

Manual

148 460

MITUTOYO SURFTEST SJ 201P surface roughness tester



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CONVENTIONS USED IN USER'S MANUAL

Safety Precautions

To operate the instrument correctly and safely, Mitutoyo manuals use various safety signs (Signal Words and Safety Alert Symbols) to identify and warn against hazards and potential accidents.

The following signs indicate **general** warnings:



Indicates an imminently hazardous situation which, if not avoided, will result in serious injury or death.



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



Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury or property damage.

The following signs indicate **specific** warnings or prohibited actions, or indicate a mandatory action:



Alerts the user to a specific hazardous situation. The given example means "Caution, risk of electric shock".



Prohibits a specific action. The given example means "Do not disassemble".



Specifies a required action. The given example means "Ground".

CONVENTIONS USED IN USER'S MANUAL

On Various Types of Notes

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

-
- IMPORTANT**
- An *important note* is a type of note that provides information essential to the completion of a task. You cannot disregard this note to complete the task.
 - An important note is a type of precaution, which if neglected could result in a loss of data, decreased accuracy or instrument malfunction/failure.
-

NOTE A *note* emphasizes or supplements important points of the main text. A note supplies information that may only apply in special cases (e.g.. Memory limitations, equipment configurations, or details that apply to specific versions of a program).

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

Mitutoyo assumes no liability to any party for any loss or damage, direct or indirect, caused by use of this instrument not conforming to this manual.
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PRECAUTIONS

To obtain the highest performance from this instrument and to use it safely, read this User's Manual prior to use.

Observe the following precautions to get the most of the instrument and to attain high accuracy for long time.



This instrument has a sharp stylus at the edge of the detector. Take care not to be injured.

IMPORTANT

- For the power supply, follow the conditions described on the AC adapter supplied. Do not use other than the AC adapter provided.
 - Do not disassemble the instrument unless otherwise specified in this User's Manual. It will result in instrument failure or damage. The instrument has been rigorously adjusted and assembled at the factory.
 - Do not drop or give impact to the detector. The detector is a precision part.
 - Do not use the instrument in an environment where it is subject to dust or vibrations. Also keep it as far apart from noise generator such as large power supply, high-voltage relay switch as possible.
 - Avoid using the instrument where there is sudden temperature change, and operate it where the temperature is between 0 and 30°C(RH: 85 % or less). Do not operate/store the instrument close to a room heater or in the direct sunlight.
 - Store the instrument where the temperature can be controlled between -10 and 40°C.
 - When mounting the detector to the drive unit, take care not to apply excessive force to the drive unit.
 - Before connecting /detaching the connector or connecting cable, turn the power off (by auto sleep function).
 - The stylus tip is machined precisely. Take care not to break it.
 - Before measurement, wipe off oil or dust on the workpiece surface to be measured.
-

WARRANTY

This instrument has been manufactured, adjusted, and inspected under rigorous quality control system of Mitutoyo. In the event that this instrument should fail within one year from the original date of purchase through normal use conforming to the User's Manual provided with the product, we will repair or replace it, at our option, free of charge, upon its prepaid return to Mitutoyo.

This warranty shall not apply if the product has been subject to fair wear and tear, abuse through misuse or improper use/handling/storage/maintenance/service/repair or through adaptation/modification by the original purchaser or any third party without prior written consent of Mitutoyo or as a result of damage by an actual disaster or circumstances beyond the control of Mitutoyo.

This warranty is not transferable and is only valid within the country of the original purchase.

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SERVICE NETWORK

MEMO

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SJ-201P OVERVIEW

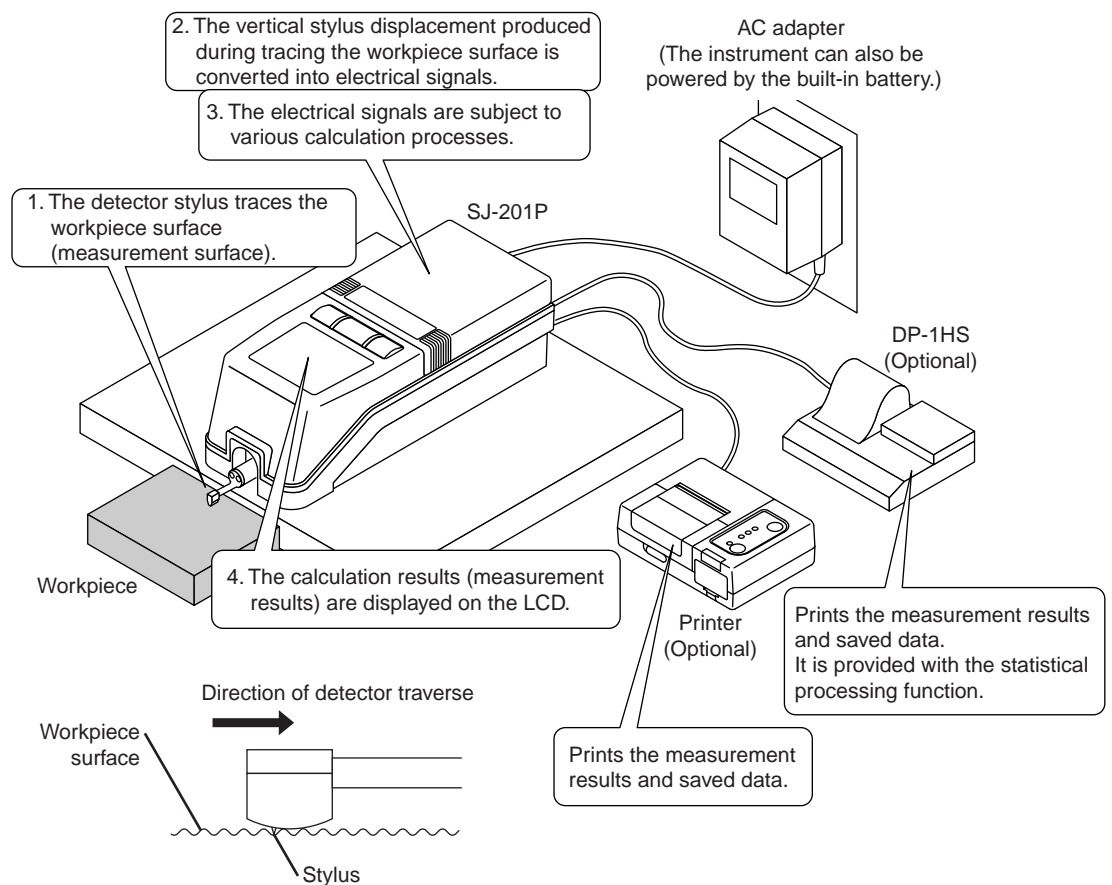
1.1 Outline of the SJ-201P

The Surftest SJ-201P is a shop-floor type surface-roughness measuring instrument, which traces the surfaces of various machine parts, calculates their surface roughness based on roughness standards, and displays the results.

This section explains the principle of surface roughness measurement and the features of the SJ-201P.

■ SJ-201P surface roughness measurement principle

A pick-up (hereinafter referred to as the “stylus”) attached to the detector unit of the SJ-201P will trace the minute irregularities of the workpiece surface. The vertical stylus displacement during the trace is processed and digitally displayed on the liquid crystal display of the SJ-201P.



■ Features of the SJ-201P

- Designed to be convenient

The SJ-201P has a lightweight (0.5 kg) design for excellent portability. In addition, it is made compact so that it can be held and operated in one hand.

The built-in battery makes it easy to perform roughness measurement on the shop floor or other sites where there may be no AC power supply.

NOTE No power is drawn from the battery while the instrument is supplied power via the AC adapter.

For more information about the built-in battery, refer to “3.5.2 Recharging the built-in battery” and “Chapter 7 Replacement of the Built-in Battery Pack”.

- Wide measurement range and various roughness parameters

The instrument has a maximum measurement range of 350 μm (-200 μm to +150 μm) or 13780 μin (-7880 μin to +5900 μin) and can represent surface texture using various surface roughness parameters.

- Auto-sleep function to save power

If the SJ-201P is not used for more than 30 seconds, it is automatically turned off, even if AC power is being supplied. SJ-201P measurement conditions are, however, retained.

- Large-size LCD and external output functions

Measurement results are displayed on the large easy-to-view LCD unit. These measurement results can also be outputted externally as SPC (Statistical Process Control) data. If connected to a personal computer, the SJ-201P can be remotely controlled (for output or measurement commands) via the RS-232C communication interface.

- Measurement result saving function

The SJ-201P can save measurement results up to 10 cases of measurements. It can also call the saved data to display and print the data.

- Compatible with various surface roughness standards

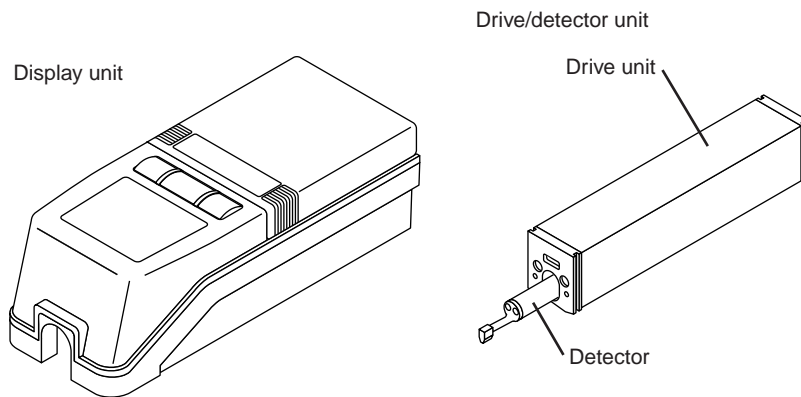
The SJ-201P outputs measurement results conforming to a variety of surface roughness standards, including New JIS (JIS-B-0601-1994), Old JIS (JIS-B-0601-1982), DIN, ISO, and ANSI.

1.2 Standard SJ-201P Configuration

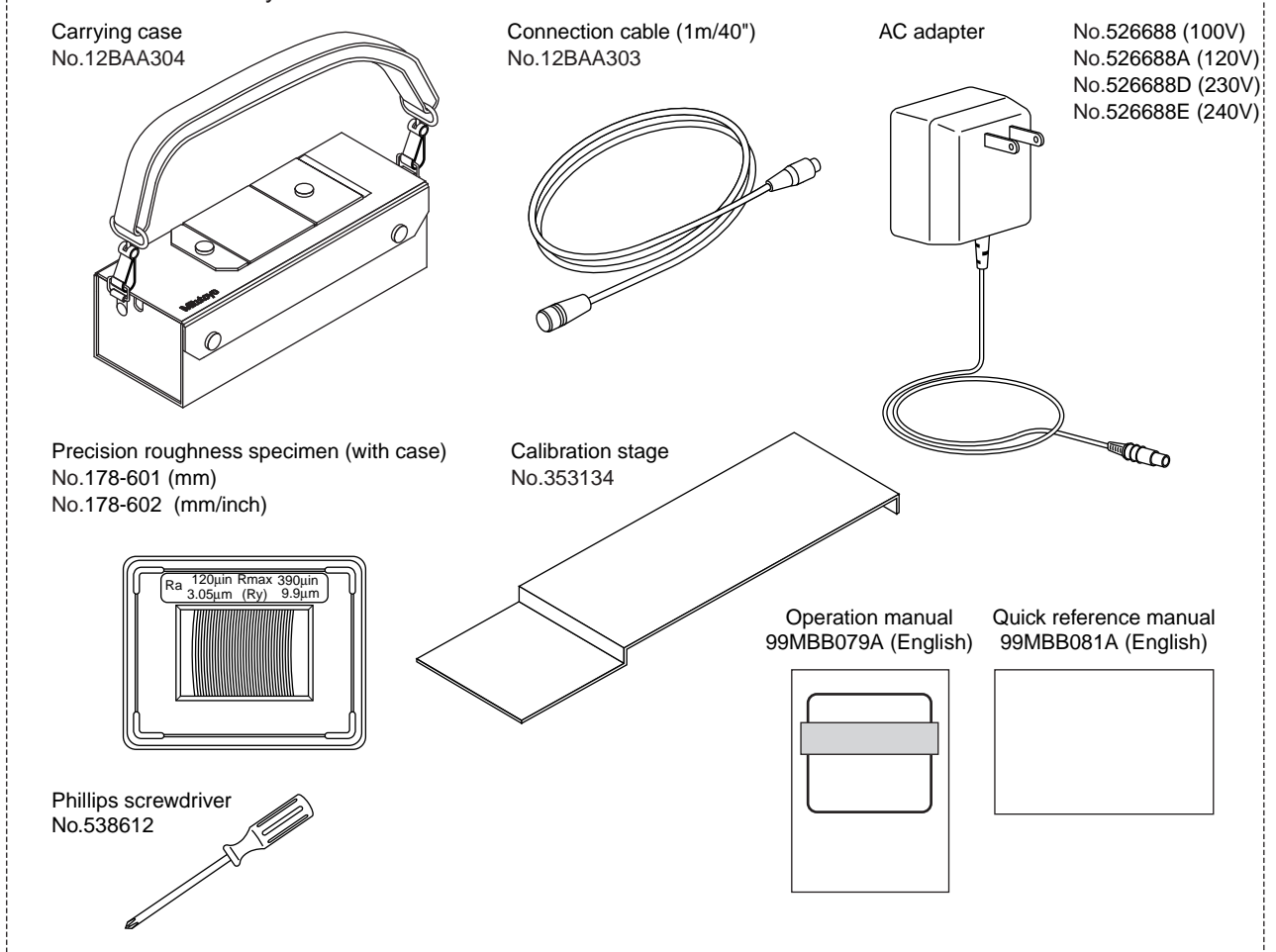
This section explains the standard configuration, the standard set, and typical uses of the optional accessories.

■ Standard SJ-201P configuration

After unpacking, confirm that all the items given below are present in your SJ-201P package.



Standard accessory



■ SJ-201P set configuration

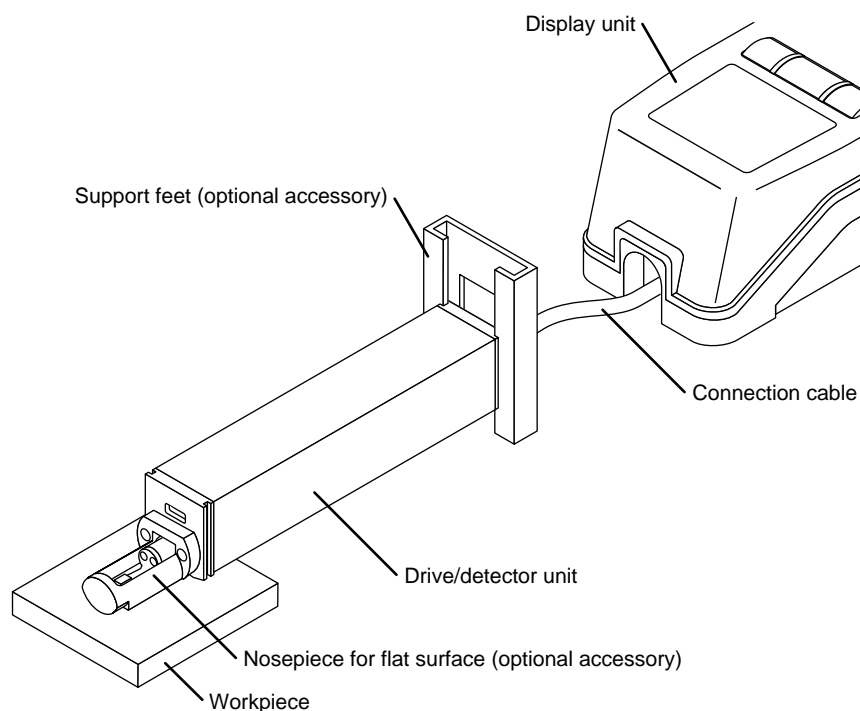
The following combinations are provided depending on the measuring force, measurement unit system and AC adapter used.

Model No.	SJ-201P (Measuring force: 4mN)		SJ-201P (Measuring force: 0.75mN)		AC adapter	
	mm	mm/inch	mm	mm/inch	Order No.	Line voltage
Set No.	178-920K	178-923	178-930K	178-933	526688	100 V AC
	178-920A	178-923A	178-930A	178-933A	526688A	120 V AC
	178-920D	178-923D	178-930D	178-933D	526688D	230 (220) V AC
	178-920E	178-923E	178-930E	178-933E	526688E	240 V AC
Detector	178-390		178-395		-	
Drive unit	178-230					-
Display	178-243	178-248	178-243	178-248	-	

IMPORTANT Only use the supplied AC adapter for this instrument. Otherwise, not only the adapter but that equipment it is used with may be damaged.

■ SJ-201P optional accessories

Depending on the shape of the workpiece, it may be necessary to use optional accessories to set up the SJ-201P. Consider the shape of the workpiece when purchasing an optional accessory. The following illustration gives an example of how optional accessories can be used.



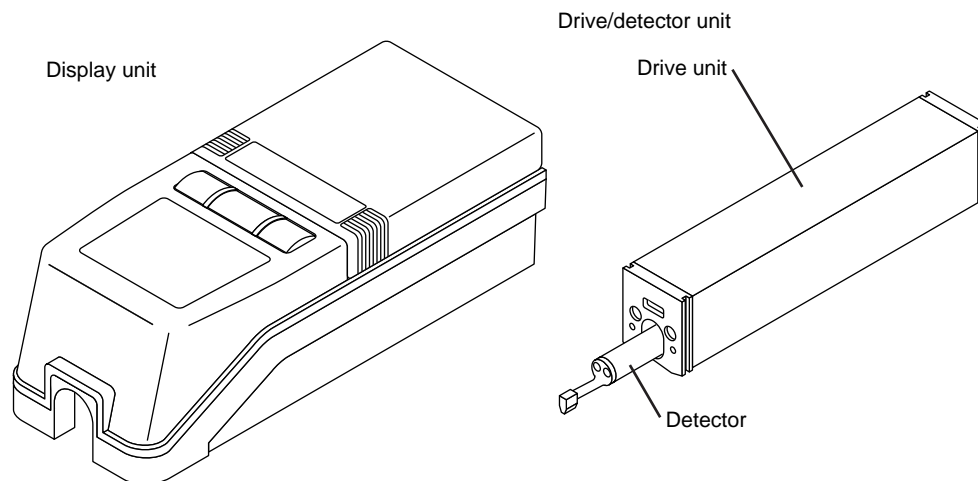
TIP For a complete list of optional accessories refer to “Chapter 5 Installing the SJ-201P with Optional Accessories”.

1.3 Name of Each Part on the SJ-201P

This section gives the name of each key on the display unit.

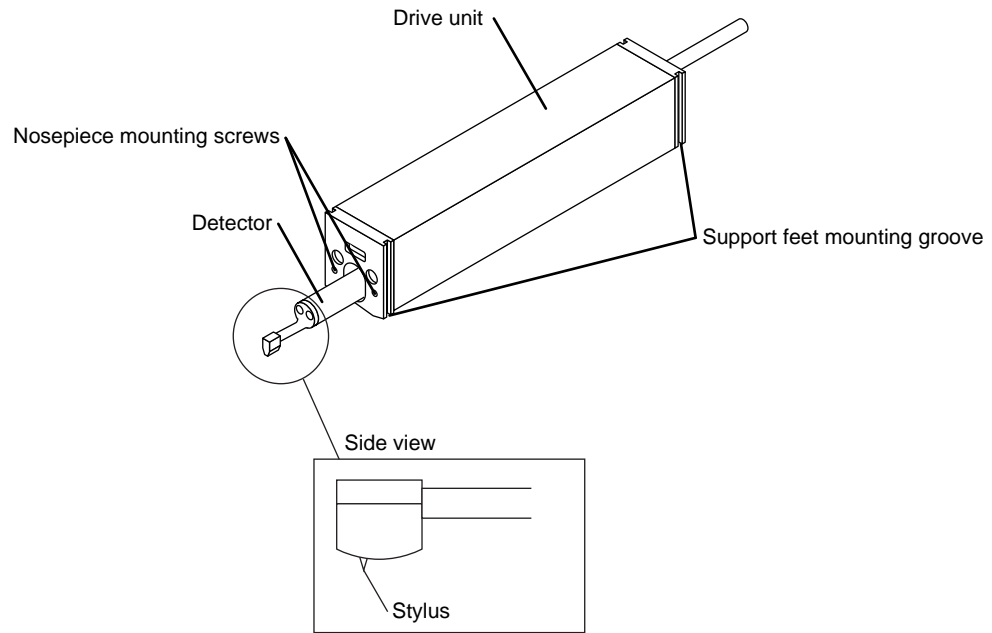
■ Display unit and drive/detector unit

The SJ-201P consists of the display unit and drive/detector unit. The drive/detector unit is designed to be removable from the display unit. Depending on the shape of the workpiece, it may be easier to perform measurement without mounting the drive/detector unit to the display unit.



TIP For information about attaching and detaching the drive/detector unit refer to “1.4 Attaching and Detaching the Drive/Detector Unit”.

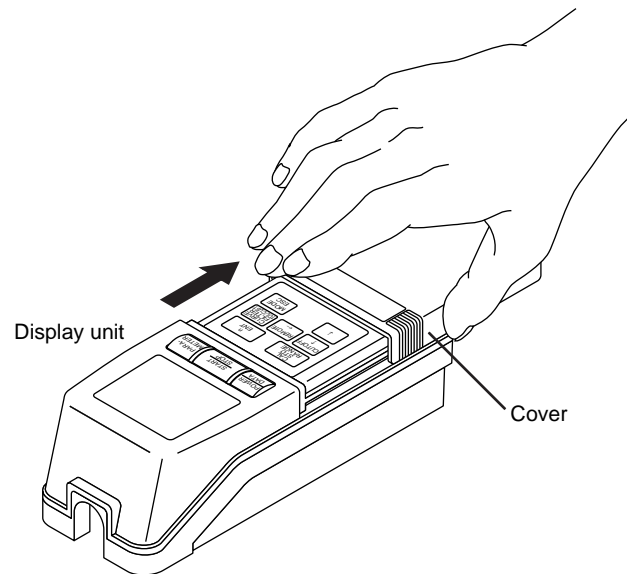
■ Names of each part on the drive/detector unit



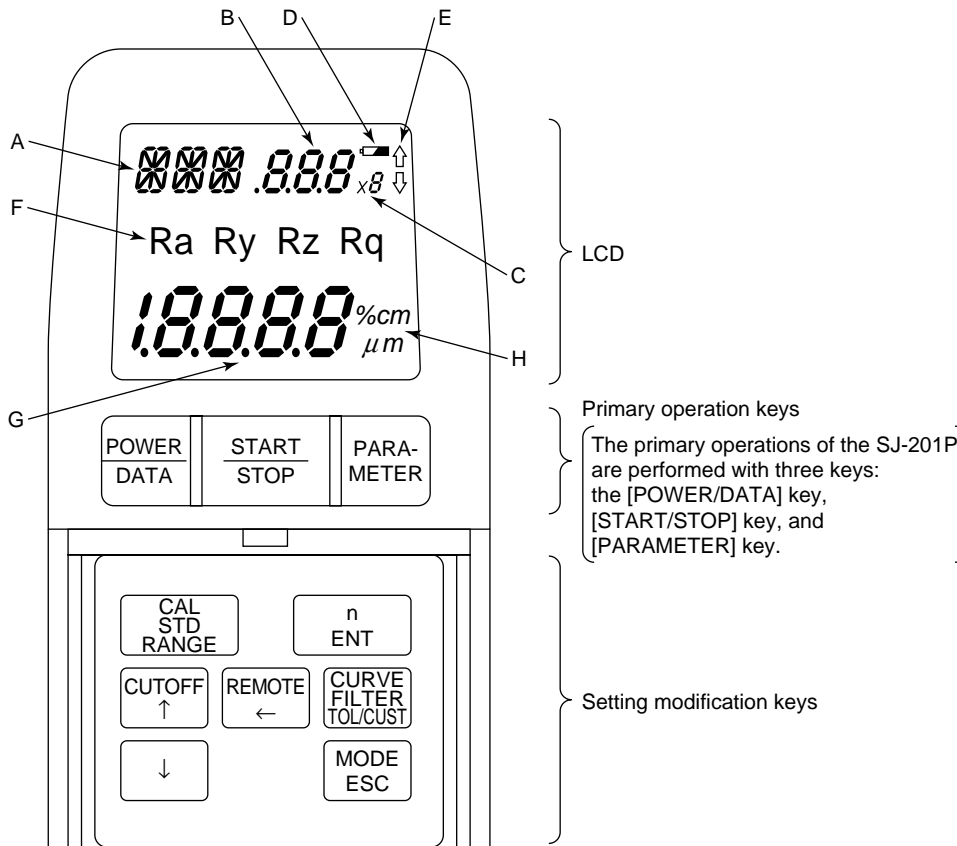
Nosepiece and support feet are optional.

■ Display unit cover

The top cover of the display unit slides to allow access to the setting modification keys underneath.



■ Name of each part on the display unit



< Items to be displayed on LCD >

- A: In measurement mode:
Objective parameter name
- In condition setting mode:
Abbreviation of the mode name
- B: Cutoff length
- C: Number of sampling lengths
- D: Low battery voltage alarm
- E: GO/NG judgment result
- F: Objective parameter name
- G: Calculation result (measurement result)
- H: Unit of measurement

<Names of each key>

- [POWER/DATA] key (Power/Data key)
- [START/STOP] key (Start/Stop key)
- [PARAMETER] key (Parameter key)
- [CAL/STD/RANGE] key (Calibration/Standard/Range key)
- [n/ENT] key (n/Enter key)
- [CUTOFF ↑] key (Cutoff/Increment key)
- [REMOTE ←] key (Remote/Digit shift key)
- [CURVE/FILTER/TOL/CUST] key (Curve/Filter/Tolerancing/Customize key)
- [↓] key Decrement key.

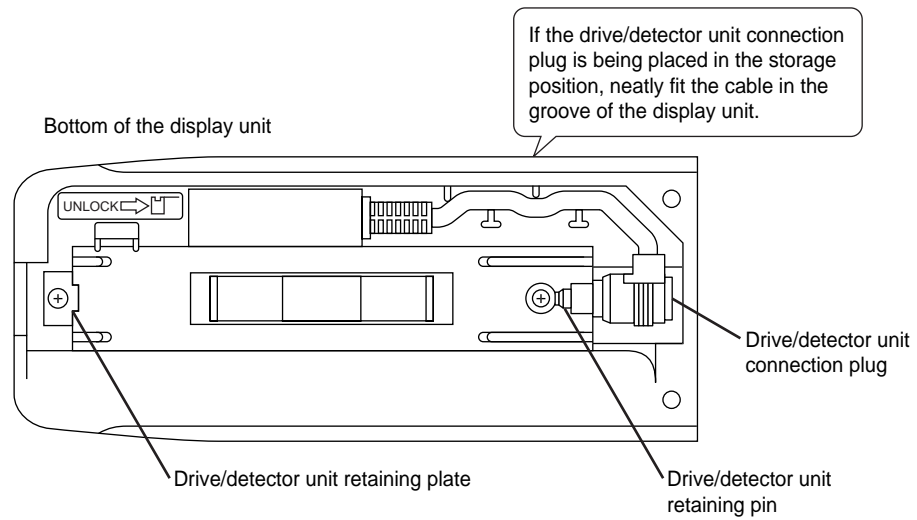
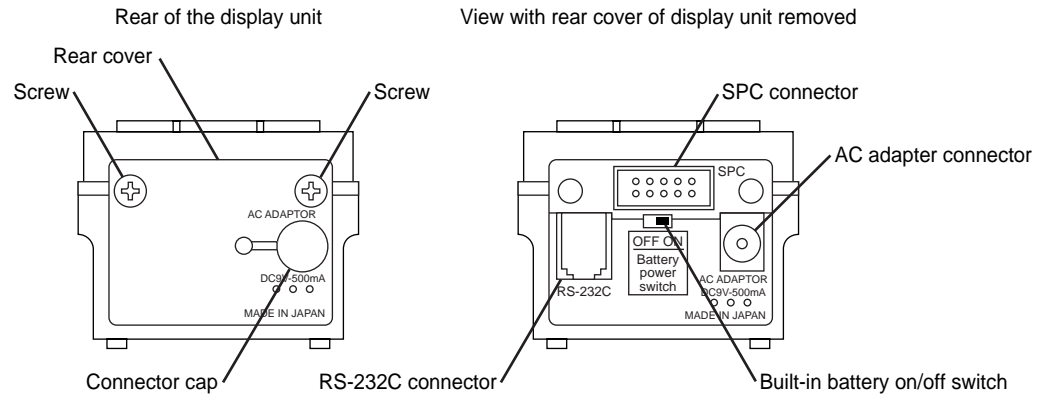
With the mm/inch model, the following key is provided and can also be used for metric/inch conversion.



In the following pages, it is represented by [↓] if used as the decrement key.

- [MODE/ESC] key (Mode/Escape key)

■ Names of the connectors on the display unit

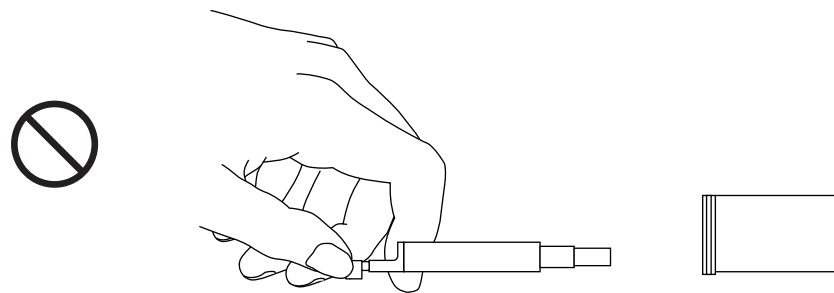
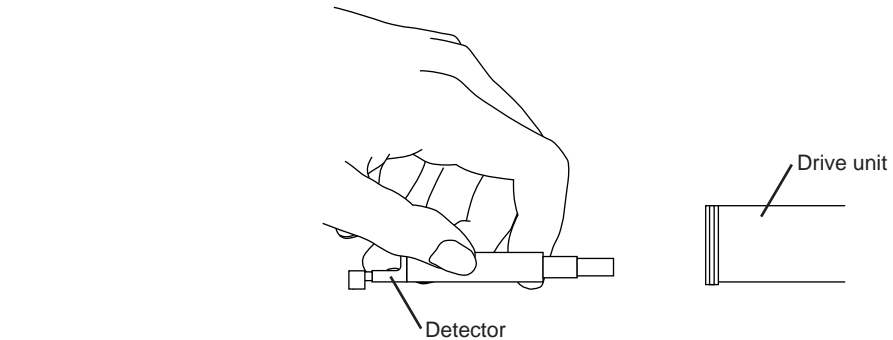


1.4 Attaching and Detaching the Drive/Detector Unit

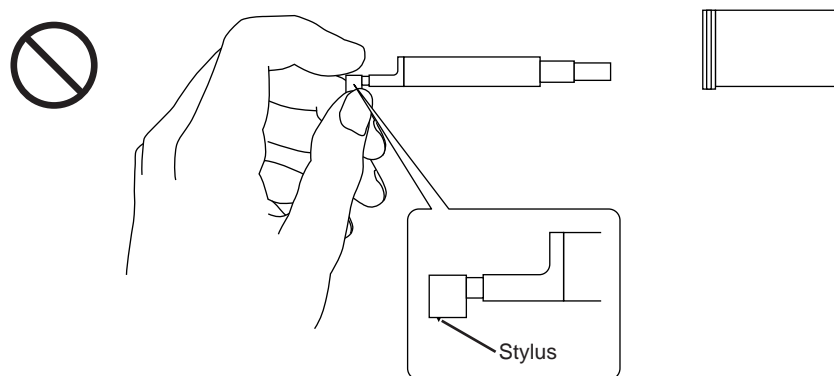
1.4.1 Attaching and Detaching the Detector

The detector can be detached from the drive unit. Each time a measurement task has been completed with the SJ-201P, it is recommended that the detector be detached from the drive unit and stored in a safe place to prevent damage caused by such as a blow, etc.

IMPORTANT Always hold the detector body if it is being attached or detached. If the tip or stylus is held during attachment or detachment, the detector may be damaged.

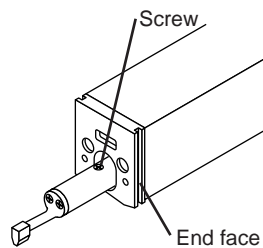


IMPORTANT Never touch the stylus, otherwise it may be damaged.



■ Attaching the detector

- IMPORTANT**
- If fitting the detector into the drive unit, do not force the detector. Doing so may damage the instrument.
 - The detector moves smoothly at first being fitted with the guide way in the drive unit, then pins of the connectors on the detector and the drive unit must be fitted to each other. After the detector is felt tight in the guide of the drive unit, further push in the detector until it stops with the pins on the connectors fitted. If the detector is firmly fitted in the drive unit, the screw on the top of the detector is aligned with the end face of the drive unit.

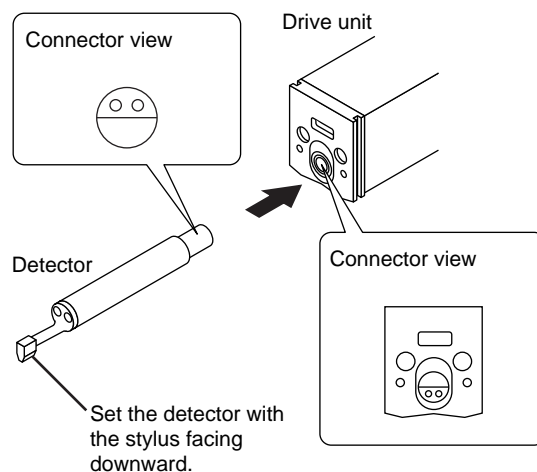


- Do not attempt inserting the detector in the drive unit if it is in detector retraction state. The connector at the recess of the detector guide way in the drive unit may not be located with the detector.

1. Press the [POWER/DATA] key if in auto-sleep state.
2. If OFF is displayed on the LCD, press the [START/STOP] key to release the detector retraction state. If OFF is not displayed, proceed to step 3.

TIP Refer to section 3.4.4, “Detector Retraction Procedure” for releasing the detector retraction state.

3. After confirming the orientations of both the detector and drive unit connectors (pin positions), gently and straightforward insert the detector into the drive unit hole.



■ Detaching the detector

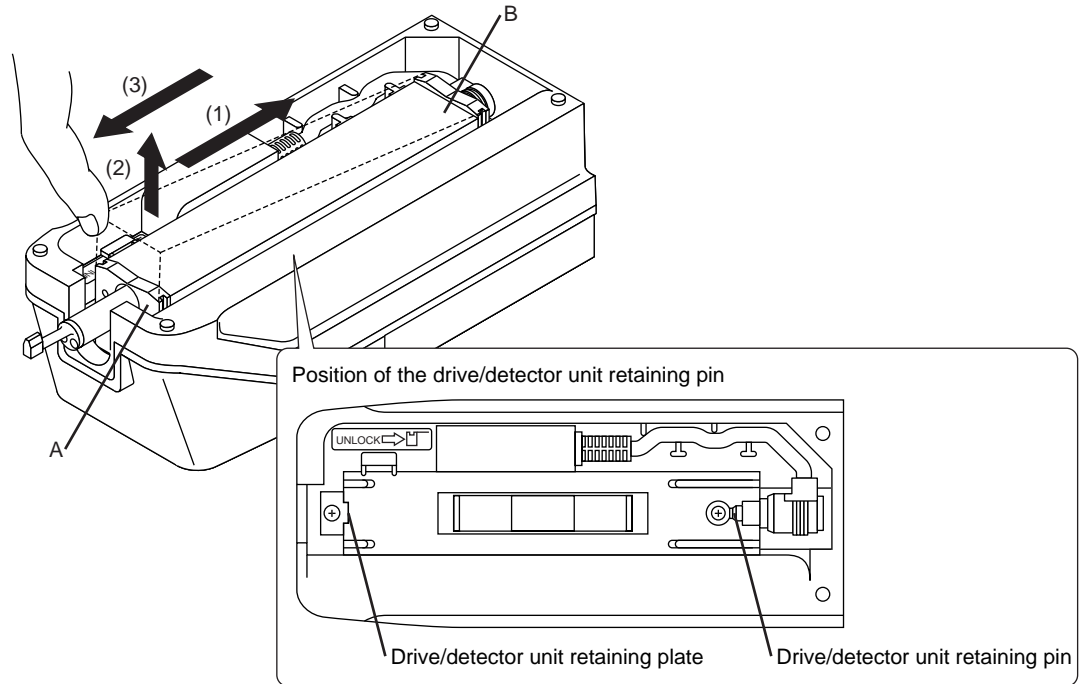
Gently pull the detector straightforward from the drive unit.

1.4.2 Attaching and detaching the drive/detector unit

Follow the method below to attach and detach the drive/detector unit to/from the display unit:

■ Detaching the drive/detector unit

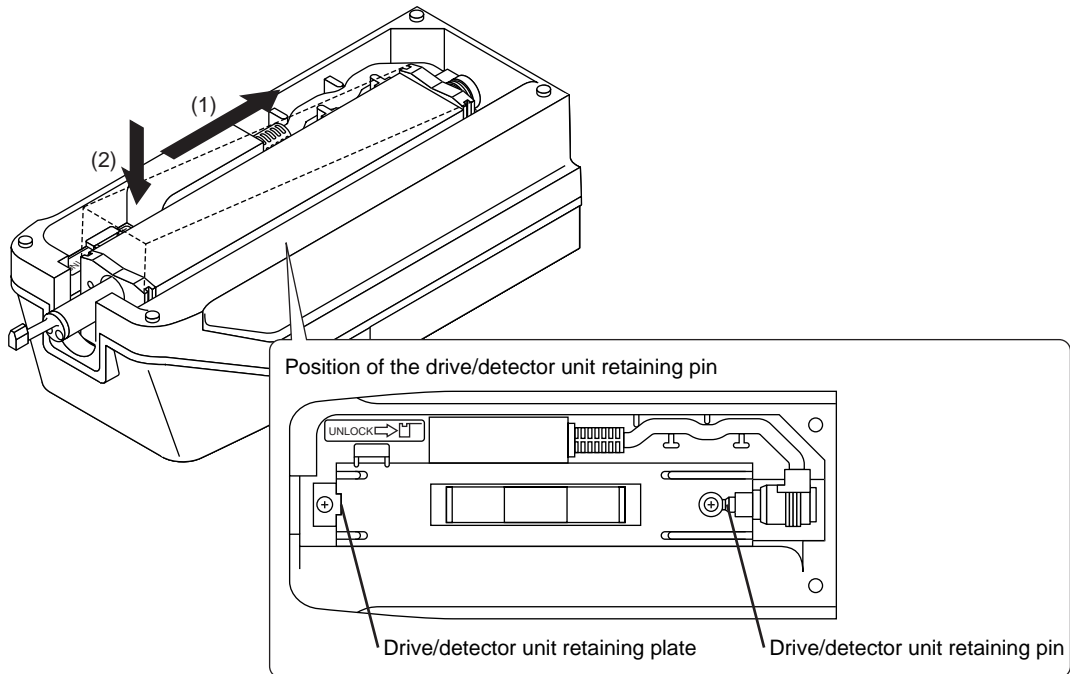
1. While pressing section A in the direction indicated by the arrow (1), erect the drive/detector unit in the direction indicated by the arrow (2).
2. Pull out section B from the drive/detector unit retaining pin on the display unit and lift it in the direction indicated by the arrow (3).



IMPORTANT Do not hold the detector when detaching the drive/detector unit. Otherwise, the detector may be damaged.

■ Mounting the drive/detector unit

1. Push the drive/detector unit all the way into the display unit as indicated by the arrow (1). It fits with the drive unit retaining pin.
2. Lower the drive/detector unit in the direction indicated by the arrow (2) while pressing it in the direction indicated by the other arrow (1) until it is caught by the hook on the drive unit retaining plate.

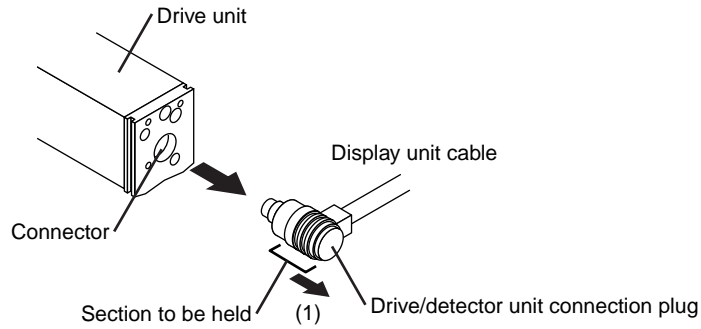


1.4.3 Plugging in and unplugging the display unit cable

IMPORTANT These connections (or disconnections) should be made while the power to the SJ-201P is off (or in the auto-sleep mode).

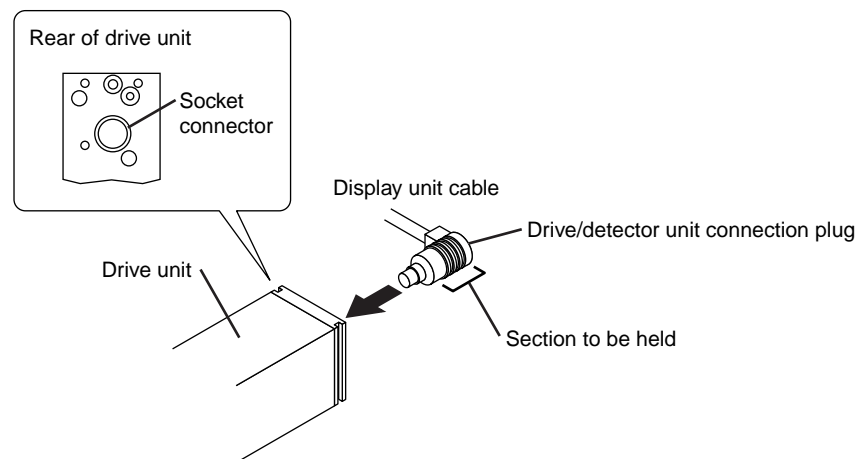
■ Disconnecting the display unit cable

Slide the shown section in the direction indicated by the arrow (1) and remove the drive/detector unit connection plug from the socket connector at the rear of the drive unit.



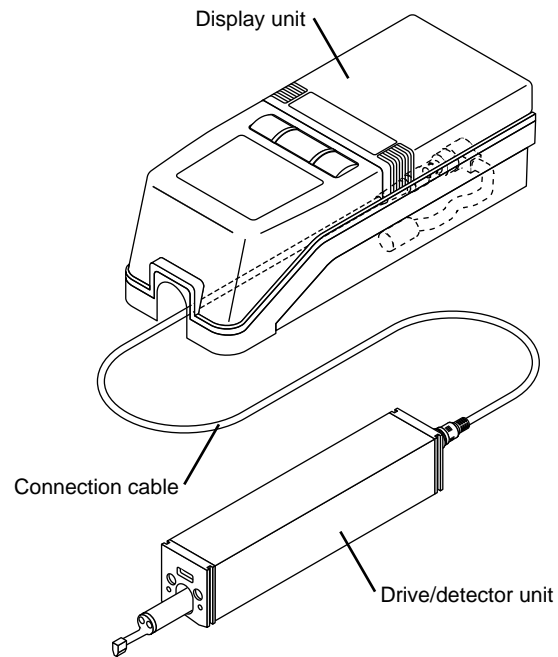
■ Connecting the display unit cable

After confirming the orientation of the socket connector (pin positions) at the drive unit and that of the drive/detector unit connection plug (pin positions), insert the plug into the connector.



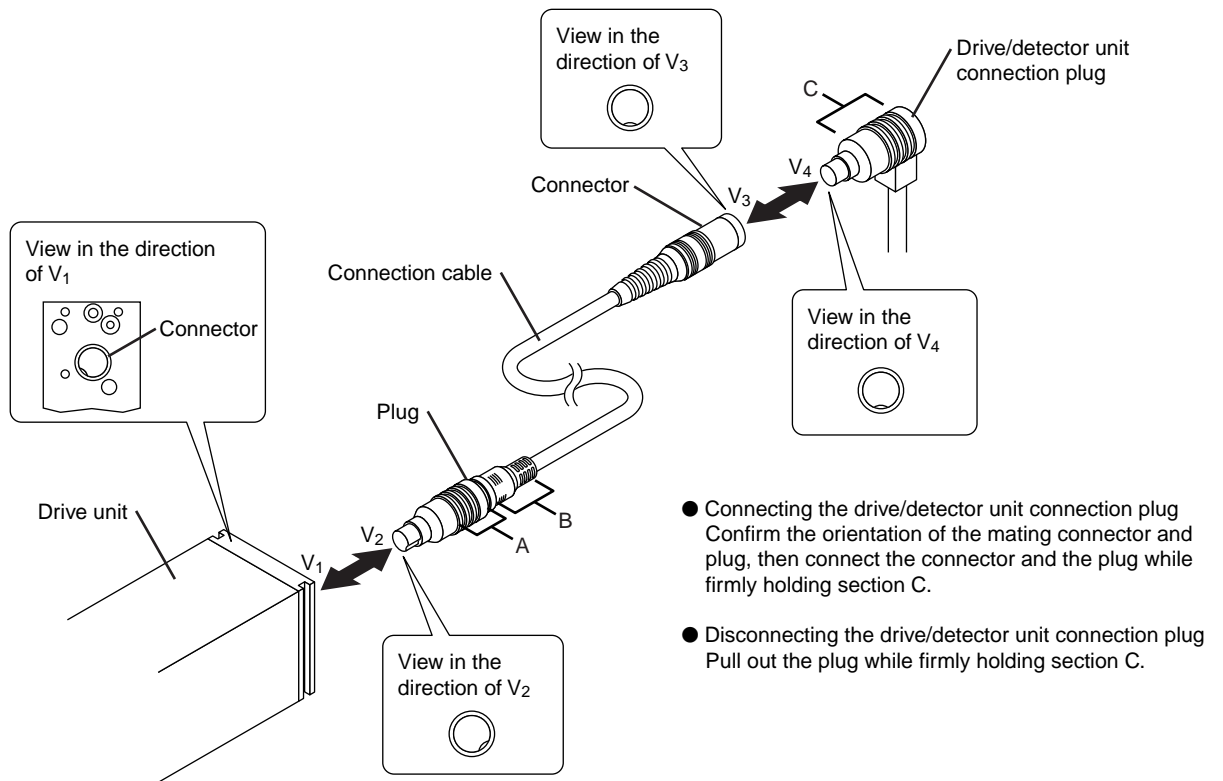
1.4.4 Using the connection cable

To operate the drive/detector unit separately from the display unit, use the connection cable as shown below.



■ Plugging in and unplugging the connection cable

Plug in and unplug the connection cable as shown below:

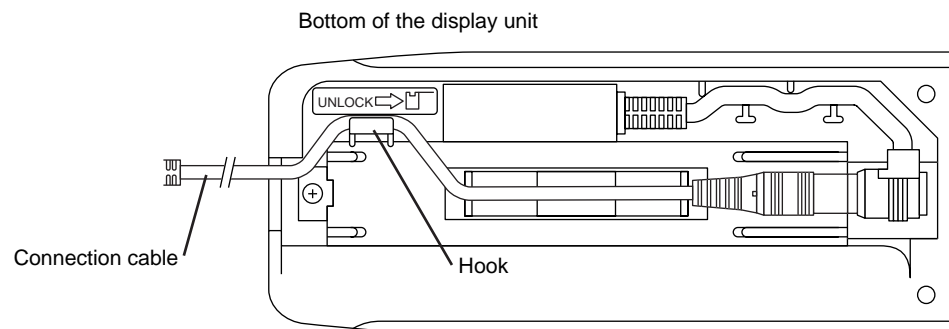


- Connecting the drive/detector unit connection plug
Confirm the orientation of the mating connector and plug, then connect the connector and the plug while firmly holding section C.
- Disconnecting the drive/detector unit connection plug
Pull out the plug while firmly holding section C.

- Connecting the connection cable plug
Confirm the orientation of the mating connector and plug, then insert the plug into the drive unit connector while firmly holding section B.
- Disconnecting the connection cable plug
While holding the section A, slide A towards B, then pull out the plug.

■ Retaining the connection cable

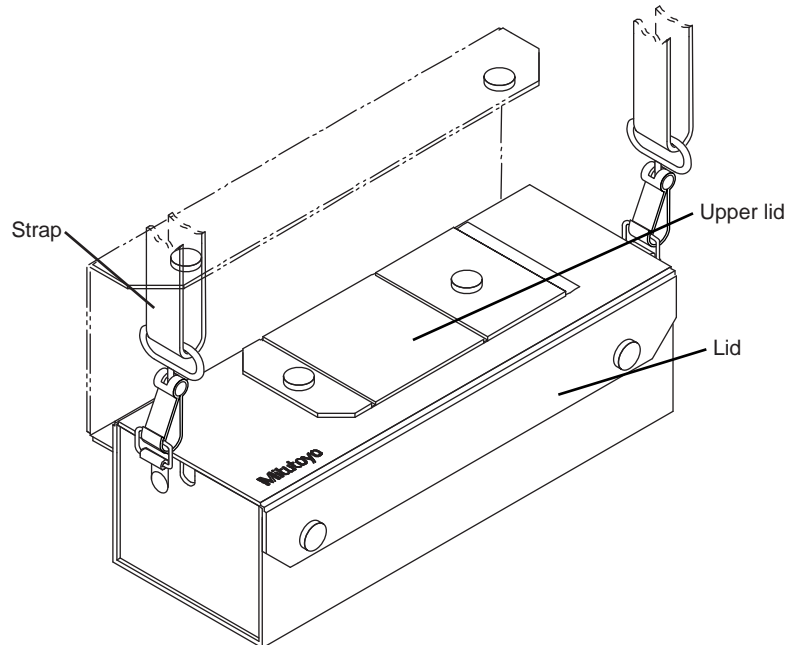
The connection cable should be positioned such that it is held in place by the hook provided on the bottom of the display unit.



