SONY

Digital Display Unit/Digitale Anzeigeeinheit

LH41

Instruction Manual
Bedienungsanleitung

1st. Edition (Revised 2)
1. Auflage (Verbessert 2)

Magnescale

CONTENTS

1. NOTE TO USERS

Read all instructions carefully before use.
The LH41 display unit will benefit you with reduced machining time and higher machining accuracy.
To make full use of the unit's functions, read this instruction manual through carefully, and keep it properly for future references.

WARNING - This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment.
This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.
You are cautioned that any changes or modifications not expressly approved in this manual could void your authority to operate this equipment.

NOTICE
THIS NOTICE IS APPLICABLE FOR USA AND CANADA ONLY.
If shipped to USA, use the UL LISTED power cord specified below.
If shipped to CANADA, use the CSA CERTIFIED power cord specified below.

DO NOT USE ANY OTHER POWER CORD.

	For 100–120 V	For 220–240 V
Plug Cap	Parallel blade with ground pin (NEMA 5-15P Configuration)	None
Cord	Type SVT or SJT, Three 16 or 18 AWG wires	Type SVT or SJT, Three 16 or 18 AWG wires
Length	Maximum 15 feet	Maximum 15 feet
Rating	Minimum 10 A, 125 V	Minimum 10 A, 250 V

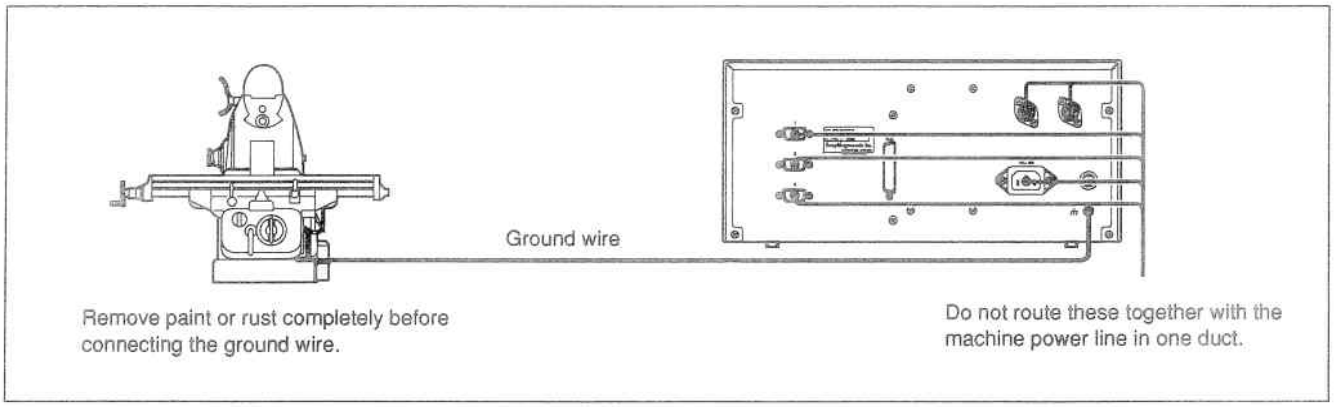
1-1. General Precautions

When using Sony Magnescale products, observe the following general precautions along with those given specifically in this manual to ensure proper use of the products.

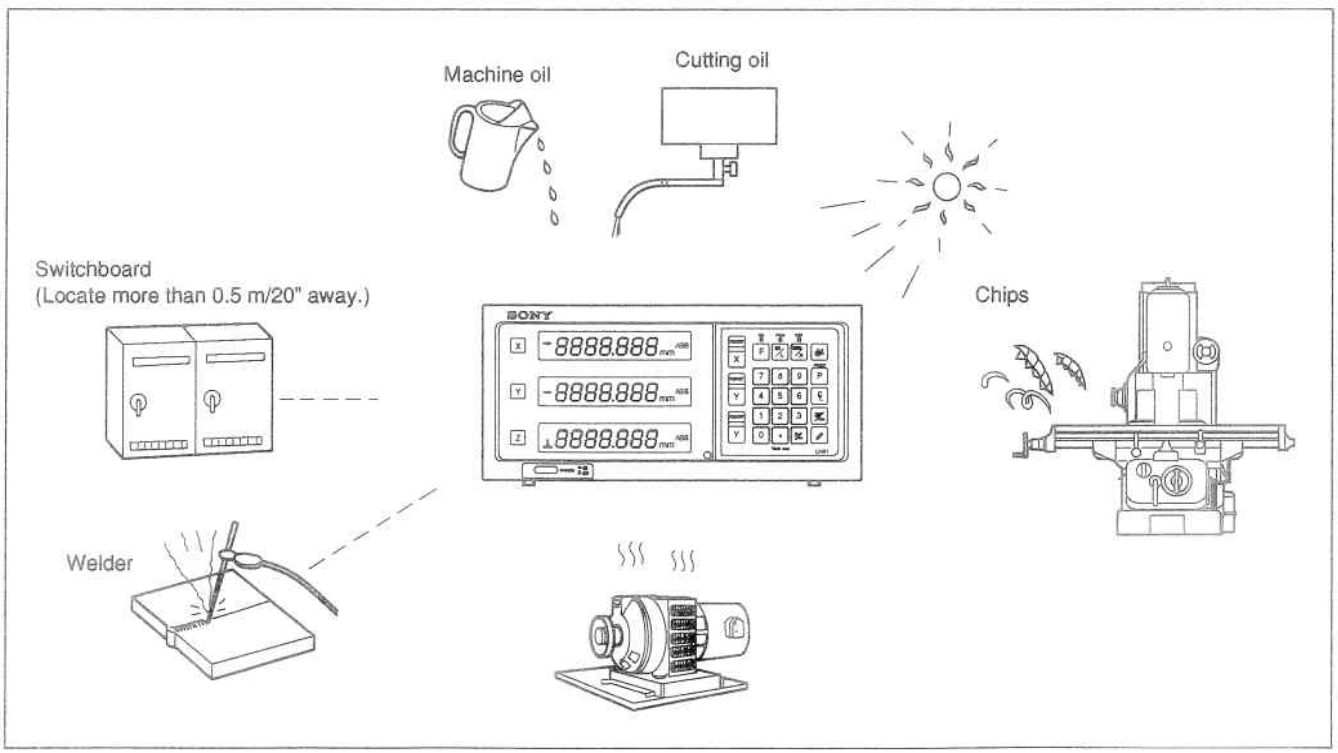
- Before and during operations, be sure to check that our products function properly.
- Provide adequate safety measures to prevent damage in case our products should develop a malfunction.
- Use outside indicated specifications or purposes and modification of our products will void any warranty of the functions and performance as specified for our products.
- When using our products in combination with other equipment, the functions and performance as noted in this manual may not be attained, depending upon the operating environmental conditions. Make a thorough study of the compatibility in advance.

