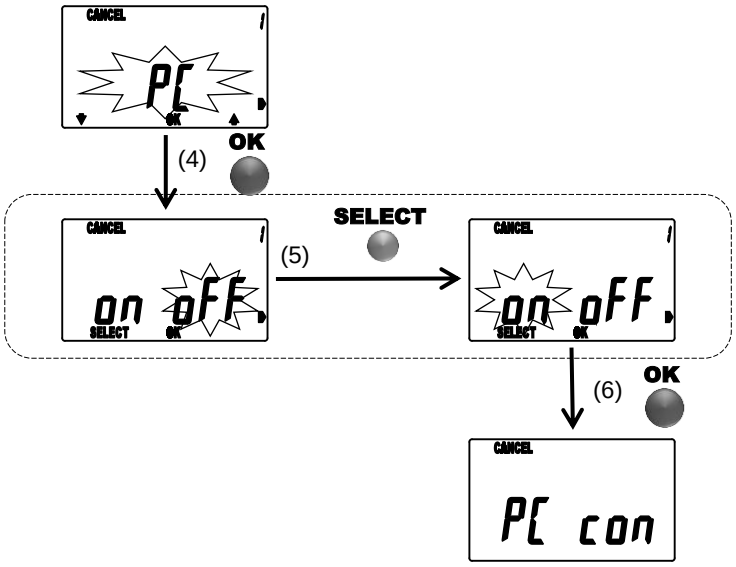
This instrument can set up or change various items with special software, if it connects to Personal computer with a Parameter setup kit (optional accessory).

- Enabling PC communication
  1. Connect a Parameter setup kit.
  2. Press the upper right key in the measurement mode to move the setup mode, and select OTHER functions. (Refer to "3.3.6 OTHER: Other functions".)
  3. Press the lower left or lower right key until "PC" is blinking.
  4. Press the center key to move the PC communication setting.
  5. Press the lower left key to select "ON".
  6. Press the center key to start communication with the PC.
     When the communication is started, "PC con" will be displayed.

NOTE

- Press the upper left key to cancel the communication with the PC.
- Remove the cap of the output connector, and securely connect the cable.
- Do not disconnect the Parameter setup kit while communicating with the PC.
- When communication with PC is finished, the measurement mode will be restored.
- For details of communication with the PC, refer to the operation manual supplied with the Parameter setup kit.

Enabling PC communication



Configurable items by external input

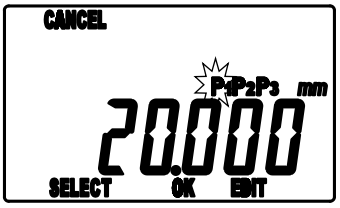
Configurable items		Settings
Preset		Preset No.: P1 / P2 / P3 Preset value: P1 / P2 / P3
Measuring system		ABS system / INC system
Unit		mm / in (only inch models)
Peak detection mode		OFF/ Run-out detection mode/ Maximum value detection mode/ Minimum value detection mode
Tolerance judgment		ON / OFF
		Upper and lower limit of each measuring system (ABS (P1, P2, P3) and INC)
Resolution	Metric	0.0002 / 0.0005 / 0.001 / 0.002 / 0.005 / 0.01 / 0.02 / 0.05 / 0.1 / 0.2 / 0.5 / 1
	Inch	0.00001 / 0.00002 / 0.00005 / 0.0001 / 0.0002 / 0.0005 / 0.001 / 0.002 / 0.005 / 0.01 / 0.02 /0.05
Calculation function		ON / OFF
		Calculation coefficients: A/ B/ C
Analog bar graduation	Metric	AUTO / 0.0002 / 0.0005 / 0.001 / 0.002 / 0.005 / 0.01 / 0.02 / 0.05 / 0.1 / 0.2 / 0.5 / 1 / 5
	Inch	AUTO / 0.00001 / 0.00002 / 0.00005 / 0.0001 / 0.0002 / 0.0005 / 0.001 / 0.002 / 0.005 / 0.01 / 0.02 / 0.05 / 0.2
Key-lock		ON / OFF
		Key-lock setting (multiple selection possible) ・PEAK (Changing the peak detection mode) ・PRESET(Preset setting) ・ZERO (Zero-set of display value) ・ABS (Switching the measuring system) ・DATA/HOLD (Holding the display value/Display value output) ・in/mm (Switching the unit (inch⇔mm)) ・→|← (Centering the analog bar) ・ORIGIN (Origin point setting)
Unit display		ON / OFF
Origin offset		ON / OFF
		Origin offset value
Analog bar display		ON / OFF
FAST mode		ON / OFF
Parameter-lock		ON / OFF
		Parameter-lock setting (multiple selection possible) ・Preset value setting: P1/ P2/ P3 ・Tolerance setting: P1: upper limit/lower limit, P2: upper limit/lower limit P3: upper limit/ lower limit, INC: upper limit, lower limit ・Calculation coefficient setting: A/ B/ C ・Origin offset value setting ・MENU key

TIP

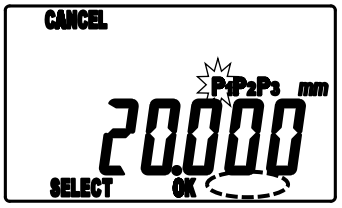
- The parameter-lock function is to disable each setting and all reset operation, and it is available only while communicating with PC.
- When the parameter lock is enabled, the locked parameter cannot be edited with the instrument.
- While the parameter lock is enabled, the "EDIT" sign with the lower right key will not be displayed.
- When the MENU Key is set to “Lock”, the parameters other than PC communication cannot be confirmed and set by operating the key of this instrument. Release the Lock of MENU Key by conducting the PC communication if you want to confirm or set each parameter.