1.5 Carrying Case

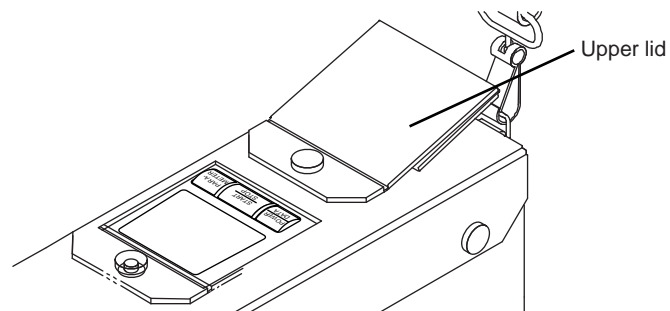
The carrying case supplied is convenient for safekeeping and carrying the SJ-201P.

It is also possible to perform measurement with the drive/detector unit being connected via connecting cable to the display unit housed in the case.



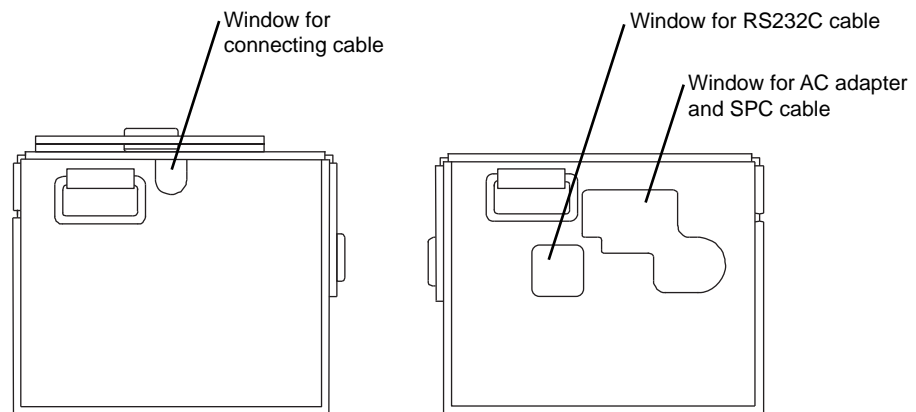
■ Opening the upper lid

Open the upper lid as shown below and the LCD display of the display unit is located, permitting operation of the primary operation keys. When not in use, close the upper lid for safekeeping.



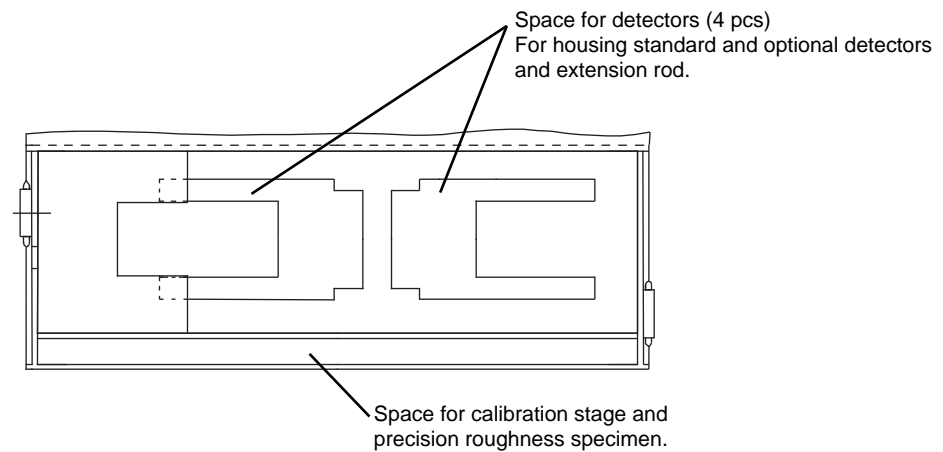
■ Connecting the connecting cable

There are windows on both sides of the carrying case as shown below, through which you can connect the display unit in the case to the external drive/detector unit.



■ Housing accessories

Accessories of SJ-201P can be stored in position as specified below.



MEMO

2

OUTLINE OF THE SJ-201P FUNCTIONS AND KEY OPERATIONS

2.1 Relationship Between SJ-201P Functions and Available Keys

In addition to the normal measurement mode, the SJ-201P has a calibration mode and condition setting mode, any of which can be selected by a simple key operation.

IMPORTANT Do not press the keys with a pointed object or fingernail. This can brake the key.

■ List of SJ-201P operation modes

The SJ-201P has various operation modes including the measurement mode, calibration mode, condition setting mode, RS-232C communication mode, and detector retraction mode.

- Measurement mode

In this mode, the SJ-201P can start and stop measurement, calculate measurements (parameters) and switch display contents, save measurement results, print data, and output SPC data.

- Calibration mode

Sets the calibration value prior to measurement and performs calibration measurement.

- Condition setting mode

Sets and modifies measurement conditions. This mode has 18 sub-modes.

- RS-232C communication mode

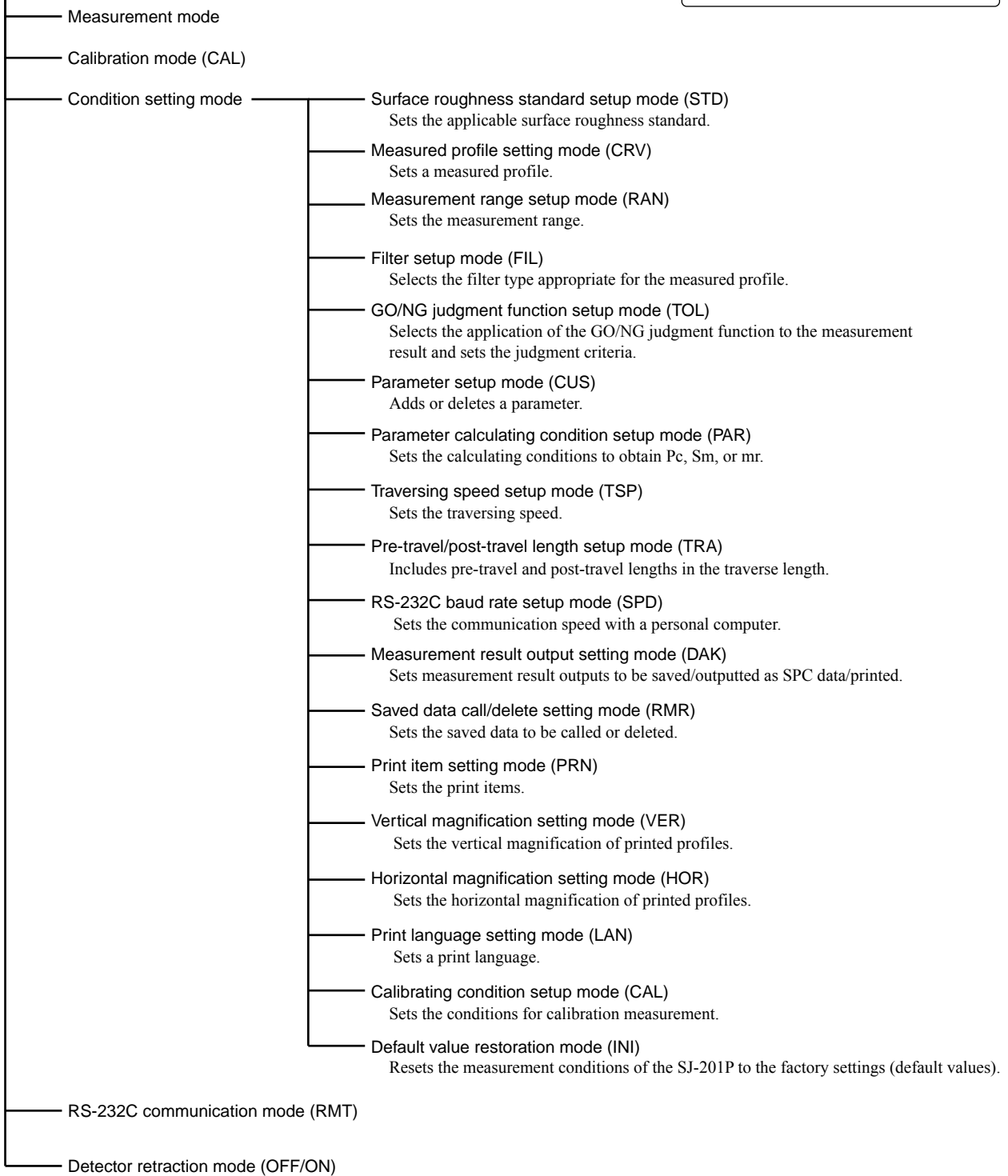
Used for communication with a personal computer.

- Detector retraction mode

Retracts the detector as required.

Power ON

(): Abbreviation displayed on the LCD

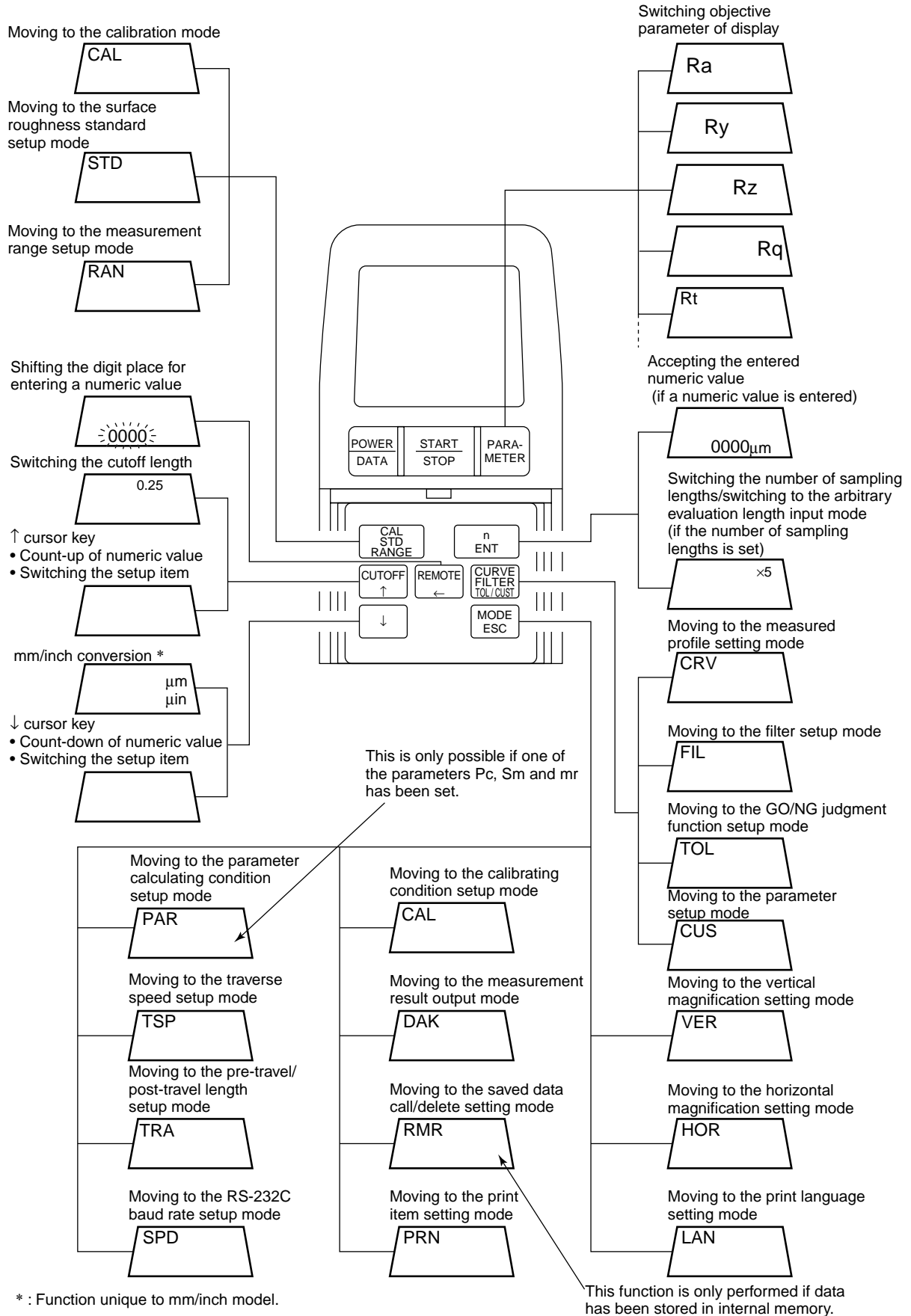


2. OUTLINE OF THE SJ-201P FUNCTIONS AND KEY OPERATIONS

■ Relationship between the operation modes and available keys

Operation mode	Symbol (on LCD)	Key for mode switching
Calibration mode	CAL	[CAL/STD/RANGE]
Surface roughness standard setup mode	STD	[CAL/STD/RANGE]
Measurement range setup mode	RAN	[CAL/STD/RANGE]
Measured profile setting mode	CRV	[CURVE/FILTER/TOL/CUST]
Filter setup mode	FIL	[CURVE/FILTER/TOL/CUST]
GO/NG judgment function setup mode	TOL	[CURVE/FILTER/TOL/CUST]
Parameter setup mode	CUS	[CURVE/FILTER/TOL/CUST]
Parameter calculating condition setup mode	PAR	[MODE/ESC]
Traversing speed setup mode	TSP	[MODE/ESC]
Pre-travel/post-travel length setup mode	TRA	[MODE/ESC]
RS-232C baud rate setup mode	SPD	[MODE/ESC]
Measurement result output setting mode	DAK	[MODE/ESC]
Saved data call/delete setting mode	RMR	[MODE/ESC]
Print item setting mode	PRN	[MODE/ESC]
Vertical magnification setting mode	VER	[MODE/ESC]
Horizontal magnification setting mode	HOR	[MODE/ESC]
Print language setting mode	LAN	[MODE/ESC]
Calibrating condition setup mode	CAL	[MODE/ESC]
Default value restoration mode	INI	Press [POWER/DATA] while simultaneously holding down [PARAMETER] and [START/STOP] during auto sleep.
RS-232C communication mode	RMT	Press [POWER/DATA] while holding down [REMOTE←] during auto sleep.
Detector retraction mode	OFF ON	Retraction: Press [POWER/DATA] while holding down [START/STOP] during auto sleep. Canceling retraction: Press [START/STOP] if the detector is retracted and the power is on.

■ Functions and how they are represented on the LCD

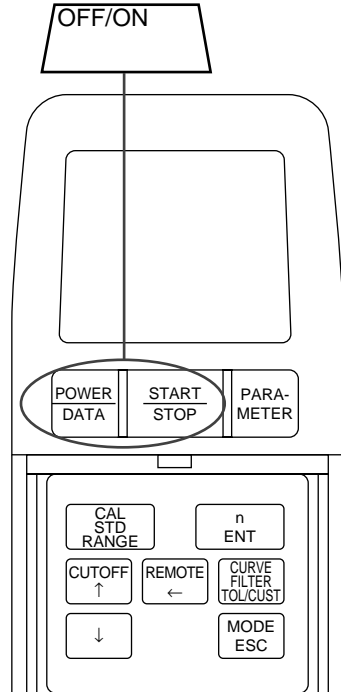


2. OUTLINE OF THE SJ-201P FUNCTIONS AND KEY OPERATIONS

- Functions enabled by pressing multiple keys and how they are represented on the LCD

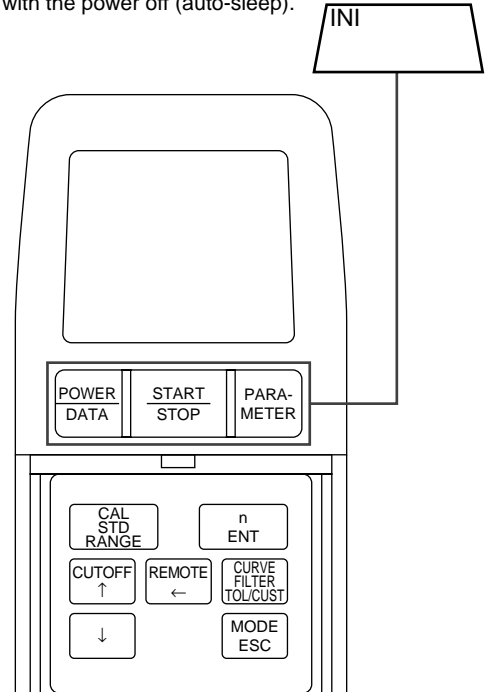
Detector retraction/cancel

Press **POWER DATA** while holding down **START STOP** if the power is off (auto-sleep).



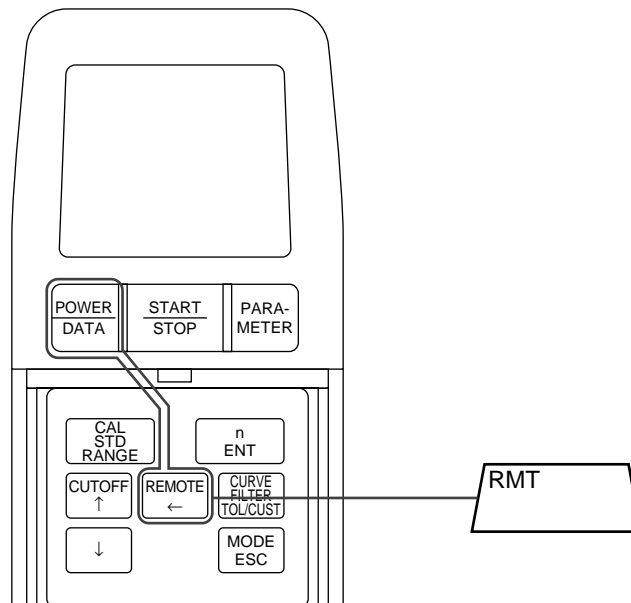
Default value restoration (default value restoration mode)

Press **POWER DATA** while simultaneously holding down **START STOP** and **PARA-METER** with the power off (auto-sleep).



Move to the RS-232C communication mode

Press **POWER DATA** while holding down **REMOTE ←** if the power is off (auto-sleep).



2.2 Key Operations to Enter Numeric Values

With the SJ-201P it is sometimes necessary to enter numeric values for such operations as modifying the measurement condition. This section explains how to enter a numeric value.

■ Key operation required to enter a numeric value to modify the measurement condition

The following keys are used to enter a numeric value.

- [CUTOFF ↑] key: Count-up (increment the numeric value)
- [↓] key: Count-down (decrement the numeric value)
- [REMOTE ←] key: Shifting the objective digit place for input
- [n/ENT] key: Accepting the entered numeric value

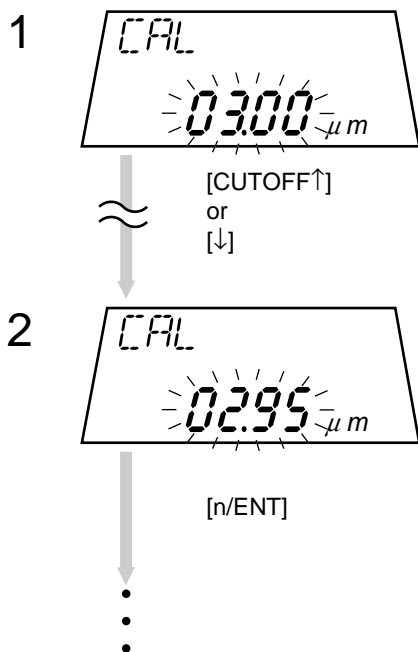
The following are two practical methods to enter a numeric value.

- No specific digit place is selected but the whole digits can be the objective for an increment.
- Selecting a specific digit place for an increment.

These two methods are explained using an example where a calibration value is modified from “3.00” to “2.95”.

NOTE Do not press the [n/ENT] key before the numeric value has been entered. Only press the [n/ENT] key to terminate numeric value entry and accept it at that point in time.

- No specific digit place is selected but the whole digits can be the objective for an increment.



Remains in the calibration mode, ready for the entry of a numeric value. “03.00” flashes.

Press the [↓] key five times.

⇒ The four digits will change to “02.95” and keep flashing.

TIP Keep holding down the [CUTOFF ↑] or [↓] key to increase the count-up or count-down speed.

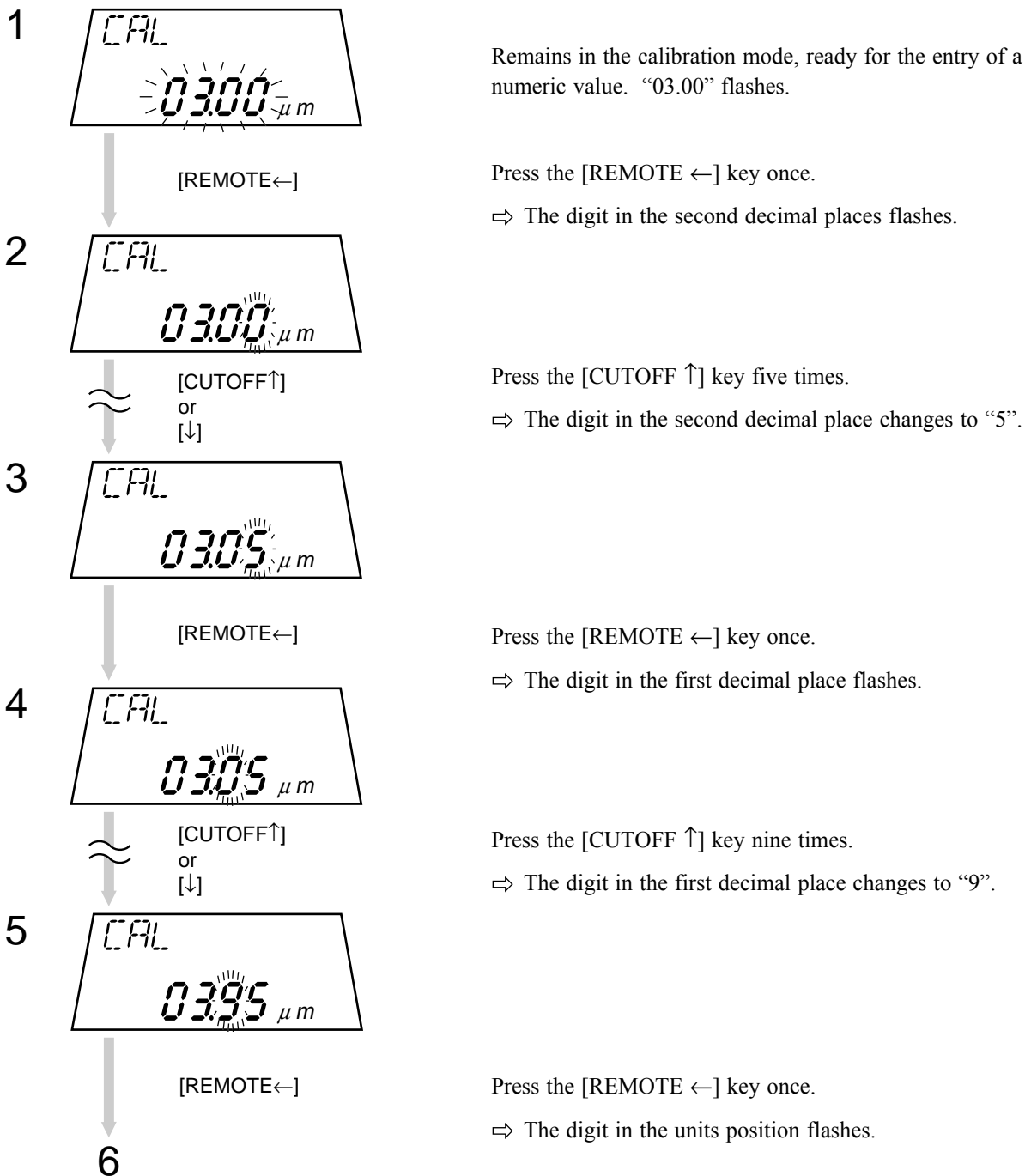
Confirm that the correct value is displayed, then press the [n/ENT] key.

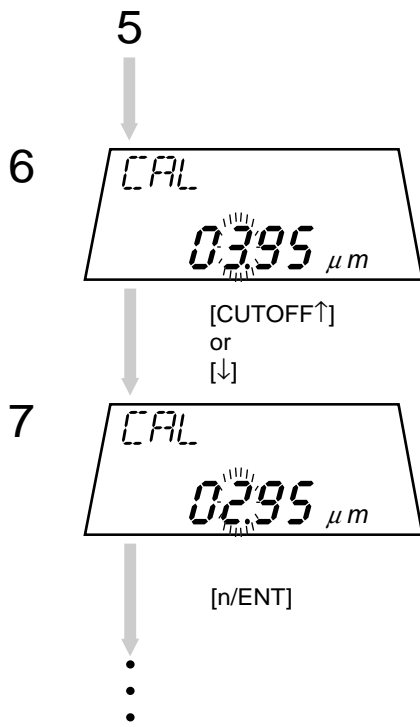
⇒ The entered value is accepted.

NOTE Numeric values to be entered may be subject to limitations.
An arbitrary evaluation length, for example, should be within a 0.3 mm (.01") to 12.5 mm (.49") range.
If the [n/ENT] key is pressed after a numeric value that is outside the permissible length is entered as the arbitrary evaluation length, it will be automatically corrected to the lower limit (0.3 mm/.01") or upper limit (12.5 mm/.49") before it is accepted.

2. OUTLINE OF THE SJ-201P FUNCTIONS AND KEY OPERATIONS

● Selecting a specific digit place for an increment





Press the [↓] key once.

⇒ The digit in the units position changes to “2”.

Confirm that the correct value is displayed, then press the [n/ENT] key.

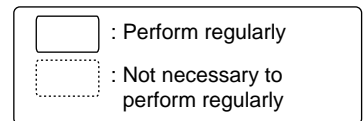
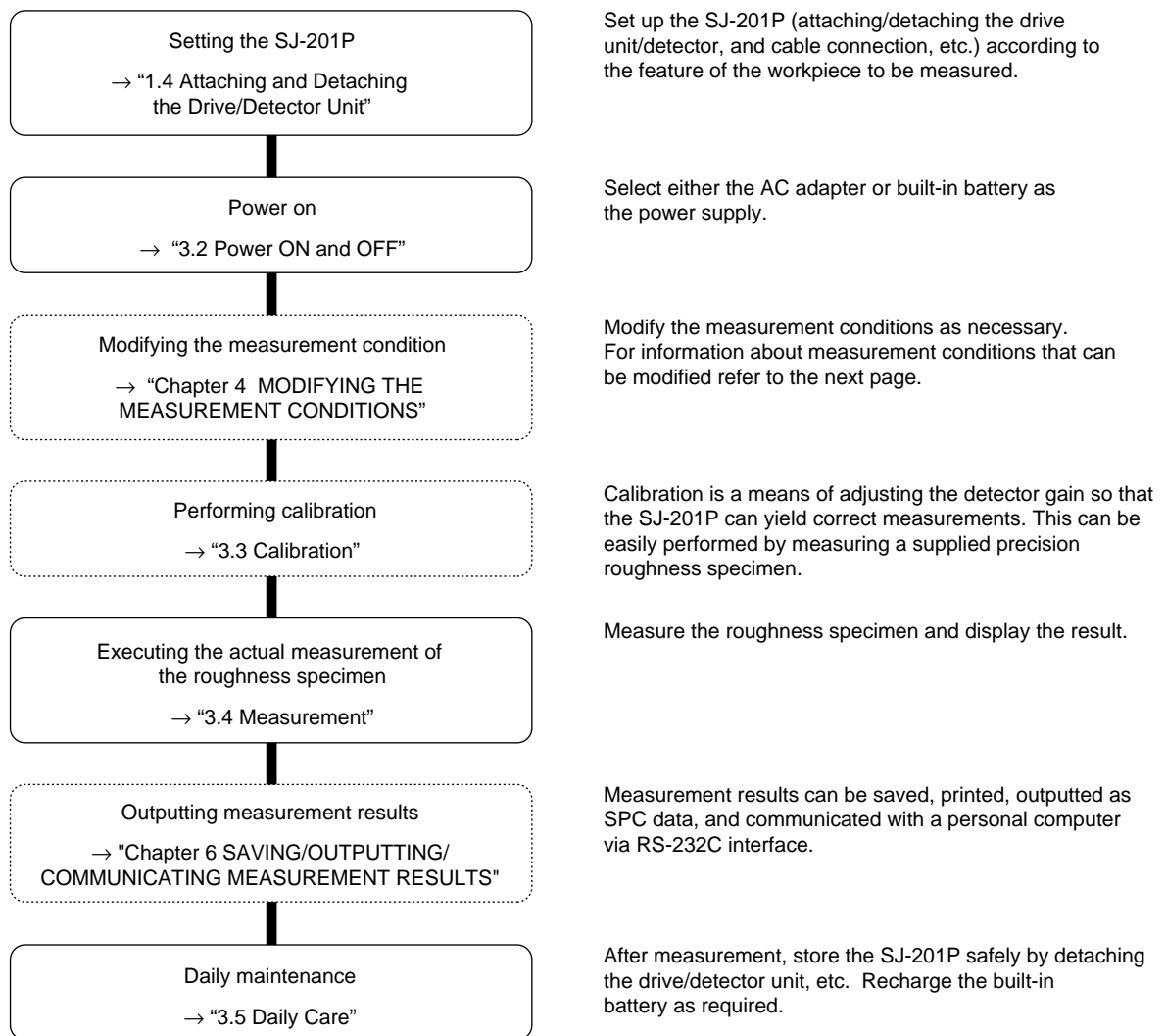
⇒ The entered value is accepted.

3

MEASUREMENT OPERATION

In this chapter the surface roughness measurement with the SJ-201P is described according to the general procedures.

3.1 Overall Measurement Flow



■ List of measurement conditions that can be modified

The following table shows the measurement conditions that can be modified by the user. If they are not modified, then measurement will be performed according to the default values (factory settings).

Measurement condition	Default value	Remark	Related section
Cutoff length (sampling length)	0.8 mm (.03 in)		4.1
Number of sampling lengths	x 5		4.2
Arbitrary evaluating length	None	If measurement is not performed with the cutoff length and the number of sampling lengths provided by the SJ-201P, set an arbitrary length for traversing.	4.3
Surface roughness standard	*1	Set to the desired standard.	4.6
Measured profile	R profile	Switch this to a measured profile to be used.	4.7
Filter	Pc50	Switch this to a filter to be used.	4.8
Application of GO/NG judgment and the range	None	Set the upper or lower roughness limit to discriminate between measured workpieces to be accepted or rejected.	4.9
Surface roughness parameter	Only Ra, Ry, Rz, Rq	Parameters to be yielded can be set on/off.	4.10
Traversing speed	0.5 mm/s (.02 in/s)	Default traversing speed can be modified.	4.11
To include pre-travel/post-travel length in the traversing length	ON	Since the existing surface roughness standards require the pre-travel/post-travel length to be included in the traversing length, the setting is usually set to “ ON” . However, if these lengths can not be traced due to the limited space, the setting can be changed to “ OFF” .	4.4
Calibration value	3.00 μm (118 μin)	Can be set according to the value of the precision reference specimen.	4.12
Unit of measurement	*2	Depending on the model/destination.	4.14
Baud rate	9600bps	Change this to a baud rate when communicating with a personal computer or the printer. Either 9600bps or 19200bps can be selected.	6.5
Print item	0111	Set this when changing the item to be printed. Select a print item from measurement condition, measured profile, calculated results, and BAC.	6.3.3
Vertical print magnification	Auto	Set the vertical magnification of a printed profile.	6.3.4
Horizontal print magnification	Auto	Set the horizontal magnification of a printed profile.	6.3.4
Print language setup	0	Set the print language to English or Japanese.	6.3.5
Measurement result output setup	0	Select whether measurement results are to be saved, printed, or outputted as SPC data.	6.1

*1, *2 :

Measurement condition	Set No.								
	178-920K 178-930K	178-920A 178-930A	178-920D 178-930D	178-920E 178-930E	178-923 178-933	178-923A 178-933A	178-923D 178-933D	178-923E 178-933E	
*1 Surface roughness standard	New JIS	ANSI	DIN	ISO	New JIS	ANSI	DIN	ISO	
*2 Unit of measurement	mm	mm	mm	mm	inch	inch	inch	inch	

■ What is calibration?

Calibration of a surface roughness measuring instrument is performed by measuring (called “calibration measurement”) a reference workpiece (precision roughness specimen) and adjust the difference (gain adjustment), if any between the measured value and reference value (precision roughness specimen).

With the SJ-201P, adjustment of the difference between the measured value and reference value (gain adjustment) can be easily achieved by calibration measurement.

Calibration should be performed periodically according to how much and in which conditions the SJ-201P is used. If the instrument is used for the first time or if the detector is mounted/replaced, calibration is essential. Without properly calibrating the instrument, correct measurement data can not be obtained.

3.2 Power ON and OFF

An AC adapter and a built-in battery are provided to supply power to the SJ-201P.

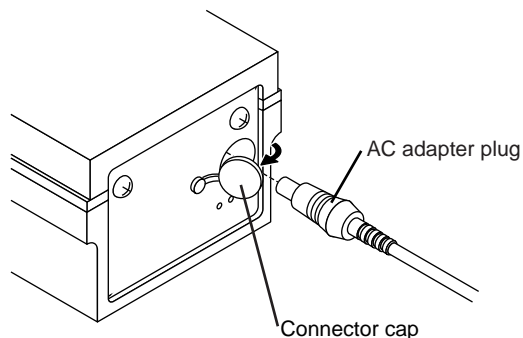
If an external power supply is available, connect the AC adapter to the SJ-201P and turn on the power.

If the AC adapter is not connected, power is supplied from the built-in battery.

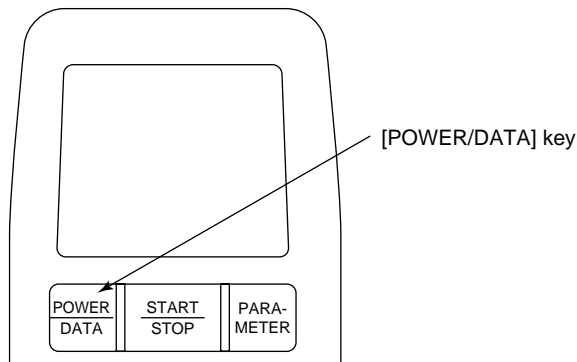
■ Using the AC adapter

-
- IMPORTANT**
- Do not connect the AC adapter to a power line which may cause electrical interference. Although this instrument has reasonable protection against electrical interference, supplying power from such a line may hamper correct measurement.
 - If you have removed the rear cover of the display unit, take care and do not connect the AC adapter plug to the SPC or RS232C connector. Instrument failure will result.
 - Do not turn on/off the battery switch with the AC adapter connected to the SJ-201P. This can cause the battery to be overcharged. Only turn on/off the battery switch if the AC adapter has been disconnected.
-

1. Turn on the battery switch prior to the connection of the AC adapter. (See the following page to locate the battery switch.) Proceed to the next step if the battery switch is on.
2. Connect the AC adapter to the wall outlet.
3. Remove the connector cap on the rear cover, then insert the AC adapter plug into the connector.

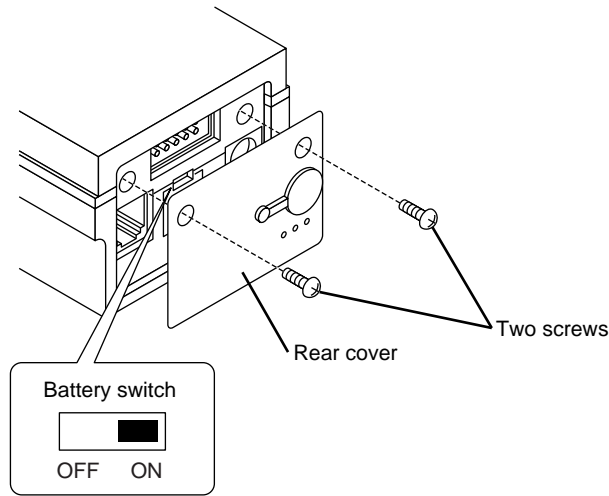


4. Press the [POWER/DATA] key.

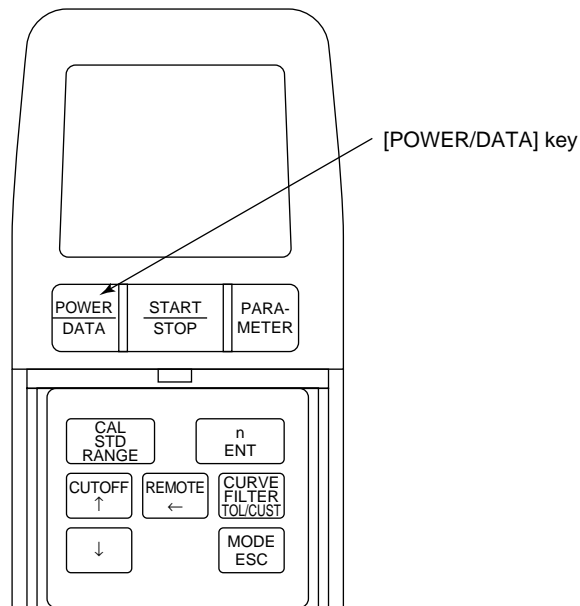


■ Using the built-in battery

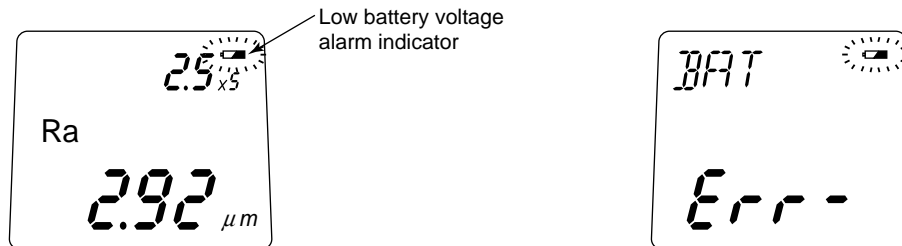
1. Remove the two screws on the rear cover using a Phillips screwdriver.
2. Remove the rear cover.
3. Turn on the battery switch.
4. Replace the rear cover and the two screws removed in step 1.



5. Press the [POWER/DATA] key.



-
- NOTE**
- If battery power falls below 1/4 of the full capacity, the low battery voltage alarm indicator starts flashing. "Err" will result if measurement is started under this condition.
 - If the built-in battery power is almost consumed, the power supply cannot be turned on. Charge the built-in battery to drive the SJ-201P again with the battery. Notice that the data including measurement results saved in the built-in memory will be cleared.
-



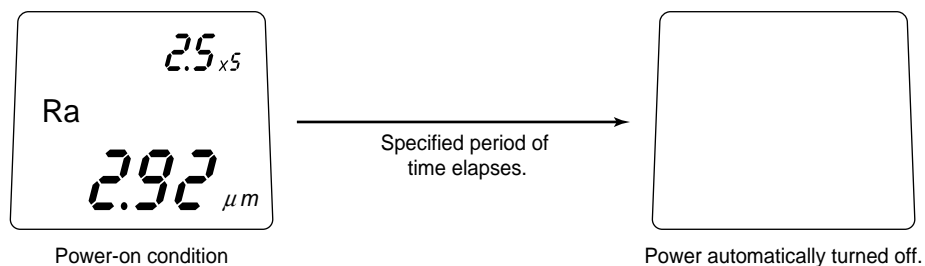
If the low battery voltage alarm indicator is flashing, recharge the built-in battery as soon as possible.

-
- TIP** For information about recharging the battery refer to "3.5.2 Recharging the built-in battery".
-

■ Power OFF (auto-sleep)

The power to the SJ-201P will be automatically turned off by the auto-sleep function if no key operation is performed for a specified period of time.

The measurement conditions are retained when the power is turned off by the auto-sleep function. The measurement results will also be retained if the battery switch is on. If this is the case, the measurement results will be displayed on the LCD the next time the power is turned on.



-
- NOTE** Retain the battery switch to on unless the SJ-201P will not be used for a long period of time (approximately 2 to 3 weeks). If the battery switch is off, the measurement results and conditions may not be stored.
-

-
- TIP** The indicator showing that recharging is in progress (low battery voltage alarm indicator) also stays on during auto-sleep. For more information refer to "3.5.2 Recharging the built-in battery".
-

3. MEASUREMENT OPERATION

The relationship between the auto-sleep function and each operation mode is given below:

SJ-201P operation mode	Auto-sleep function
Measurement mode	The power is automatically turned off if no key operation is performed for 30 seconds.
Calibration mode Condition setting mode	The power is automatically turned off if no key operation is performed for 5 minutes.
RS-232C communication mode	Auto-sleep does not take place. The power of the SJ-201P should be turned off either by pressing the [REMOTE ←] key or via a communication command.
Detector retraction mode	The power is automatically turned off if no key operation is performed for 30 seconds after detector retraction has been completed.

-
- TIP**
- If a request signal ($\overline{\text{REQUEST}}$ signal) is inputted from an external device during SPC data output, the SJ-201P power will not be turned off for a specified period of time after signal input.
 - For information about turning off the SJ-201P power while in the RS-232C communication mode refer to “6.5 Connecting with a Personal Computer”.
-

3.3 Calibration

The process of calibration involves the measurement of a reference workpiece (precision roughness specimen) and the adjustment of the difference (gain adjustment), if there is one between the measured value and the reference value (precision roughness specimen).

On the SJ-201P this difference can be easily adjusted through calibration measurement.

Depending on the usage of the SJ-201P, calibration should be performed periodically. In addition, if the instrument is used for the first time or if the detector has been mounted/replaced, calibration is essential. Without properly calibrating the instrument, correct measurements can not be obtained.

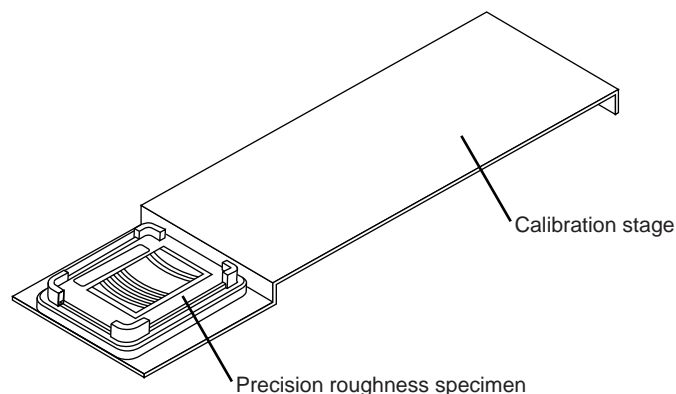
3.3.1 Calibration preparation

Use the supplied precision roughness specimen for calibration.

-
- NOTE**
- The precision roughness specimen supplied for the SJ-201P has been calibrated in accordance with the New JIS (JIS B0601-1994).
 - If calibration needs to be performed with a standard other than the supplied precision roughness specimen, it must only be done after the default calibration conditions have been modified so they are suitable for the roughness specimen. For information about the procedure used to modify the calibrating conditions refer to “4.12 Modifying the Calibration Conditions”.
-

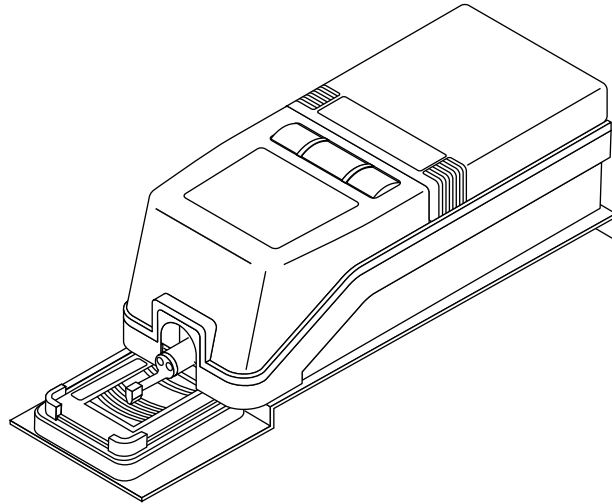
■ Setting up the precision roughness specimen, calibration stage, and SJ-201P

1. Place the precision roughness specimen and calibration stage on a level table.

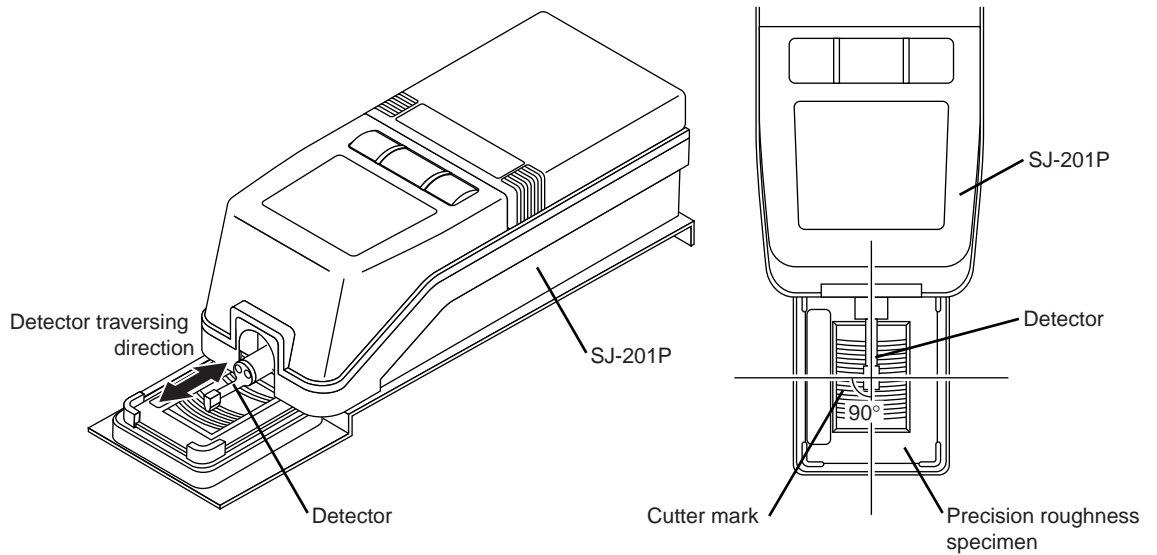


3. MEASUREMENT OPERATION

2. Mount the SJ-201P on the calibration stage.

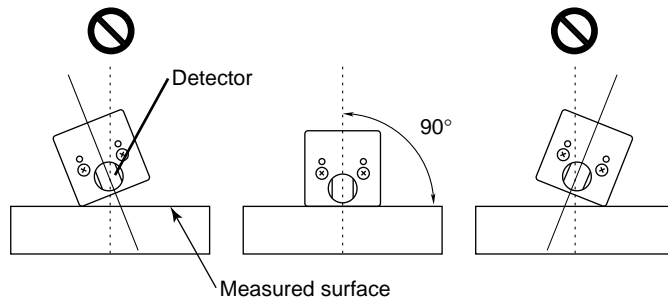


3. Set the SJ-201P so that the detector traversing direction is perpendicular to the cutter mark of the precision roughness specimen.

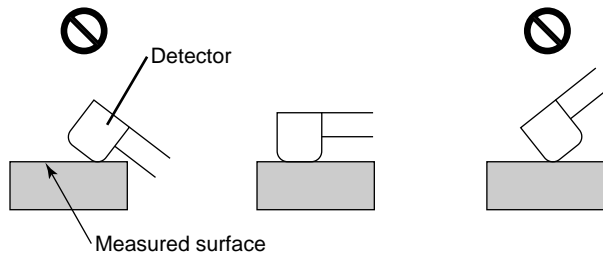


4. Confirm that the detector is parallel to the measured surface.

- Front view of detector



- Side view of detector



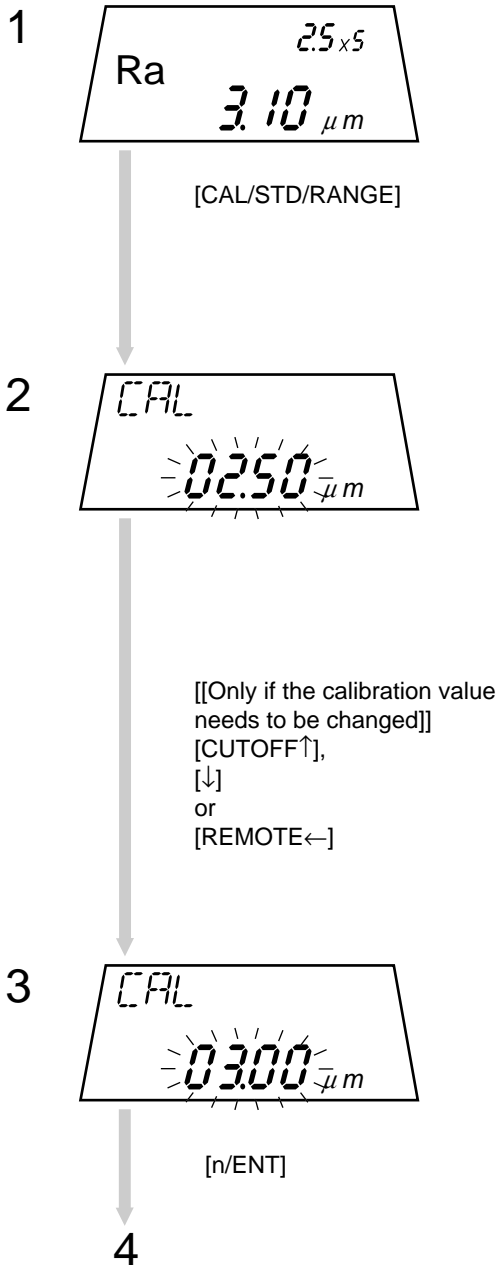
3.3.2 Performing calibration**■ Calibrating with the default values**

If calibrating the SJ-201P with the roughness specimen supplied, be sure to calibrate with the default values shown below that have been used for calibrating the roughness specimen.