1-2. Handling Instructions

- Do not route the head connecting cable, power cord, etc, together with the machine power line in one duct.
- Supply power from an AC lamp source.
- Connect the ground terminal to the machine with the supplied ground wire. Make sure the machine is grounded.



- Place the display unit more than 0.5 m (20") away from a high voltage source, large current source, large power relay, etc.
- For installation of the display unit, avoid a location exposed to chips, cutting oil, or machine oil. If unavoidable, take adequate countermeasures.
- Do not put a vinyl cover directly over the display unit or put it in a closed container.
- The ambient temperature should be in the range of 0°C to 40°C (32°F to 104°F). Avoid exposure to direct sunlight, hot air currents, or heated air.



- If the power supply voltage is lower than specified, the display may not be illuminated even with the power switch turned on.
  Be sure to use the power in the specified range.
- Note that if the power is interrupted momentarily or the voltage drops temporarily below the normal operating range, an alarm may operate or a malfunction may occur.

2. FEATURES

This display unit has functions especially suitable for milling which enable easy-to-learn operations, reduced machining time and higher-accuracy machining.

Remote control by the wireless remote controller

A remote control unit is available as an option.

Selectable resolution

The resolution is selectable: 0.0005 mm (0.00002"), 0.001 mm (0.00005"), 0.005 mm (0.0001"), 0.01 mm (0.0005"), or their respective displayed diameters (double counting).
Moreover, the high-speed response of 60m/min(39"/s) is attained for every resolution.

Machine tool error compensation

The LH41 compensates errors arising from the inclination or deflection of a machine tool, and displays the actual displacement of the machine. Thus, the displayed value accords with the actual displacement of a workpiece to achieve high-accuracy positioning and machining and restoration of machine tool accuracy.

High performance and high reliability

The LH41 uses the latest microprocessor and a large, easy-to-see fluorescent tube for the display, which ensures high reliablility and a long service life.

Data storage function

Data on display and preset data are held automatically.
Therefore, data is retained even after power is turned off or in case of a temporary power outage.

Touch Sensor

The Touch Sensor (an option) facilitates the setting of a datum point and the measurement of a workpiece.

Scale absolute zero point detection function

When a scale with built-in absolute zero point is connected, the absolute zero point on the scale (fixed point) can be detected wherever the scale stands. The detected fixed point is useful as the absolute zero point for machining.
Moreover, any offset amount from the absolute zero point can be set and recalled easily, which is useful for setting the absolute zero point on a boring machine or the like.

Programming

Program creation mode

- Manual programming in EDIT mode.
- Playback programming: program is made as maching is actually performed.

Program execution mode

- Machining sequence is displayed step by step.
- The data for each axis can be reversed with the mirror image function.

Bolt hole circle

- Bolt hole positions are automatically calculated and displayed by entering parameters such as the circle center/radius and number of holes.

Multidatum Point

Up to 10 points can be stored in memory in ABS coordinates.

RS232C input/output

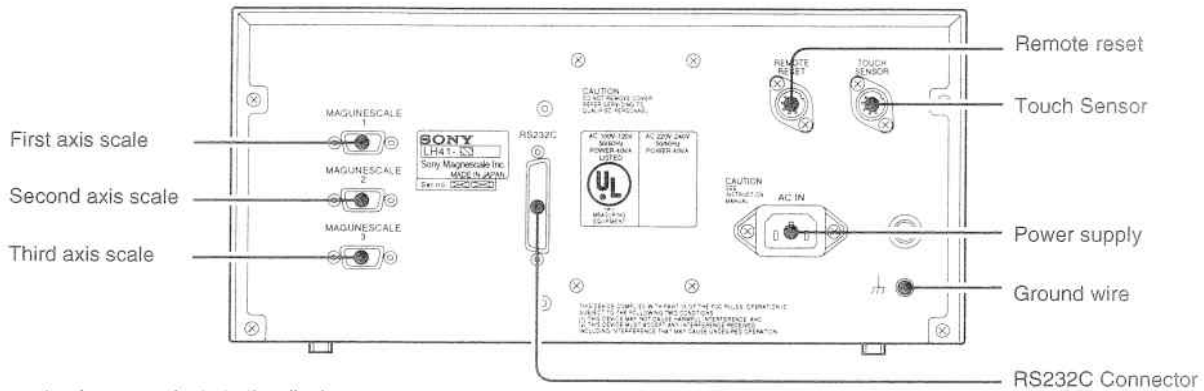
The following input/output is possible via RS232C.

- Key operation input and display data output.
- Program data input and output.