Display example during parameter-lock (Preset setting)

【Parameter-lock OFF】



【Parameter-lock ON】



※The "EDIT" sign will not be displayed

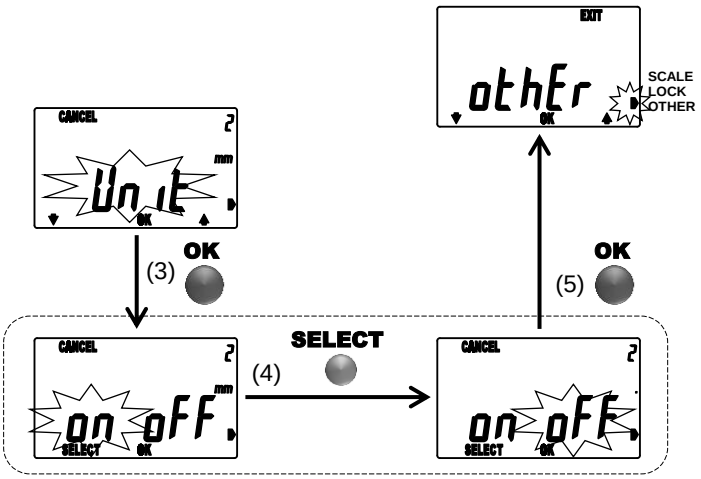
3.3.6.2 UNIT(2): Unit display

Unit can be hidden.

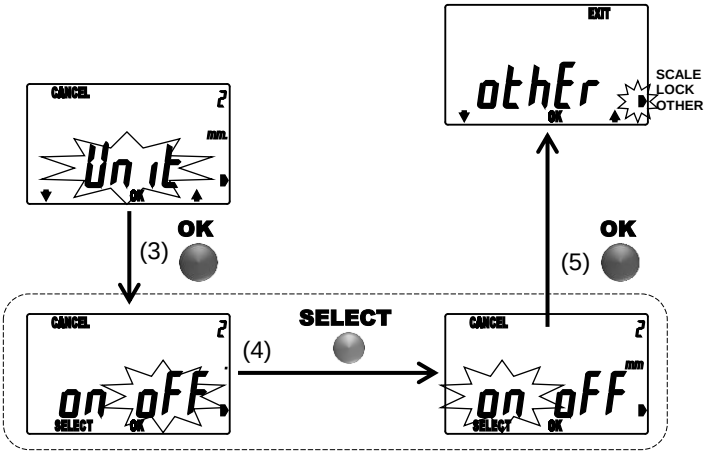
- Hiding the unit
  1. Press the upper right key in the measurement mode to move the setup mode, and select OTHER functions. (Refer to "3.3.6 OTHER: Other functions".)
  2. Press the lower left or lower right key until "Unit" is blinking.
  3. Press the center key to move the ON/OFF selection of the unit display.
  4. Press the lower left key to select "OFF".
  5. Press the center key to hide the unit and return to the parameter setting. (Refer to "3.3 Setup Mode".)
- Displaying the unit
  1. Press the upper right key in the measurement mode to move the setup mode, and select OTHER functions. (Refer to "3.3.6 OTHER: Other functions".)
  2. Press the lower left or lower right key until "Unit" is blinking.
  3. Press the center key to move the ON/OFF selection of the unit display.
  4. Press the lower left key to select "ON".
  5. Press the center key to display the unit and return to the parameter setting. (Refer to "3.3 Setup Mode".)

NOTE
- When the unit is hidden, "." (dot) will be displayed.
- When the unit is hidden, the graduation will be same as the previously set unit.

Hiding the unit



Displaying the unit



3.3.6.3 OFFSET(3): Origin offset

Origin offset adds an offset value “d” to the spindle displacement "x".
And then enables measuring with the formula, $f(x)=A(x+d)+B+C(x+d)^{-1}$, when Calculation function is ON.