Calibrating condition setup item	Default value
Parameter	Ra
Cutoff length	2.5mm (.1")
Number of sampling lengths	5
Measurement range	Auto
Measured profile/filter	R-profile/Pc50(depends)
Pre-travel/post-travel length	ON

NOTE If the SJ-201P needs to be calibrated with a standard other than the supplied precision roughness specimen, the default calibration conditions must be modified for the roughness specimen to be used. For information about the procedure used to modify the calibration conditions refer to "4.12 Modifying the Calibration Conditions".

■ Calibration procedure



Press the [CAL/STD/RANGE] key in the measurement mode.

The calibration mode is entered and the current calibration value is displayed. In this state the calibration value can be modified.

If the displayed value is different from that marked on the precision roughness specimen, modify the calibration value.

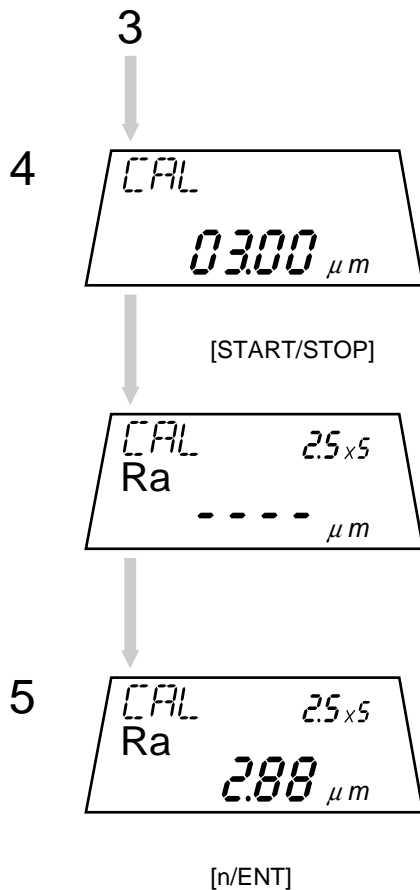
If the calibration value does not require modification, proceed to the next step.

TIP

- If the SJ-201P is being calibrated for the first time, “3.00 μm (118 μin)” will be displayed.
- See also “2.2 Key Operation to Enter Numeric Values”.
- The calibration value to be set is the Ra value marked on the specimen.
- To cancel the numeric entry operation press the [MODE/ESC] key. This restores the measurement mode.

Confirm the displayed value, then press the [n/ENT] key.

⇒ The entered calibration value is set.



The calibration value has now been set.

Press the [START/STOP] key.

⇒ A calibration measurement with the precision roughness specimen is performed, and “-----” is displayed during the calibration measurement (while the detector is traversing).

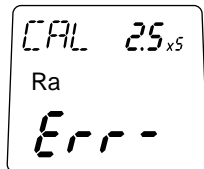
NOTE Calibration measurement can not be started if the low battery voltage alarm indicator is flashing. See “3.2 Power On and Off” for details.

⇒ When the calibration measurement has been completed, the measured value will be displayed.

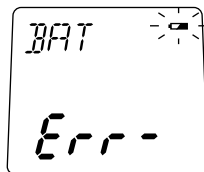
Press the [n/ENT] key.

⇒ The calibration factor is updated, completing the entire calibration operation.

NOTE • If “CAL Err” appears, perform calibration measurement again. If the same error persists, refer to “Chapter 8 TROUBLESHOOTING”.



• If “BAT Err” appears, charge the battery with the AC adapter. See “3.5.2. Re-charging the built-in battery”.



• To cancel the calibration result (calibration factor) press the [MODE/ESC] key. This restores the measurement mode and retains the calibration factor obtained in the previous calibration.

3.4 Measurement

To start measurement, set the SJ-201P on a workpiece and press the [START/STOP] key. After measurement has been completed, the measurement result will be displayed on the LCD for confirmation.

3.4.1 Setting the workpiece and SJ-201P

■ Placing the workpiece and SJ-201P

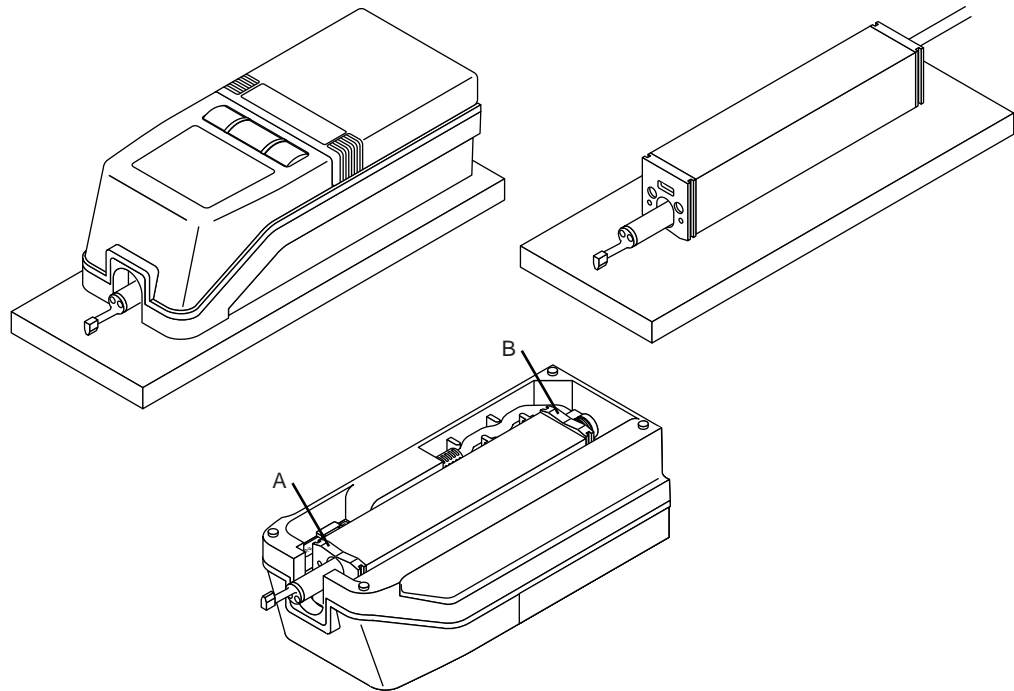
If the workpiece surface is large enough for the SJ-201P, place the SJ-201P on the workpiece.

For surface roughness measurement to be successful, it should be performed on a firm base that is insulated as well as possible from all sources of vibration. If measurement is performed being subject to significant vibrations, results may be unreliable.

TIP In cases where the measured surface is smaller than the SJ-201P or where the surface is curved (cylindrical, etc.), install the SJ-201P using an appropriate optional accessory. See also “Chapter 5 INSTALLING THE SJ-201P WITH OPTIONAL ACCESSORIES”.

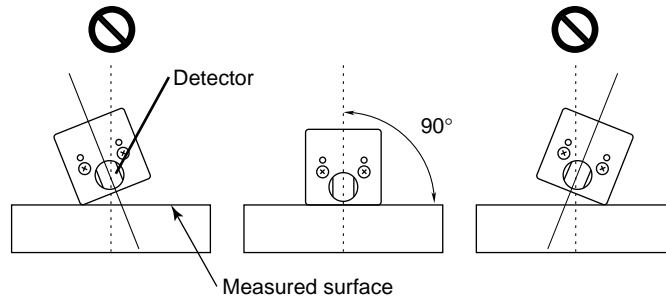
1. Position the workpiece so that the measured surface is level.
2. Place the SJ-201P on the workpiece.

In this operation support the SJ-201P by reference surfaces A and B, as shown below.

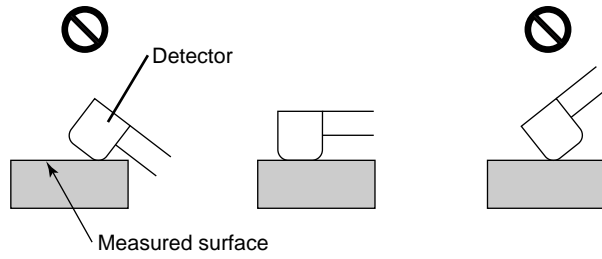


3. Confirm that the stylus is in proper contact with the measured surface.
In addition, confirm that the detector is parallel to the measured surface.

- Front view of detector



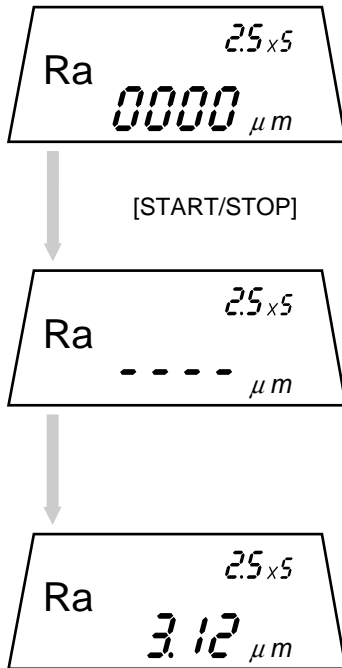
- Side view of detector



3.4.2 Starting measurement

■ Measurement procedure

1



Press the [START/STOP] key in the measurement mode.

⇒ The detector starts traversing to perform measurement.

⇒ While measurement is being performed (detector is traversing), “----” is displayed on the LCD.

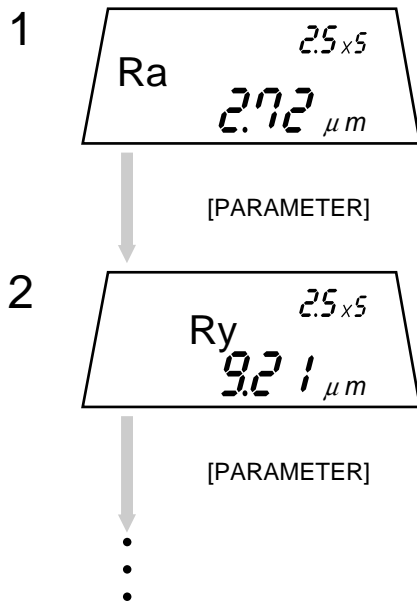
⇒ After the measurement has been completed, the measured value will be displayed.

NOTE Measurement can not be started if the low battery voltage alarm indicator is flashing. See "3.2 Power On and Off" for details.

3.4.3 Switching the objective parameter to be displayed

The objective parameter to be displayed can be switched by pressing the [PARAMETER] key while the measurement result is being displayed on the LCD.

■ Switching the parameter display



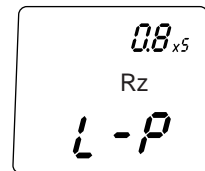
A measurement result (on parameter Ra) is being displayed now.

Press the [PARAMETER] key until the desired parameter value is displayed on the LCD.

⇒ Each time the key is pressed, the displayed parameter changes in the following order: Ra -> Ry -> Rz -> Rq -> Ra.

TIP

- For information on how to switch the displayed parameter refer to “4.10 Setting Parameters Other Than Ra, Ry, Rz, and Rq”.
- Parameter value Rz can be calculated and displayed even from peaks and valleys of the insufficient number for the specifications. In this case, a message “LES” is displayed as shown below. If there is no peaks and valleys, a display of “L-P” results.

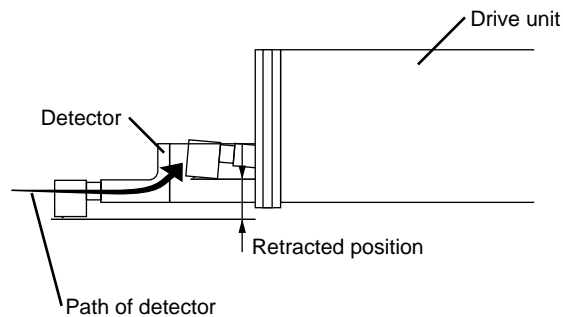


3.4.4 Detector retraction procedure

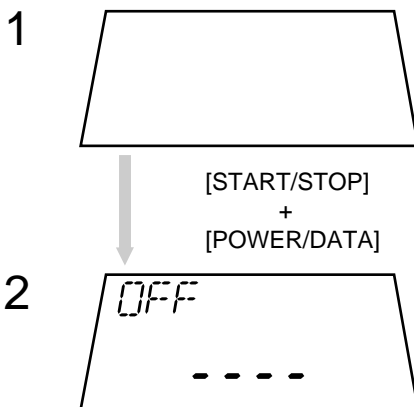
If moving the SJ-201P or if it will not be used for a long period of time, prevent damage to the detector or workpiece caused by the detector tip interfering with the workpiece by retracting the detector.

IMPORTANT Do not perform detector retraction if an extension rod (optional) is installed. The extended detector is subject to an external force: This may cause breakage of the drive unit.

■ Retracting the detector



■ Detector retraction procedure



NOTE The retraction function will not work while the power is on.

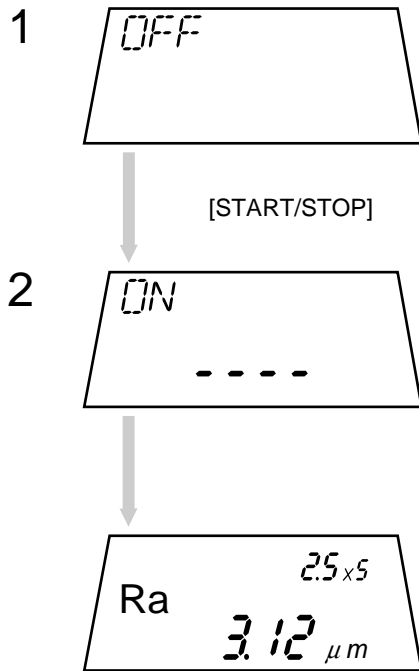
When the power is off, press the [POWER/DATA] key while holding down the [START/STOP] key.

⇒ This retracts the detector.

During retraction “----” will be displayed on the LCD.

NOTE If no key operation is performed for more than 30 seconds after retraction has been completed, the power will be automatically turned off by the auto-sleep function.

■ Canceling detector retraction



While the detector is in retraction, press the [START/STOP] key.

⇒ The detector returns to the position it was in before retraction started.

While the detector is being moved, “-----” will be displayed on the LCD.

As the detector is restored to its previous position, the string of “-” disappears gradually.

⇒ If the detector is completely released from retraction, the measurement mode is entered.

3.5 Daily Care

3.5.1 Storage of SJ-201P

■ Detaching the drive/detector unit

After a measurement task has been completed, detach the drive/detector unit from the display unit and separate the detector from the drive unit. Store all the SJ-201P components and its accessories in cases to keep out dust and moisture.

NOTE Keep the battery switch on unless the SJ-201P will not be used for a long period of time (more than 2 to 3 weeks). With the battery switch on, measurement results obtained immediately before the SJ-201P is turned off by the auto-sleep function will be saved and displayed on the LCD the next time the instrument is used. However, if the battery switch is off, the measurement results will be lost. The setup specifications, however, will not be lost even if the battery switch is turned to off in the auto-sleep mode.

TIP For information on how to detach the drive/detector unit and the separation of the two, refer to "1.4 Attaching and Detaching the Drive/Detector Unit".

■ Selecting a suitable storage place

Store the SJ-201P in a suitable place where the temperature can be maintained in a range between -10°C and 40 °C. The service life of the built-in battery varies a substantial amount depending on the ambient temperature conditions, etc.

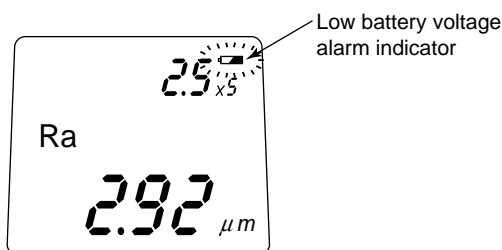
■ Cleaning

If the SJ-201P is soiled, wipe it using a soft, dry cloth. Do not use thinner or benzene for cleaning.

3.5.2 Recharging the built-in battery

Charge the battery in the following cases:

- If the low battery voltage alarm indicator starts flashing (during measurement) as illustrated below.



- If the battery power is supposed to be exhausted after having performed significant times of measurements although the low battery voltage alarm indicator is not flashing.

NOTE The battery will not be charged in the following cases if the low battery voltage alarm indicator is not flashing.

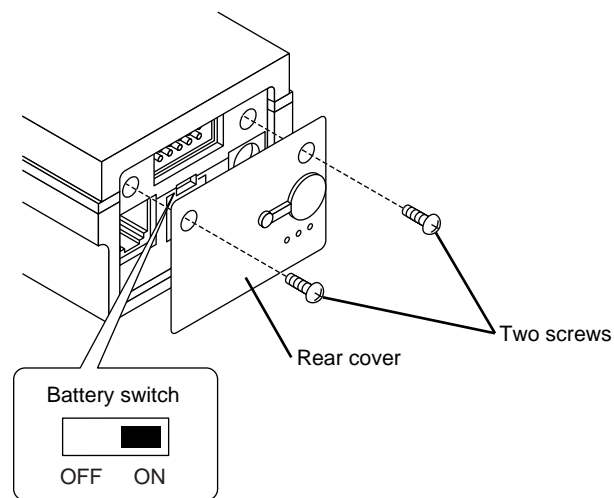
- If the battery switch was switched after the previous charging of the battery.
- If more than 50% of battery power remains.

The low battery voltage alarm indicator does not turn on in this case.

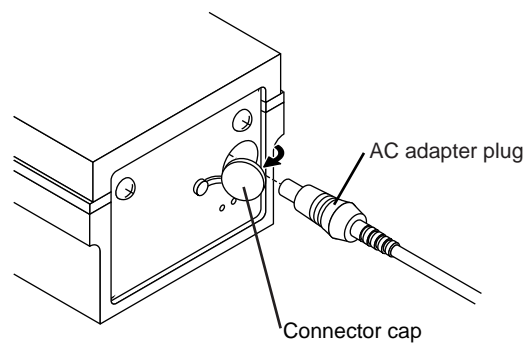
TIP If almost all the battery power is exhausted, it takes about 16 hours to fully recharge it.

■ Recharging the battery

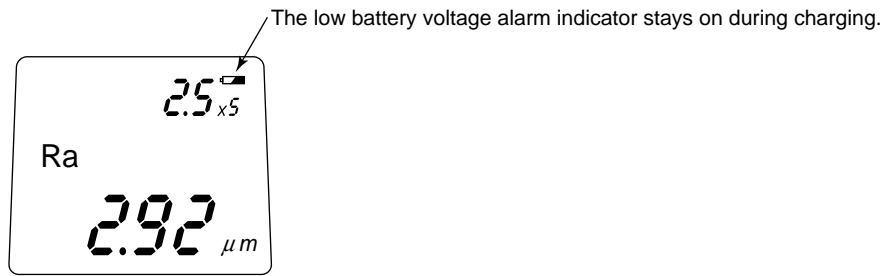
The battery switch must be on to recharge the battery. If the switch is off, remove the rear cover by loosening the specified screws and turn the switch on.



1. Connect the AC adapter to the wall outlet.
2. Remove the connector cap from the rear cover, then insert the AC adapter plug into the connector.

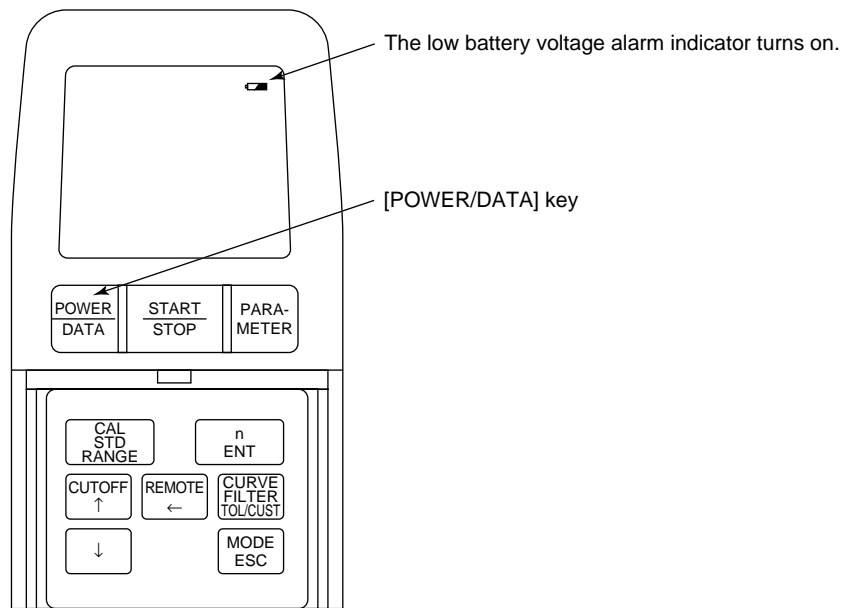


- If the AC-adaptor is connected to the display unit while it is on, recharging of the battery will automatically start. The low battery voltage alarm indicator turns on during charging and goes off if the battery is fully charged.



- If the AC-adaptor is connected to the display unit while it is off (auto-sleep mode), proceed to step 3 below.

3. Press the [POWER/DATA] key.



Recharging starts and the low battery voltage alarm indicator turns on.

If fully charged, the low battery voltage alarm indicator goes off.

NOTE Do not turn off the battery switch during charging. Charging will be terminated if the switch is turned off.

4

MODIFYING THE MEASUREMENT CONDITIONS

Modify the measurement conditions according to the surface roughness parameters, the amplitude of roughness, the conditions of the objective area of measurement, etc.

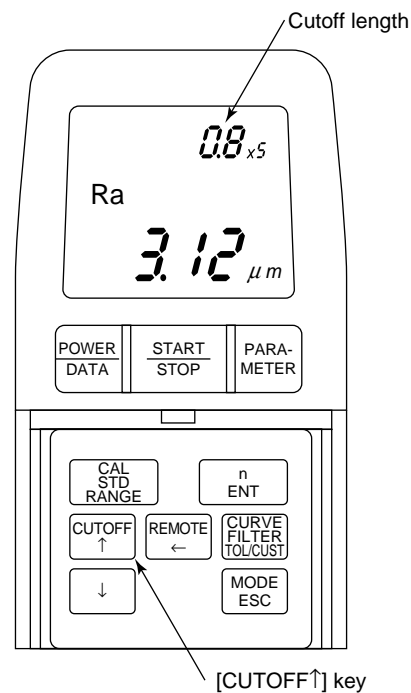
The SJ-201P can obtain each roughness parameter based on the New JIS, Old JIS, DIN, ISO, and ANSI standards.

Refer to “Chapter 10 REFERENCE INFORMATION” for measurement conditions to be set according to the surface roughness standard.

4.1 Switching the Cutoff Length

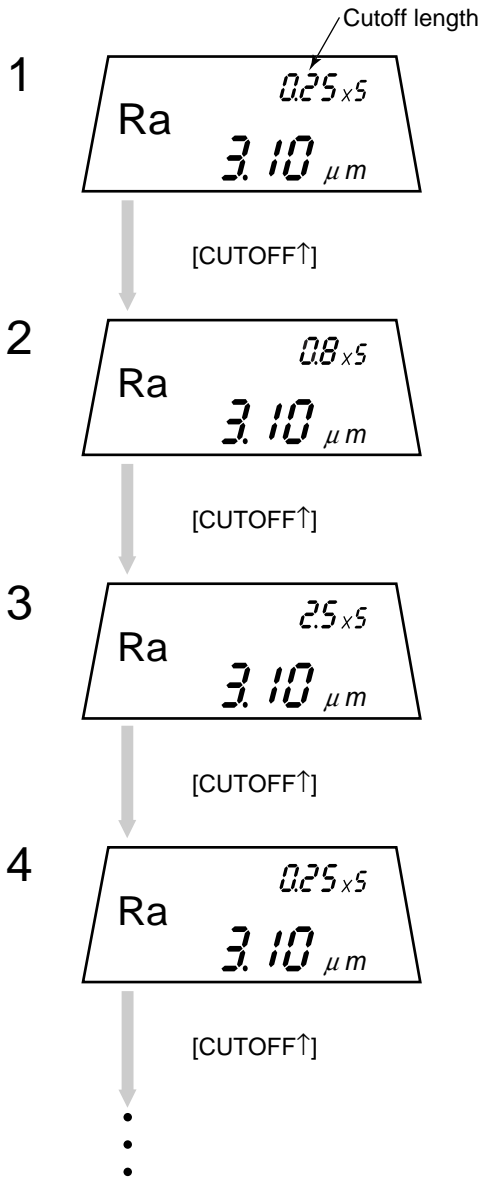
The cutoff length can be switched to either 0.8, 2.5, or 0.25mm (.03, .1, or .01”).

■ Display and operation keys



■ Operating procedure

Each time the [CUTOFF ↑] key is pressed, the displayed cutoff length changes in the following order: 0.8 → 2.5 → 0.25 → 0.8 (mm) (.03 → .1 → .01 → .03 (in)).



Press the [CUTOFF ↑] key in the measurement mode.

⇒ The displayed cutoff length changes to “0.8”.

TIP Each time the [CUTOFF ↑] key is pressed, the displayed cutoff length changes as follows: 0.8 → 2.5 → 0.25 → 0.8 (mm) (.03 → .1 → .01 → .03 (in)).

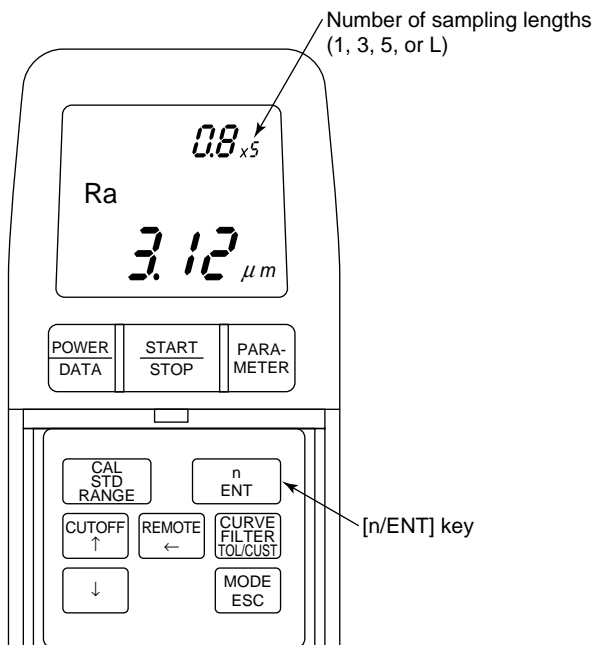
TIP

- For information on how to set the evaluation length to an arbitrary length refer to “4.3 Setting the Evaluation Length to an Arbitrary Length”.
- If the cutoff length has been set to 0.8 (.03), either 0.5 mm/s (.02in/s) or 0.25 mm/s (.01in/s) can be selected as the traversing speed. See also “4.11 Modifying the Traversing Speed”.

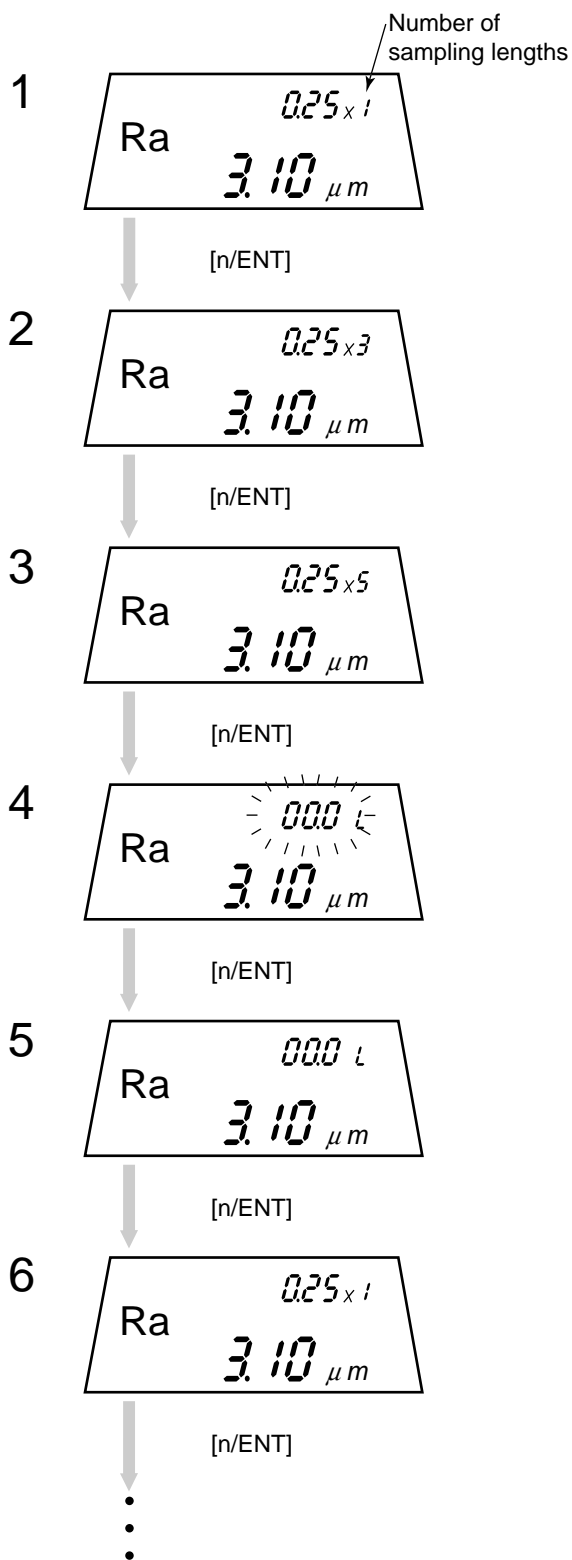
4.2 Modifying the Number of Sampling Lengths

The “evaluation length” (sampling length x number of sampling lengths) can be set on the SJ-201P by switching the number of sampling lengths to either “1”, “3”, “5”, or “L”. If “L” is selected, the evaluation length can be set as desired within the range between 0.3mm (.01”) and 12.5mm (.49”).

■ Display and operation keys



■ Operating procedure



Press the [n/ENT] key in the measurement mode.

⇒ Each time the [n/ENT] key is pressed, the displayed number of sampling lengths changes in the following order: 1 → 3 → 5 → L → 1.

⇒ The “L” indicates that the input wait state has been entered for an arbitrary evaluation length. In this stage an evaluation length can be entered. See also “4.3 Setting the Evaluation Length to an Arbitrary Length”.

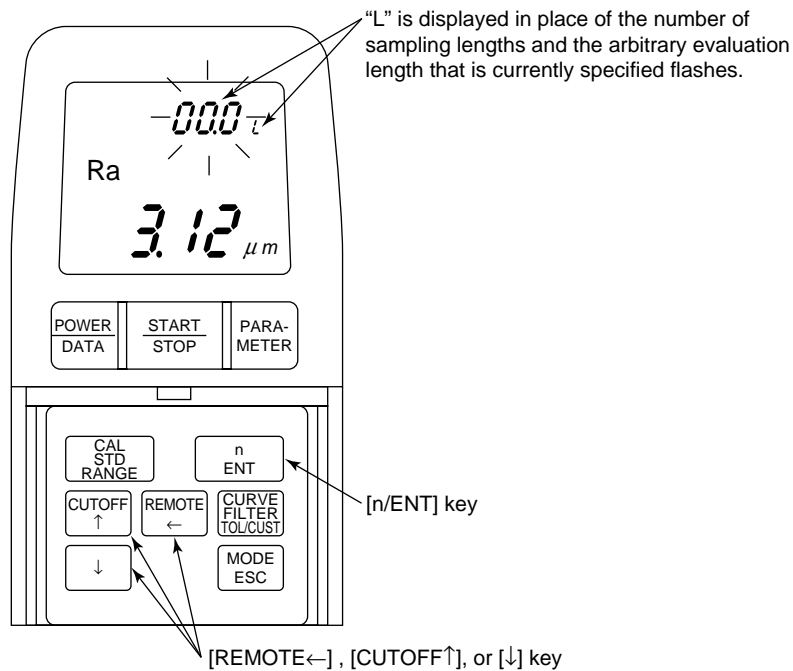
⇒ Returns to the step in which the number of sampling lengths was selected.

4.3 Setting the Evaluation Length to an Arbitrary Length

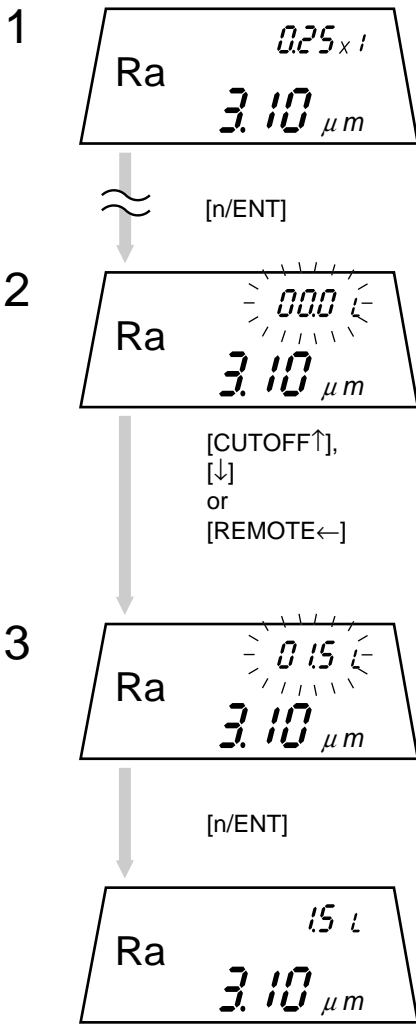
On the SJ-201P the evaluation length can be set as desired in a range between 0.3mm and 12.5mm (.01" and .49").

TIP For information about the relationship between the arbitrary evaluation length and cutoff length if the roughness profile (R) is specified, refer to "9.3.3 Cutoff length/sampling length, number of sampling lengths, and sampling interval".

■ Display and operation keys



■ Operating procedure



In the measurement mode press the [n/ENT] key until an “L” appears in place of the number of sampling lengths.

⇒ The input wait state for an arbitrary evaluation length is entered.

Enter a desired length.

This value must be between 0.3 (.01") and 12.5 mm (.49") with 0.1 mm (.01") increments.

TIP For information about the method used to enter a numeric value refer to “2.2 Key Operations to Enter Numeric Values”.

Confirm the displayed value and press the [n/ENT] key.

⇒ This accepts the entered value.

If the [n/ENT] key is pressed for a length that is out of range, it will be automatically corrected to either of the following, then set.

If the setting value is less than the lower limit, 0.3 mm (.01") is set.

If the setting value is greater than the upper limit, 12.5 mm (.49") is set.

TIP If the arbitrary evaluation length is set to between 1.2 mm and 4.0 mm, the traversing speed can be set to between 0.5 mm/s or 0.25 mm/s (.02"/s or .01"/s).

4.4 Setting the Pre-travel/Post-travel Length to OFF

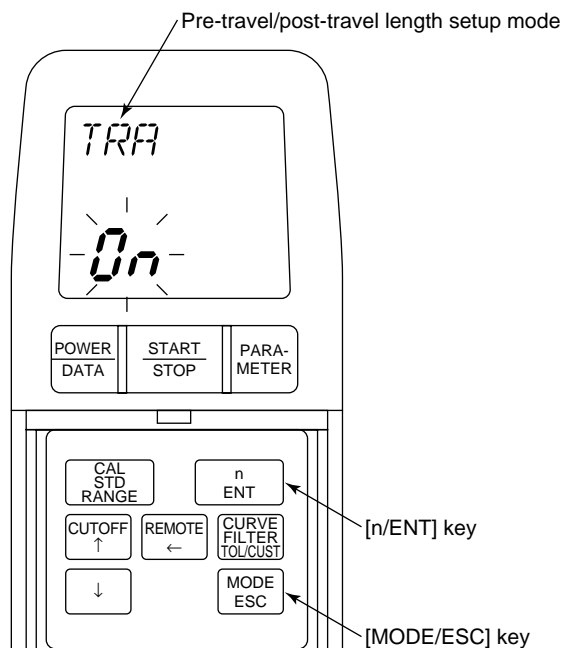
The use of the pre-travel/post-travel lengths can be set to none (OFF) in specific cases where the traversing length must be limited for the measurement in which the roughness profile is employed as the measured profile. Doing so can reduce the traversing length as much as the pre-travel length and post-travel length, allowing the measurement to be performed in the limited range.

The pre-travel/post-travel length is factory-set to “ON”.

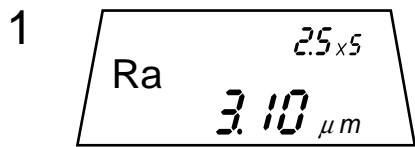
IMPORTANT Generally, the pre-travel/post-travel length should be set to “ON”. If it is set to OFF errors in the calculated value may result depending on the workpiece.

TIP For more information about the traversing length refer to “10.4 Traversing Length”.

■ Display and operation keys



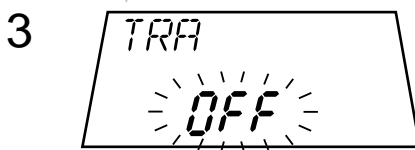
■ Operating procedure



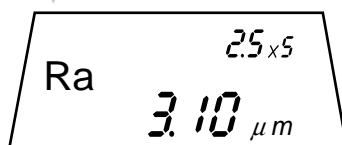
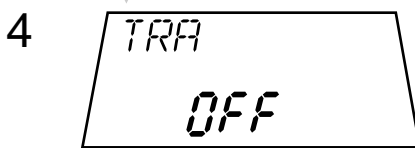
≈ [MODE/ESC]



[CUTOFF ↑]
or
[↓]



[n/ENT]



In the measurement mode press the [MODE/ESC] key until the pre-travel/post-travel length setup mode is entered.

Press the [CUTOFF ↑] key or [↓] key.

⇒ Each time the key is pressed the display toggles between "On" and "OFF".

On: Includes the pre-travel and post-travel lengths in the traversing length.

OFF: Does not include the pre-travel and post-travel lengths in the traversing length.

Press the [n/ENT] key.

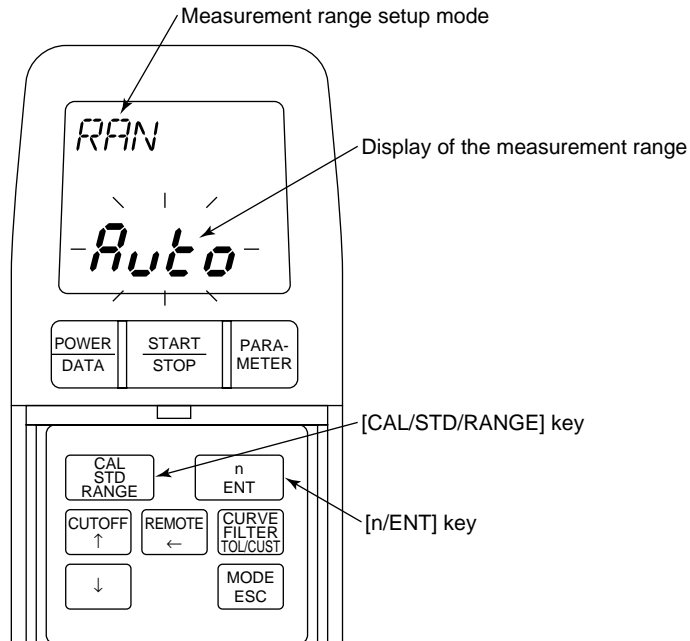
This accepts the switched setting.

⇒ The measurement mode is restored.

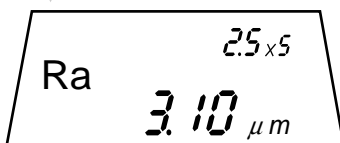
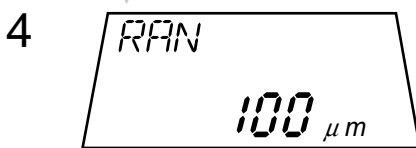
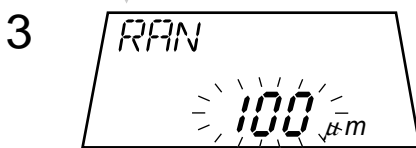
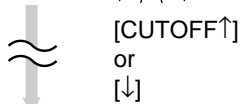
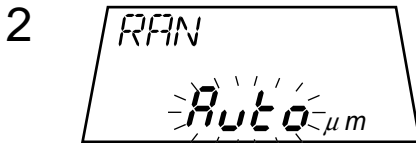
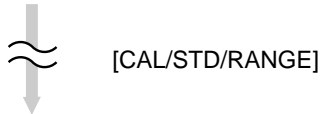
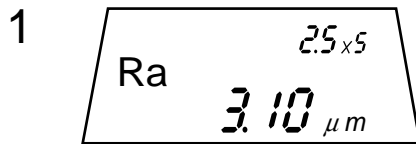
4.5 Modifying the Measurement Range

The measurement range on the SJ-201P can be selected from “Auto”, 350, 100, 50, or 10 μ m (14000, 4000, 2000, or 400 μ m). Generally it should be set to “Auto”, since a highly-sensitive (narrow) measurement range may easily cause an over-range error.

■ Display and operation keys



■ Operating procedure



In the measurement mode press the [CAL/STD/RANGE] key three times.

⇒ Used to switch to the measurement range setup mode.

Press the [CUTOFF ↑] key or [↓] key until the desired measurement range appears on the LCD.

⇒ Each time the key is pressed the display changes as follows: Auto ↔ 350 ↔ 100 ↔ 50 ↔ 10 (μm). (Auto ↔ 14000 ↔ 4000 ↔ 2000 ↔ 400 (μin))

After the desired range is displayed, press the [n/ENT] key. This accepts the selected measurement range.

⇒ The measurement mode is restored.

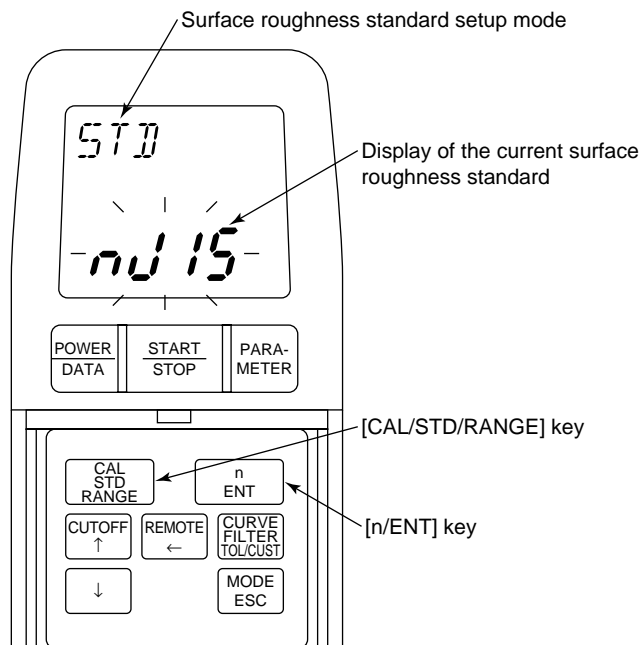
- TIP**
- If the [MODE/ESC] key is pressed before the [n/ENT] key has been pressed, the selected measurement range is canceled and the measurement mode is restored.
 - If a measurement range is changed, the resolution is automatically changed accordingly.

4.6 Switching the Surface Roughness Standard

The SJ-201P is compatible with each of the New JIS, Old JIS, DIN, ISO, and ANSI surface roughness standards.

TIP For about 1 second after the power is turned on the current setting contents, including the surface roughness standard, are displayed. Use this display to confirm the currently set surface roughness standard.

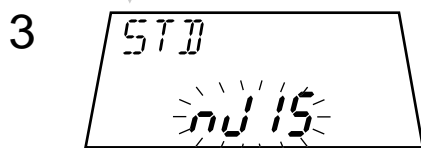
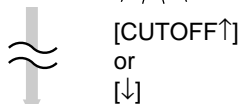
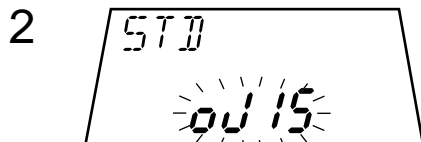
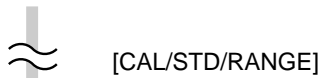
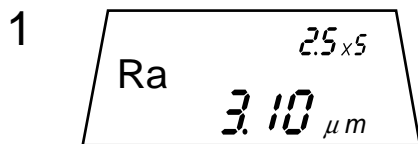
■ Display and operation keys



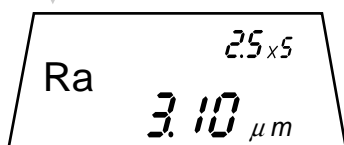
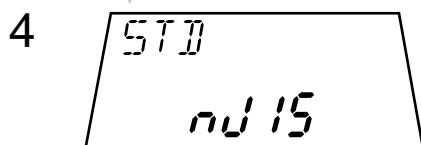
● Correspondence between the surface roughness standards and their notations on the display

Surface roughness standard	Displayed notation
New JIS	nJIS
Old JIS	oJIS
DIN	dIn
ISO	ISO
ANSI	AnSI

■ Operating procedure



[n/ENT]



In the measurement mode press the [CAL/STD/RANGE] key twice.

⇒ The surface roughness standard setup mode is entered.

Press the [CUTOFF ↑] key or [↓] key until the desired surface roughness standard appears on the LCD.

⇒ Each time the key is pressed the display changes as follows: “oJIS” ↔ “nJIS” ↔ “dIn” ↔ “ISO” ↔ “AnSI”.

Press the [n/ENT] key if the desired Standard is selected.

This accepts the selected surface roughness standard.

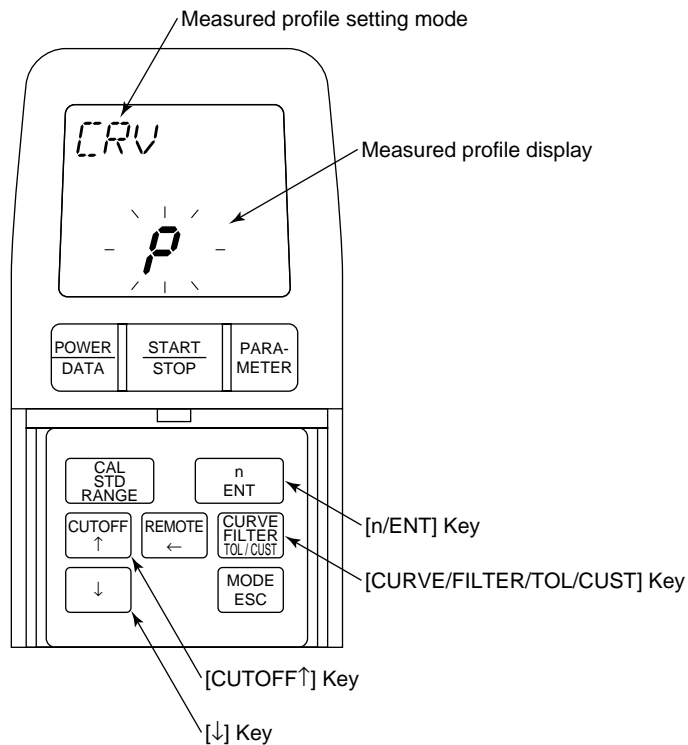
⇒ The measurement mode is restored.

- TIP**
- If the [MODE/ESC] key is pressed before the [n/ENT] key has been pressed, the selected surface roughness standard is canceled and the measurement mode is restored.
 - Changing a surface roughness standard causes the filter setting to be automatically changed accordingly.

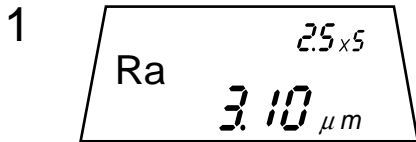
4.7 Changing the Measured Profile

The measured profile can be changed to either primary profile (P profile), R profile, or DIN4776.