3. INSTALLATION

3-1. Connection of Cables

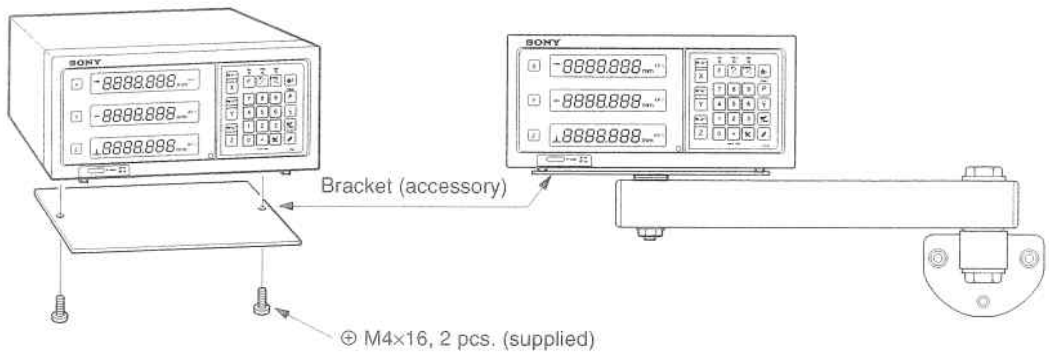
Fasten the connecting cables to stationary members to prevent accidental disconnection. Be sure to turn off the power of the display unit before connecting or disconnecting the connector.



Connect only our products to the display.

3-2. Mounting of Display Unit

Use the accessory brackets and screws for mounting the display unit.

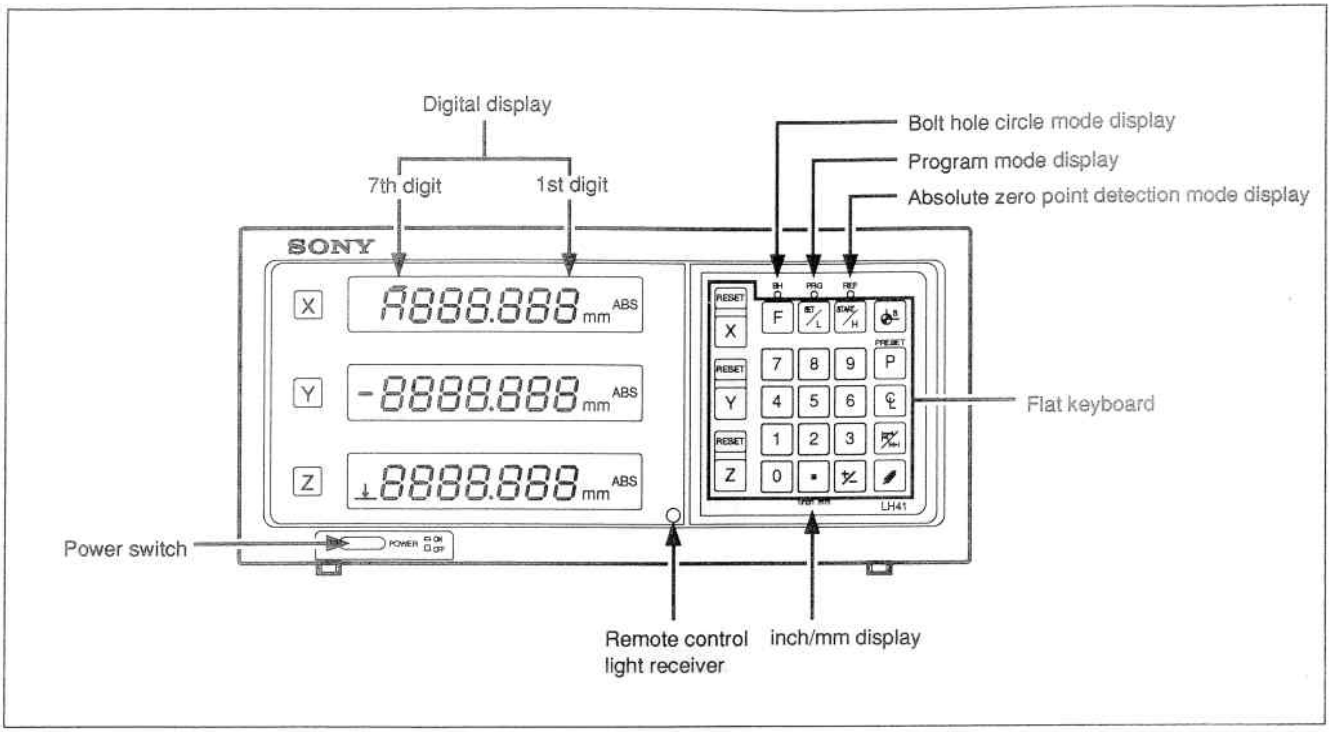


Note

Be sure to use the supplied screws. Use of oversized screws may damage the internal circuitry.

4. NAME AND FUNCTION OF EACH PART

4-1. Front Panel



Name of part	Function
Power Switch	Depress it to turn on the power, and SONY will be displayed. To turn off the power, depress it again.
Remote control light receiver	Signal input from the remote control unit (option) is received here. Be sure to keep the receiver free from oil, dust, etc.

4-2. Flat keyboard

Reset and cancel keys

Name of part	Function
RESET Reset key	Resets displayed value to zero.
Cancel key	1. Cancels a value set on the axis. 2. Releases the hold value to display the current value. 3. Use to interrupt the various setting and confirmation operations partway.

Designation of operation axis and presetting of values

Name of part	Function
X Y Z Axis selector key	Select an axis to give a command for the selected axis.
0 ~ 9 . Number keys	Sets desired values and a decimal point.
+/- Polarity selector key	1. Sets a value of minus polarity. Press this key before setting a numeric value. 2. Used to set the mirror image.
P Preset key	1. Displays a preset value. If a new value is not input, the previous preset data is displayed. 2. If this key pressed when the present values are displayed, the data being displayed is output to the RS232C.
Display mode selector key	Switches between ABS and INC displays.