- Enabling origin offset. Checking and changing origin offset
  1. Press the upper right key in the measurement mode to move the setup mode, and select OTHER functions. (Refer to "3.3.6 OTHER: Other functions".)
  2. Press the lower left or lower right key until "OFFSET" is blinking.
  3. Press the center key to move the ON/OFF selection of the origin offset.
  4. Press the lower left key to select "ON".
  5. Press the center key to move the setting of the origin offset value. The currently set origin offset will be displayed.
  6. To change the origin offset, press the lower right key and move the numerical value setting. (Refer to "3.2.3 Numerical value setting".)
  7. Press the center key after checking or changing the origin offset value. The origin offset is set "ON", and the mode returns to the parameter setting. (Refer to "3.3 Setup Mode".)
- Disabling origin offset
  1. Press the upper right key in the measurement mode to move the setup mode, and select OTHER functions. (Refer to "3.3.6 OTHER: Other functions".)
  2. Press the lower left or lower right key until "OFFSET" is displayed blinking.
  3. Press the center key to move the ON/OFF selection of the origin offset.
  4. Press the lower left key to select "OFF".
  5. Press the center key to set the origin offset "OFF" and return to the parameter setting. (Refer to "3.3 Setup Mode".)

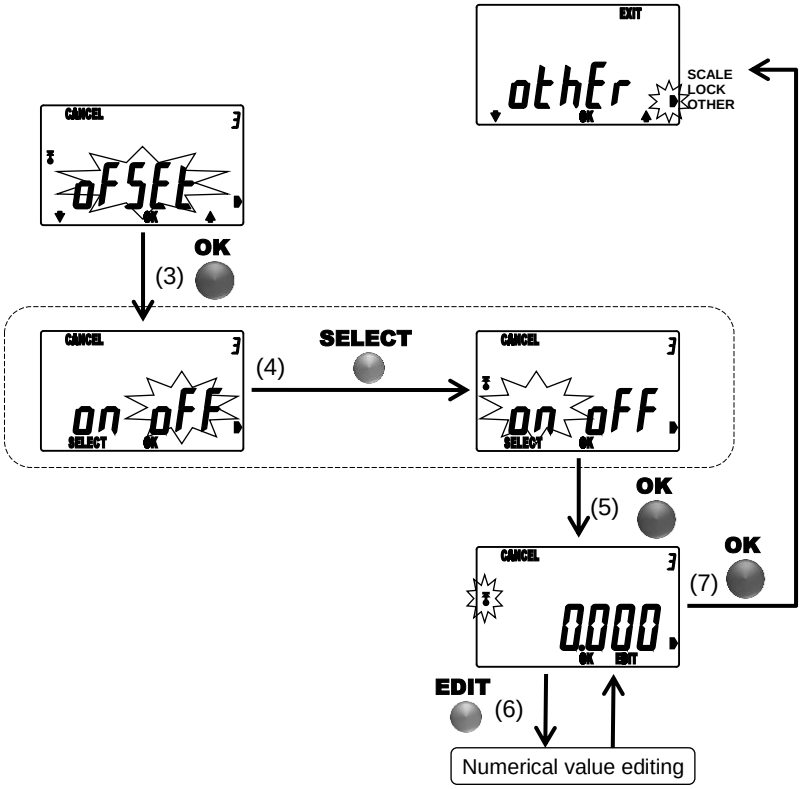
IMPORTANT

- When enabling the origin offset or changing the origin offset value while the calculation function (Refer to "3.3.3 Calculation function".) is enabled in the ABS system, the preset position will be cleared(Preset No. will be disappeared.). However the preset value can be called, as it is being registered.
- When enabling the origin offset or changing the origin offset value while the calculation function (Refer to "3.3.3 Calculation function".) is enabled in the INC system, the zero set position will be cleared (“INC” will be disappeared.). Set to zero after moving the spindle to an appropriate position. (Refer to "3.2.5 Zero-setting display value".)

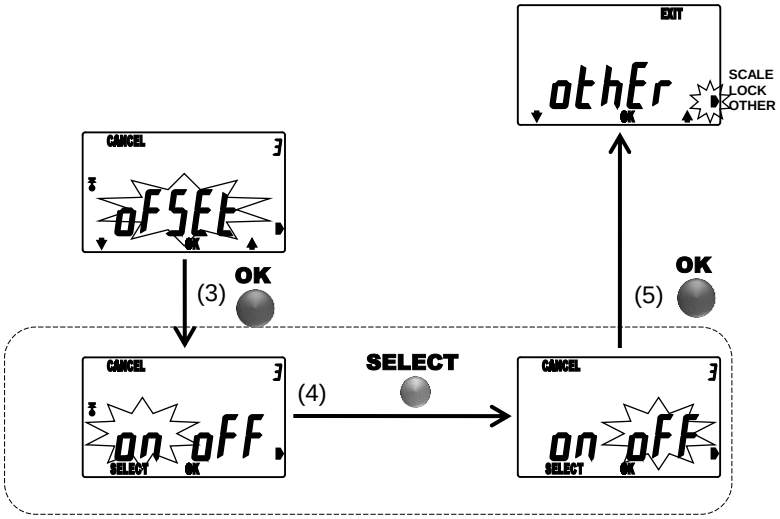
NOTE

- Switching the resolution will not convert the origin offset value.
- The origin offset value will be calculated automatically according to the unit. Check the origin offset value after the unit is changed, since the conversion error or overflow error (Err95) may occur.
- The origin offset setting cannot be completed if Overflow error of origin offset value (Err95) is occurring. Reset the origin offset value.