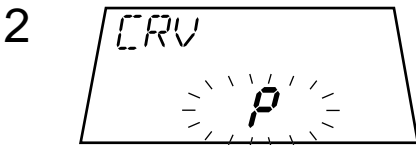
■ Display and operation keys



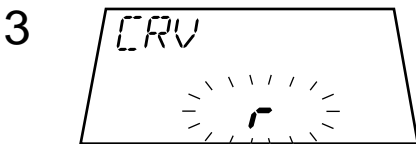
■ Operating procedure



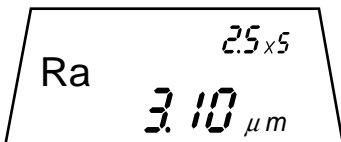
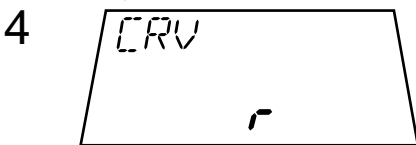
[CURVE/FILTER/
TOL/CUST]



[CUTOFF ↑]
or
[↓]



[n/ENT]



Press the [CURVE/FILTER/TOL/CUST] key several times in the measurement mode.

⇒ The SJ-201P is switched to the measured profile setting mode (CRV display) to display the settings.

P: Primary profile (P profile)

r: R profile

d: DIN4776

Press the [CUTOFF ↑] key or [↓] key until a measured profile desired to be set is displayed.

⇒ Each time either key is pressed, the measured profile is switched in the order of "P" ↔ "r" ↔ "d".

When the measured profile to be set is displayed, press the [n/ENT] key to load the measured profile.

⇒ The SJ-201P returns to the measurement mode.

TIP If the [MODE/ESC] key is pressed before loading the measured profile, the selected measured profile will be canceled, and then the SJ-201P returns to the measurement mode.

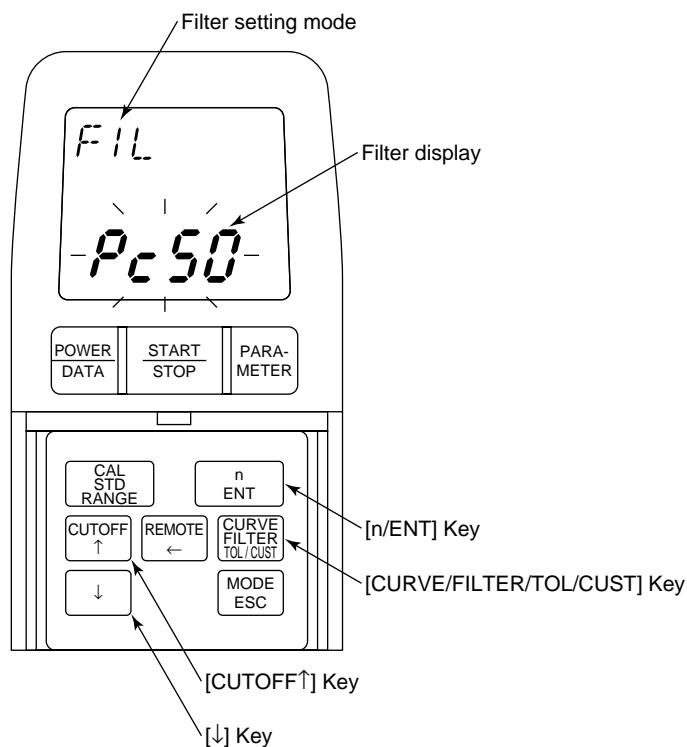
4.8 Changing the Filter

If the measured profile is set to R profile or DIN4776, the filter can be switched to either "2RC", "Pc50", or "Pc75". If the measured profile is set to P profile, the SJ-201P automatically selects "No filter".

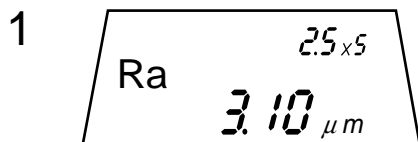
TIP For information about the measured profile and filter definitions, refer to "10.2 Assessed Profile and Applicable Filters".

NOTE If changing the roughness standard, note that the filter is automatically changed according to a selected roughness standard.

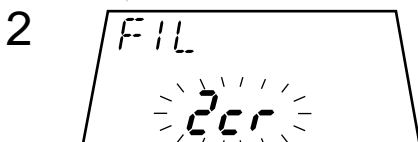
■ Display and operation keys



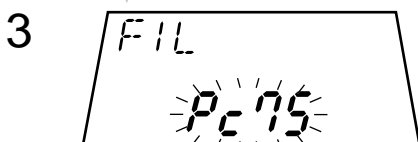
■ Operating procedure



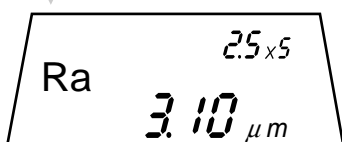
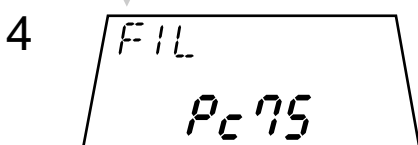
[CURVE/FILTER/
TOL/CUST]



≈ [CUTOFF ↑]
or
[↓]



[n/ENT]



Press the [CURVE/FILTER/TOL/CUST] key several times in the measurement mode.

⇒ The Surftest is switched to the filter setting mode (FIL display) to display the settings.

Pc50: PC50

2cr: 2RC75

Pc75: PC75

Press the [CUTOFF ↑] key or [↓] key until a filter desired to be set is displayed.

⇒ Each time either key is pressed, the filter to be set is switched in the order of "Pc50" ↔ "2cr" ↔ "Pc75".

When the filter to be set has been set, press the [n/ENT] key to load the filter.

⇒ The SJ-201P returns to the measurement mode.

TIP If the [MODE/ESC] key is pressed before loading the filter, the selected filter will be canceled, and then the SJ-201P returns to the measurement mode.

4.9 Setting the GO/NG Judgment Function

The SJ-201P is provided with the GO/NG judgment function to facilitate GO/NG judgment of workpieces based on the surface roughness.

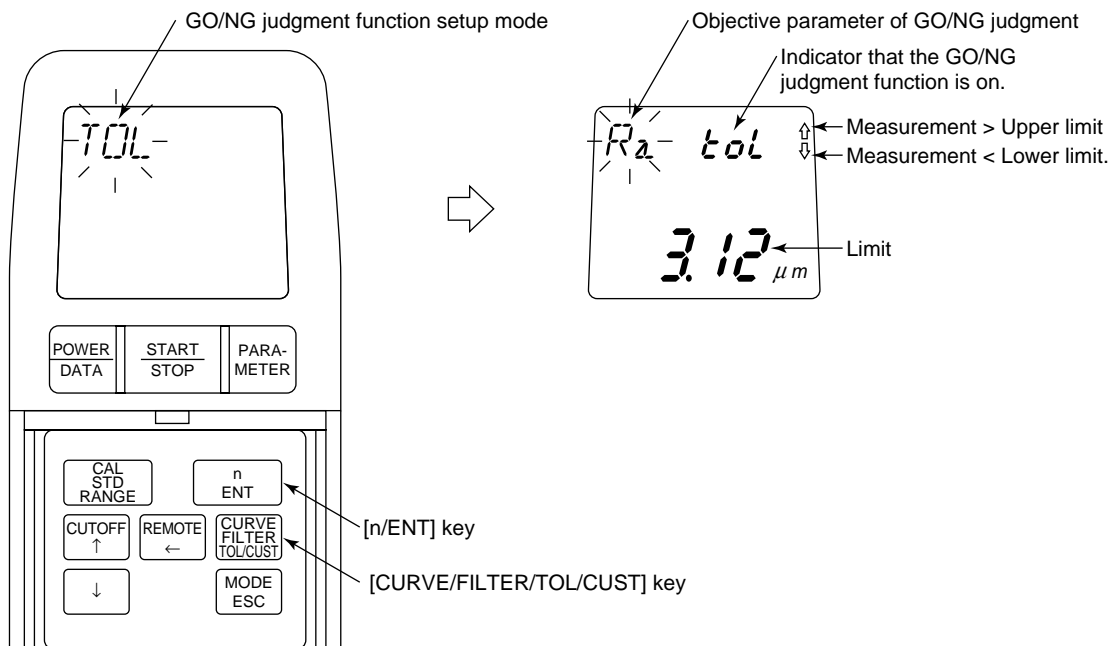
With this GO/NG judgment function the measurement result is compared to its upper and lower limits, and if it exceeds either of the limits, the judgment result will be indicated by “↑” or “↓”.

■ GO/NG judgment is possible for up to two parameters

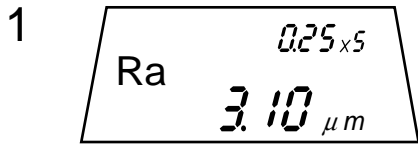
The GO/NG judgment function can be set for two parameters. To perform GO/NG judgment for parameters other than those currently set, cancel the setting of this function for either of the two (by setting the upper limit to zero), then set this function to the objective parameter. This function is valid only for parameters that can be displayed on the LCD.

TIP For information about the method used to set the parameters refer to “4.10 Setting Parameters Other Than Ra, Ry, Rz, and Rq”.

■ Display and operation keys



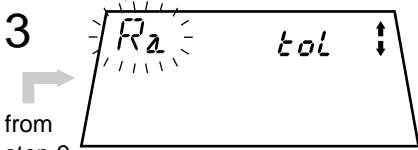
■ Operating procedure



[CURVE/FILTER/TOL/CUST]



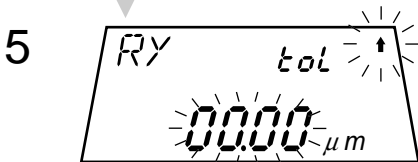
[n/ENT]



[PARAMETER]



[n/ENT]



[CUTOFF↑],
[↓]
or
[REMOTE←]

6

In the measurement mode press the [CURVE/FILTER/TOL/CUST] key three times.

⇒ The GO/NG judgment function setup mode is entered.

Press the [n/ENT] key.

⇒ If this function has already been set, then the set value will be displayed.

Press the [PARAMETER] key, if required, to switch to the parameter for which the GO/NG judgment function is to be set.

If there is no need to switch from the current parameter, proceed to the next step without pressing the [PARAMETER] key.

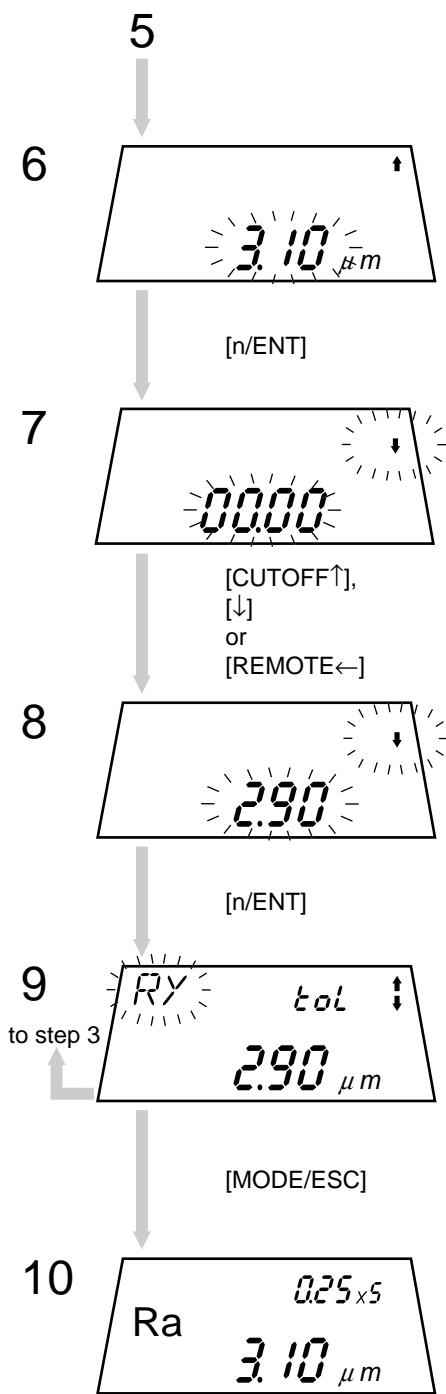
⇒ The currently flashing parameter changes.

While the desired parameter is flashing, press the [n/ENT] key.

The objective parameter of the GO/NG judgment is accepted.

Enter the upper limit.

TIP For information on how to enter a numeric value refer to “2.2 Key Operations to Enter Numeric Values”.
During numeric entry if the [MODE/ESC] key is pressed before the [n/ENT] key has been pressed, the entered value is canceled and the measurement mode is restored.



NOTE Here, if "00.00" or "0000" is accepted with the [n/ENT] key, the GO/NG judgment is not to be performed.

Confirm the limit value displayed, then press the [n/ENT] key.

⇒ The entered value is accepted and the display remains in the input wait state for a lower limit.

Enter the lower limit.

NOTE Here, if "00.00" or "0000" is accepted as the lower limit, the GO/NG judgment according to the lower limit is not performed.

Confirm the limit value displayed, then press the [n/ENT] key.

⇒ This accepts the entered value.

To continue setting the GO/NG judgment function for other parameters, return to step 3.

To exit from the GO/NG judgment function setup procedure, press the [MODE/ESC] key.

⇒ The measurement mode is restored.

4.10 Setting Parameters Other Than Ra, Ry, Rz, and Rq

Surface roughness measurement can be performed with parameters other than Ra, Ry, Rz, and Rq.

■ Outline of the parameter setup function

With the factory settings parameters Ra, Ry, Rz, and Rq are calculated and displayed without particular setup operation.

For measurement with other parameters it is necessary to set (enable) them individually in this parameter setup mode. To prevent a parameter from being displayed, disable it. Only through this parameter setup can the necessary parameters be set so they are calculated and displayed.

As a result of parameter selection the time required to calculate the measurement result is reduced, and operation of the parameter-related keys, such as those for switching the parameter display, can be simplified.

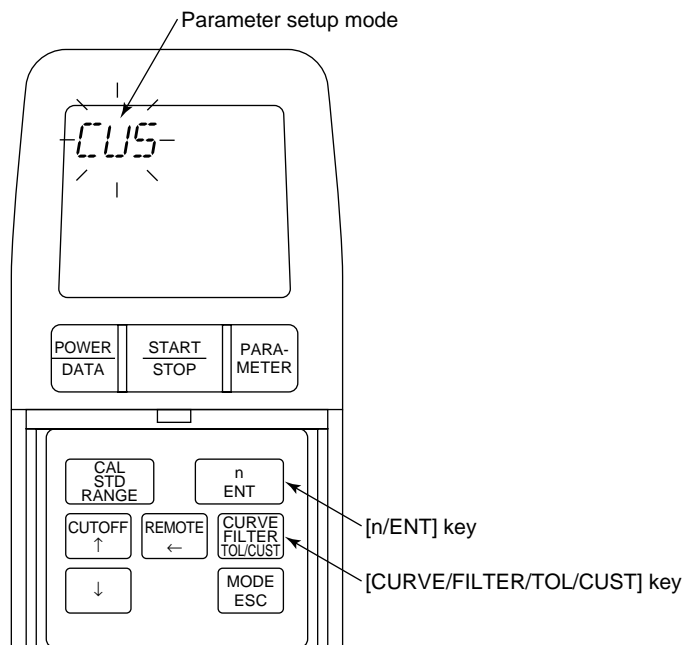
NOTE If the Pc, Sm, or mr parameters are set, the count level and slice level, which are the calculating conditions, must be set.
For information on how to set the count level and slice level if a Pc, Sm, or mr parameter has been set, refer to “■ Setting the calculating conditions if Pc, Sm, or mr is set”.
For the definition of each parameter calculation refer to “10.5 Definitions of the SJ-201P Surface Roughness Parameters”.

4. MODIFYING THE MEASUREMENT CONDITIONS

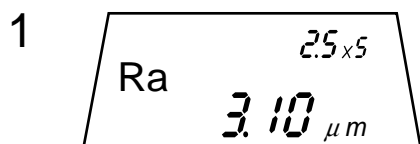
The parameters that can be set differ depending on the selected measured profile. The combinations of each measured profile and parameters are listed in the following table.

Displayed parameter	Old JIS		New JIS/DIN/ISO/ANSI		
	P (Primary profile)	R (Roughness profile)	P (Primary profile)	R (Roughness profile)	DIN4776
Ra	–	Ra	Pa	Ra	–
Ry	Ry	–	Py	Ry	–
Rz	Rz	–	Pz	Rz	–
Rq	Rq	Rq	Pq	Rq	–
Rt	Rt	Rt	Pt	Rt	–
Rp	Rp	Rp	Pp	Rp	–
Sm	Sm	Sm	PSm	RSm	–
S	S	S	PS	RS	–
Pc	Pc	Pc	PPc	RPc	–
mr	mr	mr	Pmr	Rmr	–
R3z	R3z	R3z	P3z	R3z	–
Rk	–	–	–	–	Rk
Rpk	–	–	–	–	Rpk
Rvk	–	–	–	–	Rvk
Mr1	–	–	–	–	Mr1
Mr2	–	–	–	–	Mr2
A1	–	–	–	–	A1
A2	–	–	–	–	A2
Vo	–	–	–	–	Vo

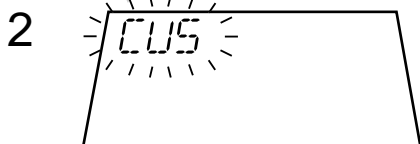
■ Display and operation keys



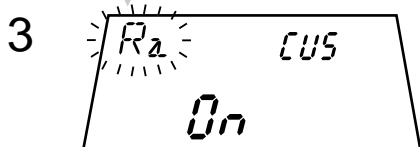
■ Operating procedure



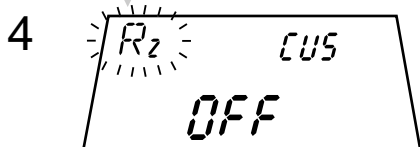
≈ [CURVE/FILTER/TOL/CUST]



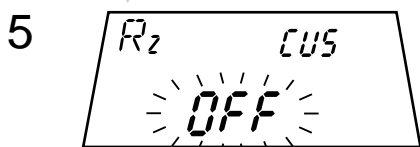
[n/ENT]



≈ [PARAMETER]



[n/ENT]



[CUTOFF ↑]
or
[↓]

6

In the measurement mode press the [CURVE/FILTER/TOL/CUST] key four times.

⇒ The parameter setup mode is entered.

Press the [n/ENT] key.

Press the [PARAMETER] key until the desired parameter symbol is displayed on the LCD.

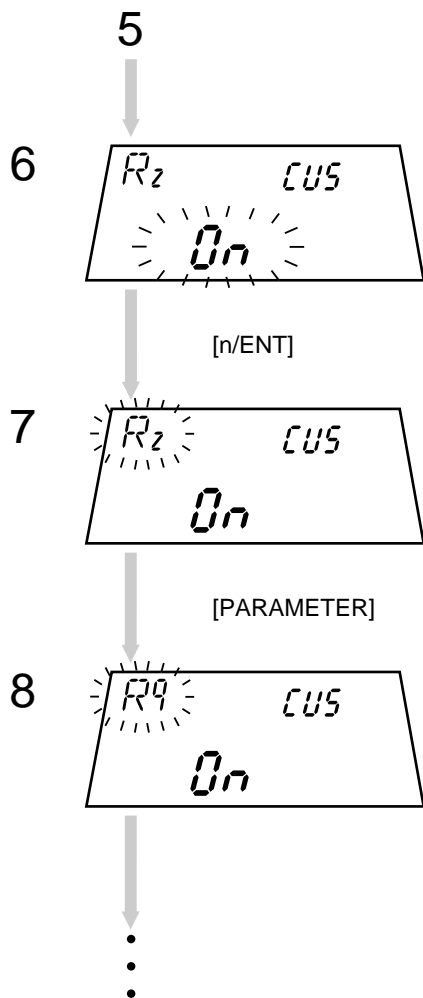
If the desired parameter symbol is displayed, press the [n/ENT] key.

Press the [CUTOFF ↑] or [↓] key.

⇒ Each time the key is pressed the display toggles between “On” and “OFF”.

On: Calculates and displays the parameter.

OFF: Does not calculate and display the parameter.



Confirm the displayed content, then press the [n/ENT] key.

⇒ The setting content is accepted.

Switch to another parameter.

TIP

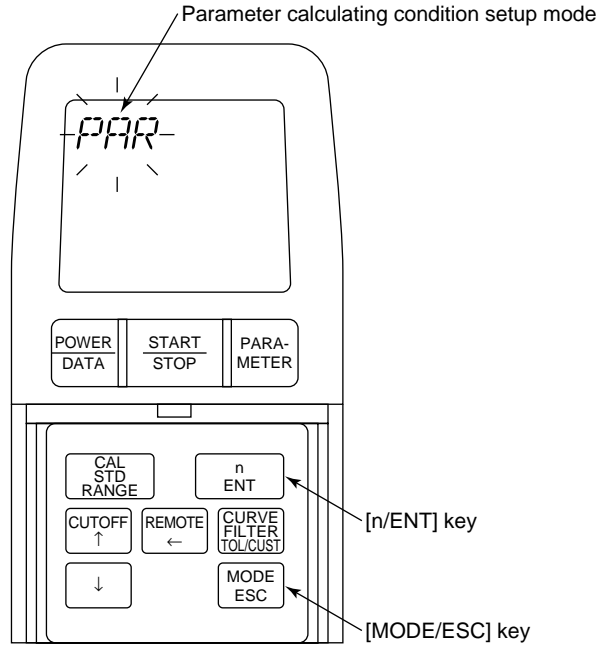
- If the [PARAMETER] key is pressed after the settings for all the necessary parameters have been made, the measurement mode is restored.
- To return to the measurement mode, press the [MODE/ESC] key.

■ Setting the calculating conditions if Pc, Sm, or mr is set

If the Pc, Sm, or mr parameter is set, the count level and slice level, which are the calculating conditions, must be set.

Below is an explanation of the operating procedure that must be used if all of parameters Pc, Sm, and mr are set.

● Display and operation keys



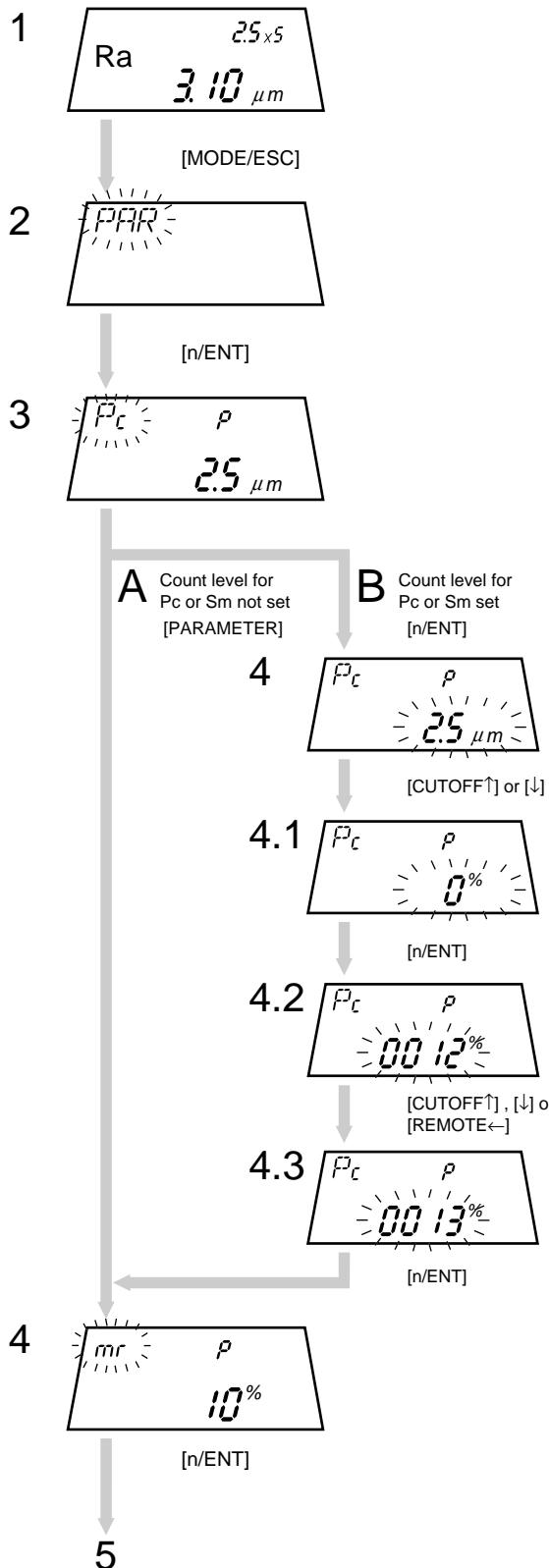
The displayed parameters follow:

Old JIS			
P (Primary profile)	R (Roughness profile)		
	2RC	PC75	PC50
—	Ra	Ra	Ra
Ry	—	—	—
Rz	—	—	—
Rq	Rq	Rq	Rq
Rt	Rt	Rt	Rt
Rp	Rp	Rp	Rp
Pc	Pc	Pc	Pc
mr	mr	mr	mr
R3z	R3z	R3z	R3z
S	S	S	S
Sm	Sm	Sm	Sm

New JIS/DIN/ISO/ANSI			
P (Primary profile)	R (Roughness profile)		
	2RC	PC75	PC50
Pa	Ra	Ra	Ra
Py	Ry	Ry	Ry
Pz	Rz	Rz	Rz
Pq	Rq	Rq	Rq
Pt	Rt	Rt	Rt
Pp	Rp	Rp	Rp
PPc	RPc	RPc	RPc
Pmr	Rmr	Rmr	Rmr
P3z	R3z	R3z	R3z
PS	RS	RS	RS
PSm	RSm	RSm	RSm

4. MODIFYING THE MEASUREMENT CONDITIONS

● Operating procedure



In the measurement mode press the [MODE/ESC] key.

⇒ This switches to the parameter calculating condition setup mode.

If the count level for Pc or Sm is not set, follow sequence A shown at the left.

<Sequence A>
Press the [PARAMETER] key.

If the count level for Pc or Sm is set, follow sequence B shown at the left.

<Sequence B>
Press the [n/ENT] key.

Specify the unit of the count level for Pc or Sm.

Each time the [CUTOFF ↑] or [↓] key is pressed the unit of the level toggles between “%” and “μm (μin)”.

Here, the explanation assumes that “%” is used as the unit of the level.

Enter the count level.

The permissible range is as follows:
1 to 99% (at 1% increments)
0.1 to 100.0 μm (at 0.1 μm increments)
or 5 ~ 4000 μin (at 1 μin increments)

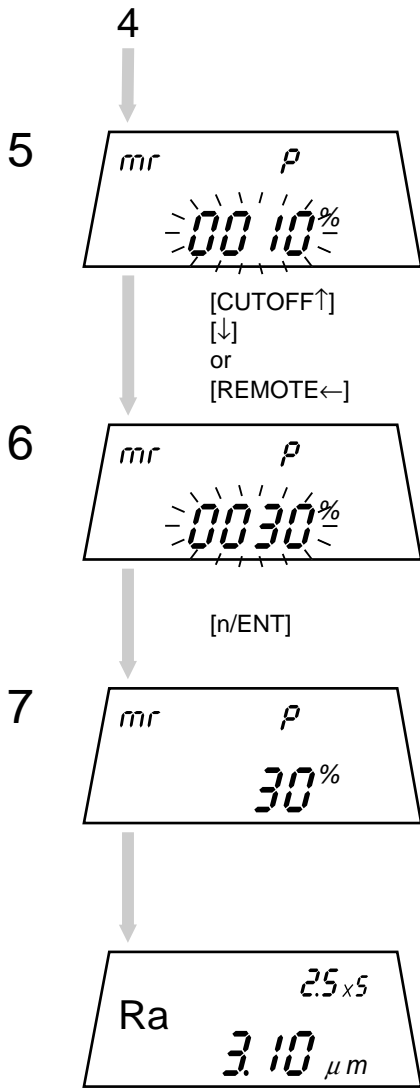
TIP For information on how to enter a numeric value refer to “2.2 Key Operation to Enter Numeric Values”.

After the desired count level is specified, press the [n/ENT] key.

The setting of the count level is identical for both Pc and Sm, since they are reciprocals of one another.

Therefore, if the Sm is selected, “Pc” is displayed in the setting display.

Parameter	Setting display	
	Pc	mr
Pc	○	-
Sm	○	-
mr	-	○



⇒ Switches to the input wait state for the slice level of parameter mr.

Enter the slice level.

This value should be between 1 to 99% and at 1% increments.

TIP For information on how to enter a numeric value refer to "2.2 Key Operation to Enter Numeric Values".

After the desired value is specified, press the [n/ENT] key.

⇒ This accepts the entered value.

⇒ The measurement mode is restored.

4.11 Modifying the Traversing speed

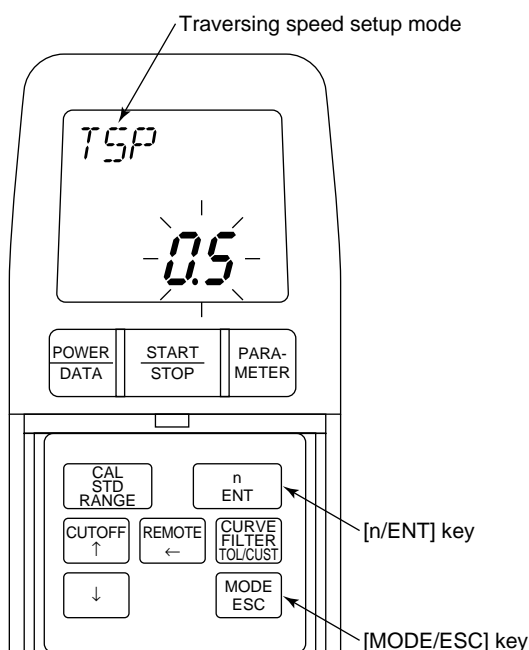
If the cutoff length has been set to 0.8 mm (.03") and the evaluation length has been set to an arbitrary length (1.2 to 4.0 mm/.047 to .157"), then either 0.25 mm/s (.01"/s) or 0.5 mm/s (.02"/s) can be selected as the traversing speed.

The factory-set default value is 0.5 mm/s.

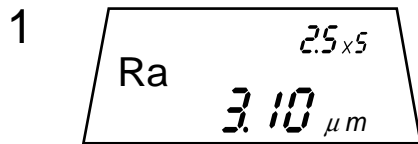
■ Relationship between the cutoff length (= sampling length) and traversing speed

Cutoff length (= sampling length)	Arbitrary length	Traversing speed
0.25 mm (.01")	$0.3 \leq L < 1.2 \text{ mm } (.01" \leq L < .05")$	0.25 mm/s (.01"/s)
0.8 mm (.03")	$1.2 \leq L < 4.0 \text{ mm } (.05" \leq L < .15")$	0.25 mm/s (.01"/s) or 0.5 mm/s (.02"/s)
2.5 mm (.1")	$4.0 \leq L < 12.5 \text{ mm } (.15" \leq L < .49")$	0.5 mm/s (.02"/s)

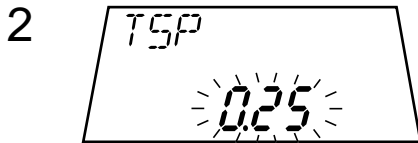
■ Display and operation keys



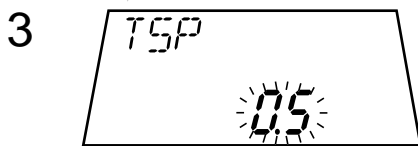
■ Operating procedure



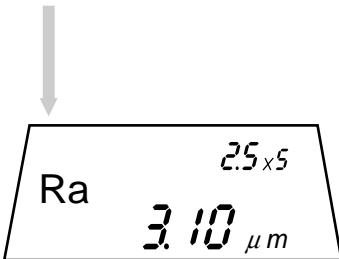
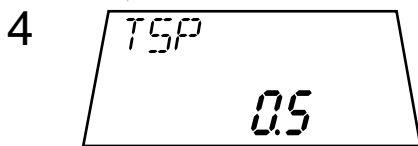
≈ [MODE/ESC]



[CUTOFF↑]
or
[↓]



[n/ENT]



In the measurement mode press the [MODE/ESC] key until the traversing speed setup mode is entered.

Press the [CUTOFF↑] key or [↓] key.

⇒ Each time the key is pressed the display toggles between 0.5 and 0.25 (mm/s) (.02 and .01 (in/s)).

If the desired speed is displayed, press the [n/ENT] key.

This determines the traversing speed.

⇒ The measurement mode is restored.

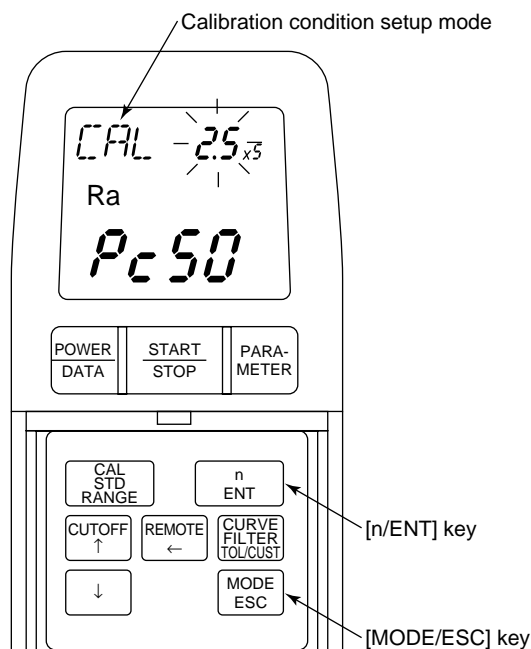
4.12 Modifying the Calibration Conditions

For calibration with other precision roughness specimen than the currently used, it is necessary to adjust the calibration conditions to those under which the new roughness specimen is evaluated.

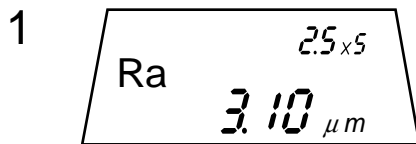
In this case, modify the cutoff length, number of sampling lengths, and filter settings accordingly.

NOTE This operation should not be performed unless absolutely necessary.

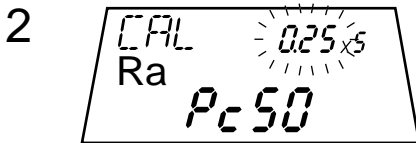
■ Display and operation keys



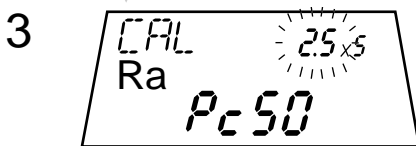
■ Operating procedure



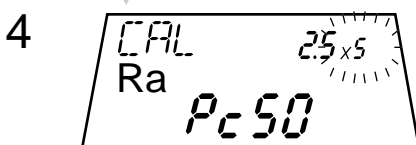
≈ [MODE/ESC]



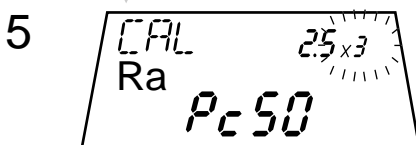
≈ [CUTOFF ↑]
or
[↓]



[n/ENT]



≈ [CUTOFF ↑]
or
[↓]



[n/ENT]

6

In the measurement mode press the [MODE/ESC] key until the calibration condition setup mode is entered.

Press the [CUTOFF ↑] key or [↓] key.

⇒ Each time the key is pressed a cutoff length of either 2.5, 0.25, or 0.8 mm (.1, .01, or .03 inches) appears.

Press the [n/ENT] key if the desired cutoff length appears.

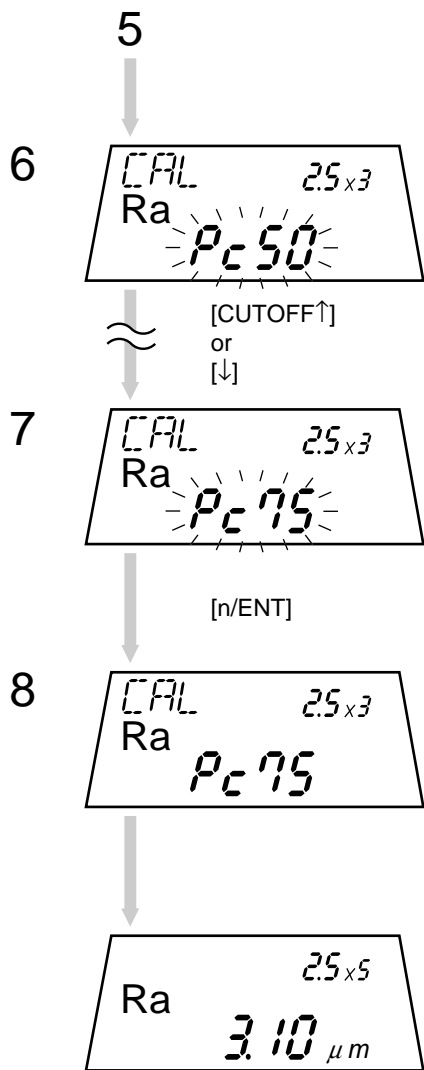
⇒ The selected cutoff length is accepted.

Press the [CUTOFF ↑] key or [↓] key.

⇒ Each time the key is pressed the number of sampling lengths, either "1", "3", or "5", appears.

Press the [n/ENT] key, if the desired number of sampling lengths appears.

⇒ The selected number of sampling lengths is accepted.



Press the [CUTOFF ↑] key or [↓] key.

⇒ Each time the key is pressed the filter, either “Pc75”, “Pc50”, or “2rc”, appears.

Press the [n/ENT] key, if the desired filter appears.

⇒ The selected filter is accepted.

⇒ The measurement mode is restored.

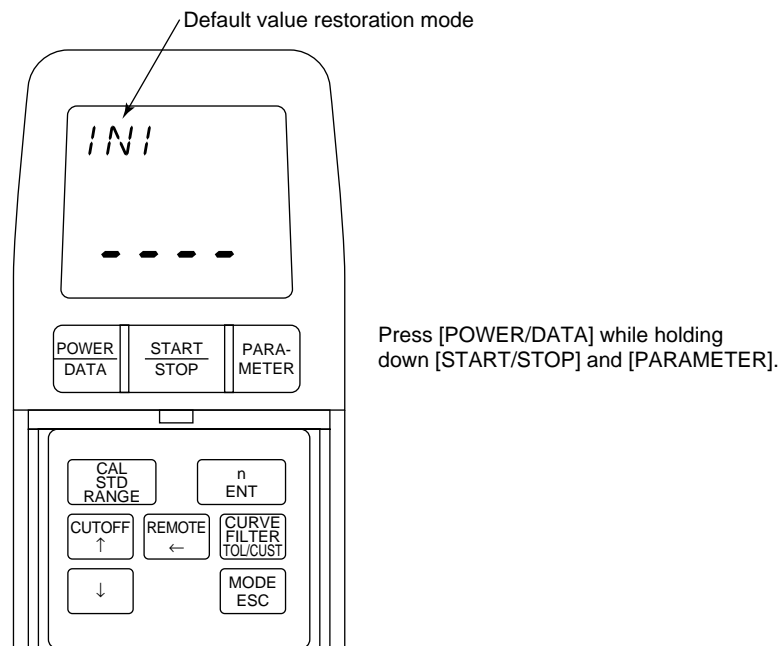
4.13 Resetting to the Factory-Set Defaults

The SJ-201P measurement conditions can be reset to the default values (factory settings).

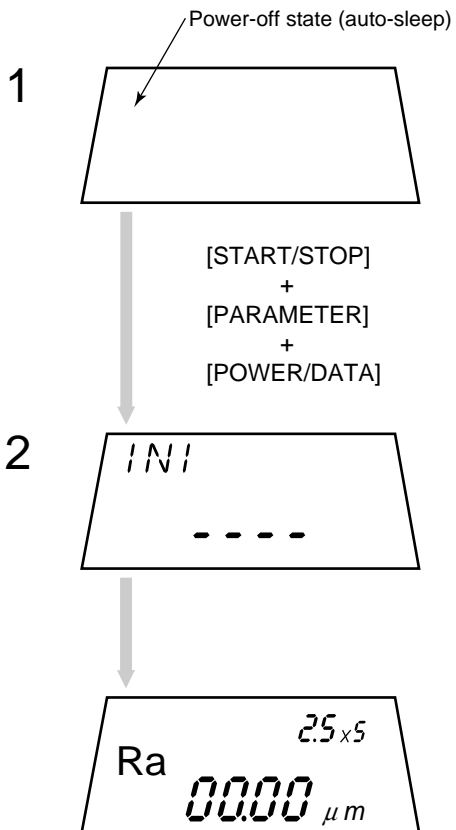
NOTE This operation must be executed carefully. Resetting to the default conditions will erase all the measurement conditions set up by the user.

TIP For information about the default values refer to “3.1 Overall Measurement Flow
■ List of measurement conditions that can be modified”.

■ Display and operation keys



■ Operating procedure



In the power-off state (auto-sleep mode) press the [POWER/DATA] key while holding down the [START/STOP] and [PARAMETER] keys.

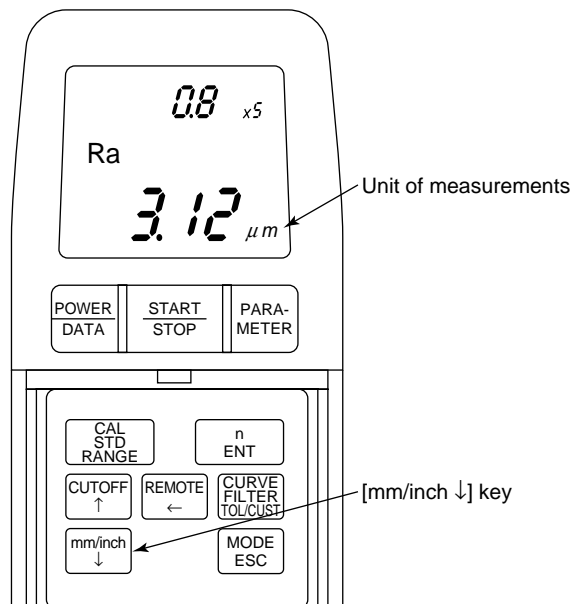
⇒ All the settings on the SJ-201P will be reset to their defaults. While restoration is being performed “-----” will be displayed.

⇒ The measurement mode is restored.

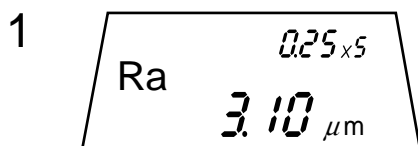
4.14 Switching the Unit of Measurements

The unit of measurements can be selected from either mm (millimeter) or inches with the mm/inch model.

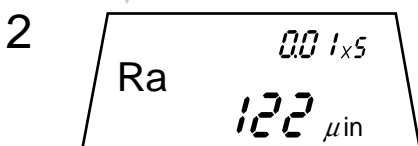
■ Display and operation keys (mm/inch model)



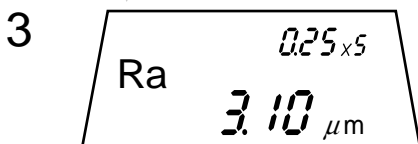
■ Operating procedure



[mm/inch ↓]



[mm/inch ↓]



⋮

Now it is set to the metric (mm) system.

Press the [mm/inch ↓] key.

⇒ The metric system changes to the inch system.

The displayed value is automatically converted.

If the [mm/inch ↓] key is pressed again, the unit of measurements is switched to metric (mm). The displayed value will also be converted.

5

INSTALLING THE SJ-201P WITH OPTIONAL ACCESSORIES

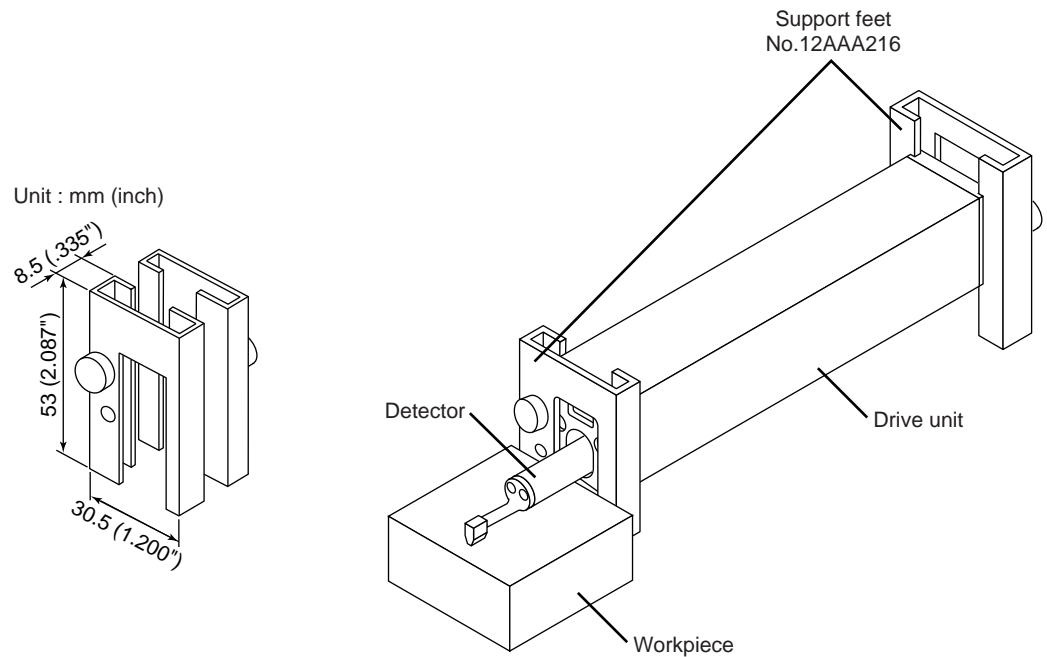
Various optional accessories are offered for the SJ-201P so it can measure a curved (cylindrical, etc.) workpiece or a workpiece with a measured surface smaller than the size of the SJ-201P.

■ Support feet

Used to measure a workpiece which is smaller than the drive/detector unit.

● Dimensions and application example

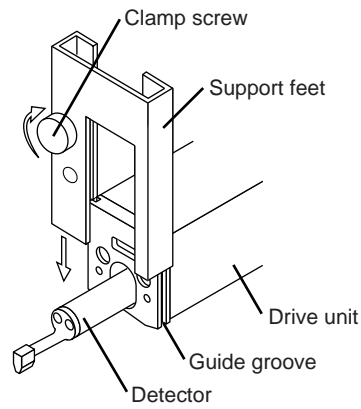
Use the support feet on the drive/detector unit to adjust it to the required height as shown below.



● Attaching the support feet

1. Fit the two support feet in the grooves on the edges of the drive unit.
2. Align the drive/detector unit so it is parallel to the measured surface.
3. After alignment fix the support feet by tightening the clamp screw clockwise.

TIP See also “3.4.1 Setting the workpiece and SJ-201P”.



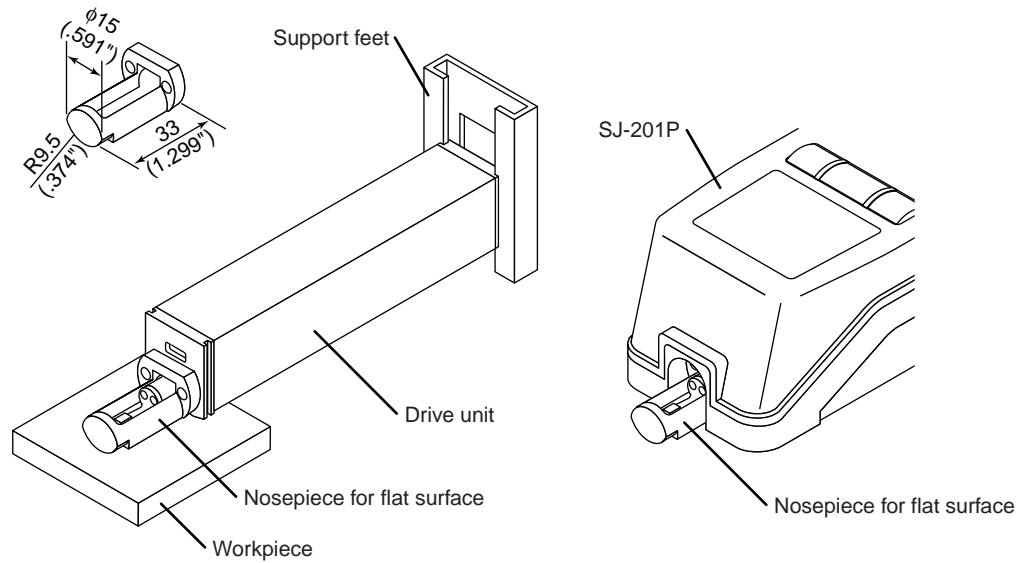
5. INSTALLING THE SJ-201P WITH OPTIONAL ACCESSORIES

■ Nosepiece for flat surface

Used to protect the detector when measuring a flat workpiece which is smaller than the SJ-201P.