Establishment of datum point

Name of part	Function
1/2 key	1. Halves the displayed value in the INC mode. 2. Touch sensor hold display is canceled, and the present position from the center of the workpiece is displayed.
S Datum point setting key	1. Establishes a datum point. 2. Used to set and confirm multiple datum points.
START/H Execute key/HOLD key	1. Used to hold the value displayed the moment the Touch Sensor touches the datum plane or scale absolute zero point is detected. 2. Used to store the hold value, release the hold and display the present value (when used with scale's absolute zero point). 3. Used to start the processes during program mode and bolt hole circle mode.
SET/L Function setting key/ LOAD key	1. When the Touch Sensor touches the datum plane or the absolute zero point sensing head passes the absolute zero point. 2. Used to make various settings during program mode and bolt hole circle mode.
F Absolute zero point/ Programming selector key	This button selects the mode when using the program or bolt hole circle functions or when using the scale absolute zero point. When this button is pressed, the mode changes in the order of program mode → bolt hole circle mode → absolute zero point detection mode → touch sensor mode → program mode.

Display of spot position and operation mode indicators

Name of part	Function
 in/mm selector key	Depress it to select English (in inches) or metric (in millimeters) display.
123.6780 Digital display	Displays for each axis a positive or negative value of 7 digits with unnecessary leading zeros blanked out. An alarm is also displayed in case of trouble.
Mode indicators	**ABS** Indicates the absolute mode is set. The distance from the spot position to the datum point initially set is displayed. ABS is indicated also when a datum point is established. Flashes when multiple datum points are used. **INC** Indicates the incremental mode is set. In this mode, incremental positioning is made with ⇨ keys and preset key [P]. Flashes when multiple datum points are used. ➡ Indicates the display unit is ready for operation commands. Flashing indicates an input wait, a processing wait or similar standby state. ⊥ Indicates the detection mode of absolute zero point of scale. **ø** Indicates that the resolution is set to diameter display mode. **mm** mm or in: Indicates the display is in millimeters or inches.
Mode indicators (LED)	**BH** Indicates the bolt hole circle function mode. **PRG** Indicates the program function mode. **REF** Indicates the absolute zero point function mode.

5. OPERATION

⚠ Cautions on Operation

1) When a malfunction occurs, characters as shown in "9. ALARM DISPLAY" on page 70 are displayed in place of numerals.When the alarm display appears, press the [RESET] key for the relevant axis and repeat the operation.
2) If two or more operation keys are pressed simultaneously, a malfunction may be caused.
3) Make sure that the least significant digit of an entered value agrees with the selected resolution.

⚠ Using the LZ30 remote controller unit (option)

The LZ30 remote controller unit for the LH20 display unit may be used with this display unit. However, note that the following controls differ from those described in the instruction manual for the LZ30.

1) **Setting channels for remote control of the display unit:**
Set the channels for remote control on the display unit according to "Initial Settings" in this manual. The axes are automatically set inside the LH41. It is not necessary to perform "[1] Setting axes" on page 9 of the LZ30 Instruction Manual.

2) **Display of display unit during remote control:**
When the LH41 display unit is controlled with the LZ30 remote control unit, the display unit displays the same information as displayed when controlled with the keyboard on the display unit. Therefore, the function indicating lamps will not light or flash as described in the instruction manual for the LZ30 remote control unit.

Additional function indicating lamps do not light or flash. [½] [H] [L] [S]

3) One LZ30 remote control unit can control up to four axes (X, Y, Z, and W). However, this display unit does not use the W-axis.

4) The LH41 allows dual control by the keys on itself and the LZ30 remote control unit. Two key operations on the LZ30 need not be the performed within 10s of each other, as with the LH20.

5) Depressing the remote control unit [½] key enables the same operations as with the "F" key. However, program functions and bolt hole circle functions cannot be used. Therefore, only absolute zero point detection mode and touch sensor mode switching is performed.
The operation for setting the absolute zero point mode by pressing the [F] key three times can be executed with the remote control unit by pressing the [½] key once.
For example, the operation consisting of [X] [½] [H] in the remote control unit manual becomes [½] [X] [H]. (The absolute zero point mode is selected before pressing the Axis selector key.)

6) Touch sensor centering in the remote control unit manual is changed from [X] [℄] to simply [℄].

5-1. Initial Settings

Before staring the operation, make the following initial settings:

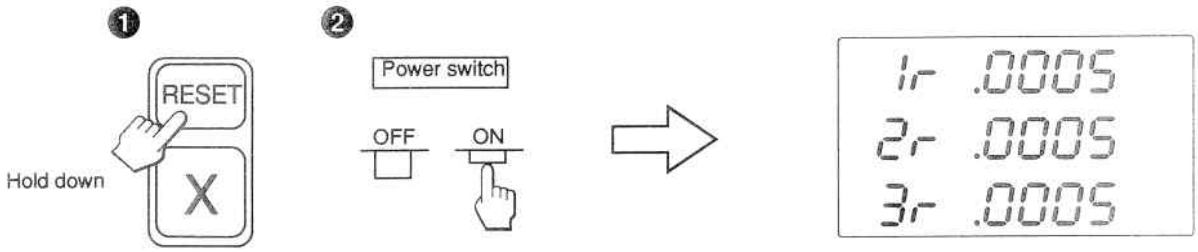
5-1-1. Setting of dispiay axis and polarity
5-1-2. Setting resolution
5-1-3. Setting linear campensation
5-1-4. Setting the scaling
5-1-5. Setting offset value ΔY
5-1-7. Setting of touch sensor radius
5-1-8. Setting channels for wireless remote control
5-1-9. RS232C setting

- Skip unnecessary initial settings by pressing an Axis selector key, and proceed to the next setting.
- After all the initial settings are completed, press the [RESET] key. The value that was displayed before the power was turned off is displayed, and the unit is switched to the measurement mode.
- By pressing the [RESET] key at any time during initial setting, the value that was displayed before the power was turned off is displayed, and the unit is switched to the measurement mode.
- The initial settings, once made, are stored even if the power is turned off. Therefore the initial settings are necessary only when the system is newly installed or when any setting revision is required.

To set the initial setting mode

Hold down the X-axis [RESET] key and turn the power switch ON.

The resolution set for each axis will be displayed.



Except for the Touch Sensor radius setting, wireless remote control setting and RC232C setting, perform all the settings for each axis. Although only the settings for the first axis are described below, follow the steps for the second and third axes in a similar manner.