Enabling origin offset. Checking and changing origin offset



Disabling origin offset



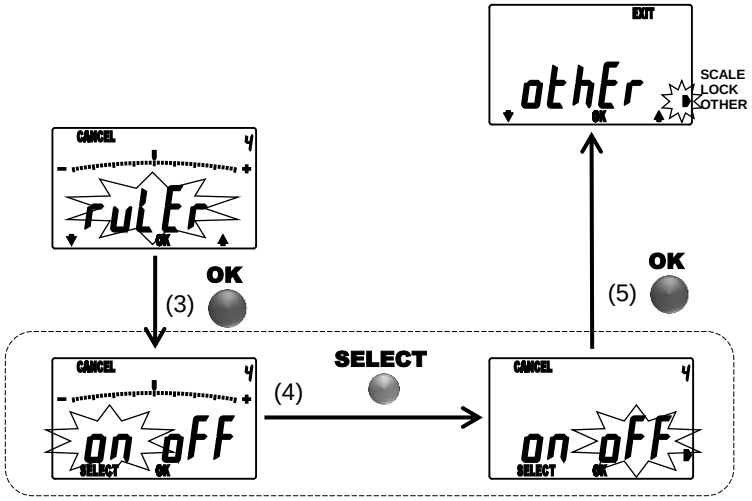
3.3.6.4 RULER(4): Analog bar display

Analog bar can be set up displayed or hidden.

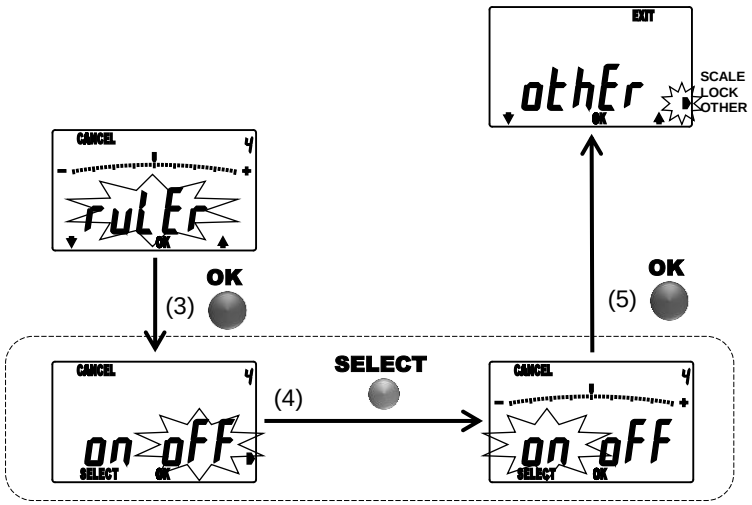
- Hiding the analog bar
  1. Press the upper right key in the measurement mode to move the setup mode, and select OTHER functions. (Refer to "3.3.6 OTHER: Other functions".)
  2. Press the lower left or lower right key until "RULER" is blinking.
  3. Press the center key to move the ON/OFF selection of the analog bar display.
  4. Press the lower left key to select "OFF".
  5. Press the center key to hide the analog bar and return to the parameter setting. (Refer to "3.3 Setup Mode".)
- Displaying the analog bar
  1. Press the upper right key in the measurement mode to move the setup mode, and select OTHER functions. (Refer to "3.3.6 OTHER: Other functions".)
  2. Press the lower left or lower right key until "RULER" is blinking.
  3. Press the center key to move the ON/OFF selection of the analog bar display.
  4. Press the lower left key to select "ON".
  5. Press the center key to hide the analog bar and return to the parameter setting. (Refer to "3.3 Setup Mode".)

NOTE ・ The analog bar will not be displayed if the graduation is changed while it is hidden. (Refer to "3.3.4 SCALE: Selecting analog bar graduation".)

Hiding the analog bar



Displaying the analog bar



3.3.6.5 FAST(5): FAST mode

When enabling the FAST mode, the detection cycle in the peak detection mode will be 20ms. It enables to detect peak value more correctly.

- Enabling the FAST mode (Detection cycle: 20msec)
  1. Press the upper right key in the measurement mode to move the setup mode, and select OTHER functions. (Refer to "3.3.6 OTHER: Other functions".)
  2. Press the lower left or lower right key until "FAST" is blinking.
  3. Press the center key to move the ON/OFF selection of the FAST mode.
  4. Press the lower left key to select "ON".
  5. Press the center key to enable this function and return to the parameter setting. (Refer to "3.3 Setup Mode".)
- Disabling the FAST mode(Detection cycle: 100msec)
  1. Press the upper right key in the measurement mode to move the setup mode, and select OTHER functions. (Refer to "3.3.6 OTHER: Other functions".)
  2. Press the lower left or lower right key until "FAST" is blinking.
  3. Press the center key to move the ON/OFF selection of the FAST mode.
  4. Press the lower left key to select "ON".
  5. Press the center key to disable this function and return to the parameter setting. (Refer to "3.3 Setup Mode".)