● Dimensions and application example

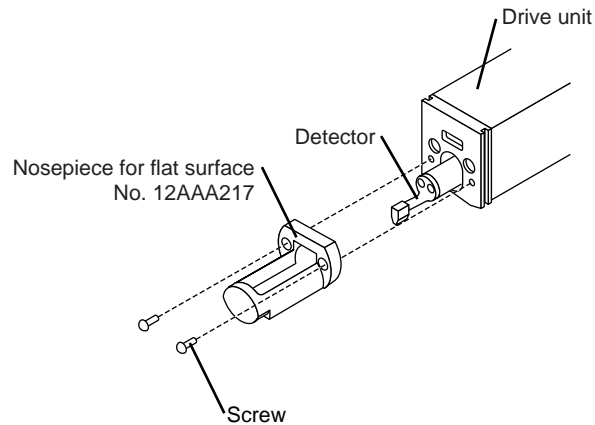
Unit : mm (inch)



● Attaching the nosepiece for flat surface

NOTE When attaching the nosepiece to the drive/detector unit, exercise care so that it does not interfere with the detector body.

1. Fit the SJ-201P detector into the slot of the nosepiece.
2. Using the supplied Allen wrench tighten the two screws specified.

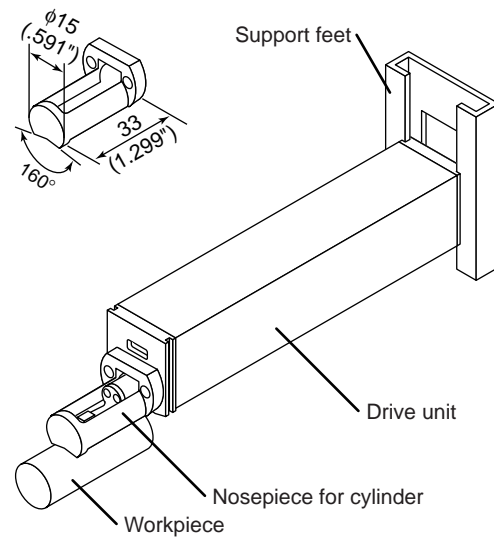


■ Nosepiece for cylinder

Used to protect and guide the detector when measuring a cylindrical workpiece which is smaller than the SJ-201P.

● Dimensions and application example

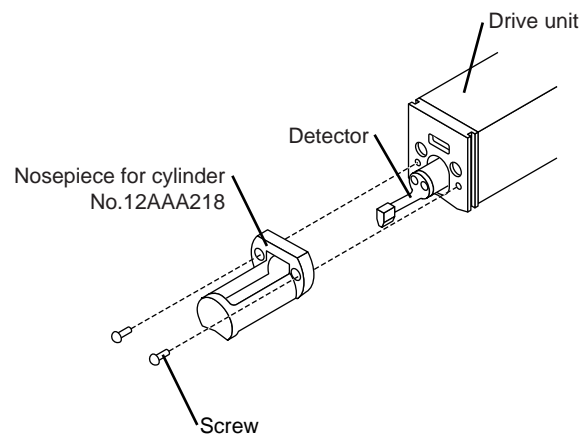
Unit : mm (inch)



● Attaching the nosepiece for cylinder

NOTE When attaching the nosepiece to the drive/detector unit, exercise care so that it does not interfere with the detector body.

1. Fit the SJ-201P detector into the slot of the nosepiece.
2. Using the supplied Allen wrench tighten the two screws specified.

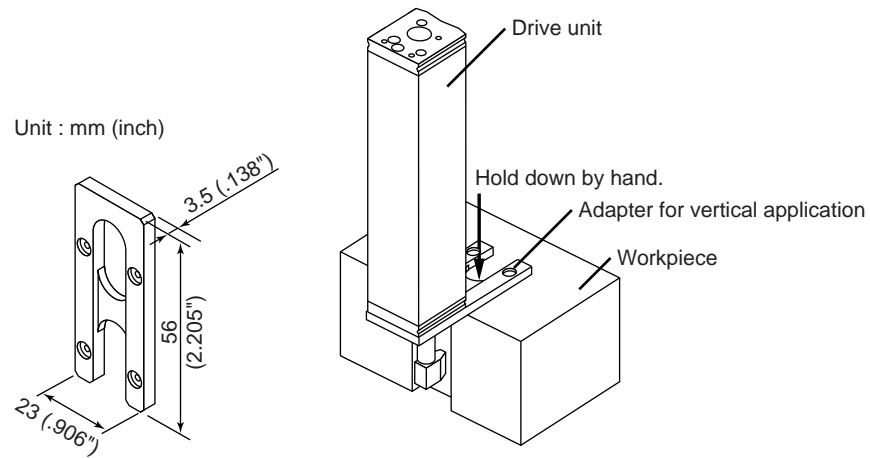


5. INSTALLING THE SJ-201P WITH OPTIONAL ACCESSORIES

■ Adapter for vertical application

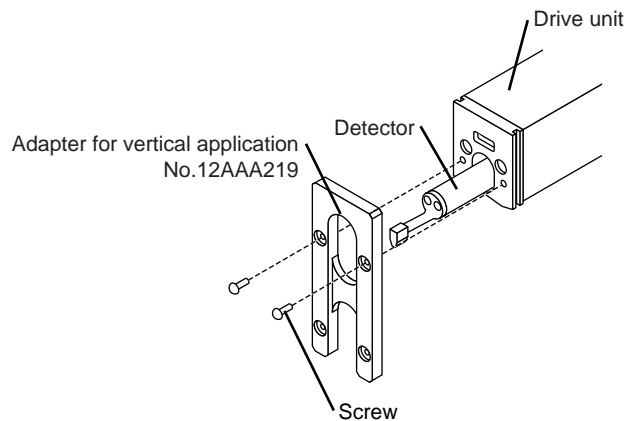
Used to support the drive/detector unit for measuring a vertical groove in which the drive/detector unit can not be placed.

● Dimensions and application example



● Attaching the adapter for vertical application

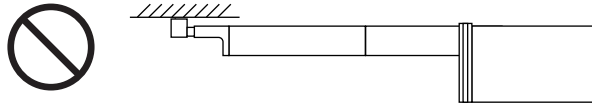
1. Put the detector through the hole of the adapter.
2. Using the supplied Allen wrench tighten the two screws specified.



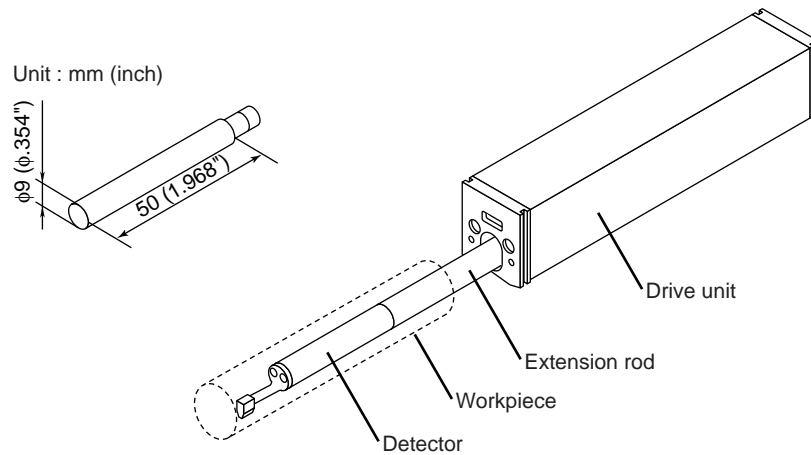
■ Extension rod

Used to measure the inside surface of a deep hole.

- IMPORTANT**
- Be sure to perform calibration when an extension rod is attached or removed.
 - If an extension rod is installed, measurement is not possible to perform with the stylus facing up.

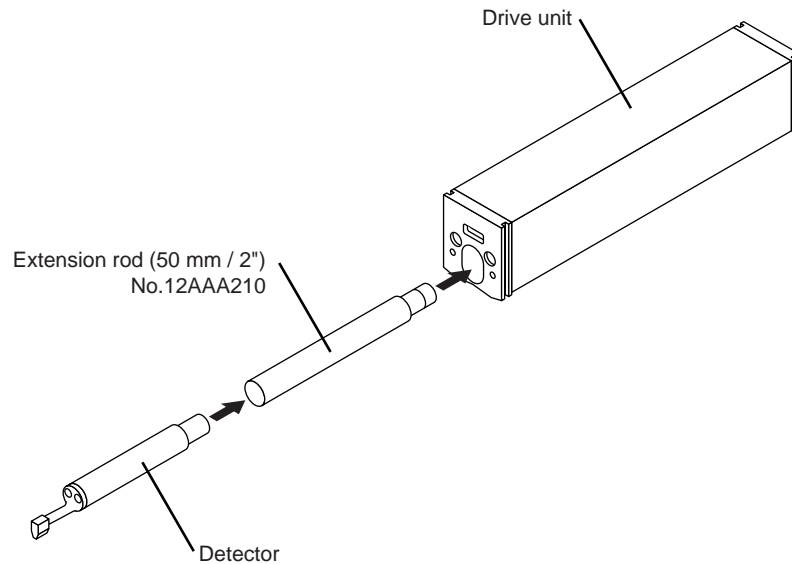


● Dimensions and application example



● Attaching the extension rod

1. Insert the extension rod into the drive unit.
2. Attach the detector to the extension rod.



5. INSTALLING THE SJ-201P WITH OPTIONAL ACCESSORIES

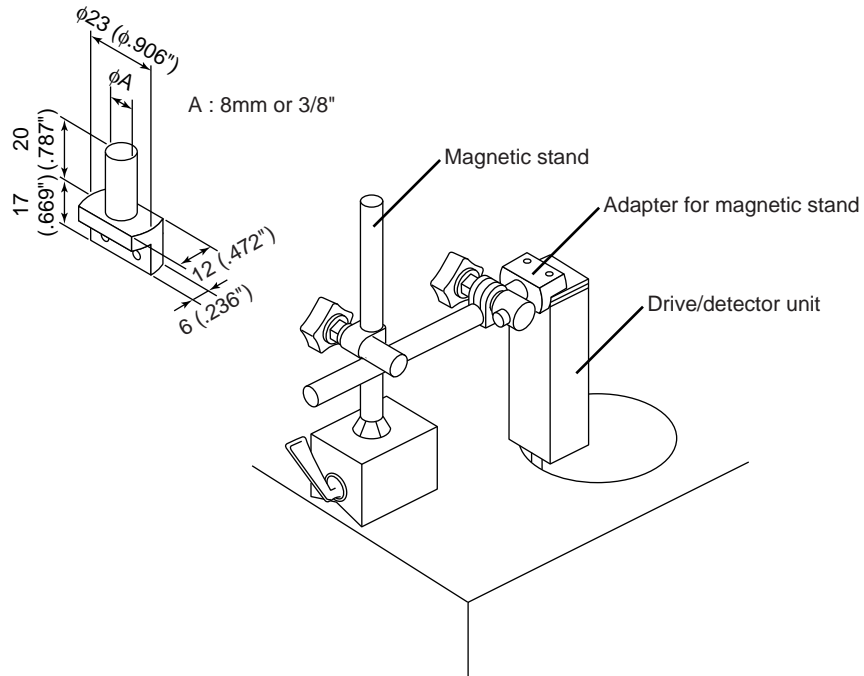
■ Adapter for magnetic stand

Used to secure the drive/detector unit to the magnetic stand.

This adapter is useful if there is insufficient space for the SJ-201P (or the drive/detector unit) or if the drive/detector unit can not be held by hand.

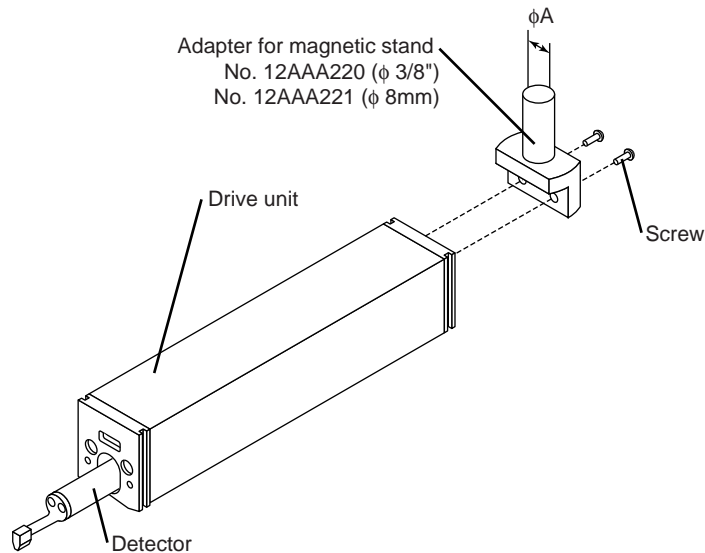
● Dimensions and application example

Unit : mm (inch)



● Attaching the adapter for magnetic stand

1. Attach the adapter for magnetic stand to the rear of the drive/detector unit.
2. Using the supplied Allen wrench tighten the two screws specified.



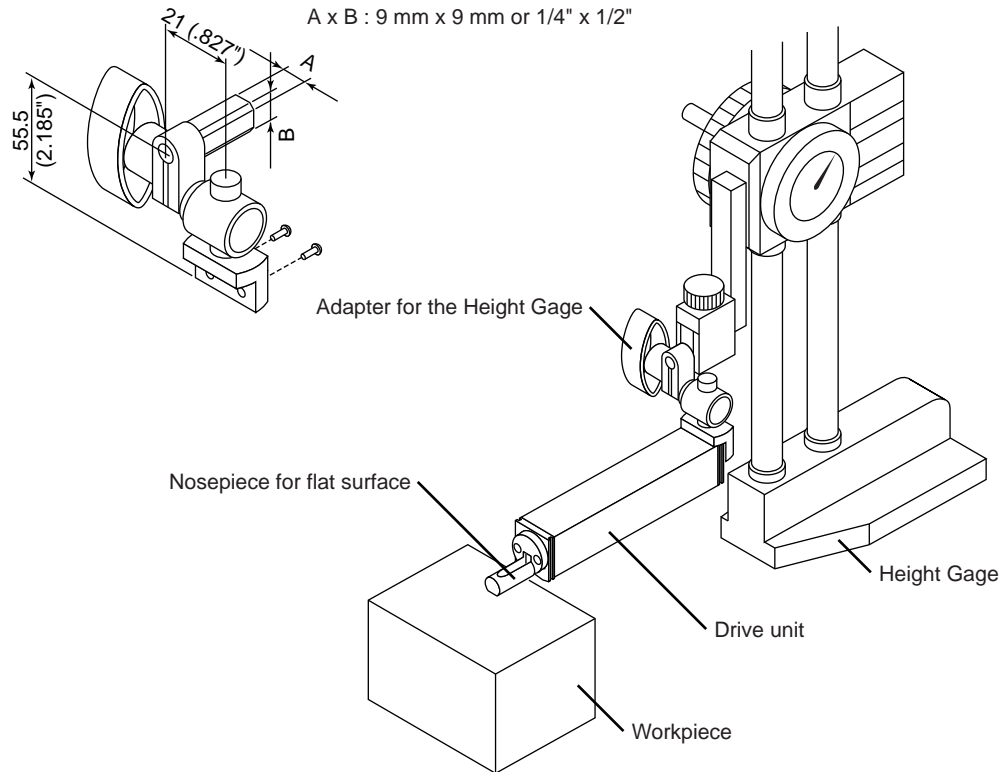
■ Adapter for Height Gage

Used to secure the drive/detector unit to the Height Gage.

The Height Gage is used to set the height of the measuring position manually or if the drive/detector unit can not be held by hand.

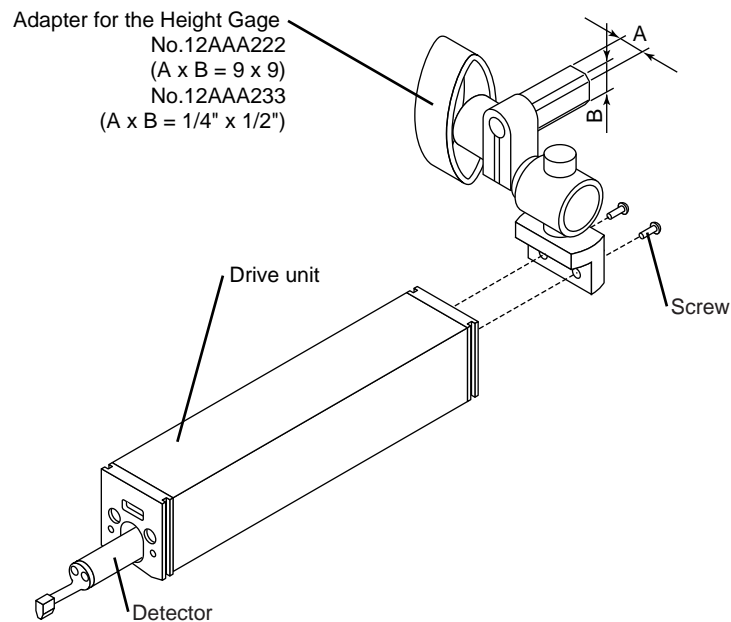
● Dimensions and application example

Unit : mm (inch)



● Attaching the adapter for the Height Gage

1. Attach the adapter to the rear of the drive unit.
2. Using the supplied Allen wrench tighten the two screws specified.



6

SAVING/OUTPUTTING/ COMMUNICATING THE MEASUREMENT RESULTS

The SJ-201P has the functions to output the measurement results displayed in the LCD as SPC data, save them in the built-in memory, and print them on the printer (optional accessory) or output them to an external device via RS-232C interface.

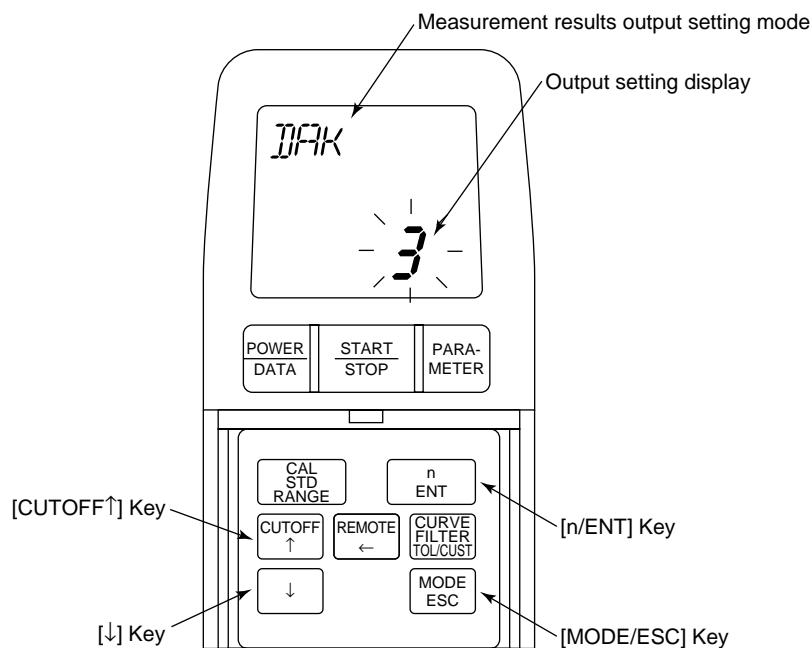
6.1 Setting the Measurement Result Output

In the "Measurement result output setting" mode, set whether the SJ-201P outputs the measurement results as SPC data, saves the results in the built-in memory, or prints the results on the printer. The contents that can be set for the measurement results are listed in the following table.

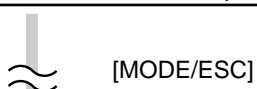
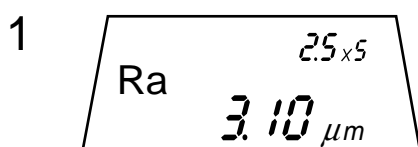
Output setting	Measurement result processing	Reference section
0	Outputs SPC data (measurement results and units) to the data processor, etc.	6.4 SPC Data Output
1	Saves measurement results (up to 10 cases) in the built-in memory.	6.2.1 Saving measurement results
2	Outputs SPC data (measurement results and units) to the data processor, etc., and saves measurement results (up to 10 cases) in the built-in memory.	6.4 SPC Data Output 6.2.1 Saving measurement results
3	Prints on the printer (measurement conditions, calculation results, measured profile, and BAC)	6.3 Printing Measurement Results and Saved Data

If data is output to an external device being connected with an RS-232C communication cable, the output setting of measurement results can be set to either of 0 to 3 (there is no effect on the SJ-201P).

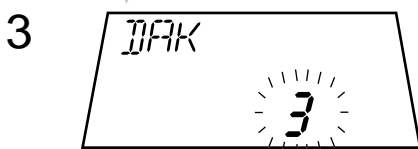
■ Display and operation keys



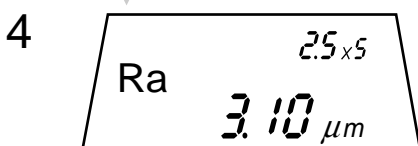
■ Operating procedure



[CUTOFF↑]
or
[↓]



[n/ENT]



Press the [MODE/ESC] key several times in the measurement mode until "DAK" (measurement result output setting mode) is displayed.

⇒ The output setting value of the measurement results will flash on the LCD.

0: SPC data output

1: Saving in the built-in memory

2: Outputting SPC data and saving in the built-in memory

3: Printing on the printer

Press the [CUTOFF ↑] key or [↓] key several times until the value desired to be set is displayed on the LCD.

When the value to be set has been displayed, press the [n/ENT] key to load it.

⇒ The SJ-201P returns to the measurement mode.

6.2 Saving/Calling/Deleting Measurement Results

The SJ-201P can save measurement results up to 10 cases. Also, it can call the saved data and delete data from memory.

6.2.1 Saving measurement results

The SJ-201P is equipped as standard with the built-in memory that can save up to 10 cases of measurement results.

One of the data numbers 1 to 10 is appended in ascending order to each of the saved measurement results. If more than 10 cases of measurement results are to be saved, data numbers are repeatedly used from 1 as saving destinations. At the same time, the surplus existing measurement results are deleted from data number 1.

1→2→3→.....→9→10→1→2→.....

⋮

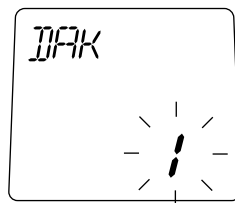
Data No.1 is used again at the time the eleventh measurement result is saved.

TIP Even if measurement results have been saved, all saved data is cleared in the following cases.

- The SJ-201P power supply cannot be turned on due to low level power of the built-in battery.
- The SJ-201P is used with the built-in battery switch being off, or the built-in battery switch is turned off.
- All saved data has been deleted. (Refer to "6.2.3 Deleting the Saved Data".)

■ Procedure for saving measurement results

1. Before performing measurement, set "Save" (or "SPC Output & Save").



Set the measurement result output mode to 1 (or 2).

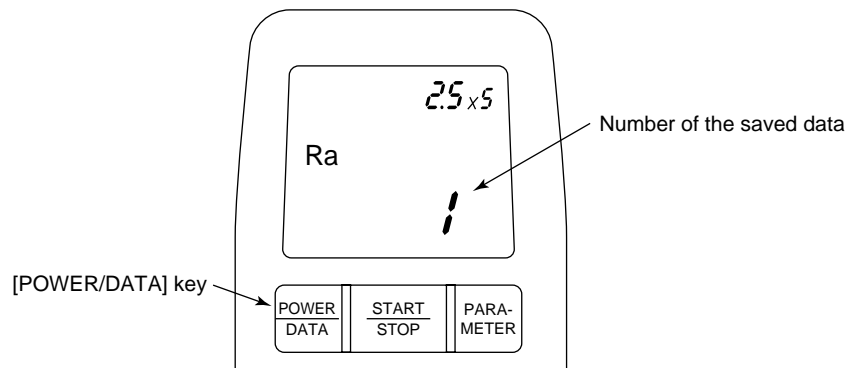
TIP For information about measurement result output setup, refer to "6.1 Setting the Measurement Result Output".

2. Perform measurement.

3. Press the [POWER/DATA] key.

When the data is saved, the number of the saved data is displayed for approximately two seconds as shown in the following figure.

When the data has been saved, the display changes to the calculated results.



6. SAVING/OUTPUTTING/COMMUNICATING THE MEASUREMENT RESULTS

6.2.2 Calling the saved data

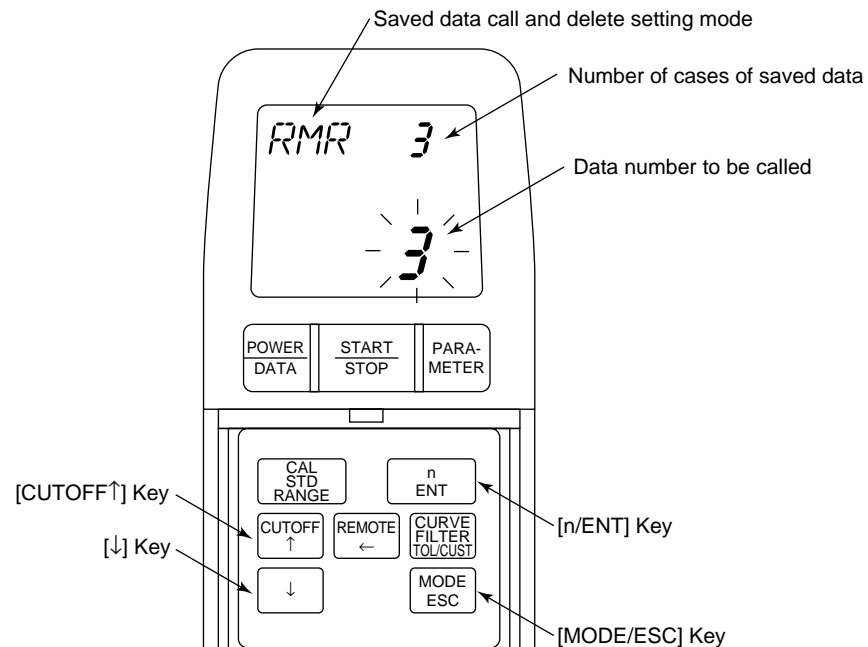
The saved measurement results (saved data) can be called to display on the LCD.

NOTE To print or delete the saved data, or output it as SPC data, first call the saved data from memory.

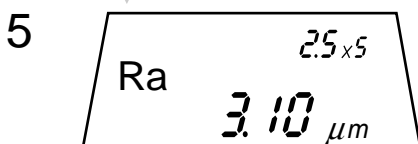
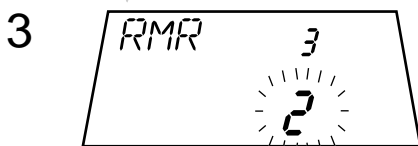
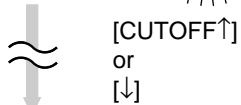
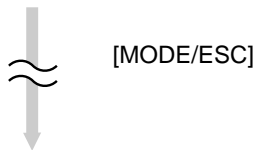
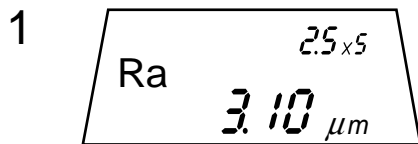
TIP Even if measurement results have been saved, all saved data is cleared in the following cases.

- The SJ-201P power supply cannot be turned on due to low level power of the built-in battery.
- The SJ-201P is used with the built-in battery switch being off, or the built-in battery switch is turned off.
- All saved data has been deleted. (Refer to "6.2.3 Deleting the Saved Data".)

■ Display and operation keys



■ Setting procedure



Press the [MODE/ESC] key several times in the measurement mode until "RMR" (saved data call and delete setting mode) is displayed.

⇒ The data number will flash on the LCD.

Press the [CUTOFF ↑] key or [↓] key several times until the data number to be called is displayed.

When the data number to be called has been displayed, press the [n/ENT] key.

⇒ The contents of the saved data are displayed.

⇒ The displayed parameter will flash on the screen where the contents of the saved data are displayed.

-
- TIP**
- Each time the [PARAMETER] key is pressed, a displayed parameter of the called measurement results is switched.
 - Press the [n/ENT] key once more to return to RMR.
-

To terminate calling the saved data, press the [MODE/ESC] key.

⇒ The SJ-201P returns to the measurement mode.

6.2.3 Deleting the saved data

There are two methods of deleting the saved data from memory: deleting one selected case of data and deleting all the saved data.

■ Number change due to deletion of the saved data

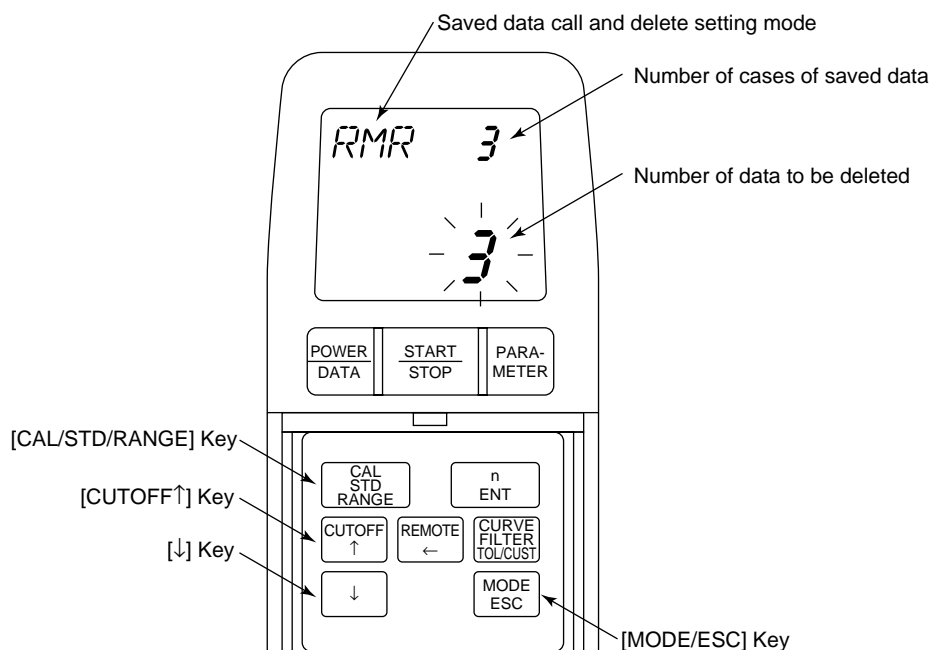
If either case of saved data is deleted, the data numbers greater than that of the deleted data are reduced by one. For example, if the data of number 6 is deleted from 10 cases of saved data, number 7 and greater data numbers are changed from 7 to 6, from 8 to 7, from 9 to 8, and from 10 to 9, respectively.

■ Deleting all the saved data

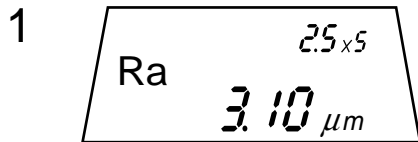
To delete all the saved data, press the [POWER/DATA] key while holding down the [MODE/ESC] key in the power-off state. All the data is deleted and the number of cases of saved data becomes zero.

■ Deleting one case of saved data

● Display and operation keys



● Setting procedure



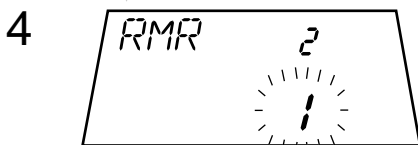
[MODE/ESC]



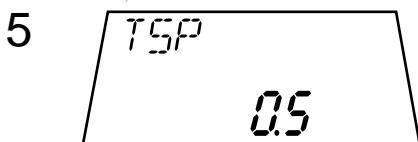
[CUTOFF ↑]
or
[↓]



[CAL/STD/RANGE]



[MODE/ESC]



Press the [MODE/ESC] key several times in the measurement mode until "RMR" (saved data call and delete setting mode) is displayed.

⇒ The data number will flash on the LCD.

Press the [CUTOFF ↑] key or [↓] key several times until the data number to be deleted is displayed.

When the data number to be deleted has been displayed, press the [CAL/STD/RANGE] key.

⇒ The selected case of saved data is deleted. The LCD shows the data number less by one than that of the deleted data.

TIP If either case of saved data is deleted, the LCD shows the data number less by one than that of the deleted data. For example, if the number of the data to be deleted is 3, the displayed data number changes to 2.

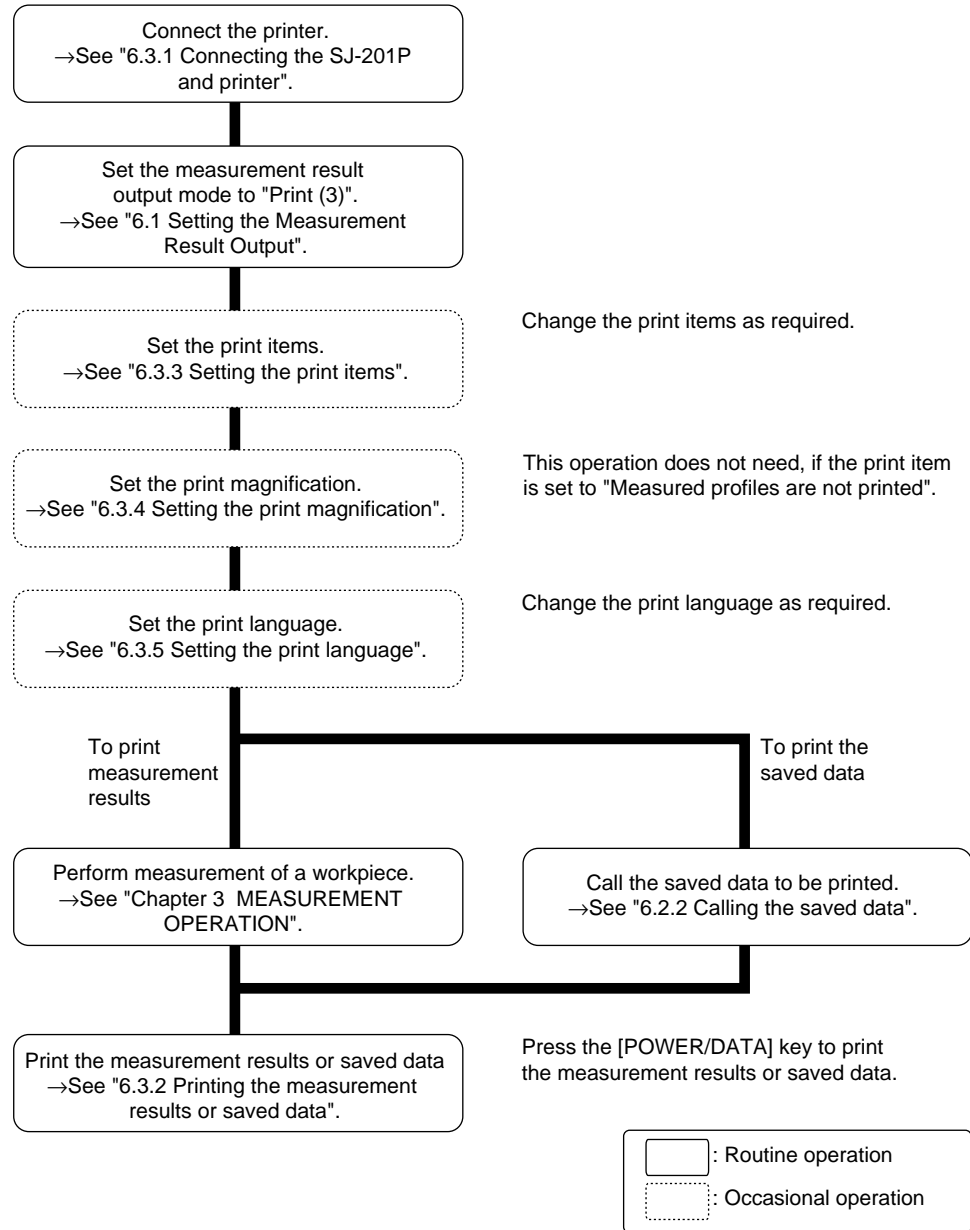
To terminate deleting the saved data, press the [MODE/ESC] key.

⇒ The SJ-201P enters the next operation mode. To return to the measurement mode, press the [MODE/ESC] key several times.

6.3 Printing Measurement Results and Saved Data

Connect the SJ-201P and the printer (optional accessory) using the RS-232C printer cable (optional accessory). This allows the printer to print measurement conditions, calculation results, measured profile, and BAC. The SJ-201P can print not only the data immediately after measurement, but also the data saved in the built-in memory after calling it.

The operation flow for printing measurement results is described below.

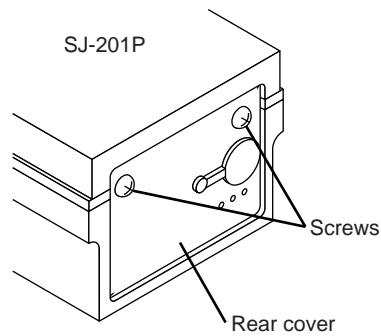


6.3.1 Connecting the SJ-201P and printer

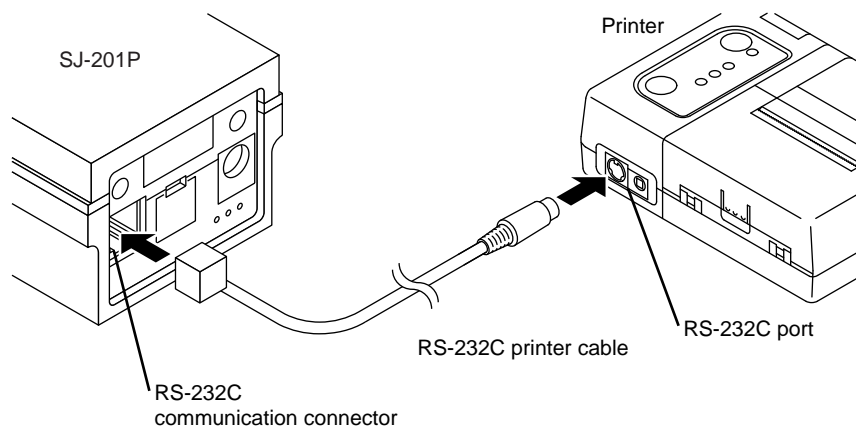
To print data on the printer, connect the SJ-201P and printer with the RS-232C printer cable, and then set the communication conditions on the printer side and the baud rate on the SJ-201P side.

■ Procedure for connecting the RS-232C printer cable

1. Unscrew the two screws on the SJ-201P rear cover with a Phillips screwdriver.
2. Remove the rear cover.



3. Connect the RS-232C communication connector on the rear of the SJ-201P with the RS-232C port on the printer using the optional RS-232C printer cable.



■ Setting the communication conditions on the printer side

Set the communication conditions on the printer side. Meet the setting contents with the following protocol.

Transmission speed	9600bps/19200bps
Data length	8 bits
Parity	Even
Control mode	SBUSY mode

TIP For more information about the setting procedure of printer communication conditions, refer to the User's Manual of the printer.

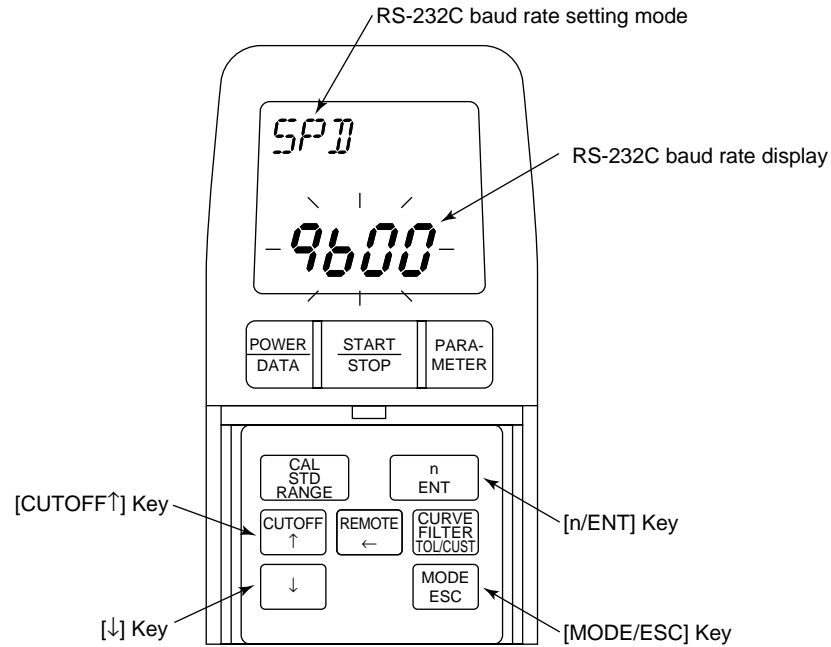
6. SAVING/OUTPUTTING/COMMUNICATING THE MEASUREMENT RESULTS

■ Procedure for setting the baud rate on the SJ-201P side

Set the RS-232C baud rate of the SJ-201P to 9600bps or 19200bps.

NOTE The baud rate to be set on the SJ-201P side must be identical to that on the printer side.

● Display and operation keys



● Setting procedure



≈ [MODE/ESC]



[CUTOFF ↑]
or
[↓]



[n/ENT]



Press the [MODE/ESC] key several times in the measurement mode until "SPD" (RS-232C baud rate setting mode) is displayed.

⇒ The RS-232C baud rate setting will flash on the LCD.

Press the [CUTOFF ↑] key or [↓] key.

⇒ Each time the key is pressed, the flashing baud rate will be toggled between "9600" and "19200".

When the required baud rate has been displayed, press the [n/ENT] keys to load the baud rate.

⇒ After loading the baud rate, the SJ-201P returns to the measurement mode.

6.3.2 Printing the measurement results or saved data

To print the measurement results or saved data from the SJ-201P to the printer, set the measurement result output mode to "Print (3)".

Immediately after measurement or after calling the saved data, press the [POWER/DATA] key, and then the data will be printed.

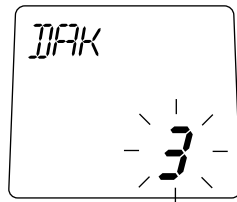
If necessary, reset the "print items (items to be printed)", "print magnification", and "print language" to change the print image. Printout examples are shown in the later page. Also, the reference sections that give each print setting method are described in the following printing procedure.

■ Printing procedure

1. Connect the printer to the SJ-201P, then perform setup for the connection.

TIP For information about connecting the SJ-201P and printer, refer to "6.3.1 Connecting the SJ-201P and printer".

2. Before performing measurement or calling the saved data, set the measurement result output mode to "Print (3)".



← Set the measurement result output mode to "Print (3)".

TIP For information about measurement result output setup, refer to "6.1 Setting the Measurement Result Output".

NOTE The measurement result output mode has been factory-set to "SPC output (0)". When printing data on the printer, be sure to change the output mode.

3. Set the print items, print magnification, and print language as required.

TIP

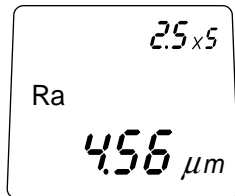
- For information about the print item setup, refer to "6.3.3 Setting the print items".
- For information about the print magnification setup, refer to "6.3.4 Setting the print magnification". The print magnification of the vertical and horizontal size has been factory-set to "Auto" (automatic setup for the optimal magnification).
- For information about the print language, refer to "6.3.5 Setting the print language". The print language has been factory-set to English.

4. Perform measurement or call the saved data.

- TIP**
- For information about measurement, refer to "Chapter 3 MEASUREMENT OPERATION".
 - For information about calling the saved data, refer to "6.2.2 Calling the saved data".
-

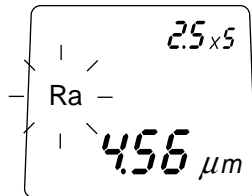
< When performing measurement >

Enter the screen at the end of measurement (screen in which measurement results are displayed),



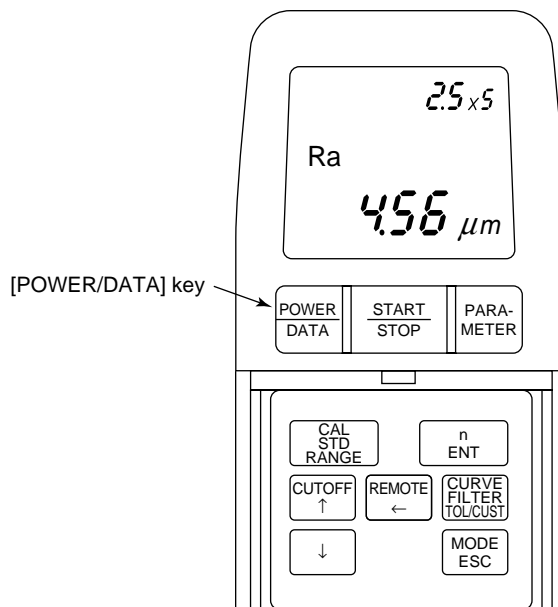
< When calling the saved data >

Enter the screen in which the contents of the saved data to be printed are displayed and the parameter display is flashing.



5. Press the [POWER/DATA] key.

The measurement results or saved data will be printed on the printer.

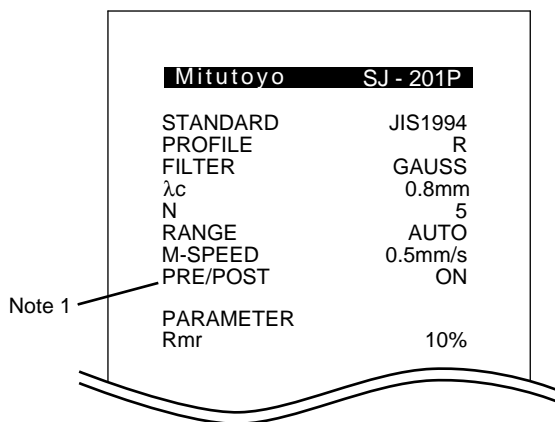


6. SAVING/OUTPUTTING/COMMUNICATING THE MEASUREMENT RESULTS

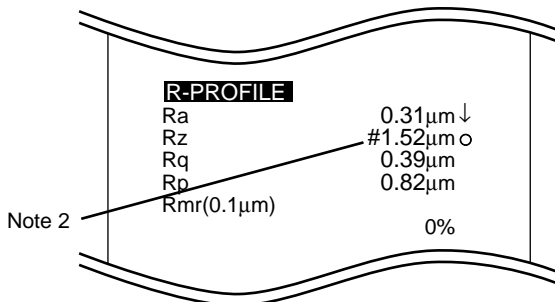
■ Printout examples

The printout examples of the SJ-201P are shown below.

< Measurement conditions >



< Calculated results >

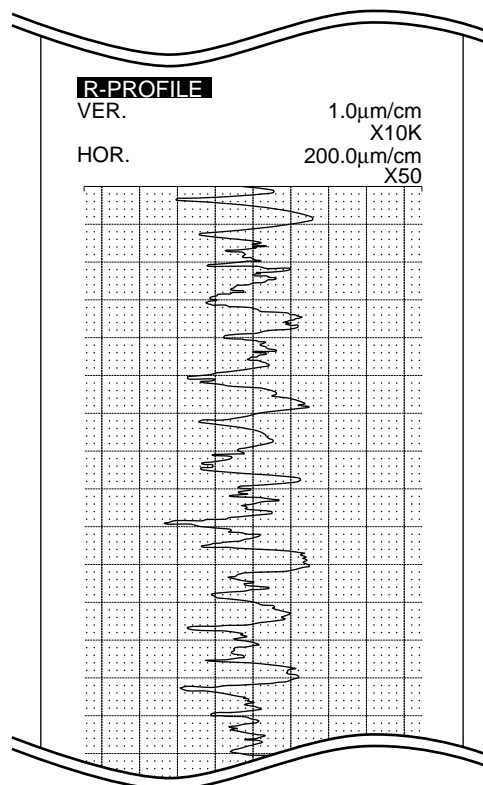


Note 1: The "Preliminary length" ON/OFF setup indicates the presence/absence of pre-travel and post-travel length setup.

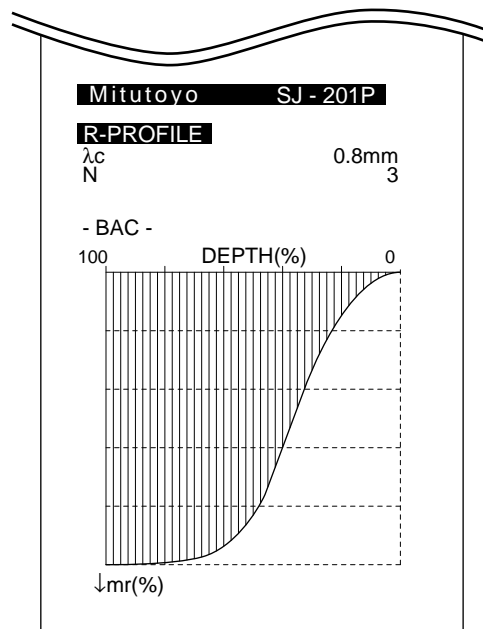
For information about the pre-travel/post-travel length, refer to "4.4 Setting the Pre-travel/Post-travel to OFF".

Note 2: "#" appended to a numeric value indicates that the value has been calculated from the number of peaks and valleys that is less than specified in the standard.