5-1-1. Setting of display axes and polarity

- Press the X-axis selector key in the Initial Setting mode to select the Display Axis/Polarity Setting mode.
- Select either 1st, 2nd or 3rd axis input for the X-axis.
- The minus "–" indicates the reverse of the polarity.
- Use the [0] key or [+/–] key to set or change the display axis and polarity.
- The inputs to the first, second and third axes are factory-set to the X-, Y- and Z-axis respectively.

Example

Operating Procedure		Display
[X]	Press the X-axis selector key.	→ 1Cn 1 (1st axis display input connector: 1st axis input)
[0]	Press the 0 key to increase the value.	→ 1Cn -1 (1st axis display input connector: reverse polarity 1st axis input)
[+/–]	Press this key to decrease the value.	→ 1Cn -3 (1st axis display input connector: reverse polarity 3rd axis input)

Display	Display axis	Input
1Cn 1/1Cn –1	X-axis	1st axis
1Cn 2/1Cn –2		2nd axis
1Cn 3/1Cn –3		3rd axis
2Cn 1/2Cn –1	Y-axis	1st axis
2Cn 2/2Cn –2		2nd axis
2Cn 3/2Cn –3		3rd axis
3Cn 1/3Cn –1	Z-axis	1st axis
3Cn 2/3Cn –2		2nd axis
3Cn 3/3Cn –3		3rd axis

Note
When setting the polarity, note the machine's movement direction.

5-1-2. Setting resolution

- Select the Resolution setting mode by pressing the X-axis selector key when the display is as shown in 5-1-1.
- The resolution can be set and changed with the [0] key or [±] key.
- The resolution is factory set to "0.0005" .

Example

Operating Procedure		Display
[X]	Select the input to the first axis.	→ 1r .0005
[0]	Press the 0 key to increase the value.	→ 1r .0005 (ø lights)
[±]	Press this key to decrease the value.	→ 1r .01 (ø lights)

Display	Resolution
(mm lamp lights)	
.0005	0.0005 mm
.0005 (ø lights)	ø
.001	0.001 mm
.001 (ø lights)	ø
.005	0.005 mm
.005 (ø lights)	ø
.01	0.01 mm
.01 (ø lights)	ø

Display	Resolution
(inch lamp lights)	
.00002	0.00002 in
.00002 (ø lights)	ø
.00005	0.00005 in
.00005 (ø lights)	ø
.0001	0.0001 in
.0001 (ø lights)	ø
.0005	0.0005 in
.0005 (ø lights)	ø

Note

ø: Diameter display (double counting)
The decimal point remains at the same position.

5-1-3. Setting linear compensation

- After completing 5-1-2, press the Axis selector key for the Linear compensation setting mode.
- Number keys and [P] key are used to choose one of the linear compensation amounts below. The lower 3 digits of the compensation amount to be set are displayed.
- For details, refer to "6. LINEAR COMPENSATION."
  The unit is delivered without compensation set ("LC 000").
- Select the linear compensation amount per meter as shown below.
  246 different linear compensations (per meter/inch) are available for selection: ±0.002 mm/±0.000002", ±0.004 mm/±0.000004", ±0.006 mm/±0.000006", ±0.008 mm/±0.000008, ±0.010mm/±0.000010", ±0.015 mm/±0.000015" (in 0.005 mm/±0.000005 steps) to ±0.600 mm/±0.000600"

Example

Operating Procedure	Display
[X] **Example:** To set the compensation amount for the first axis to –0.015 mm Select the input to the first axis.	1LC 000
[0] [1] [5] Press the number keys.[Note]	Lights → 1LC 015
[+/–] Press the Minus key.	Lights → 1LC -015
[P] Press the Preset key to complete the setting.	1LC -015

Note

- The setting cannot be performed if a number key other than those specified for the linear compensation is pressed.
- The arrow indicator lights during number input, and goes out when the [P] key is pressed to confirm the number.

5-1-4 Setting the scaling

- After completing the operation in 5-1-3, depress the Axis selector key again to select the setting mode for the scaling.
- Use the number keys and [P] key to set and change the scaling.
- The scaling is set at the factory to 1.000000.

Example

Operating Procedure	Display
[X] Select the input to the first axis.	SCALING (Displayed for approx. 1 second) ↓ 1.000000
[0] [.] [5] Depress the number keys.	Lights → 0.5
[P] Depress the Preset key to complete the setting.	0.500000

Note

- When the scaling function is used, a reduction or magnification count of any ratio can be performed with respect to the actual movement distance. This compensates contraction of the resin during mold manufacture, etc., enabling the product dimensions to be converted to the mold dimensions.
  A setting of 0.100000 to 9.999999 can be made for each axis.
  Display value = actual movement distance x n (n = scaling value)
- The arrow indicator lights during number input, and goes out when the [P] key is pressed to confirm the number.

5-1-5. Setting offset value ΔY

- After completing 5-1-4, depress the Axis selector key for the offset value ΔY setting mode.
- Number keys and [P] key are used to set and change the offset value ΔY.
- If the display unit has been replaced and thus the offset value ΔY has been measured, ΔY may be set in this procedure.
- The offset value ΔY is factory set to 0.0000mm.

Example

Operating Procedure		Display
[X]	**Example:** To set the offset value ΔY to 10 mm. Select the X-axis.	⊥ 0.0000 mm REF REF lights
[1] [0]	Depress the number keys.	Lights ⊥ 10._ _ _ _ mm REF REF Flashes
[P]	Depress the Preset key to complete the setting.	⊥ 10.0000 mm REF REF lights

Note

- When ΔY is not yet measured, refer to "5-12. Offset Zero Point." (See page 40.)
- Numbers that can be input vary according to the resolution.
  Example: In the case of 0.0005 mm: –999.9995 to +999.9995
  In the case of 0.01 mm: –99999.99 to +99999.99
  If the resolution is made finer after a large value is input with a coarse resolution, an overflow alarm display will result for the offset value ΔY.
- The arrow indicator lights and REF flashes during number input, and when the [P] key is pressed to confirm the number the arrow indicator goes out and REF lights.