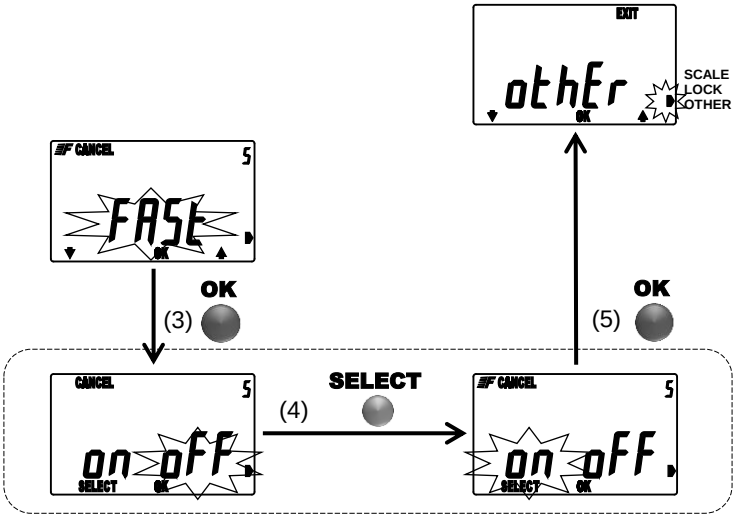
IMPORTANT

- The accuracy will not be affected by this function.

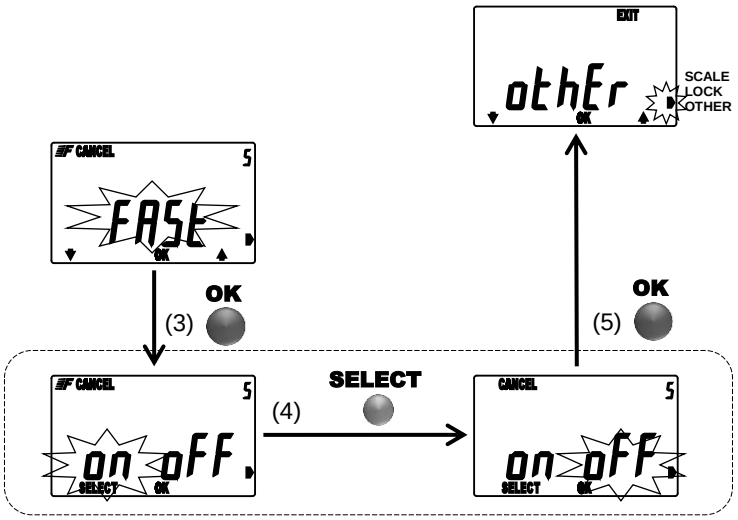
NOTE

- Operating in this function will shorten the battery life.
  It is recommended to operate with disabling this function if not necessary.

Enabling the FAST mode



Disabling the FAST mode



3.3.6.6 RESET(6): All reset

It restores the factory default.

- Executing all reset
  1. Press the upper right key in the measurement mode to move the setup mode, and select OTHER functions. (Refer to "3.3.6 OTHER: Other functions".)
  2. Press the lower left or lower right key until "RESET" is blinking.
  3. Press the center key to move the all reset setting.
  4. Press the lower left key to select "YES".
  5. Press the center key, then "YES" will be displayed again.
  6. Press the center key to execute all reset.
     The display turns off shortly, and restores the display of the time when the battery is installed.