< Measured profile >



< BAC >

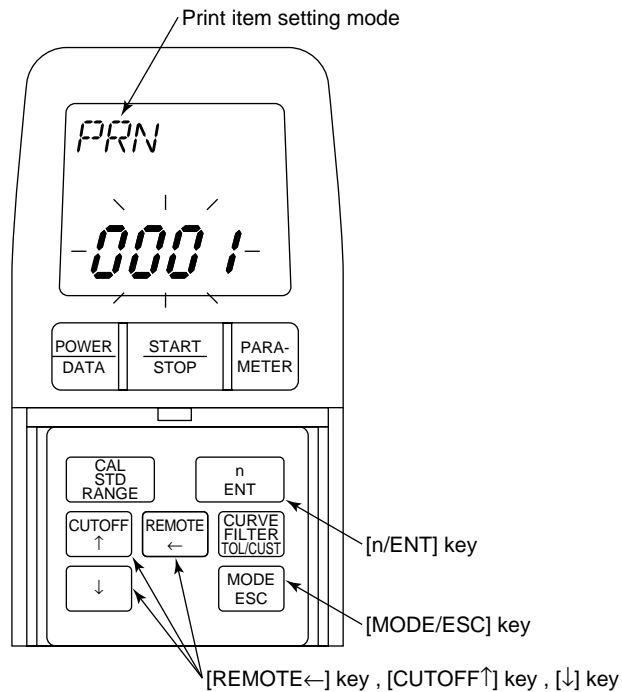


6.3.3 Setting the print items

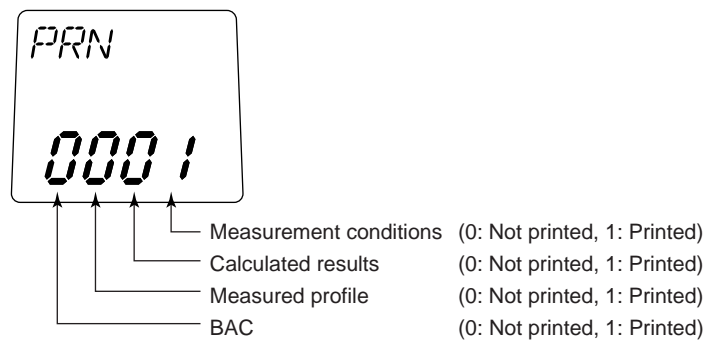
The SJ-201P can print the measurement conditions, calculated results, measured profile, and BAC on the printer.

These items are referred to as the print items of the SJ-201P. It is possible to set whether to print the item content for individual print items.

■ Display and operation keys



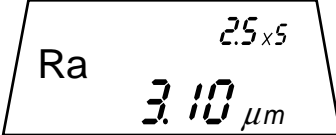
In the print item setting mode, the LCD shows a 4-digit number that indicates whether to print each of the four print items. The following shows the meaning of each digit number.




NOTE "0111" has been factory-set for the print items (the measurement conditions, calculated results, and measured profile are printed, and the BAC is not printed).

6. SAVING/OUTPUTTING/COMMUNICATING THE MEASUREMENT RESULTS


■ Setting procedure

1 


≈ [MODE/ESC]

2 

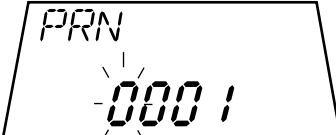
Change the number (if necessary) with the [CUTOFF ↑] or [↓] key, then press the [REMOTE ←] key.

3 

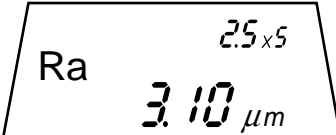
Change the number (if necessary) with the [CUTOFF ↑] or [↓] key, then press the [REMOTE ←] key.

4 

Change the number (if necessary) with the [CUTOFF ↑] or [↓] key, then press the [REMOTE ←] key.

5 

[n/ENT]

6 

Press the [MODE/ESC] key several times in the measurement mode until "PRN" (print item setting mode) is displayed.

⇒ The setting for the print items is displayed and the digit (rightmost) of measurement conditions flashes on the LCD.

0: Not printed
1: Printed

Press the [CUTOFF ↑] key or [↓] key, if necessary, to change the number, then press the [REMOTE ←] key.

⇒ The digit (second from the rightmost) of calculated results flashes.

0: Not printed
1: Printed

Press the [CUTOFF ↑] key or [↓] key, if necessary, to change the number, then press the [REMOTE ←] key.

⇒ The digit (third from the rightmost) of a measured profile flashes.

0: Not printed
1: Printed

Press the [CUTOFF ↑] key or [↓] key, if necessary, to change the number, then press the [REMOTE ←] key.

⇒ The digit (leftmost) of a BAC flashes.

0: Not printed
1: Printed

If the required setting has been displayed, press the [n/ENT] key to load the setting.

⇒ After loading the setting, the SJ-201P returns to the measurement mode.

6.3.4 Setting the print magnification

The SJ-201P can change the vertical and horizontal magnifications at the print of a measured profile.

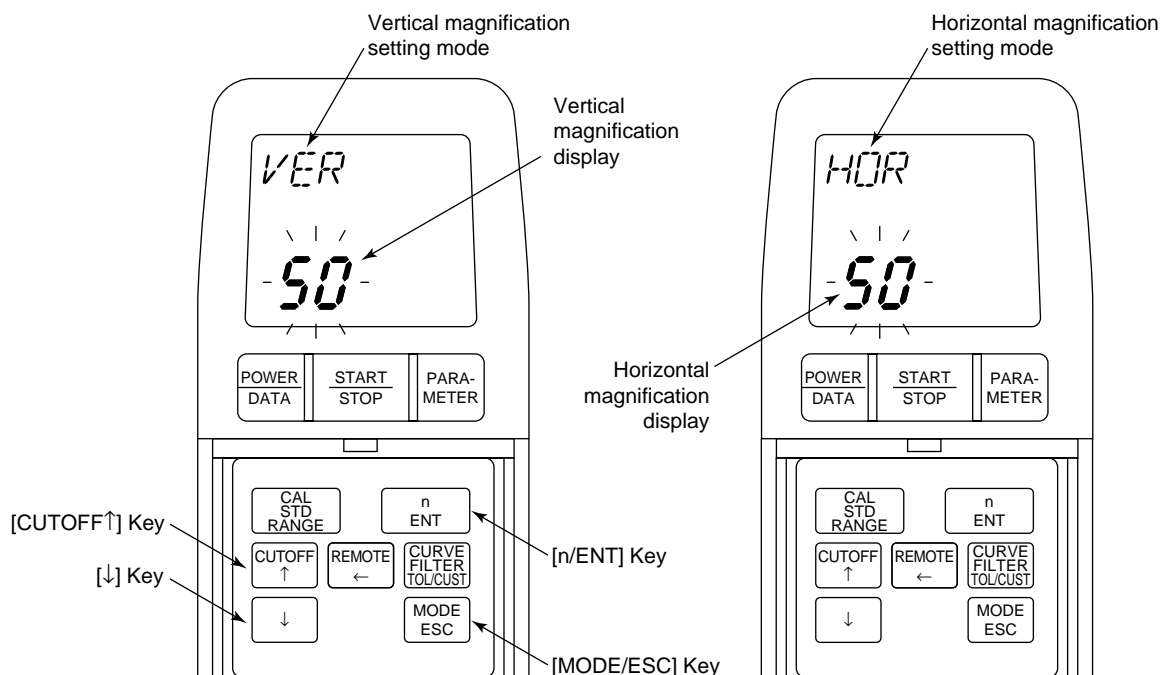
■ Kind of vertical and horizontal magnifications

The following tables show the print magnifications that can be set for vertical magnification and horizontal magnification along with each magnification display.

Vertical magnification		Horizontal magnification	
Display magnification	Print magnification	Display magnification	Print magnification
20	20	1	1
50	50	2	2
100	100	5	5
200	200	10	10
500	500	20	20
1E3	1000	50	50
2E3	2000	100	100
5E3	5000	200	200
1E4	10000	500	500
2E4	20000	1E3	1000
5E4	50000		
1E5	100000		
Auto	Automatic setup of the optimal magnification	Auto	Automatic setup of the optimal magnification

NOTE Each vertical and horizontal magnification has been factory-set to "Auto" (automatic setup for the optimal magnification).

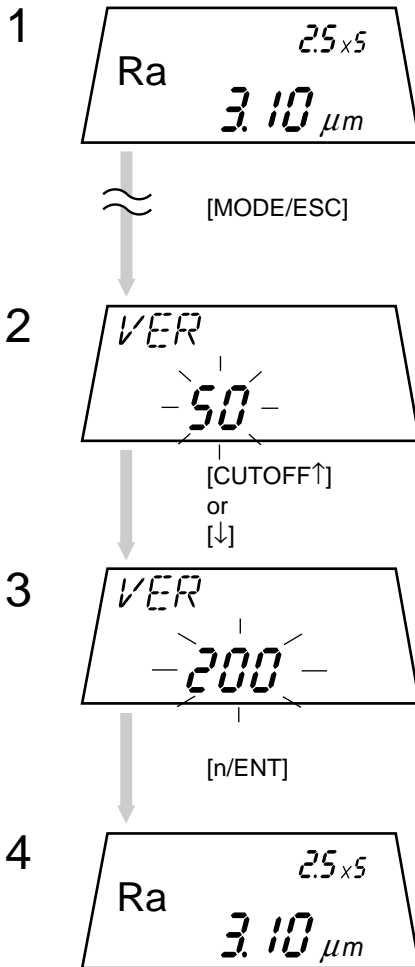
■ Display and operation keys



6. SAVING/OUTPUTTING/COMMUNICATING THE MEASUREMENT RESULTS

■ Setting procedure

● Procedure for setting a vertical magnification



[MODE/ESC]

[CUTOFF ↑]
or
[↓]

[n/ENT]

Press the [MODE/ESC] key several times in the measurement mode until "VER" (vertical magnification setting mode) is displayed.

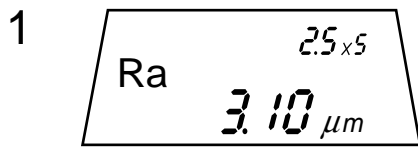
⇒ The vertical magnification setting will flash on the LCD.

Press the [CUTOFF ↑] key or [↓] key several times until the value desired to be set is displayed.

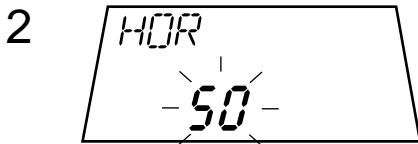
When the value to be set has been displayed, press the [n/ENT] key to load it.

⇒ After loading the value, the SJ-201P returns to the measurement mode.

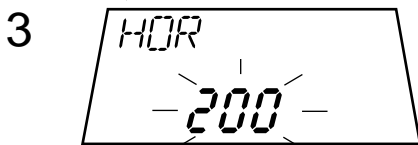
● Procedure for setting a horizontal magnification



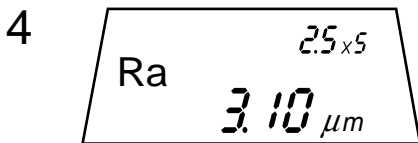
≈ [MODE/ESC]



[CUTOFF ↑]
or
[↓]



[n/ENT]



Press the [MODE/ESC] key several times in the measurement mode until "HOR" (horizontal magnification setting mode) is displayed.

⇒ The horizontal magnification setting will flash on the LCD.

Press the [CUTOFF ↑] key or [↓] key several times until the value desired to be set is displayed.

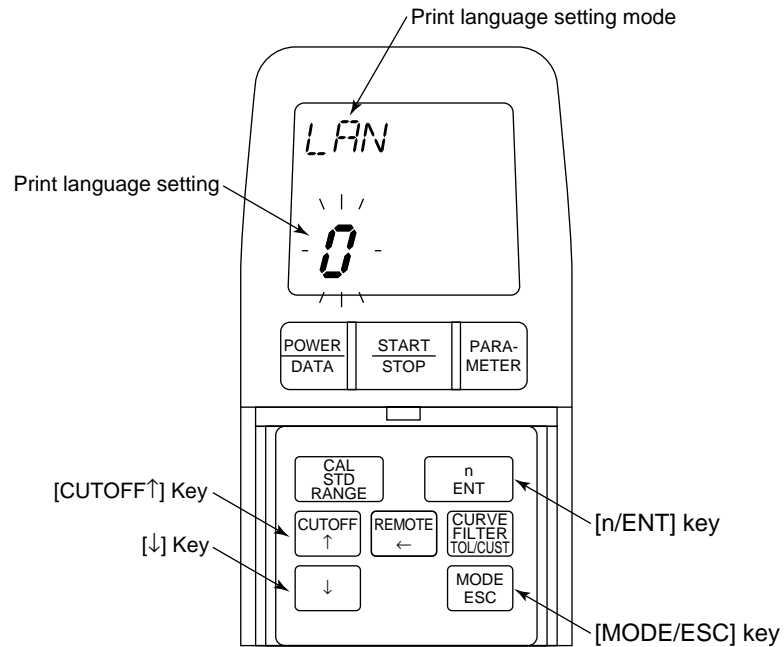
When the value to be set has been displayed, press the [n/ENT] key to load it.

⇒ After loading the value, the SJ-201P returns to the measurement mode.

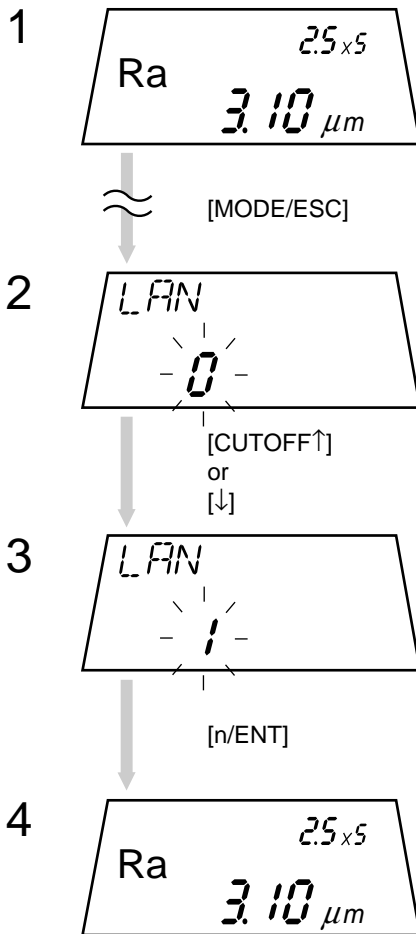
6.3.5 Setting the print language

The SJ-201P can use English or Japanese for the print language at the print of measurement results on the printer.

■ Display and operation keys



■ Setting procedure



Press the [MODE/ESC] key several times in the measurement mode until "LAN" (print language setting mode) is displayed.

⇒ The print language setting will flash on the LCD.

0: English

1: Japanese

Press the [CUTOFF ↑] key or [↓] key.

⇒ Each time the key is pressed, the displayed setting will be toggled between "0" and "1".

When the required print language setting has been displayed, press the [n/ENT] keys to load the setting.

⇒ After loading the print language, the SJ-201P returns to the measurement mode.

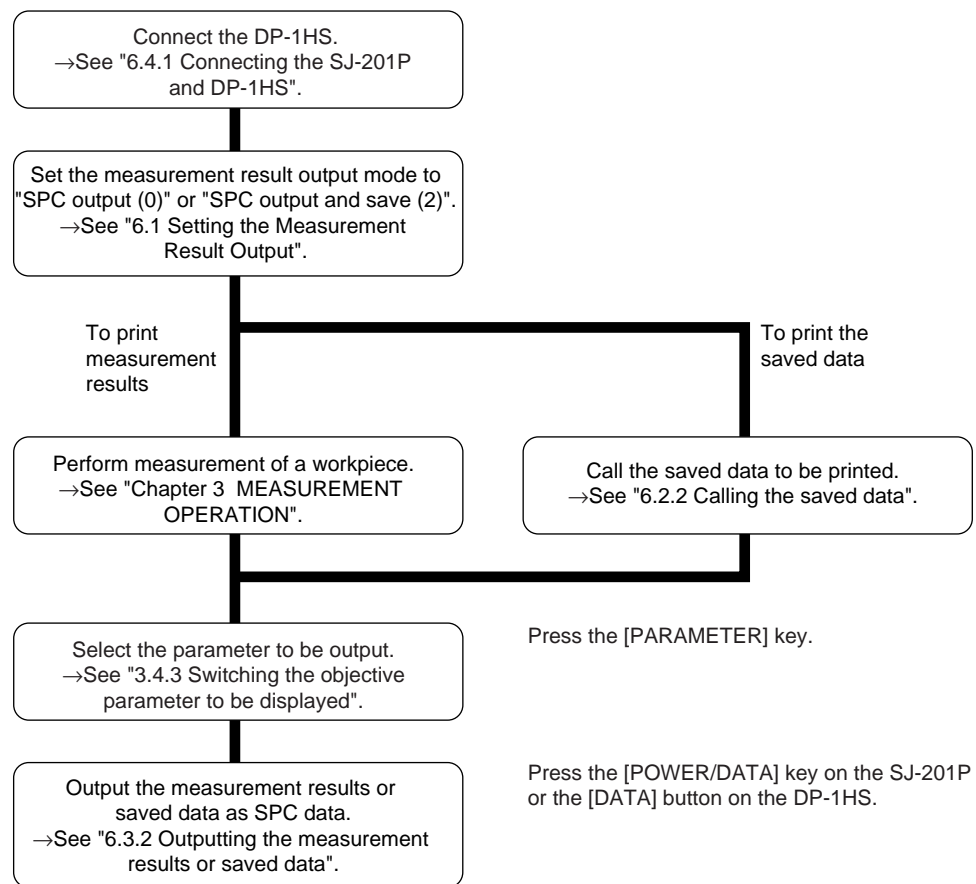
6.4 SPC Data Output

If the SJ-201P is connected to a Mitutoyo Digimatic Data Processor (DP-1HS, etc.), it can output the measurement results (including the unit of measurement) as SPC data.

IMPORTANT The SPC data available from the SJ-201P is the measurement of the parameter being displayed on the LCD and the unit of measurement. Parameter names, etc., will not be output.

For the data of multiple parameters to be statistically processed with a data processor (DP-1HS), it is necessary to arrange the measurement sequence so that data sampling can be performed consecutively on the same parameter data for the specified sample size, etc. without being mixed up with data of different parameters. An error occurs if multiple pieces of parameter data having different number of decimal places and units are mixed during sampling of SPC data.

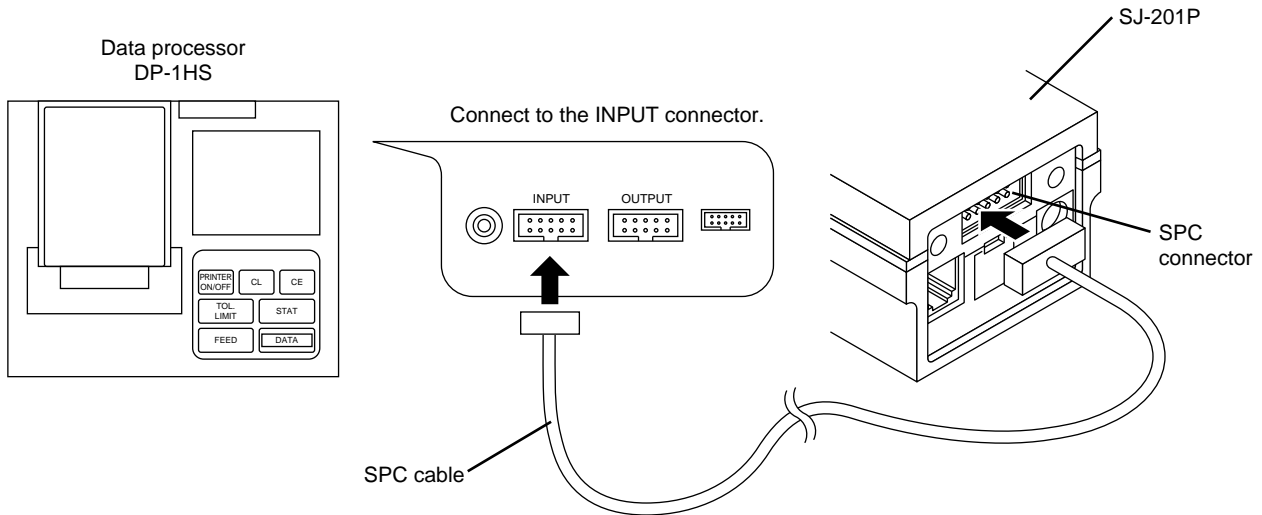
The operation flow of outputting SPC data is described below.



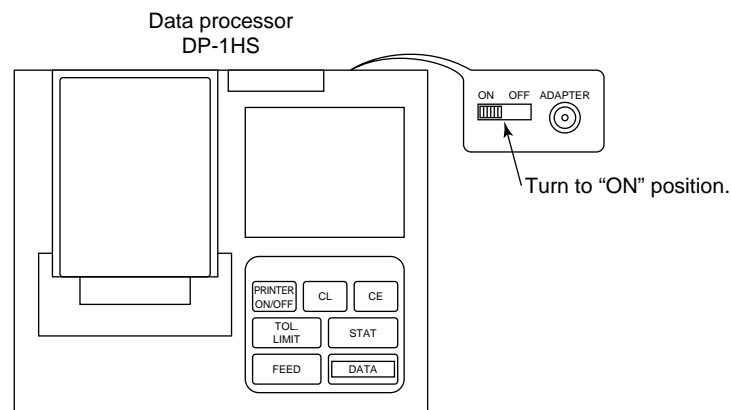
6.4.1 Connecting the SJ-201P and DP-1HS

Connect the SJ-201P and DP-1HS using the SPC cable according to the following procedure.

1. Remove the two screws securing the rear cover of the SJ-201P, then remove the rear cover.
2. Use the dedicated connection cable to link the SJ-201P and DP-1HS.



3. Turn on the DP-1HS.



6.4.2 Outputting the measurement results or saved data

To output the measurement results or saved data from the SJ-201P to the DP-1HS, set the measurement result output to "SPC output (0)" or "SPC output and save (2)".

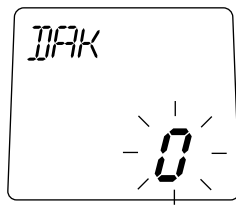
After performing measurement or calling the saved data under the above setting, press the [POWER/DATA] key on the SJ-201P or the [DATA] button on the DP-1HS, and then the measurement results or saved data will be output.

■ Procedure for outputting SPC data

1. Connect the SJ-201P and DP-1HS.

TIP For information about the connection of the SJ-201P and DP-1HS, refer to "6.4.1 Connecting the SJ-201P and DP-1HS".

2. Before performing measurement or calling the saved data, set the measurement result output to "SPC output (0)" or "SPC output and save (2)".



← Set the measurement result output to 0 (or 2).

TIP For information about output setup for measurement results, refer to "6.1 Setting the Measurement Result Output".

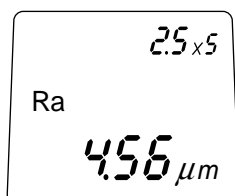
NOTE The measurement result output has been factory-set to "SPC output (0)".

3. Perform measurement or call the saved data.

- TIP**
- For information about measurement, refer to "Chapter 3 MEASUREMENT OPERATION".
 - For information about calling the saved data, refer to "6.2.2 Calling the saved data".
-

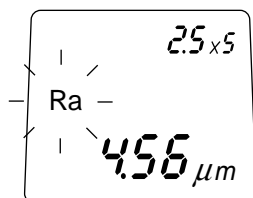
< When performing measurement >

Enter the screen at the end of measurement (screen in which measurement results are displayed),

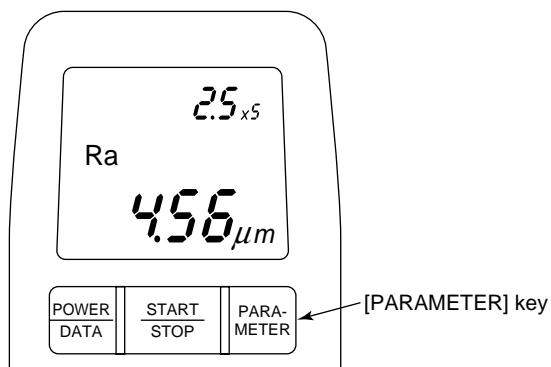


< When calling the saved data >

Enter the screen in which the contents of the saved data to be printed are displayed and the parameter display is flashing.

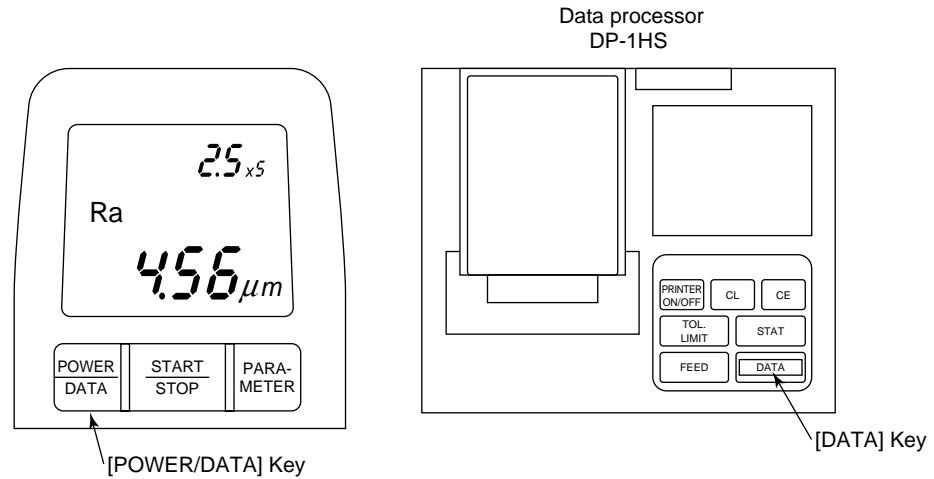


4. Press the [PARAMETER] key of the SJ-201P until the objective parameter for output is displayed.



6. SAVING/OUTPUTTING/COMMUNICATING THE MEASUREMENT RESULTS

5. Press the [POWER/DATA] key of the SJ-201P or the [DATA] button on the DP-1HS.



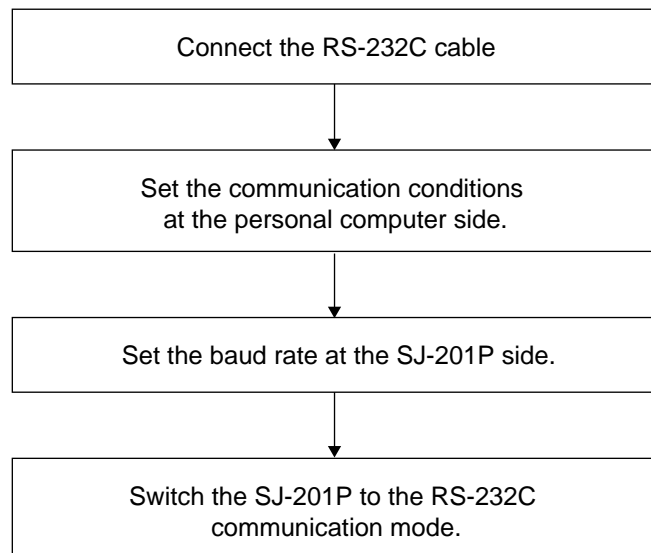
The measurement result or saved data will be outputted from the SJ-201P to the DP-1HS.

TIP For the statistical processing operation of the measurement result, see also the DP-1HS User's Manual.

6.5 Connecting with a Personal Computer

When the SJ-201P is connected to a personal computer, etc., it is possible to output measurement results or measurement conditions from the SJ-201P to the personal computer. It is also possible to send a measurement start signal from the personal computer to the SJ-201P.

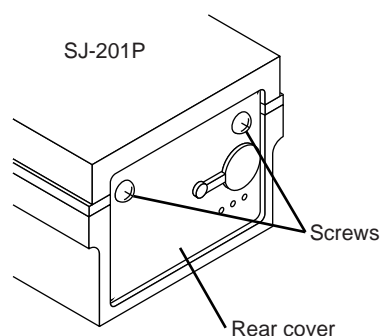
■ Procedure for connecting with a personal computer



NOTE For mm/inch model determine the unit of measurement before connecting to a personal computer. Once the SJ-201P is connected to a personal computer with the RS-232C cable, the unit of measurement can not be switched with the key or command from the personal computer.

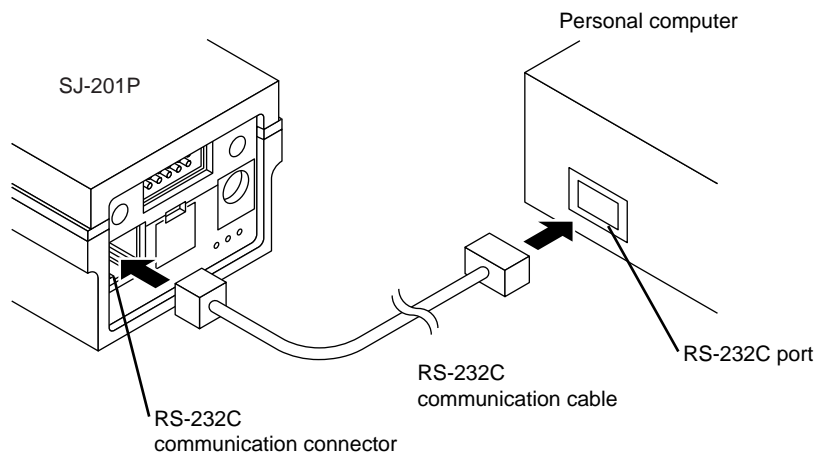
■ Connecting the RS-232C cable

1. Use a Phillips screwdriver to remove the two screws that secure the rear cover of the SJ-201P.
2. Remove the cover.



6. SAVING/OUTPUTTING/COMMUNICATING THE MEASUREMENT RESULTS

3. Connect the RS-232C communication connector located at the rear of the SJ-201P display unit and the RS-232C port of the personal computer with the RS-232C communication cable (optional).



■ Setting the communication conditions at the personal computer side

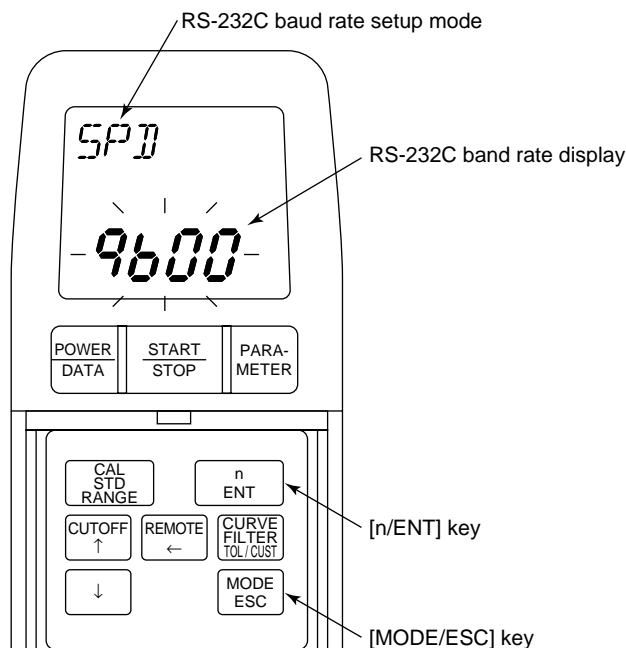
Set the communication conditions at the personal computer side as follows:

Communication method	Start/stop method
Baud rate	9600bps/19200bps
Data bits	8bits
Parity	EVEN
Stop bit	1bit
X parameter	ON

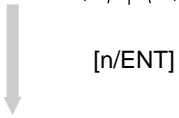
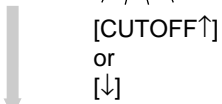
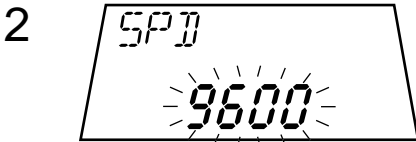
■ Setting the baud rate at the SJ-201P side

Set the RS-232C baud rate at the SJ-201P side to either 9600 bps or 19200 bps.

● Display and operation keys



● Operating procedure



Press the [MODE/ESC] key several times in the measurement mode until “SPD” is displayed.

⇒ This enters the RS-232C baud rate setup mode.

Press the [CUTOFF↑] key or [↓] key.

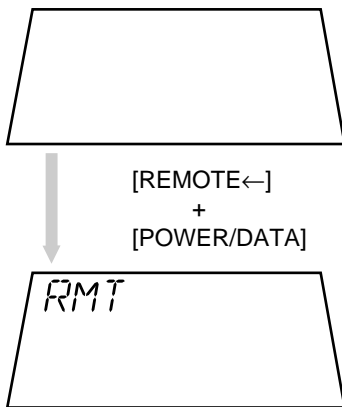
⇒ Each time the key is pressed the display toggles between “9600” and “19200”.

Press the [n/ENT] key.

⇒ This accepts the selected baud rate. After it has been accepted the measurement mode is restored.

6. SAVING/OUTPUTTING/COMMUNICATING THE MEASUREMENT RESULTS

- Switching the SJ-201P to the RS-232C communication mode



When the power is off (auto-sleep mode) press the [POWER/DATA] key while holding down the [REMOTE<-] key.

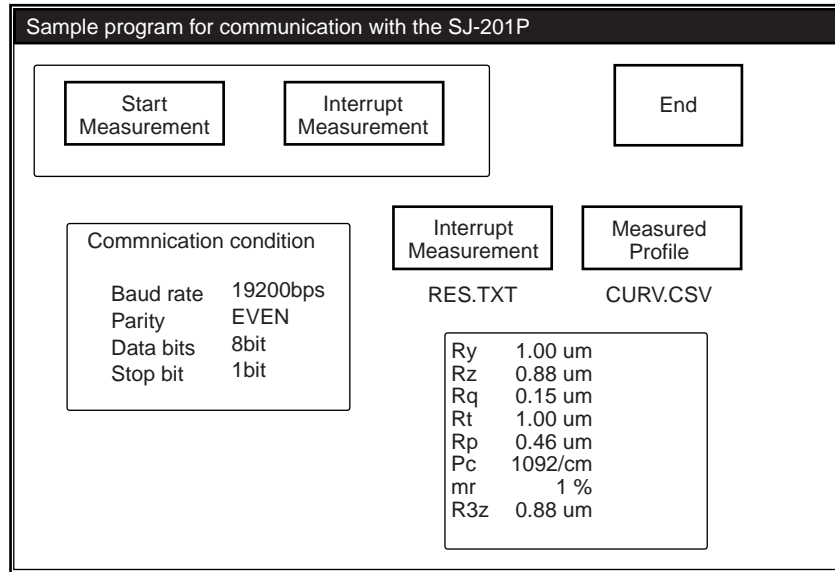
⇒ This enters the RS-232C communication mode.

NOTE While in the RS-232C communication mode the SJ-201P can be turned off by pressing the [REMOTE<-] key.

TIP

- For information about the communication commands refer to “9.10 RS-232C Communication Specifications”.
- A sample program list in VB-Basic is given in the following pages.

■ Sample program for communication with the SJ-201P(VB-Basic)



● Sample program list using the VB-Basic

```

Option Explicit
*****
'*      Start Measurement      *
*****
,
Private Sub Command2_Click()
    Dim sts As String

    If MSComm1.PortOpen = False Then MSComm1.PortOpen = True '--- open the line.

    Call CMD_SEND("WRSTA") '--- Send the command.
    Call STS_RD(sts) '--- Receive the status.

    If sts = "OK" Then Text1.Text = "Start Measurement" '--- Nomal status.
End Sub

*****
'*      Interrupt Measurement  *
*****
,
Private Sub Command3_Click()
    Dim sts As String

    If MSComm1.PortOpen = False Then MSComm1.PortOpen = True
    Call CMD_SEND("WRSTP")
    Call STS_RD(sts)

    If sts = "OK" Then Text1.Text = "Interrupt Measurement"
End Sub
  
```

6. SAVING/OUTPUTTING/COMMUNICATING THE MEASUREMENT RESULTS

```
*****
'*      Call Calculated Results      *
*****
'
Private Sub Command4_Click()
    If MSComm1.PortOpen = False Then MSComm1.PortOpen = True
    Call CMD_SEND("RDRES00")
    Call RES_RD                                     '--- Call Calculated Results.
End Sub

*****
'*      Call Measured Profile Data   *
*****
'
Private Sub Command5_Click()
    Dim sts As String

    If MSComm1.PortOpen = False Then MSComm1.PortOpen = True

    Call CMD_SEND("WRCAN0000101")
    Call STS_RD(sts)

    '--- Specify the data call starting as the first point.

    If sts = "NG02" Then
        Text1.Text = "Under measurement"
    Else
        Call CMD_SEND("WRNUM00001")
        Call STS_RD(sts)
        '--- Specify one-time transfer size of the data call command as one point.

    If sts = "NG02" Then
        Text1.Text = "Under measurement"
    Else
        Open "CURV.CSV" For Output As #1           '--- Data save file "CURV.CSV"
        Do
            Call CMD_SEND("RDDTA00")             '--- Data call command
            Call STS_RD(sts)
            Text1.Text = Mid$(sts, 8)
            Print #1, Mid$(sts, 8)
        Loop Until (sts = "NG04")
        Close #1
        Text1.Text = "End reading"
    End If
End If

End Sub
```

```

*****
'*      Issue the Send Command      *
*****
,
Private Sub CMD_SEND(send_cmd As String)
    Dim d$

    d$ = send_cmd+Chr$(13)
    MCom1.Output = d$

End Sub

*****
'*      Receive the Status          *
*****
,
Private Sub STS_RD(ByRef status As String)
    Dim a$, b$, d$
    Dim L As Integer

    Do
        DoEvents
        a$ = MCom1.Input
        b$ = Right(a$, 1)
        d$ = d$ + a$
    Loop Until (b$ = Chr$(13))

    L = Len(d$)
    status = Mid$(d$, 1, L - 1)

End Sub

*****
'*      Receive the Calculated Results      *
*****
,
Private Sub RES_RD()
    Dim a$, b$, d$
    Dim L As Integer
    Dim i As Integer
    Dim j As Integer
    Dim RES(0 To 30) As String

    Do
        DoEvents
        a$ = MCom1.Input
        b$ = Right(a$, 1)
        d$ = d$ + a$
    Loop Until (b$ = Chr$(13))

```

6. SAVING/OUTPUTTING/COMMUNICATING THE MEASUREMENT RESULTS

```
If Mid$(d$, 1, 4) = "NG04" Then Text1.Text = "No calculated result"
```

```
If Mid$(d$, 1, 4) = "NG02" Then Text1.Text = "Under measurement"
```

```
If Mid$(d$, 1, 2) = "OK" Then
```

```
  Open "RES.TXT" For Output As #1
```

```
  d$ = Mid$(d$, 3)
```

```
  j = 0
```

```
  RES(j) = ""
```

```
  i = 0
```

```
  Text1.Text = ""
```

```
  Do
```

```
    i = i + 1
```

```
    a$ = Mid$(d$, i, 1)
```

```
    If (a$ = ", " Or a$ = Chr$(13)) Then
```

```
      RES(j) = RES(j) + Chr$(13) + Chr$(10)
```

```
      Text1.Text = Text1.Text + RES(j)
```

```
      Print #1, RES(j);
```

```
      j = j + 1
```

```
    Else
```

```
      RES(j) = RES(j) + a$
```

```
    End If
```

```
  Loop Until (a$ = Chr$(13))
```

```
  Close #1
```

```
End If
```

```
End Sub
```

```
*****
```

```
*           End           *
```

```
*****
```

```
,
```

```
Private Sub Command1_Click()
```

```
  End
```

```
End Sub
```

MEMO

7

REPLACEMENT OF THE BUILT-IN BATTERY PACK

7.1 Purchasing a Built-In Battery Pack

The maximum rechargeable capacity of the built-in battery will gradually deteriorate after extended use. In other words, the hours of service it can provide per recharge will become less and less each time it is fully recharged. If this maximum hours of service reaches a level at which the measuring operation may not be performed properly, then the battery pack must be replaced.

To purchase a replacement battery pack (Part No. 12BAA240), contact the sales representative from which your SJ-201P was purchased.

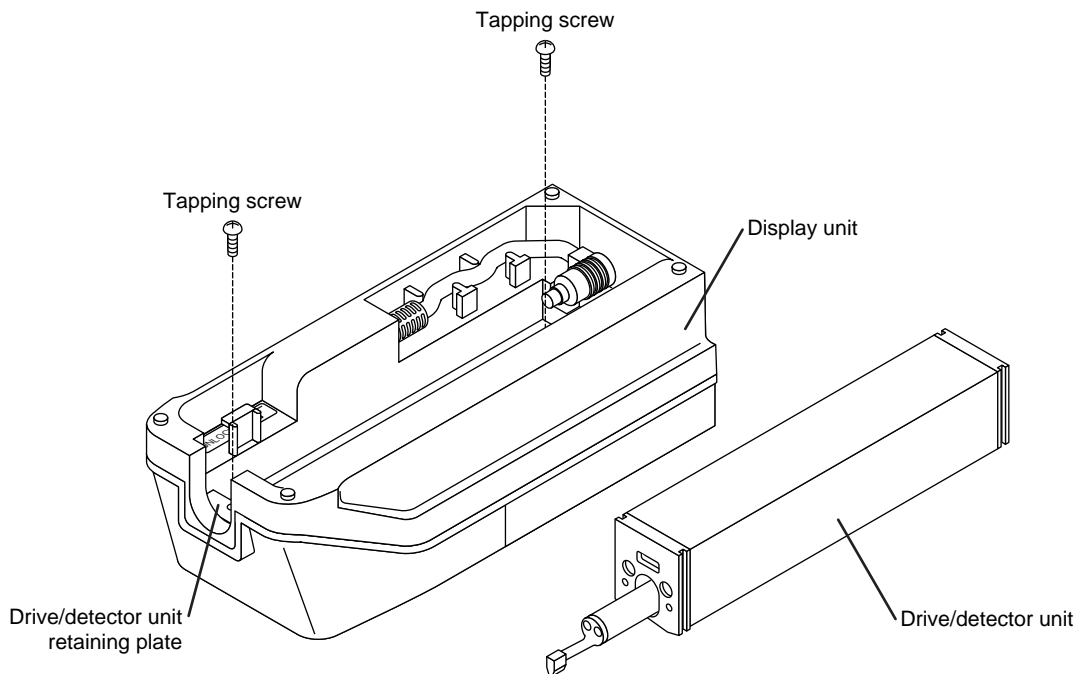
7.2 Replacing the Built-In Battery Pack

■ Replacement procedure of built-in battery pack

IMPORTANT Follow the directions given below and exercise care when replacing the built-in battery pack not to break or damage the PCB or cable.

NOTE The battery pack replacement should be done where there is as little dust and other shop contaminations as possible. In addition, exercise care so that dust or oil mist does not penetrate the display unit. During the battery pack replacement the circuit board in the SJ-201P is temporarily exposed. A malfunction may result if dust or shop contaminations soil the circuit board.

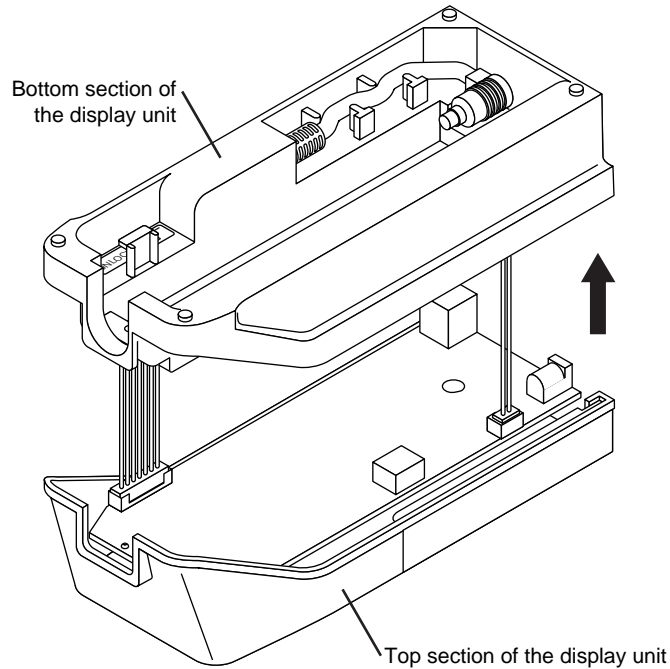
1. Separate the drive/detector unit from the display unit.
2. Remove the two tapping screws at the bottom of the display unit using a Phillips screwdriver. Do not lose the tapping screws and drive/detector unit retaining plate during this operation.



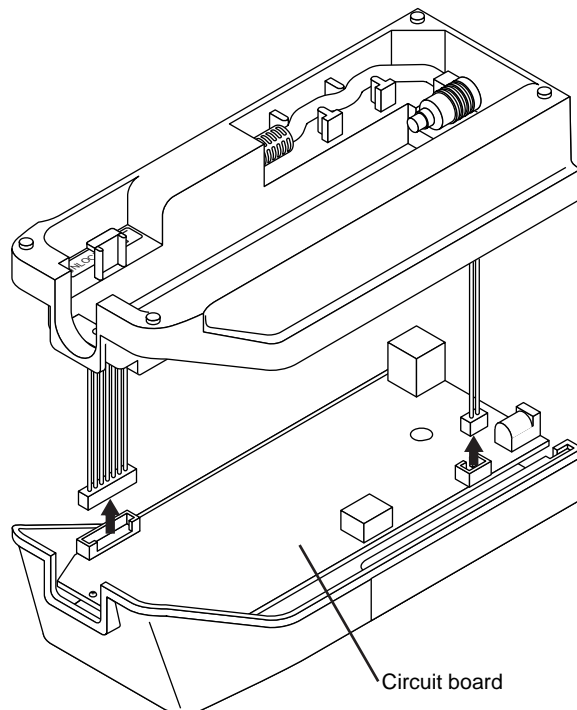
7. REPLACEMENT OF THE BUILT-IN BATTERY PACK

IMPORTANT Exercise care when removing the bottom section of the display unit. The top and bottom sections of the display unit are connected with cables, which, including the connectors, may be damaged if excessively strained.

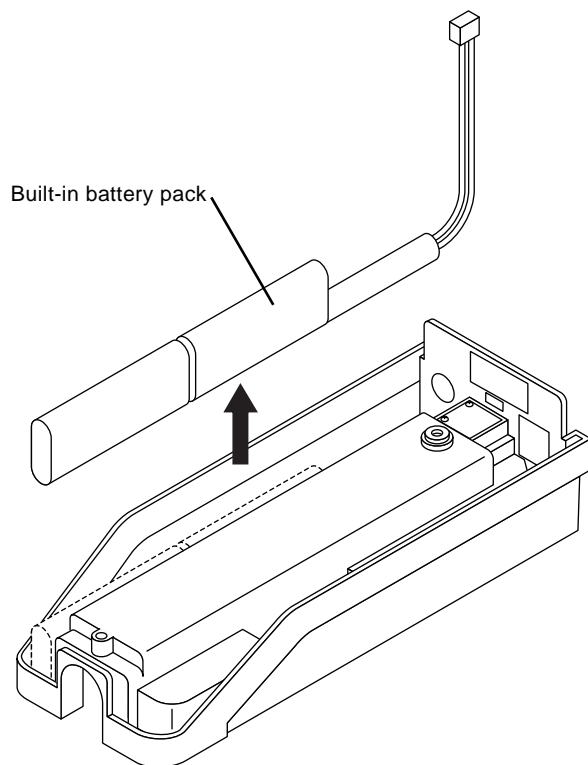
3. Gently remove the bottom section of the display unit.



4. Disconnect the two connectors from the circuit board inside the display unit: One connects the top and bottom sections of the display unit, and the other is connected to the battery pack.



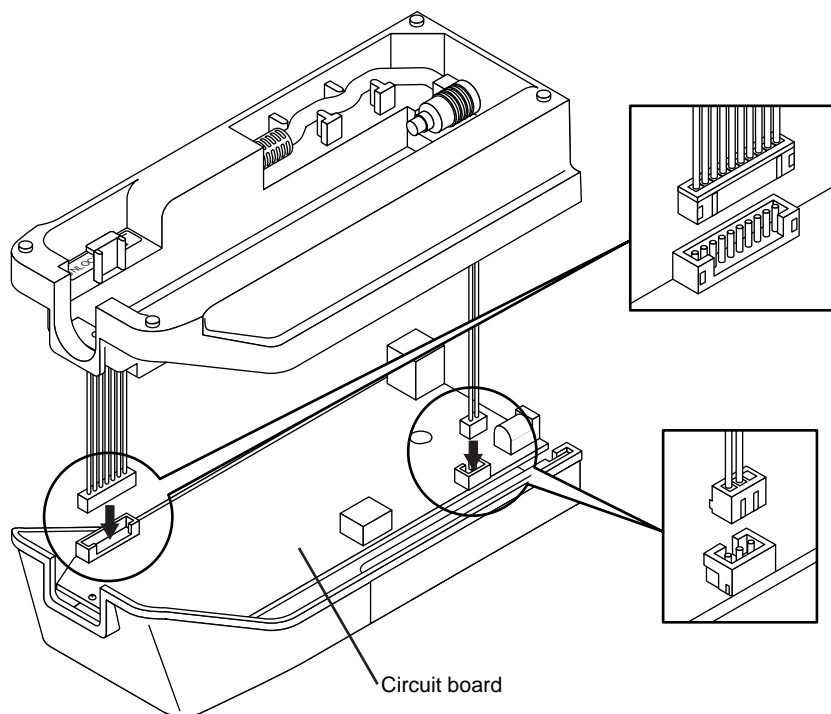
5. Remove the battery pack from the display unit.