5-1-6. Absolute zero point clear control

- This control becomes necessary when the scale with built-in absolute zero point is replaced or reinstalled. This control is usually not necessary when using the unit for the first time.
- When the scale with built-in absolute zero point is replaced, be sure to perform the following controls in the setting mode as described in 5-1-5.

Operating Procedure		Display
	To set the absolute zero point offset amount setting mode, press the Cancel key.	rEF CLr (Displayed for approx. 2 seconds) REF flashes.
	Setting completed.	⊥ 10.0000 mm REF lights.

Note

REF flashes during absolute zero point clearance processing. When the processing ends, REF lights steadily.

5-1-7. Setting of touch sensor radius

- After completing 5-1-6 , depress the Axis selector key for the Touch sensor radius setting mode.
- Number keys and [P] key are used to set and change the touch sensor radius.
- The touch sensor radius is factory set to 5.0000 mm.
- Correct setting of the touch sensor radius makes correct display of the reference point or measuring range possible in the load or hold operation with the touch sensor.
- In the example below, the resolution is set to 0.0005 mm.

Note
The touch sensor radius setting can only be made for the input to the first axis.

Example: Input to the first axis

Operating Procedure		Display
[X]	**Example:** Setting the radius to 10 mm. Select the input to the first axis.	75_rAd (Displayed for approx. 1 second)
[1] [0]	Press the number keys.	↓ 5.0000 Lights →10.
[P]	Press the Preset key to complete the setting.	10.0000

Note
The arrow indicator lights during number input, and goes out when the [P] key is pressed to confirm the number.

5-1-8. Setting channels for wireles remote control

When using the LZ30 remote control unit, be sure to set the channel number on the display unit so that it matches the channel number on the remote control unit.

Since the remote control unit is an optional accessory, read its own instruction manual carefully before proceeding to the following operation.

- After the operations in section 5-1-7 are completed, and when the axis selector key is pressed, "CodE -- " or, instead of " - - ", the previously selected remote control channel, is displayed, and the remote control unit channel number setting mode is set.
- A channel between 0 to 15, from a total of 16 channels, can be selected. When "CodE -- " is displayed, the remote control signal cannot be received.
- To set the remote control channel number, enter the same number as the channel number label specified for the LZ30 remote control unit. The same channel number is used for X, Y and Z axes.
- Use the number keys and [P] key to set and change the remote control channel number.

Follow the numerical sequence for operation.

Operating Procedure		Display
[X]	Select the X-axis.	Factory value CodE --
[0] [1]	**Example:** Setting channel 1. Depress the number keys.	Lights → CodE 01
[P]	Depress the Preset key to complete the setting.Note)	CodE 1

Note

- Wireless remote control setting applies to first axis input only.
- If the [P] key is depressed without setting a number, the unit will be unable to receive remote control signals ("CodE -- " is displayed).
- The arrow indicator lights during number input, and goes out when the [P] key is pressed to confirm the number.

5-1-9. RS232C setting

After completing the settings in 5-1-8, depress the Axis selector key again to select the setting mode for the RS232C.

Note
The RS232C only sets the first axis.

Communication mode setting

- P30 mode is the mode for our company's P30 printer. The communication speed, parity and other items are set automatically. (Communication speed: 2400 dps, no parity, stop bits: 1, data length: 8) Also, programs input/output is not possible.
  If program input/output is to be performed, the COMP mode should be set.
- COMP is the standard communication mode, and the communication speed and other items below must be set.
- The following cannot be set in P30 mode.
  The unit will return to the initial setting item (setting resolution).

Operating Procedure		Display
[X]	Select the X-axis.	→ rd COMP (Computer communication mode)
[0] [+/-]	Depress the "0" and "+/-" keys to switch the communication mode. P30 ⇔ COMP	→ rd P30 (Printer P30 output mode)

Setting the data format

Operating Procedure		Display
X	Select the X-axis.	→ F0 XYZ
0 +/−	Depress the "0" and "+/-" keys to switch the data output format mode.	→ F0 X.Y.Z.

XYZ: Continuous output mode

X ① ② = Data Space Y ① ② = Data Space Z ① ② = Data CR LF

X.Y.Z.: New line output mode

X ① ② = Data CR LF
Y ① ② = Data CR LF
Z ① ② = Data CR LF

Data : Data is signed zero-suppressed 7-digit data (Space when sign is positive)

① : Display status (N: normal, D: double display)

② : Display mode (I: INC, A: ABS)

③ : Unit (M: mm, I: inch)

Note

- The data format during P30 mode is R ③ ① Space Data CR LF.
  The data is signed zero-suppressed 6-digit X-axis data (space when the sign is positive), and the 7th digit is not output.
- When statistical data processing is performed using our company's P30 or P40 printer, P30 mode should be used. (Statistical processing can only be performed for the X-axis).
- If only X, Y, and Z-axis data is to be output, the P40 should be used in COMP mode. With the P30, communication processing takes time, and therefore it cannot be used in COMP mode. Data reception will become impossible partway, and data will be lost.
  (In P30 mode, a delay time is included that accords with the communication processing time.)

Communication speed setting

Operating Procedure		Display
X	Select the X-axis.	→ br 9600
0	Depress the "0" key. The communication speed increases.	→ br 1200
+/−	Depress the "+/-" key. The communication speed decreases.	→ br 4800

Parity setting

Operating Procedure		Display
X	Select the X-axis.	→ PA OFF (No parity)
0	Depress the "0" key to increase the parity.	→ PA Odd (Odd parity)
+/-	Depress the "+/-" key to decrease the parity.	→ PA EVEN (Even parity)

Stop bit setting

Operating Procedure		Display
X	Select the X-axis.	→ Sb 1
0 or +/-	Depress the "0" or "+/-" key to switch the stop bit.	→ Sb 2

Data length setting

Operating Procedure		Display
X	Select the X-axis.	→ dL 8
0 or +/-	Depress the "0" or "+/-" key to switch the data length.	→ dL 7

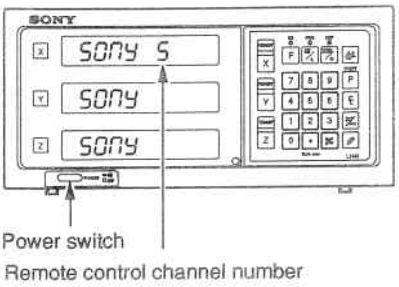
This completes all the initial settings. When the Axis selector key is pressed, resolution setting is returned to.
Perform initial settings in the same way for the other axes (Y, Z). First, press the Axis selector key for the axis for which you want to make the settings.