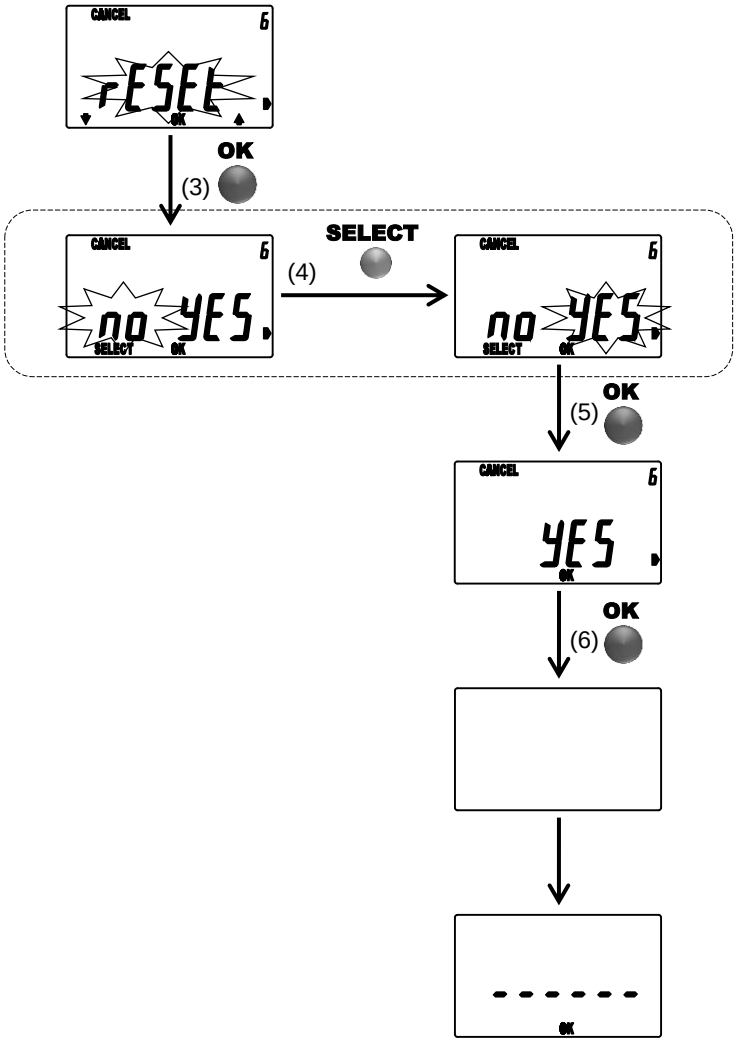
IMPORTANT

- The setting before executing all reset cannot be restored.

Factory default

Setting items	Settings
Preset	Preset No. (P1/P2/P3): P1 Preset values (P1/P2/P3): Zero for all
Measuring system	ABS
Unit	mm (for inch models: in)
Peak detection mode	OFF
Center position of the analog bar	Centered at zero
Tolerance judgment	OFF Tolerance judgment (upper limit/lower limit): Zero for all
Resolution	0.001mm (0.00005in)
Calculation function	OFF Calculation coefficients: A=1.0000, B=C=0
Analog bar graduation	Auto
Key-lock	OFF All key function: Enabled
Unit display	ON
Origin offset	OFF Origin offset value: Zero
Analog bar display	ON
FAST mode	OFF
Parameter-lock	OFF

Excuting all reset



3.4 Calibration mode

In this mode the instrument can measure with an appropriate setting of accuracy inspection and calibration while retaining the current settings in memory. And also in this mode when the instrument receives an output request (REQ) from the data processor, it outputs a display value. (Refer to 3.2.8. Display value output)

The settings of calibration mode
(The settings change automatically when starting the calibration mode)

Setting items	Settings
Measurement mode	Normal mode
Measuring system	INC
Unit	mm / in(for inch models)
Resolution	0.001mm / 0.00005in(for inch models)
Other	Tolerance judgment :OFF Calculation function :OFF Key-lock :OFF Analog bar display :OFF

Key function for the calibration mode

Keys	Press	Press and hold
Lower left	-	-
Center	Set to zero	-
Lower right	-	Changing unit
Upper left	-	
Upper right	-	

●Starting the calibration mode

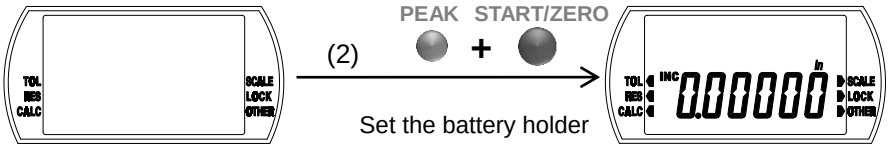
1. Remove the battery holder by using a flat-blade screwdriver or the like.
2. While pressing the lower left key and center key, set to the battery holder. This instrument will be started up in the calibration mode.

●Stopping the calibration mode

1. Remove the battery holder, so it means stopping the calibration mode. The measurement mode (the normal mode) will be restarted when the battery holder is set into the original position again (Refer to 2. SETUP).

IMPORTANT

・ The preset setting is required in the measurement mode after using this mode (Refer to 3.2.2. Preset setting). And also set the origin point if you want because the origin point setting is cleared (Refer to 3.2.1. Origin point setting). However other settings and parameters are held with the former setting which moves to this mode.



(1) Calibration mode

4 DATA OUTPUT

This chapter describes how to output data.

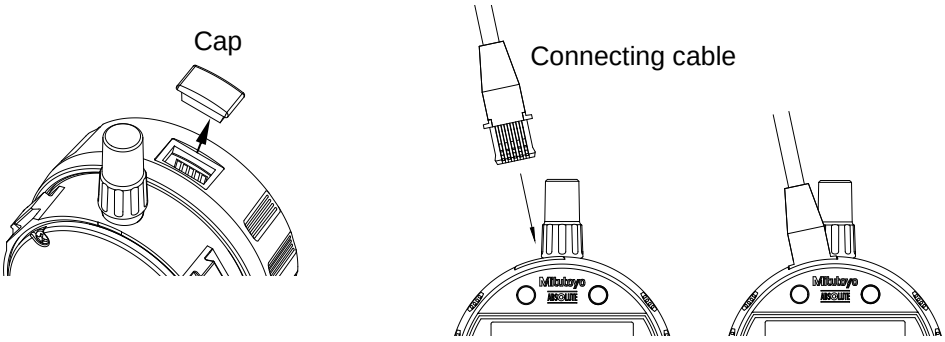
The measurement data can be outputted to the data processor such as Digimatic Mini-processor DP-1VR with an optional connecting cable (Parts No. 905338 (1m) or No. 905409 (2m)). And the data can be summed up or recorded

NOTE

- Use only the output cable of Mitutoyo specific accessories. The use of an improper cable or deteriorated cable may disable data output.
- Prior to data output carefully read the user's manual of the data processor to use it correctly.