6. Place a new battery pack inside the display unit.

NOTE When re-connecting the two connectors note their location and orientation (pin positions). Firmly connect them. If the connectors are not firmly connected, the instrument may not operate properly.

7. Reconnect the two connectors to their original connections on the circuit board.



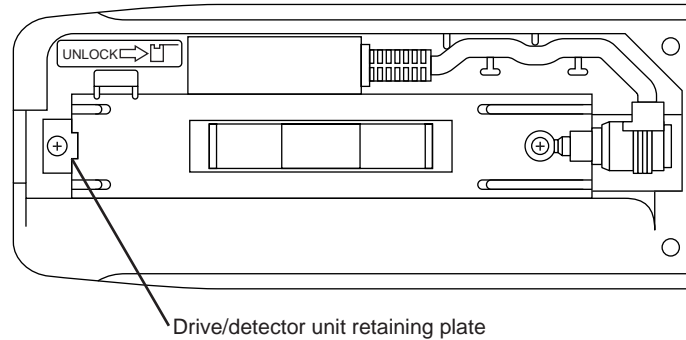
7. REPLACEMENT OF THE BUILT-IN BATTERY PACK

IMPORTANT Exercise care not to have the cable pinched by the PCBs or by the upper and lower sections of the display unit when fitting the lower section to the upper section. Cable or display unit breakage may result.

8. Couple the bottom section of the display unit with the top section.

NOTE The tapping screws must not be tightened to more than 29.4 N•cm (3 kgf•cm). Otherwise, the display unit may be damaged.

9. While confirming that the hooks on the drive/detector unit retaining plate are correctly aligned, tighten the two tapping screws on the bottom face of the display unit.

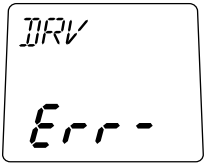
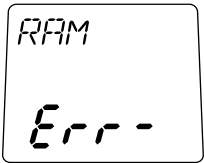
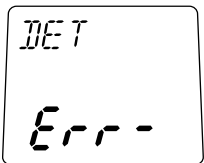
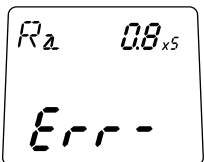


MEMO

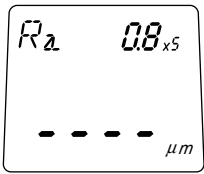
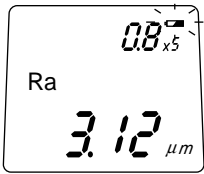
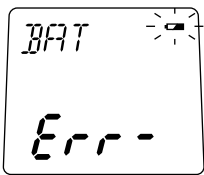
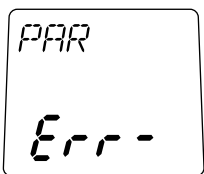
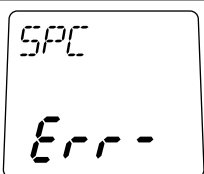
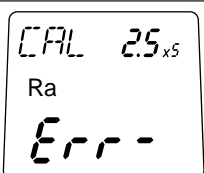
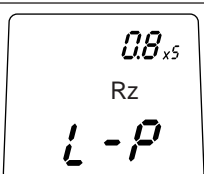
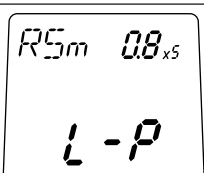
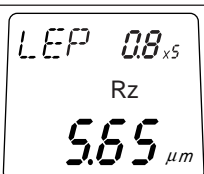
8

TROUBLESHOOTING

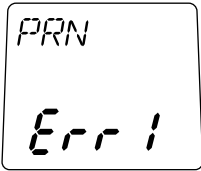
■ Troubleshooting (1/3)

Symptom/Error display	Possible causes	Remedies
SJ-201P can not be turned on if it is powered by the built-in battery (and with the AC adapter disconnected)	Remaining battery voltage is low. Battery switch is set to OFF.	Recharge the battery. Set the battery switch to ON.
SJ-201P can not be turned on if the AC adapter is connected.	Poor connection of the AC adapter. Other than the above.	Connect the AC adapter properly. Contact your dealer or the nearest Mitutoyo sales office.
Built-in battery can not be recharged	Battery switch is set to OFF. The battery has deteriorated. Power supply is put in the OFF (Auto-sleep) mode.	Set the battery switch to ON. Replace the battery pack. Press the [POWER/DATA] key after connecting the AC adapter.
Abnormal measurement result	Detector is not properly connected to the drive unit. Calibration measurement was not performed correctly due to improper setup of the SJ-201P. Stylus is worn. Other than the above.	Properly connect the detector to the drive unit. Re-calibrate the SJ-201P. Contact your dealer or the nearest Mitutoyo sales office.
	Drive/detector unit is not properly connected to the display unit. Other than the above.	Properly connect the drive/detector unit to the display unit. Contact your dealer or the nearest Mitutoyo sales office.
	Display unit is operating abnormally.	Contact your dealer or the nearest Mitutoyo sales office.
	Measurement is started under a condition of detector over-range. Connecting condition of the detector is abnormal.	Properly set the detector on the workpiece. Properly connect the detector to the drive unit.
	Over-range error occurs during measurement.	If the measurement range has been fixed, set it to a wider range or Auto.

■ Troubleshooting (2/3)

Symptom/Error display	Possible causes	Remedies
	Calculation result of the parameter exceeds the display range.	
	Remaining battery voltage is low.	Connect the AC adapter and recharge the battery.
	Measurement is performed during the low battery voltage alarm indicator is flashing.	Recharge the battery with the AC adapter.
	All parameters are disabled according to the parameter setup function.	Enable the necessary parameters.
	SPC cable is not connected correctly. Digimatic data processor is turned off.	Properly connect the SPC cable Turn on the Digimatic data processor.
	Result of calibration measurement exceeds the possible range of calibration.	Check the value of the precision roughness specimen and the inputted calibration value. Also check the calibration measurement setup conditions.
	Parameter Rz can not be calculated as there exists no peak/valley.	
	Insufficient number of peaks and valleys for Sm calculation.	
	The displayed Rz value is determined from peaks and valleys of the number less than the specifications.	

■ Troubleshooting (3/3)

Symptom/Error message	Possible causes	Remedies
	<p>The SJ-201P is not properly connected with the printer.</p> <p>When printout is started, no recording paper is loaded on the printer.</p> <p>The printer head unit was raised.</p> <p>The settings of the SJ-201P baud rate and printer baud rate are not identical.</p> <p>Abnormal temperature was generated on the printer head.</p> <p>Abnormal power was supplied to the printer.</p>	<p>Connect the printer properly with the SJ-201P.</p> <p>Load the recording paper on the printer.</p> <p>Position the printer head unit properly.</p> <p>Set the printer band rate to the same numeric value as that of the SJ-201P band rate. Next, turn off the power to the printer and the SJ-201P (put the SJ-201P in the Auto-sleep state), then turn on the both power again</p> <p>Turn off the power to the printer once, then turn it on again after a while. If the error still occurs, contact your dealer or the nearest Mitutoyo sales office.</p>

MEMO

9

PRODUCT SPECIFICATIONS

9.1 Detector

Detection method	: Differential inductance method
Measurement range	: 350 μ m (-200 μ m to +150 μ m) 13780 μ in (-7880 μ in to +5900 μ in)
Stylus material	: Diamond
Tip radius	: 5 μ m (200 μ in) 2 μ m (80 μ in) (0.75mN measuring force type)
Measuring force	: 4mN (0.4gf) 0.75mN (0.075gf) (0.75mN measuring force type)
Radius of skid curvature	: 40mm (1.57in)

9.2 Drive Unit

Detector drive range	: 21mm (.82in)
Traversing speed	Measurement : 0.25mm/s, 0.5mm/s (.01in/s, .02in/s) Return : 0.8mm/s (.03in/s)
Detector retraction function	: Stylus UP
Bottom configuration	: V-way

9.3 Display Unit

9.3.1 Compatible surface roughness standard

New JIS (JIS B 0601-1994)
 Old JIS (JIS B 0601-1982)
 DIN
 ISO
 ANSI

9.3.2 Measured profiles and applicable filters

Measured profile	Filter
R profile	PC50 (Gaussian) PC75 2RC75 (without phase compensation)
P profile	-
DIN4776	PC50 (Gaussian) PC75 2RC75 (without phase compensation)

9.3.3 Cutoff length/sampling length, number of sampling lengths, and sampling interval

Cutoff length (λ_c)	Sampling length (ℓ)	λ_s	Sampling interval	Number of pieces of data in a sampling length	Number of sampling lengths
0.25mm (.01in)	0.25mm (.01in)	2.5 μ m (98.4 μ in)	0.25 μ m (9.84 μ in)	1000	1, 3, 5
0.8mm (.03in)	0.8mm (.03in)	2.5 μ m (98.4 μ in)	0.5 μ m (19.69 μ in)	1600	1, 3, 5
2.5mm (.1in)	2.5mm (.1in)	8 μ m (315 μ in)	1.5 μ m (59.1 μ in)	1666	1, 3, 5

Arbitrary evaluation length (L)	Cutoff length λ_c *1	λ_s	Sampling interval	Number of pieces of data
0.3mm (.01in) \leq L < 1.2mm (.05in)	0.25mm (.01in)	2.5 μ m (98.4 μ in)	0.25 μ m (9.84 μ in)	1000 to 4800
1.2mm (.05in) \leq L < 4.0mm (.15in)	0.8mm (.03in)	2.5 μ m (98.4 μ in)	0.5 μ m (19.69 μ in)	2400 to 8000
4.0mm (.15in) \leq L \leq 12.5mm (.49in)	2.5mm (.1in)	8 μ m (315 μ in)	1.5 μ m (59.1 μ in)	2666 to 8333

*1: These cutoff lengths λ_c are applied if the R profile is specified.

9.3.4 Roughness parameters and display range

Parameter	Display range	
Ra	0.01μm to 100μm (.4μin to 4000μin)	
Rq		
Ry	0.02μm to 350μm (.8μin to 14000μin)	
Rz		
Rt		
Rp		
R3z		
Rk		
Rpk		
Rvk		
S		2μm to 4000μm (80μin to 0.16in)
Sm		
Pc	2.5 to 5000/cm (6.35 to 12500/in)	
mr	0% to 100%	
Mr1		
Mr2		
A1	0 to 15000	
A2		
Vo	0mm ³ /cm ² to 10000mm ³ /cm ²	

9.3.5 Evaluation length

Measured profile	Evaluation length
R profile	λc x n (n = 1, 3, or 5)
P profile	Sampling length (ℓ)

9.3.6 Measurement range and resolution

Measurement range	Resolution
Auto	0.01μm to 0.4μm depending on the measurement range
350μm (14000μin)	0.4μm (12.8μin)
100μm (4000μin)	0.1μm (3.2μin)
50μm (2000μin)	0.05μm (1.6μin)
10μm (400μin)	0.01μm (.4μin)

9.4 Power Supply

- AC adapter

Rating : 9V, 500mA
Supply voltage : 100V, 120V, 230V (to be specified when ordering)

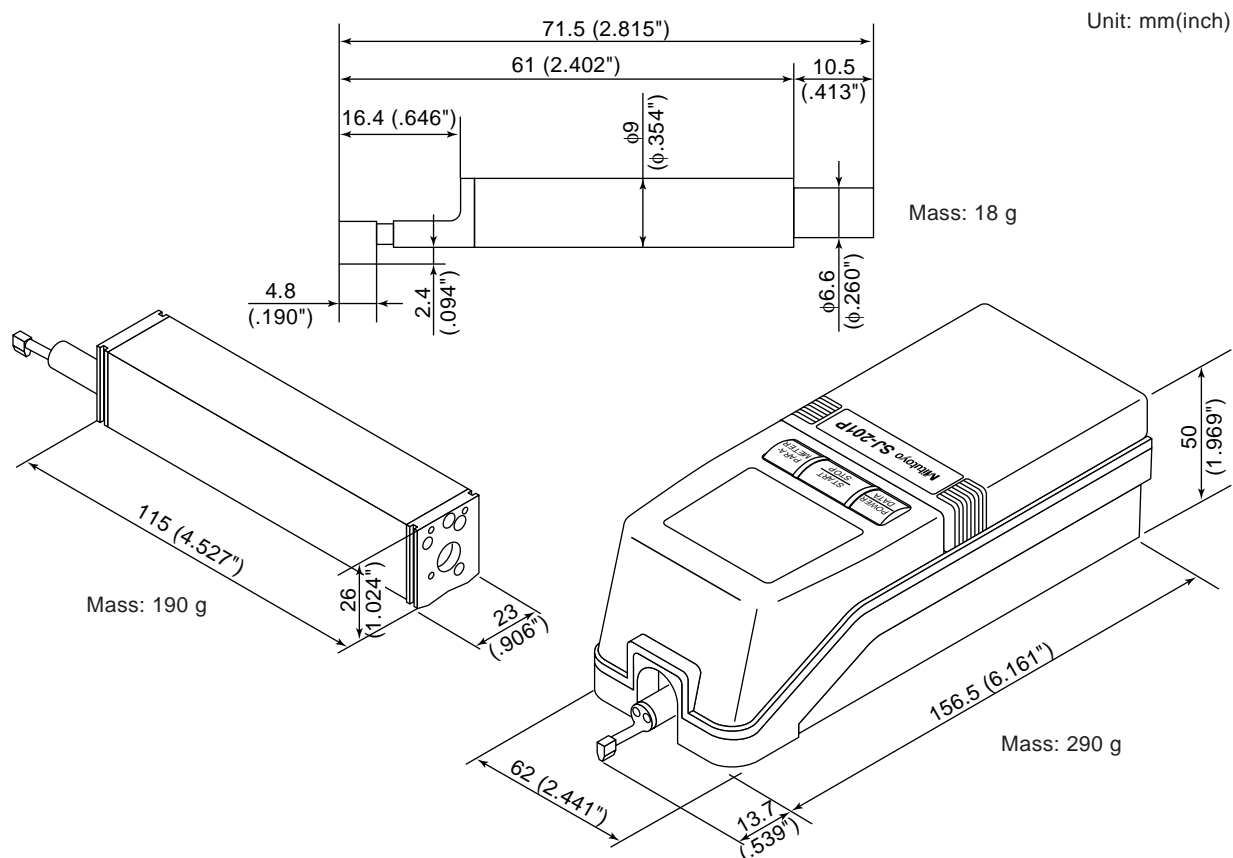
- Built-in battery (Ni-H battery)

Charging hours : 16 hours maximum
Number of measurements per charge : 500 approx. (with full charge)
Charging temperature : 5°C to 35°C
Auto-sleep function : Display turns off if not operated for 30 seconds.

9.5 Temperature/Humidity Range

Operation temperature : 5°C to 40°C
Storage temperature : -10°C to 40°C

9.6 External Dimensions and Mass

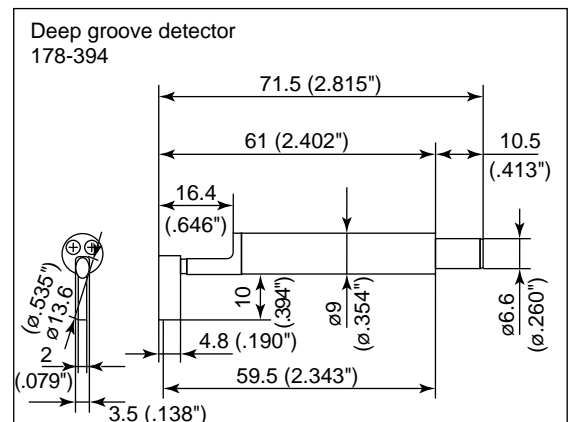
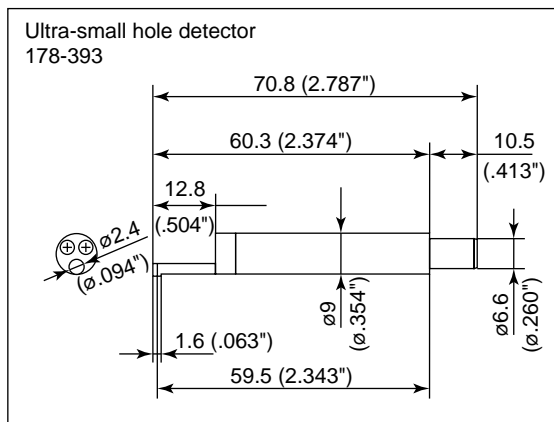
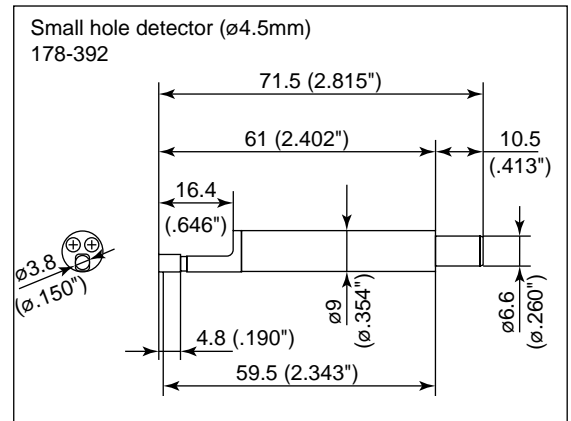
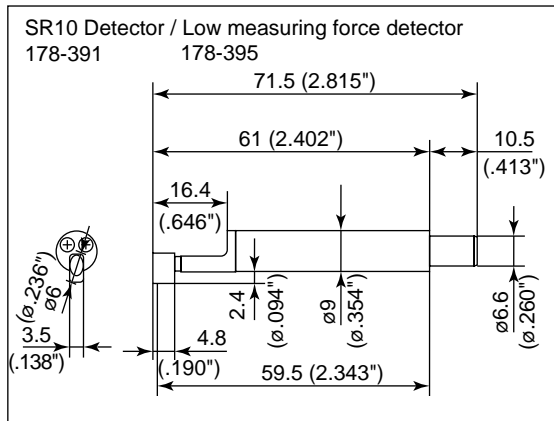


9.7 Optional Accessories

SR10 Detector (Stylus tip R:10 μ m)	No.178-391
Small hole detector (ϕ 4.5mm)	No.178-392
Ultra-small hole detector	No.178-393
Deep groove detector	No.178-394
Low measuring force detector	No.178-395
Support feet	No.12AAA216
Nosepiece for flat surface	No.12AAA217
Nosepiece for cylinder	No.12AAA218
Adapter for vertical application	No.12AAA219
Extension rod (50mm/2")	No.12AAA210
Adapter for magnetic stand (ϕ 3/8")	No.12AAA220
Adapter for magnetic stand (ϕ 8mm)	No.12AAA221
Adapter for Height Gage (9mm x 9mm)	No.12AAA222
Adapter for Height Gage (1/4" x 1/2")	No.12AAA233
SPC cable, 1m	No.936937
SPC cable, 2m	No.965014
RS-232C communication cable	No.12AAA208 (for DOS/V)
Printer	No.178-420A
Printer	No.178-420D
Printer	No.178-420E
Recording paper (20 rolls)	No.12AAC243

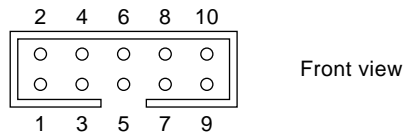
External Dimensions of Detectors

Unit : mm (inch)



9.8 SPC Output Specifications

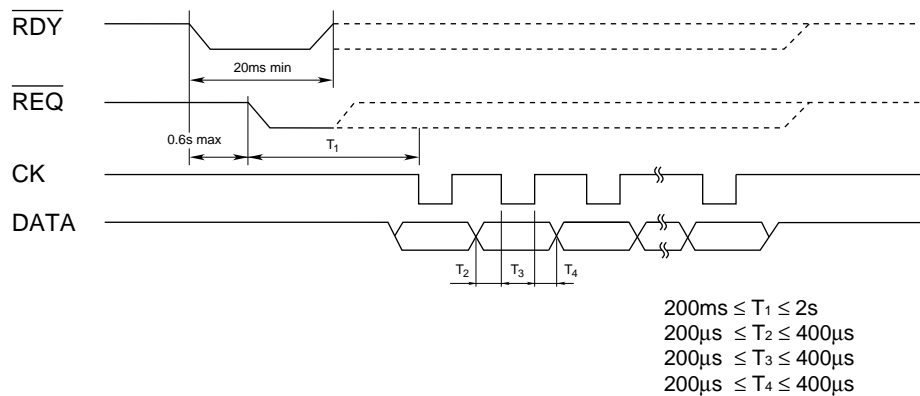
■ Connector pin assignment



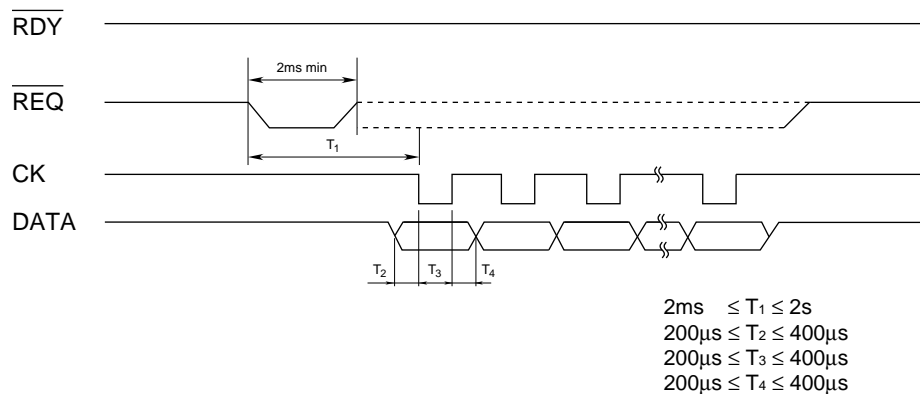
Pin No.	Signal name	Description
1	GND	Ground
2	DATA	Open-collector output
3	CK	
4	$\overline{\text{RDY}}$	
5	$\overline{\text{REQUEST}}$	Pull up to V_{DD} (5V)
6 to 10	N.C to N.C	-

■ Timing chart

● [POWER/DATA] key output

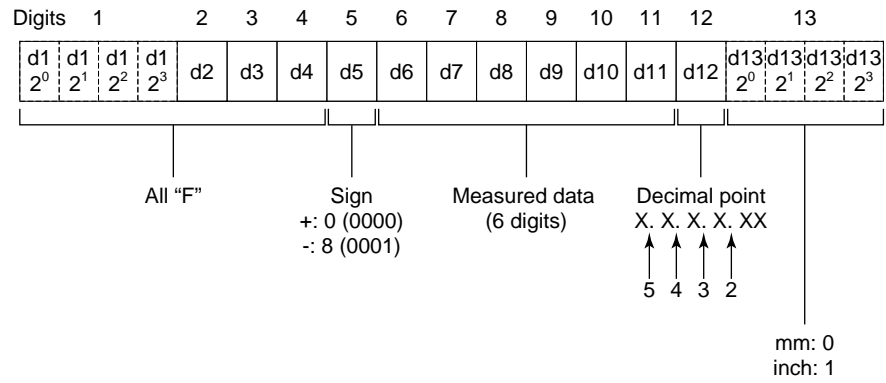


● Output request (interrupt) by external device



● Data format

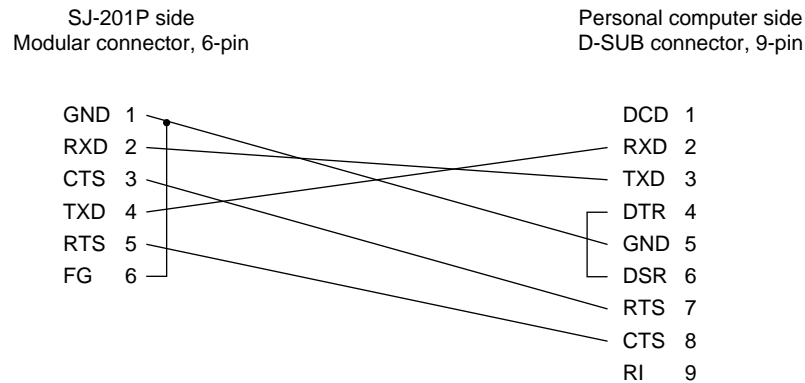
Each piece of data consists of 13 hexadecimal digits, 4 bits/digit. The data is output serially, starting from the LSB (2^0) of d1 and up to the MSB (2^3) of d13.



9.9 Connection Specifications with a Personal Computer

■ Pin assignment of the connector between the SJ-201P and a personal computer

Example connection: DOS/V personal computer



Pin No.	Signal name	Description	In/Out
1	GND	Signal ground	-
2	RXD	Receive data	In
3	CTS	Clear to send	In
4	TXD	Send data	Out
5	RTS	Request to send	Out
6	FG	Frame ground	-

■ Communication flow control and transmission/reception processing between the SJ-201P and a personal computer

Here, communication is performed by a hardware control method using two RTS and CTS lines.

If the RTS at the personal computer side is turned off during transfer, the transfer is interrupted. Transmission is resumed after waiting for the RTS at the SJ-201P to be turned on.

If the data can not be received at the SJ-201P side, the RTS is turned off.

9.10 RS-232C Communication Specifications

“EM” and “CR”, which appear in the following tables, have the following meanings:

EM : End mark
 CR : Carriage return

■ Basic answer data

● Normal response

Header		EM
O	K	CR

Header		Data			EM
O	K	*	*	...	CR

● Abnormal response

Header		Status		EM
N	G	*	*	CR

The contents of the status column shown above follows:

Status	Meaning	Status	Meaning
01	Command anomaly	09	Hardware anomaly
02	Processing in progress	10	Communication error
03	Time-out error	11	Out of the range
04	No corresponding data	12	Data is not ready
05	Over-range	16	Prohibited setting error
07	Drive/detector unit is missing		
08	Detector is missing		

● Response timing to command

A response will be returned to the write command and read command after processing.
 A response is returned to the control command according to the command reception status.

■ Control command

● Start measurement

Header		Sub-field			EM
W	R	S	T	A	CR

● Interrupt measurement

Header		Sub-field			EM
W	R	S	T	P	CR

● Power off

Header		Sub-field			EM
W	R	O	F	F	CR

30 seconds after this command is issued the SJ-201P is turned off.

● Detector retraction

Header		Sub-field			EM
W	R	E	S	P	CR

● Cancel detector retraction

Header		Sub-field			EM
W	R	R	T	N	CR

■ Read command

● Basic command

Header		Sub-field			Data		EM
R	D	R	T	N	*	*	CR

The contents of the sub-field column shown above follows:

Sub-field	Meaning	Data range
STU	Status information	00 to 01
FLG	Saved data valid flag	
CON	Saved measurement conditions	00: Measurement data 01 to 10: Saved data
DTA	Saved measured profile data	00: Measurement data 01 to 10: Saved data
RES	Saved results	00: Measurement data 01 to 10: Saved data
CUS	Customized information	**

● Return data to RDSTU00 command

Header		Data								EM
O	K	*1	*2	*3	*4	*5	*6	*7	*8	CR

The contents of *1 *2... above follow:

Data	Byte	Meaning
*1 Instrument operation status	1	0: Ready 1: Measurement in progress 2: Calculation in progress 3: No operation 4: Detector is retracted or is being retracted 5: Detector is being returned or in operation
*2 Existence of data	1	0: No measurement data 1: Measurement data present *Normally this is set at the completion of calculation.
*3 Battery status	1	0: Properly charged 1: Poorly charged
*4 Start key status	1	0: Start key OFF 1: Start key pressed *This is cleared after it is read once.
*5 Stop key status	1	0: Stop key OFF 1: Stop key pressed *This is cleared after it has been read once.
*6 Electronics status	1	1: Normal
*7, *8	2	Spare

● Return data to RDCON** command

Header		data					EM
O	K	*1	*2	*3	...	*21	CR

The contents of *1 *2... above follow:

Data	Bytes	Meaning
*1 Cutoff length	1	2: 0.25mm (.01in) 3: 0.8mm (.03in) 4: 2.5mm (.1in)
*2 Number of sampling lengths	1	1: x 1, 3: x 3, 5: x 5, L: L
*3 Profile	1	1: P, 2: R, 4: DIN4776
*4 Filter	1	1: 2RC75, 2: PC75, 3: PC50, 4: None
*5 Standard	1	1: Old JIS, 2: New JIS, 3: DIN, 4: ISO, 5: ANSI
*6 Range	1	1: 350μm (14000μin) 2: 100μm (4000μin) 3: 50μm (2000μin) 4: 10μm (400μin) A: Auto
*7 Data correction	1	1: None
*8 Inclination correction	1	1: None
*9 Traversing speed	1	2: 0.25mm/s (.01in/s) 3: 0.5mm/s (.02in/s)
*10 Unit	1	1: mm, 2: in
*11 Arbitrary evaluation length	5	mm: ***, in: ***
*12 Sampling interval	5	** **
*13 Number of pieces of data	5	***** (Number of data pieces that can be transmitted)
*14 Pc setting	8	***** (numeric value) + *** (unit) Unit: mm, μin, %
*15 mr setting	3	**%
*16 GO/NG judgment applied parameter	7	***, *** Two parameters
*17 Upper/lower limits	35	U = *****, L = *****, U = *****, L = *****
*18 Time-out period	2	** : 1 to 60 (second)
*19 File name	8	***** File No. 01 to 20 Spaces
*20 Calibration factor	7	* *****
*21 Traverse length	1	0: Not included, 1: Included
*22	133	Spare

*14: Pc setting value is left-justified and padded with space codes (20H) from the right.
Numeric section includes a “ . ” (decimal point).

■ Write command

● Basic command

Header		Sub-field			Data								EM
W	R	*	*	*	*1	*2	*3	*4	*5	*6	*7	...	CR

The contents of the above sub-field column and *1 *2... in the data column follow:

• Sub-field

Sub-field	Content of set data
CUT	Cutoff length/Number of sampling lengths
FIL	P, R ,DIN4776 and filter
L__	Arbitrary evaluation length/interval
UNT	Unit
STD	Standard
RAN	Range
T__	Time-out period
CAL	Calibration factor
LCD	LCD ON/OFF
SPD	Traversing speed
Pc__	Count level
mr__	Slice level
CUS	Customized information
TRA	Traversing length
NUM	Sets the required number of data pieces
CAN	Specifies the head of data to be transferred with the RDDTA command and specifies the measured profile selection

• Data *1

Header		Sub-field			Data		EM
W	R	C	U	T	*99	*98	CR

The contents of *99 and *98 in the above data column follow:

Data	Bytes	Meaning
*99 Cutoff length	1	2: 0.25mm (.01in) 3: 0.8mm (.03in) 4: 2.5mm (.1in)
*98 Number of sampling lengths	1	1: x1, 3: x3, 5: x5, L: L

• Data *2

Header		Sub-field			Data		EM
W	R	F	I	L	*99	*98	CR

The contents of *99 and *98 in the above data column follow:

Data	Bytes	Meaning
*99 Profile	1	1: P, 2: R, 4: DIN4776
*98 Filter	1	1: 2RC75, 2: PC75, 3: PC50, 4: None

- Data *3

Header		Sub-field			Data		EM
W	R	L	_	_	*99	*98	CR

The contents of *99 and *98 in the above data column follow:

Data	Bytes	Meaning
*99 Unit	1	1: mm, 2: in
*98 Arbitrary evaluation length	5	*****

*: The remaining portion of the data field is padded with space codes (20H).
 The numeric section includes a “.” (decimal point).
 Example: 3.6mm (1_3.6)

- Data *4

Header		Sub-field			Data	EM
W	R	U	N	T	*99	CR

The content of *99 in the above data column follows:

Data	Bytes	Meaning
*99 Unit	1	1: mm, 2: in

- Data *5

Header		Sub-field			Data	EM
W	R	S	T	D	*99	CR

The content of *99 in the above data column follows:

Data	Bytes	Meaning
*99 Standard	1	1: Old JIS, 2: New JIS, 3: DIN, 4: ISO, 5: ANSI

- Data *6

Header		Sub-field			Data	EM
W	R	R	A	N	*99	CR

The content of *99 in the above data column follows:

Data	Bytes	Meaning
*99 Range	1	1: 350μm (14000μin) 2: 100μm (4000μin) 3: 50μm (2000μin) 4: 10μm (400μin) A: Auto

- Data *7

Header		Sub-field			Data	EM
W	R	T	_	_	*99	CR

The content of *99 in the above data column follows:

Data	Bytes	Meaning
*99 Time-out period	2	1 to 60 (second)

• Data *8

Header		Sub-field			Data	EM
W	R	L	C	D	*99	CR

The content of *99 in the above data column follows:

Data	Bytes	Meaning
*99 LCD display	3	*** ON/OFF Left-justified and padded with space codes (20H) from the right.

• Data *9

Header		Sub-field			Data	EM
W	R	S	P	D	*99	CR

The content of *99 in the above data column follows:

Data	Bytes	Meaning
*99 Traversing speed	1	2: 0.25mm/s (.01in/s) 3: 0.5mm/s (.02in/s)

• Data *10

Header		Sub-field			Data	EM	
W	R	P	c	_	*99	*98	CR

The contents of *99 and *98 in the above data column follow:

Data	Bytes	Meaning
*99 Unit	1	1: mm, 2: in
*98 Count level	8	***** (numeric value) +*** (unit) Unit: μ m, μ in, %

*: Left-justified and padded with space codes (20H) from the right.
The numeric section includes a “.” (decimal point).
Example: 10 μ m (100010 μ m)

• Data *11

Header		Sub-field			Data	EM
W	R	m	r	_	*99	CR

The content of *99 in the above data column follows:

Data	Bytes	Meaning
*99 Slice level	3	**%

• Data *12

Header		Sub-field			Data	EM
W	R	C	U	S	*99	CR

The content of *99 in the above data column follows:

Data	Bytes	Meaning
*99 Customized information	Variable length	Ra, Ry, Rz, Rq · · · mr Separated by a comma “ , ”

- Data *13

Header		Sub-field			Data	EM
W	R	T	R	A	*99	CR

The content of *99 in the above data column follows:

Data	Bytes	Meaning
*99 Traversing length setting	1	0: With pre-travel/post-travel lengths 1: Without pre-travel/post-travel lengths

- Data *14

Header		Sub-field			Data	EM
W	R	N	U	M	*99	CR

The content of *99 in the above data column follows:

Data	Bytes	Meaning
*99 Required number of data pieces	5	*****

- Data *15

Header		Sub-field			Data		EM
W	R	C	A	N	*98	*99	CR

The contents of *98 and *99 in the above data column are listed in the following table:

Data	Bytes	Meaning	
*98 Start data point	5	*****	Specifies the head of data to be transferred with the RDDTA command.
*99 Measured profile selection	2	**	00: Measurement data 01: Measured profile data

10

REFERENCE INFORMATION

10.1 Surface Roughness Standard

10.1.1 Evaluation according to JIS B0601-1982

- Standard cutoff length and evaluation length for Ra (Use the 2RC75 filter.)

Range of Ra (μm)	Cutoff length (λ_c) (mm)	Evaluation length (ℓ_n) (mm)
Ra \leq 12.5	0.8	2.4 or greater
12.5 < Ra \leq 100	2.5	7.5 or greater

- Standard sampling length for Ry

Range of Ry (μm)	Sampling length (ℓ) (mm)
Ry \leq 0.8	0.25
0.8 < Ry \leq 6.3	0.8
6.3 < Ry \leq 25	2.5
25 < Ry \leq 100	8
100 < Ry \leq 400	25

- Standard sampling length for Rz

Range of Rz (μm)	Sampling length (ℓ) (mm)
Rz \leq 0.8	0.25
0.8 < Rz \leq 6.3	0.8
6.3 < Rz \leq 25	2.5
25 < Rz \leq 100	8
100 < Rz \leq 400	25

10.1.2 Evaluation according to JIS B0601-1994

■ Standard cutoff length and evaluation length for Ra

Range of Ra (μm)	Cutoff length (λ_c) (mm)	Sampling length (ℓ) (mm)	Evaluation length (ℓ_n) (mm)
$(0.006) < Ra \leq 0.02$	0.08	0.08	0.4
$0.02 < Ra \leq 0.1$	0.25	0.25	1.25
$0.1 < Ra \leq 2.0$	0.8	0.8	4
$2.0 < Ra \leq 10.0$	2.5	2.5	12.5
$10.0 < Ra \leq 80.0$	8	8	40

■ Standard cutoff length, sampling length and evaluation length for Rz

Range of Rz (μm)	Cutoff length (λ_c) (mm)	Sampling length (ℓ) (mm)	Evaluation length (ℓ_n) (mm)
$(0.025) < Rz \leq 0.10$	0.08	0.08	0.4
$0.10 < Rz \leq 0.50$	0.25	0.25	1.25
$0.50 < Rz \leq 10.0$	0.8	0.8	4
$10.0 < Rz \leq 50.0$	2.5	2.5	12.5
$50.0 < Rz \leq 200.0$	8	8	40

■ Standard cutoff length, sampling length and evaluation length for Ry

Range of Ry (μm)	Cutoff length (λ_c) (mm)	Sampling length (ℓ) (mm)	Evaluation length (ℓ_n) (mm)
$(0.025) < Ry \leq 0.10$	0.08	0.08	0.4
$0.10 < Ry \leq 0.50$	0.25	0.25	1.25
$0.50 < Ry \leq 10.0$	0.8	0.8	4
$10.0 < Ry \leq 50.0$	2.5	2.5	12.5
$50.0 < Ry \leq 200.0$	8	8	40

■ Standard cutoff length, sampling length and evaluation length for Sm

Range of Sm (mm)	Cutoff length (λ_c) (mm)	Sampling length (ℓ) (mm)	Evaluation length (ℓ_n) (mm)
$0.013 < Sm \leq 0.04$	0.08	0.08	0.4
$0.04 < Sm \leq 0.13$	0.25	0.25	1.25
$0.13 < Sm \leq 0.4$	0.8	0.8	4
$0.4 < Sm \leq 1.3$	2.5	2.5	12.5
$1.3 < Sm \leq 4.0$	8	8	40

*: See also “ 10.5.9 Mean width of the profile elements, Sm (JIS, ISO, DIN)” .

10.1.3 Evaluation according to DIN

Shown below are the standard cutoff length, sampling length, and evaluation length for evaluation according to DIN.

- Standard cutoff length, sampling length, and evaluation length for Ra, Rz, and Ry (DIN) from periodic roughness profile

Value of roughness parameter Sm (mm)	Cutoff length (λ_c) (mm)	Sampling length (ℓ_e) (mm)	Minimum value of evaluation length (ℓ_n) (mm)
0.01 < Sm ≤ 0.04	0.08	0.08	0.4
0.04 < Sm ≤ 0.13	0.25	0.25	1.25
0.13 < Sm ≤ 0.4	0.8	0.8	4
0.4 < Sm ≤ 1.3	2.5	2.5	12.5
1.3 < Sm ≤ 4	8	8	40

*: See also “ 10.5.9 Mean width of the profile elements, Sm (JIS, ISO, DIN)” .

- Standard cutoff length and evaluation length for Ra from non-periodic roughness profile

Range of Ra (μm)	Cutoff length (λ_c) (mm)	Evaluation length (ℓ_n) (mm)
Ra ≤ 0.02	0.08	0.4
0.02 < Ra ≤ 0.1	0.25	1.25
0.1 < Ra ≤ 2	0.8	4
2 < Ra ≤ 10	2.5	12.5
10 < Ra	8	40

- Standard cutoff length, sampling length and evaluation length for Rz (DIN) from non-periodic roughness profile

Range of Rz (μm)	Cutoff length (λ_c) (mm)	Sampling length (ℓ_e) (mm)	Evaluation length (ℓ_n) (mm)
Rz ≤ 0.1	0.08	0.08	0.4
0.1 < Rz ≤ 0.5	0.25	0.25	1.25
0.5 < Rz ≤ 10	0.8	0.8	4
10 < Rz ≤ 50	2.5	2.5	12.5
50 < Rz	8	8	40

10.1.4 Evaluation according to ISO

Shown below are the standard sampling length and evaluation length for evaluation according to ISO.

- Standard sampling length and evaluation length for the measurement of R-parameters of periodic profiles, and RSm of periodic or non-periodic profiles

RSm (mm)	Sampling length (ℓ) (mm)	Evaluation length (ℓ_n) (mm)
0.013 < RSm \leq 0.04	0.08	0.4
0.04 < RSm \leq 0.13	0.25	1.25
0.13 < RSm \leq 0.4	0.8	4
0.4 < RSm \leq 1.3	2.5	12.5
1.3 < RSm \leq 4	8	40

- Standard sampling length and evaluation length for the measurement of Ra and Rq from non-periodic roughness profiles

Ra (μm)	Sampling length (ℓ) (mm)	Evaluation length (ℓ_n) (mm)
(0.006) < Ra \leq 0.02	0.08	0.4
0.02 < Ra \leq 0.1	0.25	1.25
0.1 < Ra \leq 2	0.8	4
2 < Ra \leq 10	2.5	12.5
10 < Ra \leq 80	8	40

- Standard sampling length and evaluation length for measurement of Rz, Rp, and Rt from non-periodic roughness profiles

Rz (μm)	Sampling length (ℓ) (mm)	Evaluation length (ℓ_n) (mm)
(0.025) < Rz \leq 0.1	0.08	0.4
0.1 < Rz \leq 0.5	0.25	1.25
0.5 < Rz \leq 10	0.8	4
10 < Rz \leq 50	2.5	12.5
50 < Rz \leq 200	8	40

10.1.5 Evaluation according to ANSI

Shown below are the standard cutoff length and the evaluation length for evaluation according to ANSI.

■ Standard cutoff length and evaluation length for R-parameters from periodic profiles

Sm	Cutoff length (λ_c)	Evaluation length (ℓ_n)
0.013 < Sm ≤ 0.04 mm (0.0005 < Sm ≤ 0.0016 in)	0.08 mm (0.003 in)	0.4 mm (0.016 in)
0.040 < Sm ≤ 0.13 mm (0.0016 < Sm ≤ 0.005 in)	0.25 mm (0.010 in)	1.25 mm (0.05 in)
0.13 < Sm ≤ 0.40 mm (0.005 < Sm ≤ 0.016 in)	0.80 mm (0.03 in)	4.0 mm (0.16 in)
0.40 < Sm ≤ 1.3 mm (0.016 < Sm ≤ 0.05 in)	2.5 mm (0.10 in)	12.5 mm (0.5 in)
1.3 < Sm ≤ 4.0 mm (0.05 < Sm ≤ 0.16 in)	8.0 mm (0.3 in)	40.0 mm (1.6 in)

For selection of profile filter cutoff among from the table, estimate the roughness parameter Sm graphically from an unfiltered profile trace.

■ Standard cutoff length and evaluation length for R-parameters from non-periodic profiles

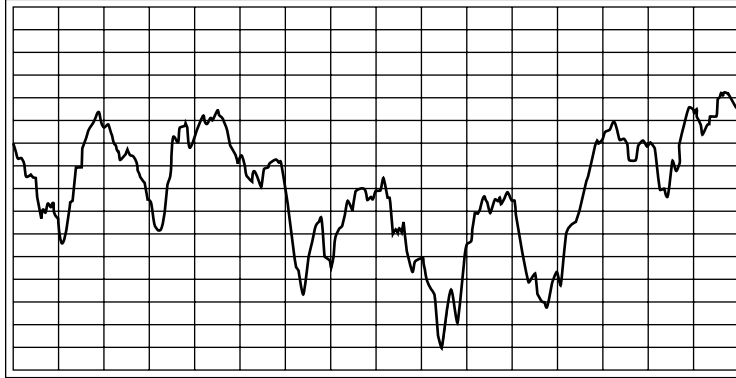
Ra	Cutoff length (λ_c)	Evaluation length (ℓ_n)
Ra ≤ 0.02 μm (Ra ≤ 0.8 μin)	0.08 mm (0.003 in)	0.40 mm (0.016 in)
0.02 < Ra ≤ 0.10 μm (0.8 < Ra ≤ 4 μin)	0.25 mm (0.010 in)	1.25 mm (0.05 in)
0.10 < Ra ≤ 2.0 μm (4 < Ra ≤ 80 μin)	0.80 mm (0.03 in)	4.0 mm (0.16 in)
2.0 < Ra ≤ 10 μm (80 < Ra ≤ 400 μin)	2.5 mm (0.10 in)	12.5 mm (0.5 in)
10 < Ra μm (400 < Ra μin)	8.0 mm (0.3 in)	40 mm (1.6 in)

10.2 Assessed Profile and Applicable Filters

10.2.1 Measured profile

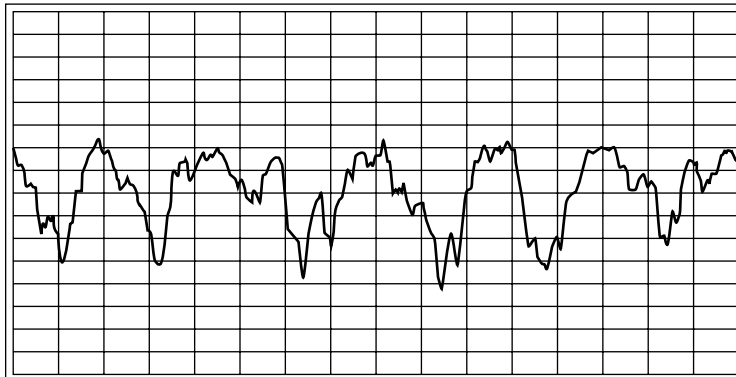
■ Primary profile P

A profile obtained by intersecting a surface with a plane normal to the nominal surface. It is a representation of the real profile (a profile of the real surface) obtained by a surface roughness measuring instrument.



■ Roughness profile R

A profile obtained by filtering the primary profile with a long-wavelength cutoff filter (high pass filter) to remove the waviness components (long wavelength components).



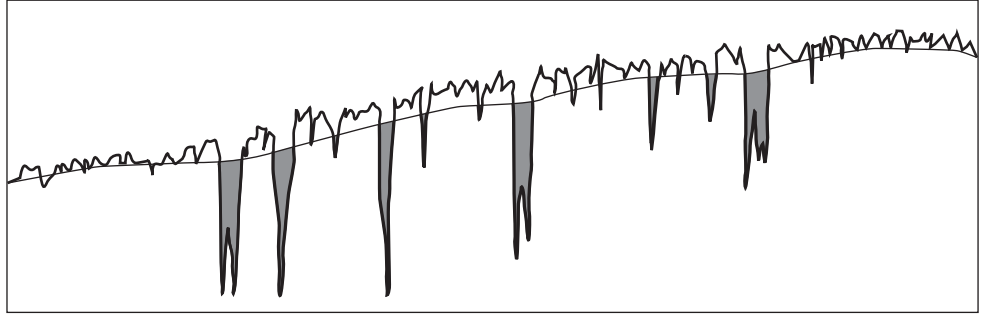
■ DIN4776 profile

For surfaces to be measured having deep valleys with respect to the irregularity on the surface, the position of the mean line may be calculated to the position shifted from the position where it is supposed to be for surface roughness evaluation.

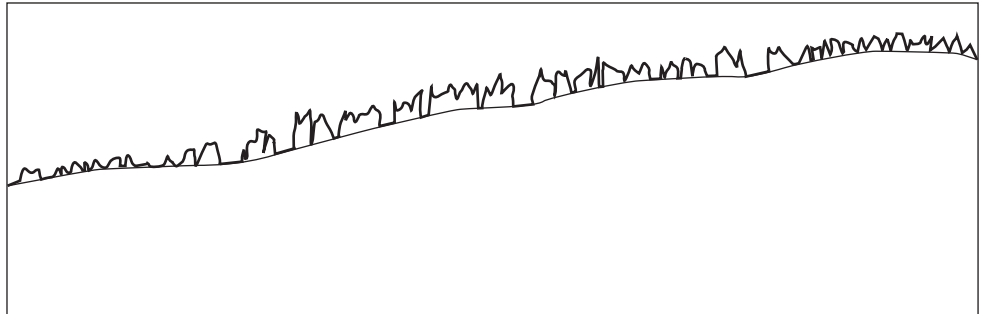
However, by this procedure, those negative effect can be avoided to a certain extent.

The actual procedure is shown below.

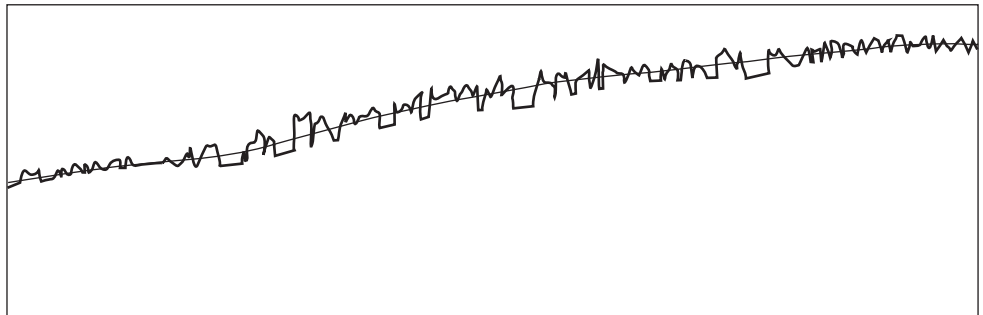
1. The first mean line is obtained with respect to the input data.