5-2. Applying Power, Luminance Adjustment and Resetting

After installation, connections and setting of the resolution have been completed, begin machining as described in the procedure below.

1 Set the Power Switch to On

Set the POWER switch to ON.
"SONY" will be displayed.
If "SONY" or "Error" flashes in the display, refer to "9. ALAM DISPLAY". When the display unit is set to be operated with the remote control unit, the channel number of the remote control unit is displayed following the "SONY" display.



2 Luminance adjustment

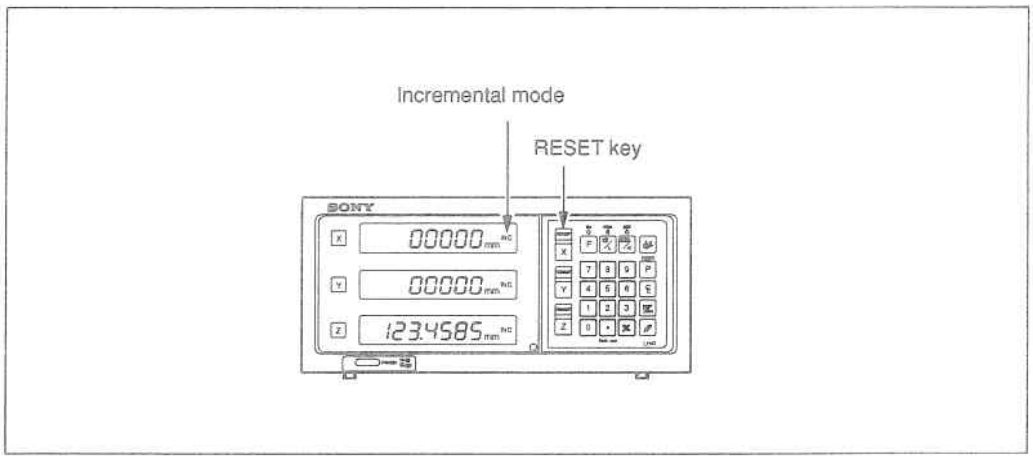
To adjust the luminance, turn on the power as described in 1, and when "SONY" is displayed, depress the Axis selector key of the axis for which you wish to adjust the luminance. The arrow indicator for that axis lights, and luminance can be adjusted in 16 steps with the "0" or "+/−" key.

Example: X Axis

Operating Procedure		Display
X	Select the X-axis. The arrow indicator lights.	Lights → SONY
0	The luminance increases every time this key is depressed.	Bright
+/−	The luminance decreases every time this key is depressed.	Dark

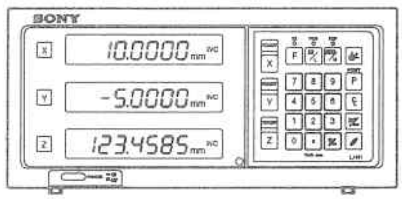
3 Depress the RESET key.

The first time the RESET key of X-, Y-, or Z-axis is depressed after the power is turned on, the previously displayed value (before the power was turned off) is displayed. After this, zero is displayed only for the reset axes. The unit is set to Incremental mode when reset.



4 Start positioning.

When the machine table is moved, the displacement is displayed. The minus (–) sign appears depending on the direction of movement of the table.



Example: Displacement of 10 mm in the plus (+) direction on the X-axis and 5 mm in the minus (–) direction on the Y-axis.

Note

In the example, the resolution is set to .0005 mm.

5-3. Basic Key Operations

The LH41series display unit is basically operated with keys in the following sequence:
Axis key, data input, and Operation key.
Following is an example of the basic key operations on X-axes.
See the following pages for details. Operate the Y- and Z-axes in the same way.

Start of operation : Turn on the power switch. [RESET]

Reset (zero display) : [RESET]

Preset : [X] [Number keys (data input) □□---□] [P]

Setting of datum point : [X] [Number keys (data input) □□---□] [⊕S]

Absolute/Incremental display selection :

[X] [H/⋙]

Touch Sensor (datum plane establishment):

[X] [SET/L] → [Touch the workpiece → Counting starts.]

Touch Sensor (distance measurement):

[X] [START/H] → [Touch the workpiece → Display is held.]

For centering the workpiece: [℄]

Absolute zero point of scale (measurement from absolute zero point):

[F] [F] [F] Depress the " F " key three times to select the absolute zero point mode.

[X] [Number keys (data input) □□---□] [SET/L] → [Absolute zero point passed → Counting starts.]

Absolute zero point of scale (measurement to absolute zero point):

[F] [F] [F] Depress the " F " key three times to select the absolute zero point mode.

[X] [START/H] → [Absolute zero point passed → Display is held.]

For storing the hold value into memory : [X] [START/H]

Offset zero point : [F] [F] [F] Depress the " F " key three times to select the absolute zero point mode.

[X] [SET/L] → [Zero point passed → Counting starts.]