4.1 Cable Connection

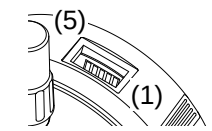
Remove the output connector cap, and then connect the instrument to the data processor by using a connecting cable. Insert the cable securely to the end, in the direction as shown.



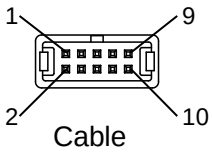
NOTE

- Store the removed cap, taking care to prevent loss.
- Install the direction of output pin correctly.
- Be sure to attach a cap to the connecting cable when not in use.

4.2 Output Connector

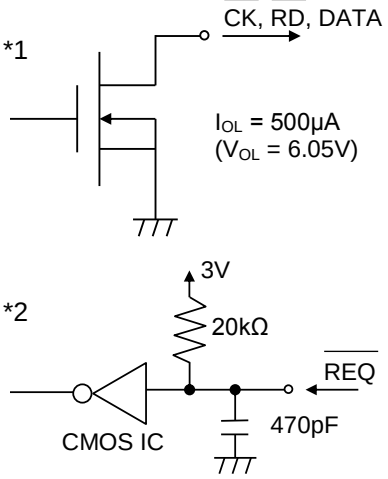


Digimatic Indicator



Cable

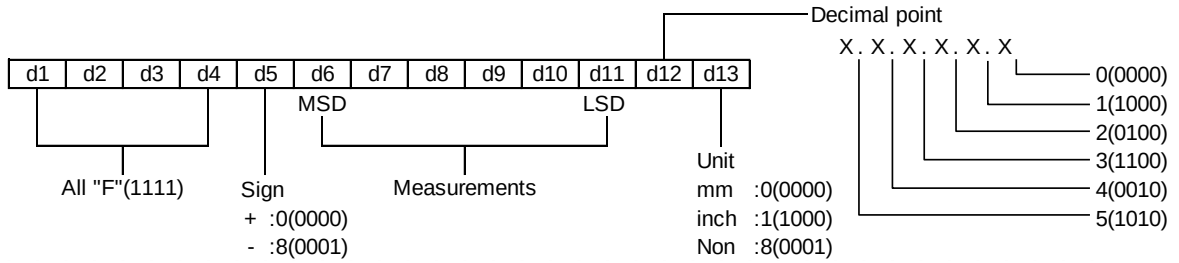
Pin No.		Signal	I/O
Indicator	Cable		
1	1	GND	-
2 *1	2	DATA	O
3 *1	3	$\overline{CK}$	O
4 *1	4	$\overline{RD}$	O
5 *2	5	$\overline{REQ}$	I
-	6-10	N.C.	-



IMPORTANT

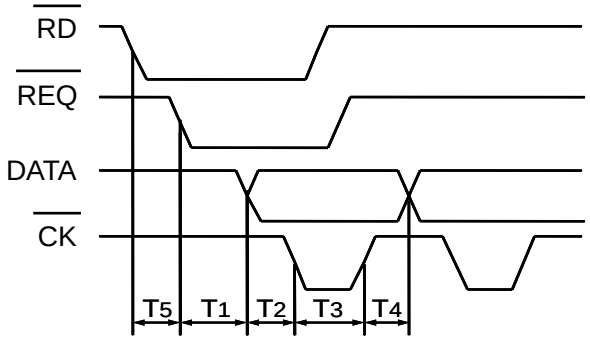
- Since the power voltage differs between this instrument and the data processor, absolutely design an output system either open-collector or open-drain. Do not use CMOS output.

4.3 Output Data Format



※This instrument outputs 13 digits from d1 to d13 by making 4 bits into 1 digit.
※Each digit is outputted in the order from least significant bit (LSB) to most significant bit (MSB).

4.4 Timing Chart



0.7 ms ≤ T1 ≤ 1.2 ms
100 µs ≤ T2 ≤ 200 µs
200 µs ≤ T3 ≤ 300 µs
100 µs ≤ T4 ≤ 200 µs
T5 : Determined by the performance of the data processor

IMPORTANT

- If the output request (REQ) signal is received during the spindle displacement or if the inverter receives output request (REQ) signals repeatedly at short intervals, the instrument may not output data.

NOTE

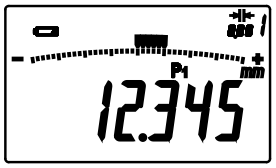
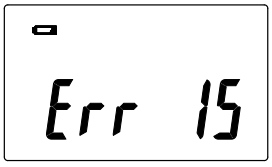
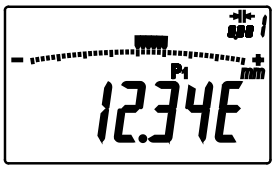
- Retain the REQ signal at Low level until the CK signal is outputted. Also, return the REQ signal to High level before the last CK signal (at the 52nd bit) is outputted.