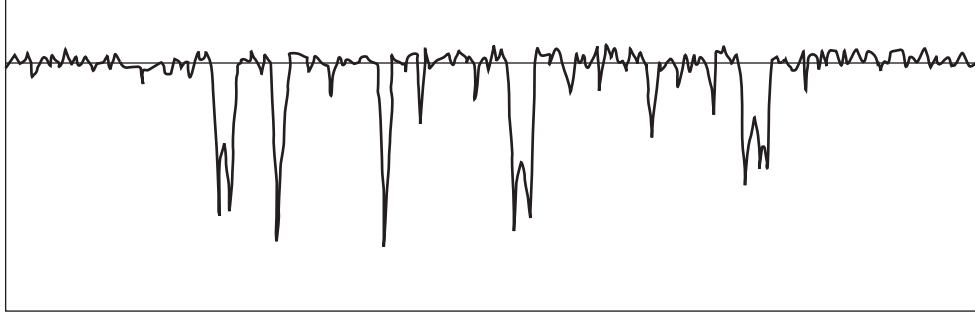
2. Valleys below the mean line are removed.



3. The second mean line is obtained with respect to the data obtained in the step 2.



4. Original input data is compensated with reference to the second mean line.



TIP The filters specified in DIN4777 are used for calculating both the first and second mean lines. For information about this, refer to section 10.1.3, "Evaluation according to DIN".

10.2.2 Filters

■ Filter types

The following 3 types of filters are available on the SJ-201P.

Name	Amplitude characteristic	Phase characteristic	Amplitude transmittance at the cutoff wavelength
2RC 75	2RC	Without phase compensation	75%
PC 75	2RC	Phase compensation type	75%
PC 50	Gaussian	Phase compensation type	50%

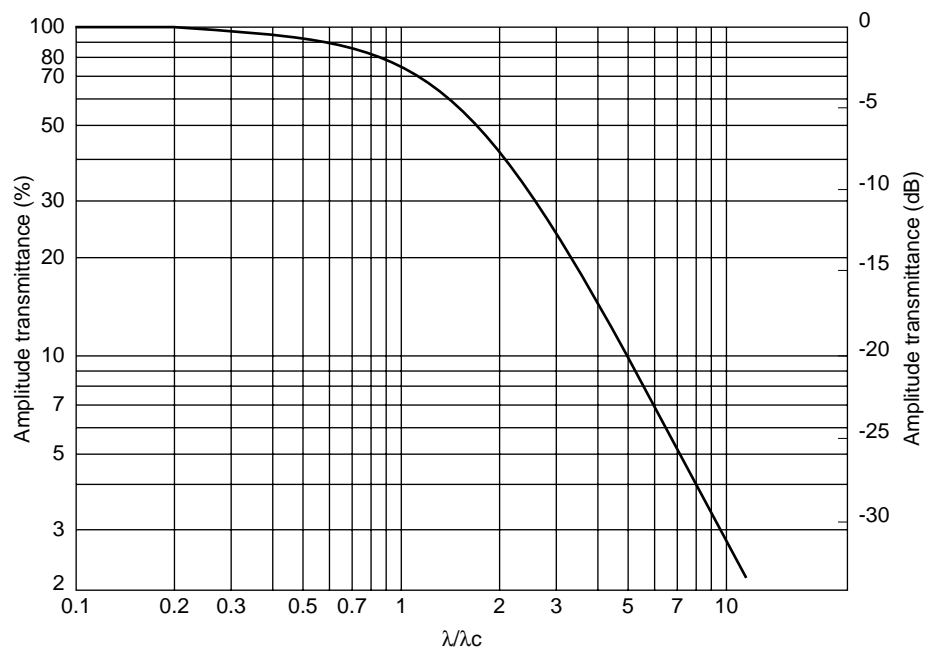
Each of the filter characteristics will be explained below.

The transmission characteristic of each filter will be represented by that of a high-pass filter.

● 2RC 75

This has the same transmission characteristic as that of two R-C circuits having identical time constants connected in series.

The transmission characteristic is -12dB/oct and the amplitude transmittance at the cutoff length is 75%, as shown in figure below.

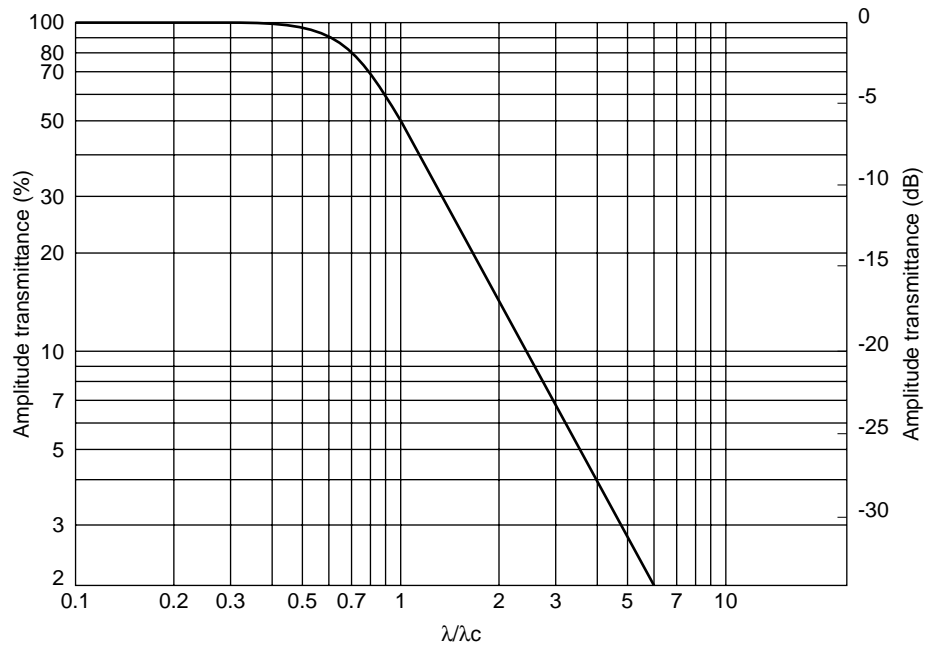


Transmission characteristic of 2RC 75 filter

$$\text{Transmission characteristic: } H(\lambda) = \frac{1}{1 + \left(\frac{\lambda}{\sqrt{3}\lambda_c}\right)^2}$$

● PC50 (Gaussian)

The transmission characteristic is approximately -11.6dB/oct and the amplitude transmittance at the cutoff length is 50%. The transmission characteristic is shown in figure below.



Transmission characteristic of PC50 (Gaussian)

$$\text{Transmission characteristic : } H(\lambda) = 1 - e^{-x} \left(\frac{\alpha \cdot \lambda c}{\lambda} \right)^2$$

$$\text{, where } \alpha = \left(\frac{\ell n 2}{\pi} \right)^{\frac{1}{2}}$$

$$\cong 0.4697$$

The use of this filter results in a simple formula of addition:

$$\text{Primary profile} = \text{Roughness profile} + \text{Waviness profile}$$

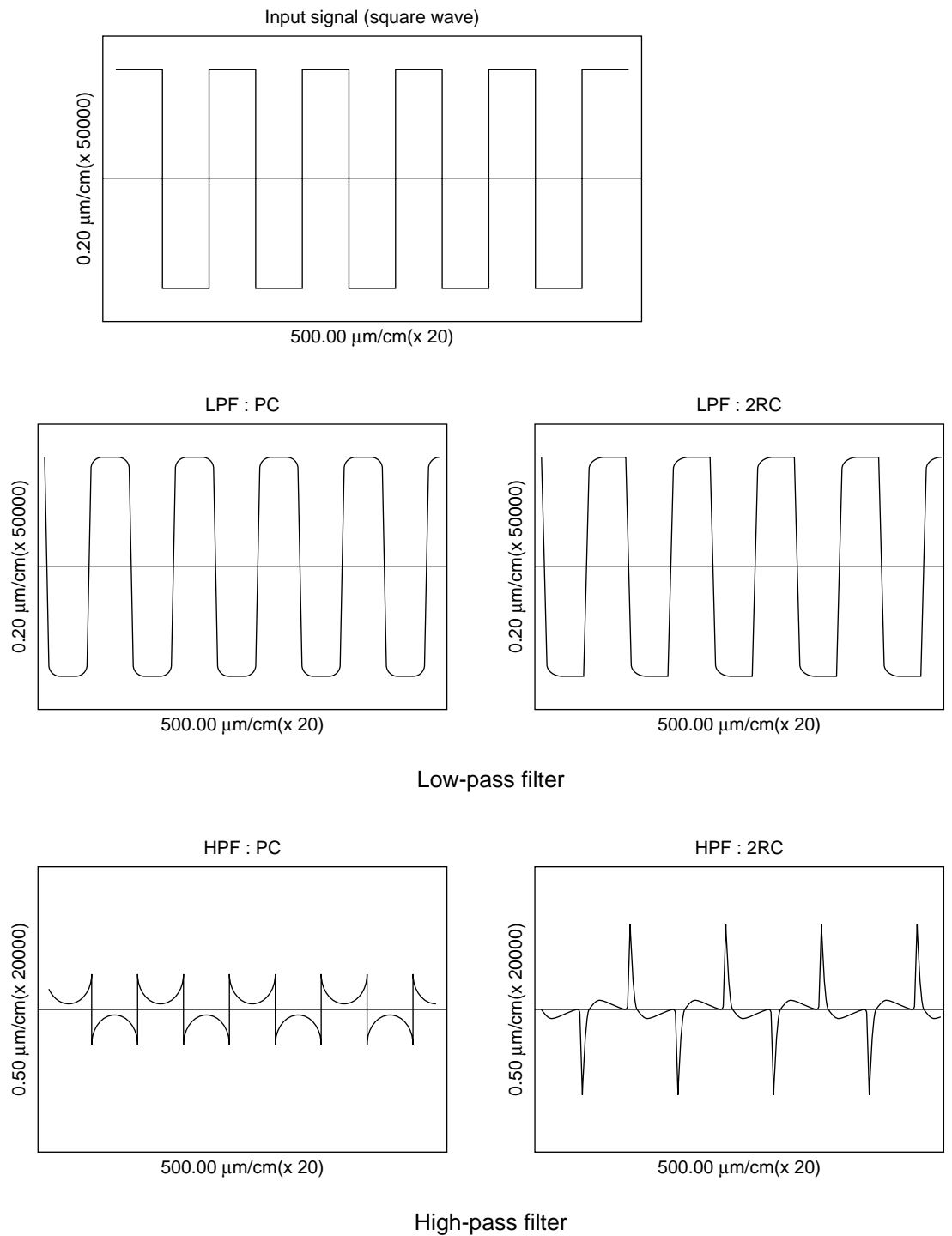
Therefore, the low-pass filter is characterized by:

$$\text{Transmission characteristic : } H(\lambda) = e^{-x} \left(\frac{\alpha \cdot \lambda c}{\lambda} \right)^2$$

- Phase compensation filters

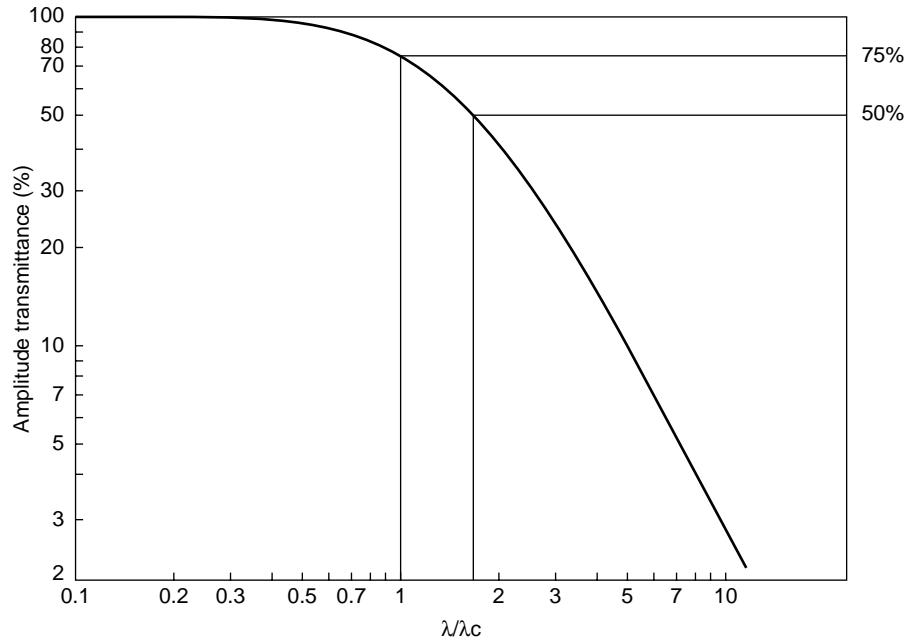
Output waveforms passing through the general 2RC filters may be distorted due to phase deviations that vary with each wavelength.

Figure shows the response of a low-pass filter to square wave input, and figure shows that of a high-pass filter.

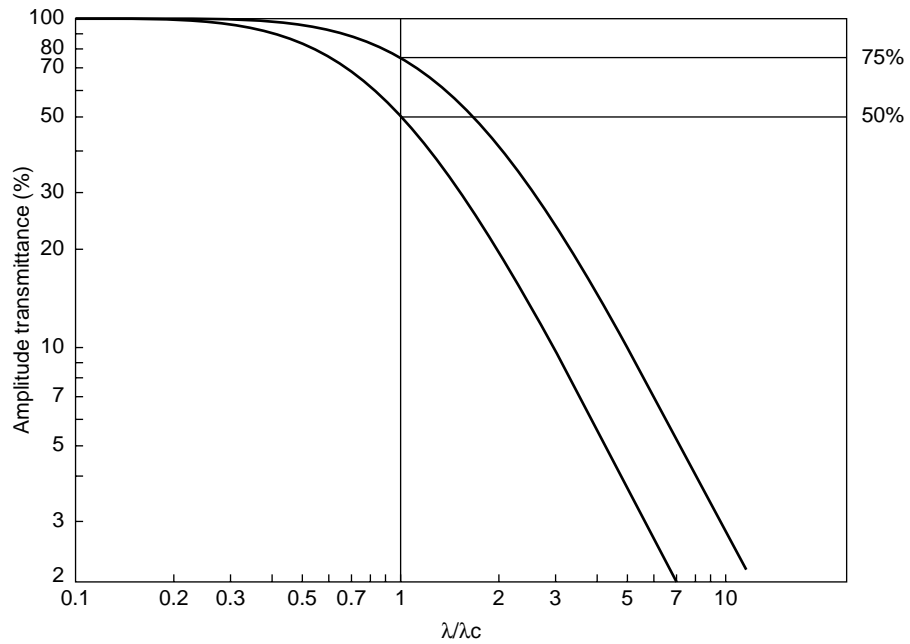


10.2.3 Difference of filter characteristics

- Difference in amplitude transmittance of 2RC (and PC) type at the cutoff length
Both are the same type of filters, except with different cutoff lengths.
The difference between the two is shown in figures.



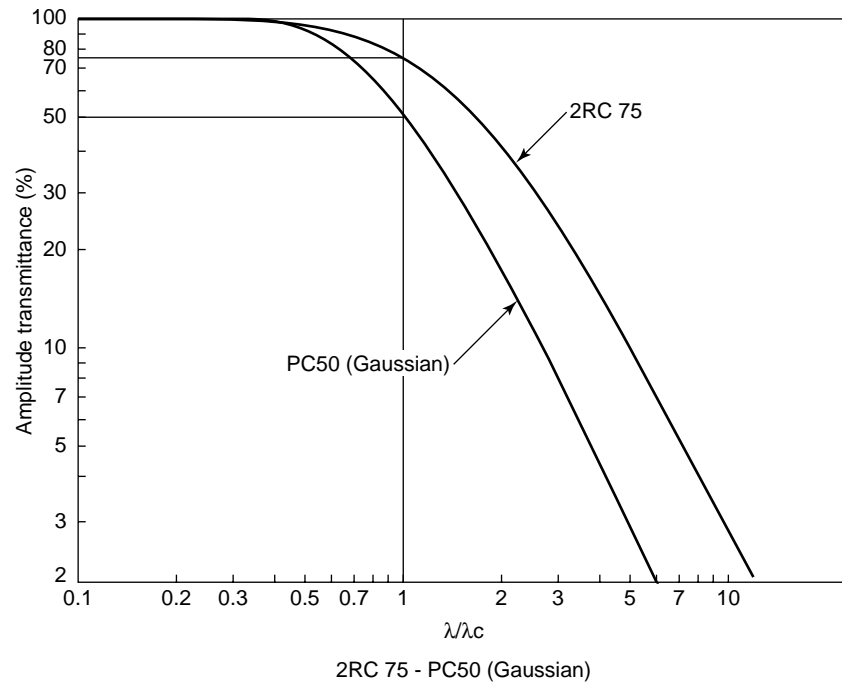
Difference in cutoff lengths of the filters



Comparison of two filters at the same cutoff length

10.2.4 Amplitude characteristic of 2RC and PC50 (Gaussian) filters

- About the amplitude characteristic of 2RC and PC50 (Gaussian) filters
The difference in amplitude characteristics between a 2RC filter and a PC50 (Gaussian) filter is shown in figures.



■ Standards of filters

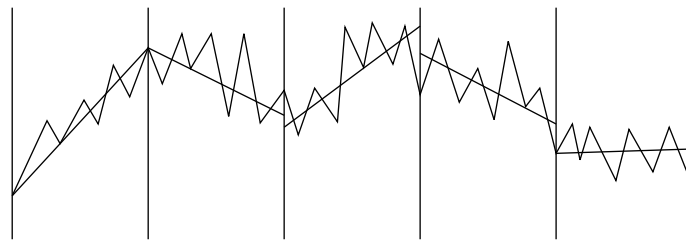
Table lists the correspondence between the filter types and their standards.

	JIS	ISO	ANSI/ASME	DIN
2RC 75	B0601-1982 B0610-1987 B0651-1976	3274 (1975)	B46.1-1985	4762
PC 75				
PC 50	B0601-1994 B0651-1996	11562 (1996)	B46.1-1995	4777

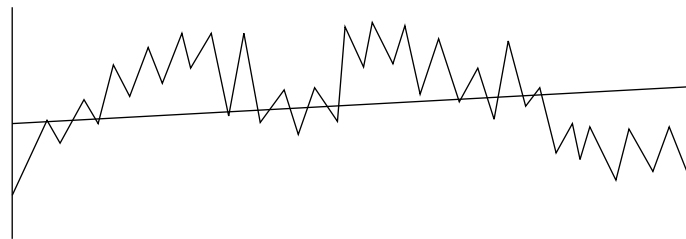
10.3 Mean line compensation

The following table shows the definition of mean line of each profile as associated with the filter.

Profile	Filter	Mean line	
Primary profile	-	Arbitrary evaluation length	A line obtained through the least square method over the evaluation length
	-	Sampling length	Lines obtained through the least square method for each sampling length
Roughness profile	2RC 75	A line obtained through the least square method over the evaluation length	
	PC 75	A line obtained through the least square method over the evaluation length	
	PC 50	Filtered waviness profil	

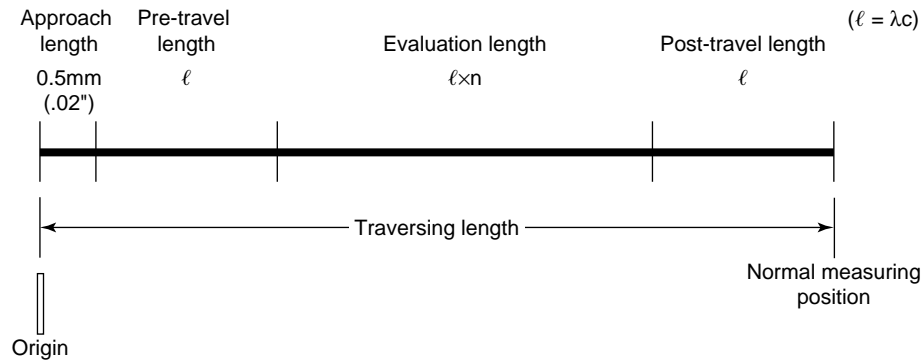


Mean lines obtained through the least square method for each sampling length



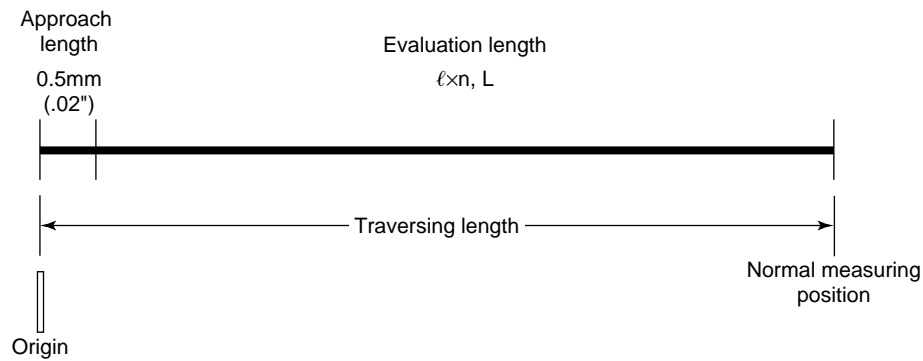
Mean line obtained through the least square method over the whole evaluation length

- If the PC75 filter is selected



Data from the pre-travel and post-travel lengths are calculated assuming that their lengths are ℓ .

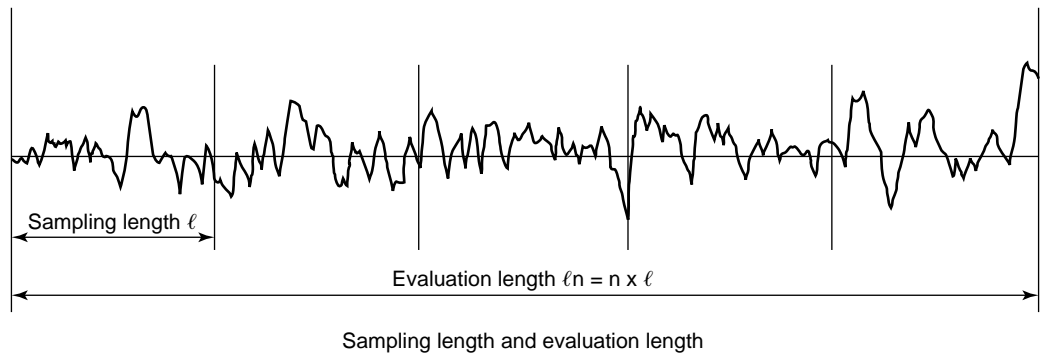
- If measuring with an arbitrary evaluation length for the primary profile (P)



TIP If measuring the roughness profile without pre-travel and post-travel lengths is selected, the data corresponding to the cutoff length λ_c are virtually obtained from the measured profile and added on both ends of the evaluation length. This also applies to the measurement with roughness profile for an arbitrary length: virtual data for the length corresponding to λ_c is obtained from both ends of the traversing length and is used as data of pre-travel and post-travel data for assessment.

10.5 Definitions of the SJ-201P Roughness Parameters

This section gives the definitions (calculation methods) of the roughness parameters that can be measured with the SJ-201P.



Each parameter explained below is defined as calculated within a sampling length. Specific parameters to be obtained over the evaluation length will be noted as required.

10.5.1 Arithmetic mean deviation of the profile, R_a

R_a is the arithmetic mean of the absolute values of the profile deviations (Y_i) from the mean line.

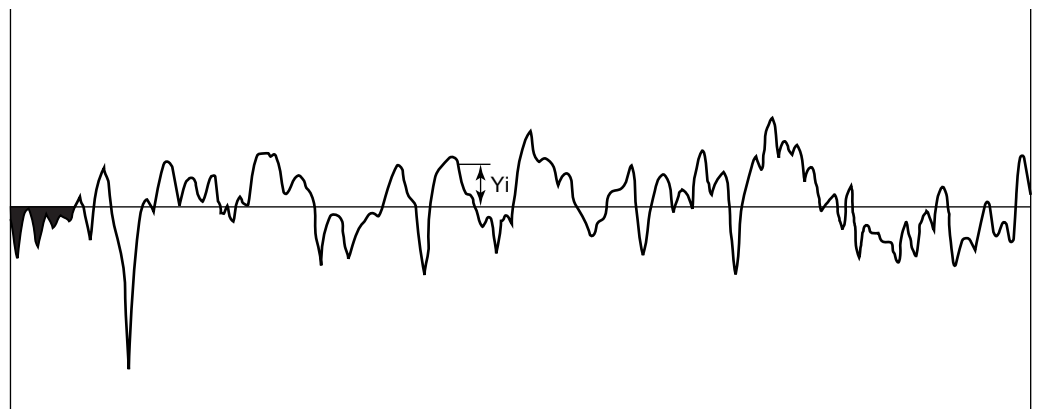
$$R_a = \frac{1}{N} \sum_{i=1}^N |Y_i|$$

- For ANSI, R_a is defined over the entire evaluation length.

10.5.2 Root-mean-square deviation of the profile, R_q

R_q is the square root of the arithmetic mean of the squares of profile deviations (Y_i) from the mean line.

$$R_q = \left(\frac{1}{N} \sum_{i=1}^N Y_i^2 \right)^{\frac{1}{2}}$$

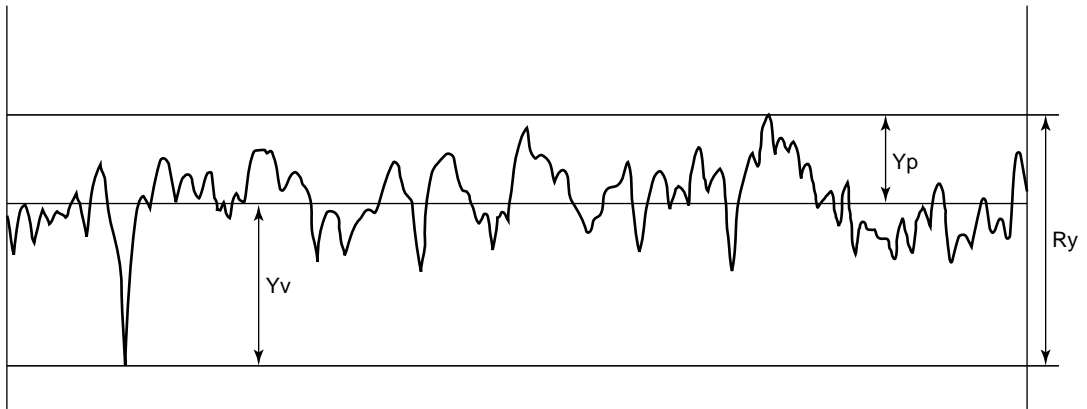


- For ANSI, R_q is defined over the entire evaluation length.

10.5.3 Maximum height of the profile, R_y (JIS)

R_y (JIS) is the sum of height Y_p of the highest peak from the mean line and depth Y_v of the deepest valley from the mean line.

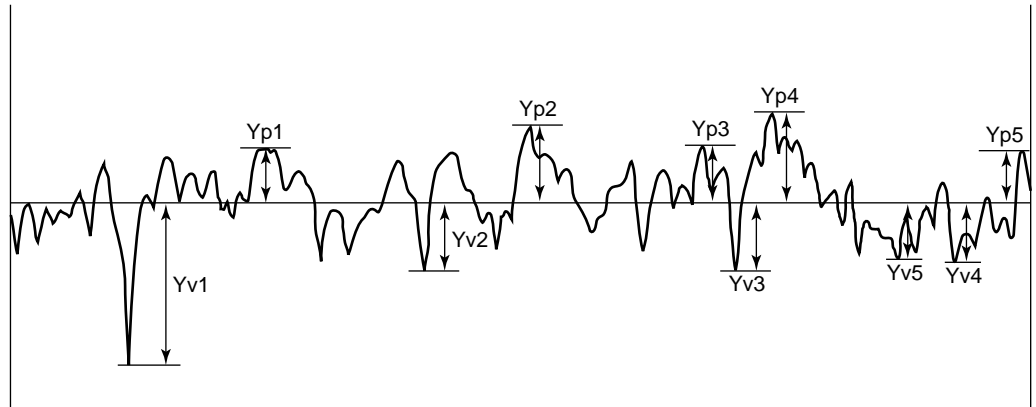
$$R_y \text{ (JIS)} = Y_p + Y_v$$



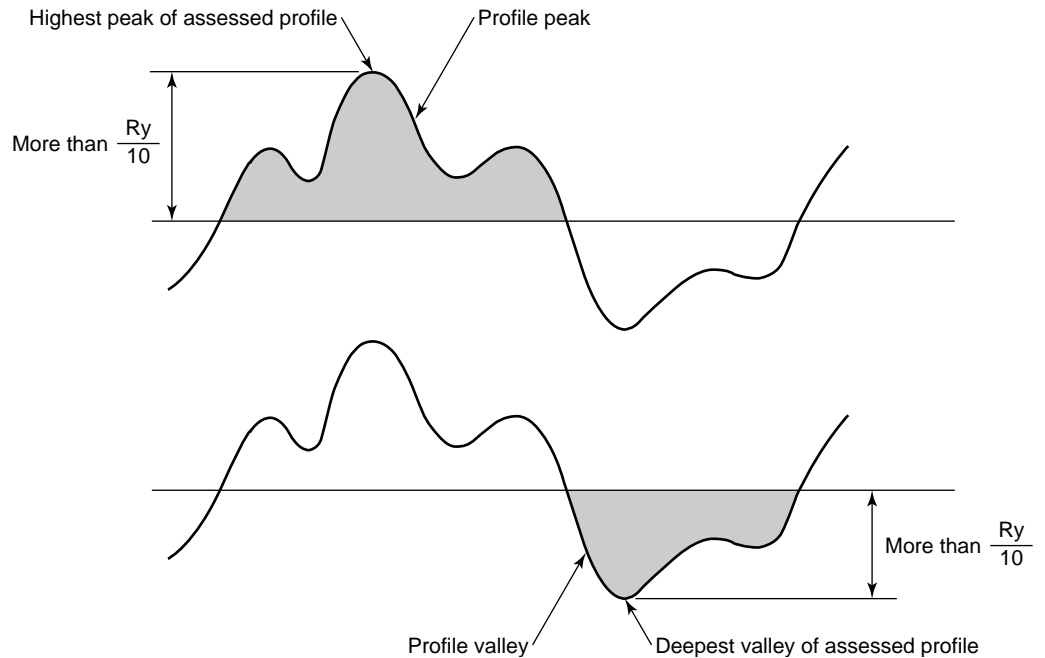
10.5.4 Ten-point height of irregularities, Rz (JIS)

Sum of the mean height of the five highest profile peaks and the mean depth of five deepest profile valleys measured from a line parallel to the mean line.

$$R_z \text{ (JIS)} = \frac{1}{5} \sum_{i=1}^5 Y_{pi} + \frac{1}{5} \sum_{i=1}^5 Y_{vi}$$



- Profile peak/highest peak and profile valley/deepest valley of assessed profiles
 A portion that projects upward (convex) from the mean line of the assessed profile is called the “profile peak”, and that which projects downward (concave) is called the “profile valley”.
 The highest point of each profile peak is called the “highest peak”, and the deepest point of each profile valley is called the “deepest valley”.
 However, if the profile peak height, or the profile valley depth is less than 10% of the Ry value, it is not regarded as the highest peak or deepest valley, respectively.



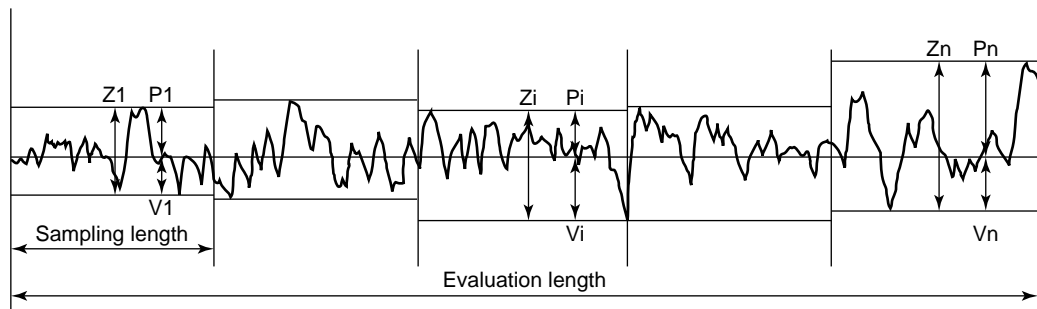
10.5.5 Maximum two point height of the profile, Ry (DIN, ANSI)

10.5.6 Maximum height of the profile, Rz (DIN, ISO, ANSI)

Obtain the sum Z_i of profile peak height P_i and profile valley depth V_i within each sampling length. The maximum value of all Z_i 's over the evaluation length is defined as R_y (DIN, ANSI), and the mean value is R_z (DIN, ISO, ANSI). In the following figure Z_n corresponds to R_y (DIN, ANSI).

$$R_z \text{ (DIN)} = \frac{Z_1+Z_2+Z_3+Z_4+Z_5}{5}$$

(where the number of sampling lengths $n = 5$)



- Profile peak/highest peak and profile valley/deepest valley of assessed profiles
A portion that projects upward (convex) from the mean line of the assessed profile is called the “profile peak”, and that which projects downward (concave) is called the “profile valley”.
The highest point of each profile peak is called the “highest peak”, and the deepest point of each profile valley is called the “deepest valley”.

10.5.7 Maximum profile peak height, Rp (DIN, ISO, New JIS)

Obtain profile peak height R_{pi} within each sampling length. The mean value of the R_{pi} 's over the evaluation length is defined as R_p .

$$R_p = \frac{R_{p1}+R_{p2}+R_{p3}+R_{p4}+R_{p5}}{5}$$

(where the number of sampling lengths $n = 5$)

- R_p (ANSI, Old JIS) is the height from the highest peak to the mean line over the evaluation length.

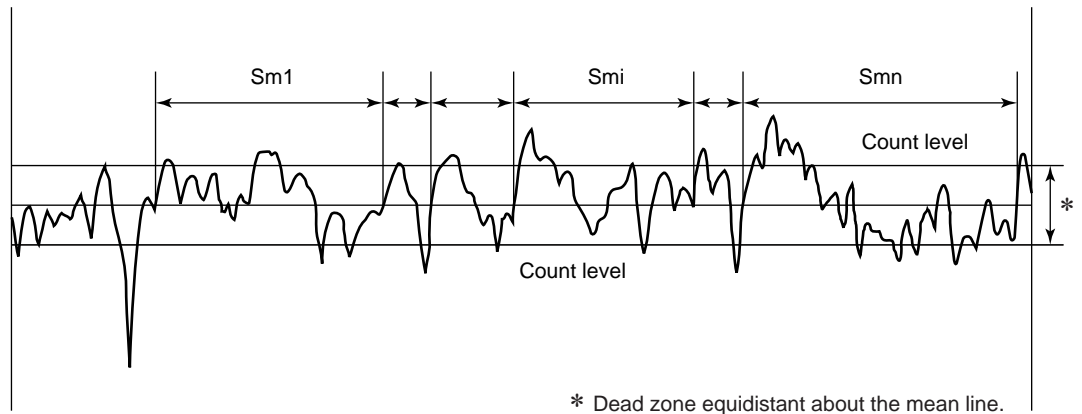
10.5.8 Total height of the profile, Rt

R_t is the sum of the height of the highest peak and the depth of the deepest valley over the evaluation length.

10.5.9 Mean width of the profile elements, S_m (JIS, ISO, DIN)

A portion projecting upward over the given upper count level is called a peak, and a portion projecting downward below the given lower count level is called a valley. The mean of the profile element (profile peak and the adjacent profile valley) widths within a sampling length is defined as S_m .

$$S_m = \frac{1}{n} \sum_{i=1}^n S_{mi}$$



- The following restrictions are provided to determine a profile element:
 - Peaks and valleys must appear alternately.
 - The intersection of the assessed profile with the mean line immediately before the profile element is the start point of it and is the end point of the previous profile element.
 - At the start point of the sampling length, however, if either the peak or valley is missing, the profile element width is not taken into account.
- For ANSI, S_m is defined over the evaluation length.

10.5.10 Peak count, P_c (JIS, ISO, DIN)

The reciprocal of the mean width of the profile elements, S_m , is “ P_c ”.

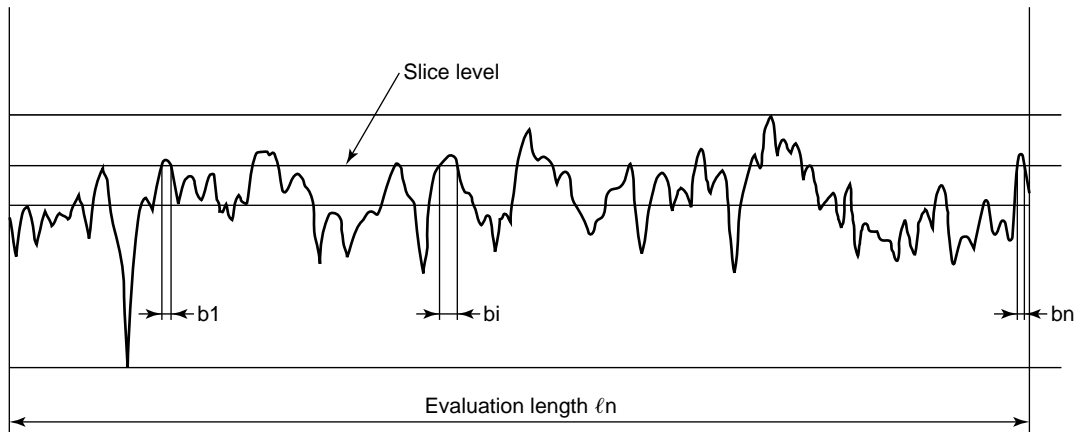
$$P_c = \text{Unit length}/S_m \quad (\text{Unit length} = 1 \text{ cm or } 1 \text{ inch})$$

- For ANSI, P_c is defined over the evaluation length.

10.5.11 Material ratio of the profile, m_r

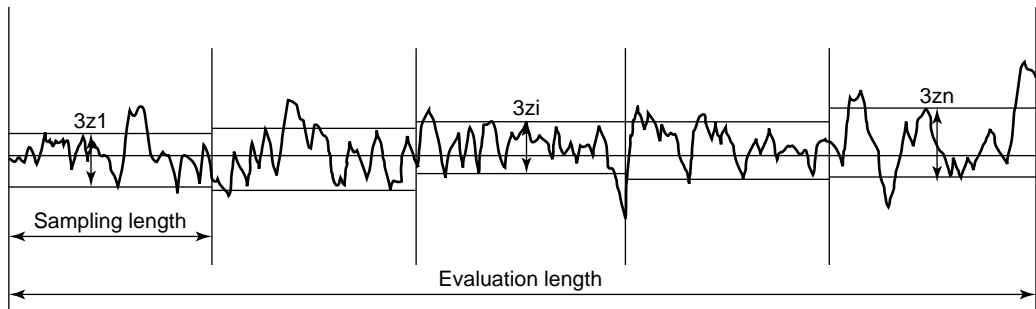
Ratio (%) of the material length of the profile elements at a given level (slice level) to the evaluation length. Here the slice level is defined as the depth from the highest peak, and is called a “peak reference”. The slice level is represented by a ratio of the depth (0 to 100%) to the R_t value.

$$m_r = \frac{\eta_p}{\ell_n} \times 100 (\%) \quad \eta_p = \sum_{i=1}^n b_i$$



10.5.12 Base roughness depth, R_{3z}

The sum ($3Z_i$) of the height of the third highest profile peak and the depth (absolute value) of the third deepest profile valley is determined within each sampling length. The arithmetic mean of the $3Z_i$'s over the evaluation length is R_{3z} .

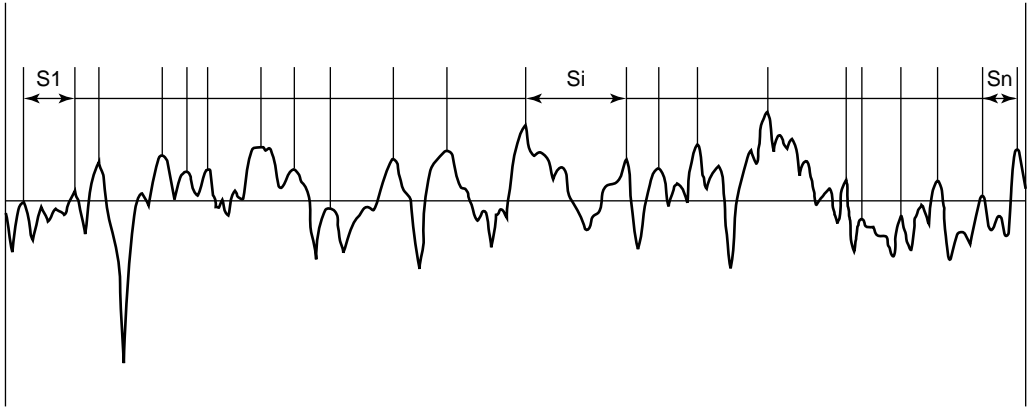


- Profile peak/highest peak and profile valley/deepest valley of assessed profiles
A portion that projects upward (convex) from the mean line of the assessed profile is called the “profile peak”, and that which projects downward (concave) is called the “profile valley”.
The highest point of each profile peak is called the “highest peak”, and the deepest point of each profile valley is called the “deepest valley”.
However, if the profile peak height, or the profile valley depth is less than 10% of the R_y value, it is not regarded as the highest peak or deepest valley, respectively.

10.5.13 Mean spacing of local peaks of the profile, S

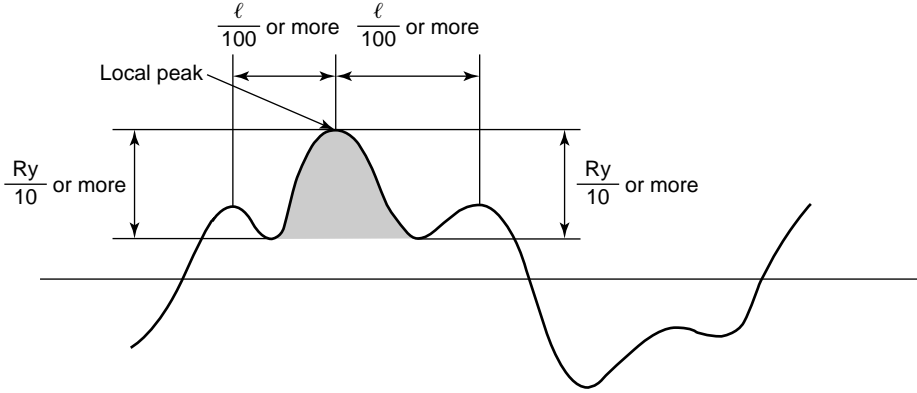
S is the mean spacing of adjacent local peaks. For ANSI, this S is defined over the evaluation length.

$$S = \frac{1}{n} \sum_{i=1}^n S_i$$



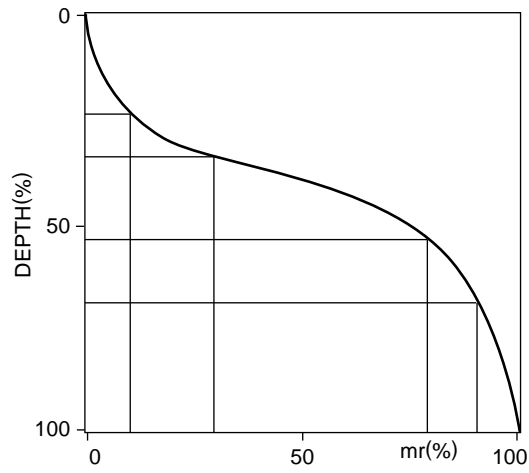
● Local peaks

If an upward convex portion of an assessed profile has concavities on both sides, the highest point of the convexity is called a local peak. However, if the lateral distance between the adjacent convexities is less than 1% of the sampling length ℓ , or if the depth of the concavities is less than 10% of R_y , the convex portion is not regarded as a local peak.



10.5.14 Material ratio curve of the profile (Abbott Firestone curve), BAC

A curve representing the material ratio of the profile as a function of (slice) level, where the mr values are plotted on the abscissa while the slice levels are on the ordinate.



10.5.15 Core roughness depth, R_k
(Depth of the roughness core profile)

10.5.16 Reduced peak height, R_{pk}
(Average height of the protruding peaks above the roughness core profile)

10.5.17 Reduced valley depth, R_{vk}
(Average depth of the profile valleys projecting through the roughness core profile)

10.5.18 Material portion, Mr_1

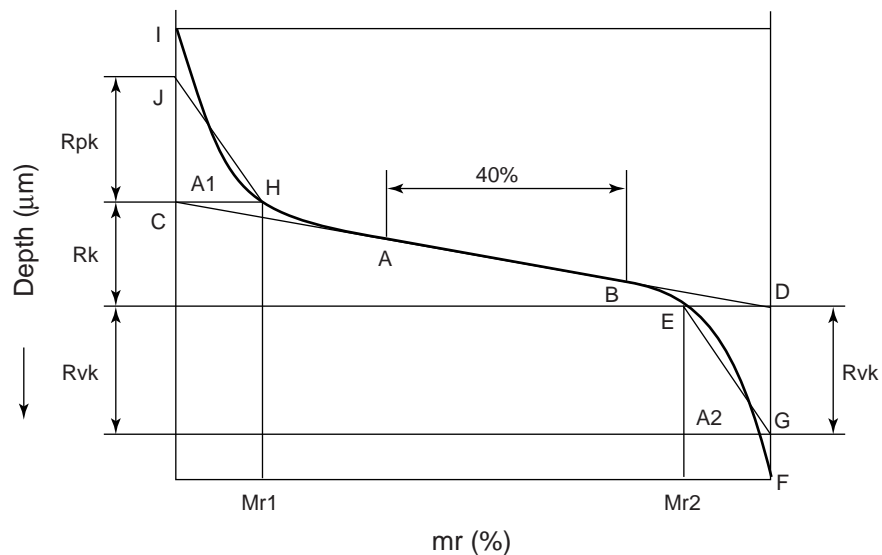
10.5.19 Material portion, Mr_2

10.5.20 Peak area, A_1

10.5.21 Valley area, A_2

Referring to the figure, a straight line is calculated for the central region of the material ratio curve *1 which passes through two points (A and B) different in the material ratio by 40% and having the smallest gradient. The core roughness depth R_k is the vertical distance between the ordinate values (i.e. slice levels) of the straight line intersecting two lines at $mr = 0\%$ position (C) and $mr = 100\%$ position (D), respectively.

Parameters R_{pk} and R_{vk} are calculated as the height of the right-angle triangle (CHJ or DEG) which is constructed to have the same area as the “peak area”(CHI) or “valley area”(DEF), respectively. The right-angle triangle corresponding to the “peak area, A_1 ” has Mr_1 as its base, and that corresponding to the “valley area, A_2 ” has $100\% - Mr_2$ as its base.



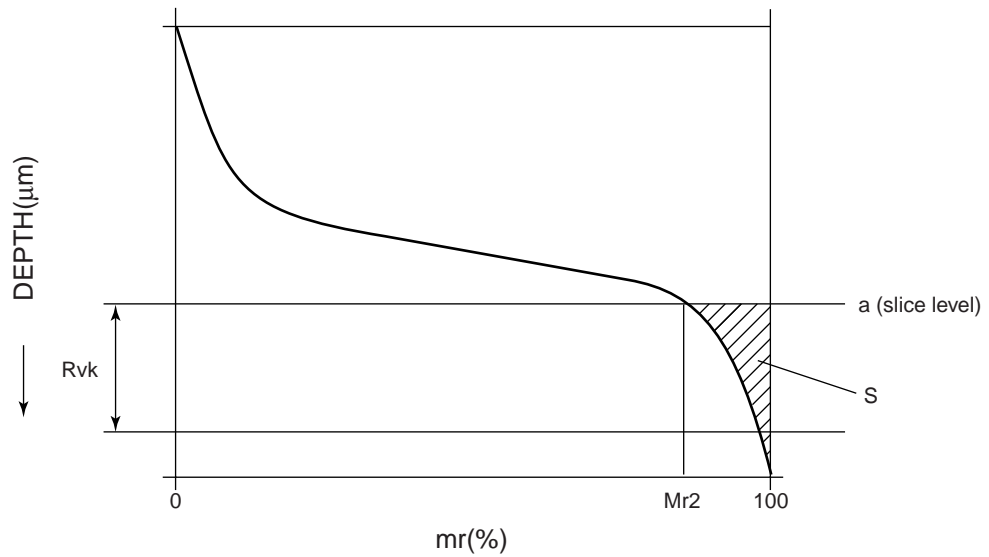
*1: The abscissa of the BAC represents mr values; the ordinate represents slice levels (μm).

10.5.22 Measuring volume V_o

Volume V_o is a value determined from the closed area (S) lower than the slice level (a) where the mr value falls at Mr_2 on the BAC (material ratio curve) and upper than the BAC.

$$V_o = \frac{(100 - Mr_2) \times Rvk}{2000} \quad Mr_2: \%, Rvk: \mu m$$

This parameter is a value that is converted from the volume (mm^3) of the concave portion lower than the slice level to a volume per area (cm^2) when viewed from the top of a workpiece, if the measured profile and slice level are assumed as a plane in a 3-dimensional space.



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