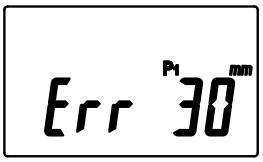
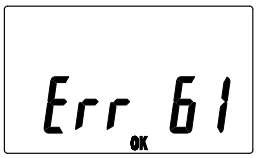
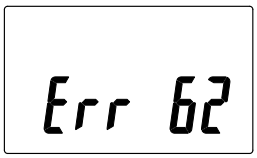
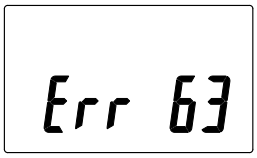
MEMO

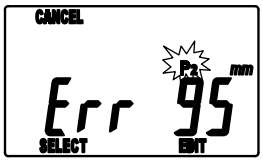
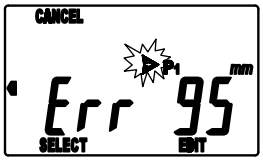
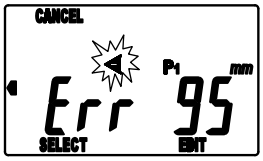
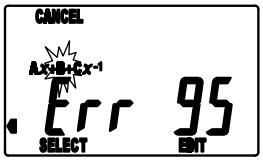
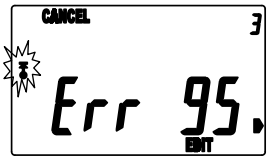
5 ERROR MESSAGE AND ACTION

This chapter describes the error messages and their corrective actions.

If any error occurs in this Digimatic indicator, a corresponding error message is displayed. If the instrument does not recover the normal conditions after corrective actions, contact your dealer or Mitutoyo sales office.

Display	definition	Actions
	Low battery alarm ・ Battery voltage is getting low	・ Replace the battery with the new one.
	Low battery error ・ Measurement cannot be performed due to consumption of the battery.	・ Replace the battery with the new one.
	Sensor signal synthesizing error ・ Synthesizing of sensor signal is failed.	・ A sensor signal synthesizing error occurred while the spindle was moving at high speed. Keep on using the indicator since this error does not affect measured values. * If this error occurs while the spindle is stopped, it could be due to sensor failure. In this case, contact the nearest Mitutoyo sales office.

	Overflow error of display value ・ The display value has exceeded the maximum number of digits that can be displayed.	・ Return the display value to the permissible number of digits to automatically reset the error. ・ Press the center key, or press and hold ・ Move the Setup mode to change the resolution. (Refer to "3.3.2 RES: Resolution".) ・ Move the Setup mode to reset the calculation coefficient.
	Setting value rewrite error ・ A setting value has been rewritten from any cause after the previous use.	・ Press the center key will return to the initial state after setting the battery. Perform re-setting after confirming the setting value, referring to "2.1 Installation (replacement) of Battery and Initial Setting".
	Setting value storage error ・ A setting value could not be stored. ・ A setting value could not be loaded.	・ Remove the battery once and perform re-setting, referring to "2.1 Installation (replacement) of Battery and Initial Setting". ・ If this error occurs even after re-setting the battery, replace it. ・ If this error occurs even after replacing the battery, it could be due to instrument failure. In this case, contact your dealer or Mitutoyo sales office.
	Internal program error ・ Measurement cannot be performed due to occurrence of an anomaly in the internal program.	・ This could be due to instrument failure. In this case, contact your dealer or Mitutoyo sales office.

	Tolerance upper/lower limit setting error ・ The tolerance limit value is set with the upper limit value being smaller than the lower limit value.	・ Press the center key to reset to be the upper limit value is greater than the lower limit value. (Refer to "3.3.1 TOL: Tolerance judgment".)
	Overflow error of preset value ・ The preset value has exceeded the maximum number of digits that can be displayed.	・ Press the lower right key to reset the preset value. ・ Lower the resolution. (Refer to "3.3.2 RES: Resolution".)
	Overflow error of upper limit value ・ The upper limit value has exceeded the maximum number of digits that can be displayed.	・ Press the lower right key to reset the upper limit value. (Refer to "3.3.1 TOL: Tolerance judgment".) ・ Lower the resolution. (Refer to "3.3.2 RES: Resolution".)
	Overflow error of lower limit value ・ The lower limit value has exceeded the maximum number of digits that can be displayed.	・ Press the lower right key to reset the lower limit value. (Refer to "3.3.1 TOL: Tolerance judgment".) ・ Lower the resolution. (Refer to "3.3.2 RES: Resolution".)
	Overflow error of calculation coefficient ・ The calculation coefficient has exceeded the maximum number of digits that can be displayed.	・ Press the lower right key to reset the calculation coefficients. (Refer to "3.3.3 CAL: Calculation function".)
	Overflow error of origin offset value ・ The origin offset value has exceeded the maximum number of digits that can be displayed.	・ Press the lower right key to reset the origin offset value coefficients. (Refer to "3.3.6.3 OFFSET(3): Origin offset".)

MEMO

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