Recall : [X] [P]

Halving displayed values : [X] [℄]

Cancel : [X] [//]

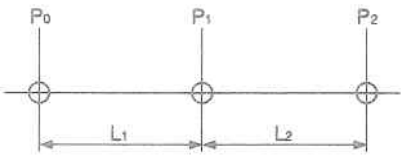
5-4. Correcting Erroneous Operations

1) **When you have pressed the wrong axis selector key:**
   - To select the correct axis, press the correct axis selector key.
   - To clear the axis selection mode, press the cancel key [/].
2) **When you have pressed the wrong number key:**
   - Press the cancel key [/] and axis selector key before entering the correct numerals. If you have pressed the [±] or [P] key by mistake, press the axis selector key before entering the correct numerals.
3) **When LOAD key [%] or HOLD key [%] is depressed by mistake:**
   Depress the Axis selector key of the relevant axis and the Cancel key [/], and repeat the entry.
4) **To cancel the hold:**
   Depress the Axis selector key of the held axis and the Cancel key [/] to return to the present value display.

5-5. Presetting

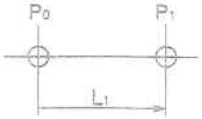
Machining by counting down to zero

Example: Counting down while moving from P_0 to P_1.



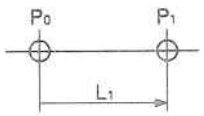
L_1=10.0
L_2=10.0

Note
In the display example below, the resolution is set to 0.0005 mm.

Operating procedure	Display
Positioning to P_1. [X] Select the X-axis.	➡ – – – – – – – mm INC
[1] [0] Enter the value L_1. **Note** To count up while moving from P_0 to P_1, enter –10.	➡ 10. mm INC
[P] Preset the input value. The INC indicator lights.	10.0000 mm INC
	Counting ↓
Move the scale until "0" is displayed to reach P_1.  	0.0000 mm INC

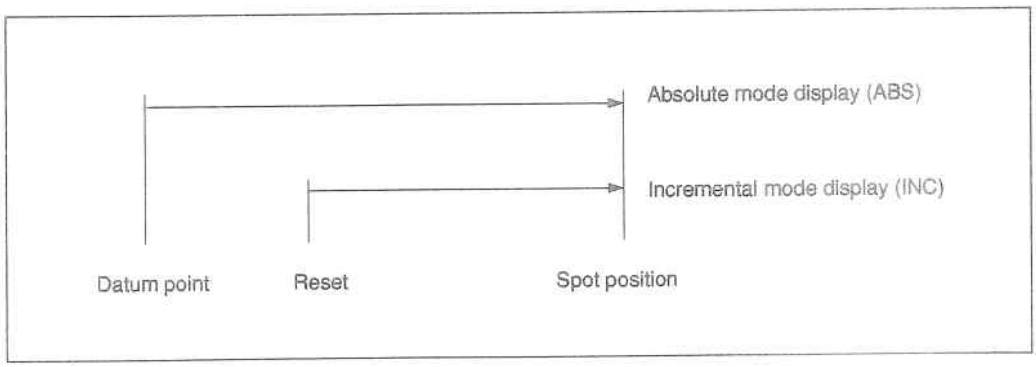
5-6. Recalling Preset Data

Pitch-feed machining

Operating procedure	Display
Positioning to P_2. [X] Select the X-axis. [P] Press the Preset key. The INC indicator lights.	→ _ _ _ _ _ _ _ mm INC 10.0000 mm INC
Move the scale until "0" is displayed to reach P_2. 	Counting 0.0000 mm INC

5-7. Datum Point Setting and Display Mode Selection

This display unit has two display modes: the absolute mode (ABS) in which the absolute distance between the datum point and the spot position is displayed, and the incremental mode (INC) in which the distance between the previous machining position and the spot position is displayed with a reset or preset operation.



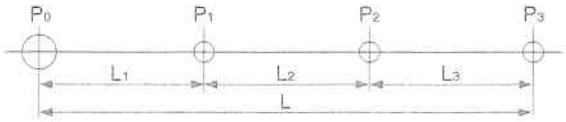
The conversion between the absolute mode (ABS) and incremental mode (INC) can be made by pressing:

[X] [F/⊢⊢] **Example:** on X-axis

To restore the original display mode, perform the same operation.

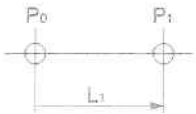
Setting datum point and display mode selection

Example: Counting down while moving from P_0 to P_1.



$L_1 = L_2 = L_3 = 1.0$
$L = L_1 + L_2 + L_3 = 3.0$

Note
In the example below, the resolution is set to 0.005 mm.

Operating Procedure	Display
[X] Select the X-axis.	→ - - - - - - - mm INC
([0]) "0" input can be omitted. To give an offset value to the datum point, enter the offset value instead of "0".	→ 0. mm INC
[S] Press the datum point setting key. The ABS indicator lights.	0.0000 mm ABS
[X] Select the X-axis.	→ - - - - - - - mm ABS
[1] Enter the value L_1. **Note** To count up while moving from P_0 to P_1, enter "–1".	→ 1. mm ABS
[P] Press the preset key. The INC mode is entered.	1.0000 mm INC ↓ Counting 0.0000 mm INC
Move the scale until "0" is displayed: P_1 is the position where "0" is displayed. Perform P_2 and P_3 positioning in the same way. 	
To find the distance between P_0 and P_3 at the end of P_3 machining:	
[X] Select the X-axis.	→ - - - - - - - mm INC
[▶▶|] Press the display mode selector key. The ABS indicator lights and the distance between P_0 and P_3 is displayed.	-3.0000 mm ABS
To restore the Previous mode:	
[X] Press the same operation keys again to return to INC mode.	→ - - - - - - - mm ABS
[▶▶|] The INC indicator is switched to.	0.0000 mm INC

5-8. Mid-Point Calculation

When the INC mode display is selected, the distance from the center value is displayed by halving the displayed value.

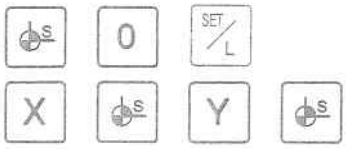
Note
In the example, the resolution is set to 0.0005 mm.

Operating procedure	Display
([ABS/INC]) If the ABS mode display is selected, change it to the INC mode before operating.	(10.0000 mm ABS)
The present value is displayed.	10.0000 mm INC
[X] Select the X- axis.	→ _ _ _ _ _ _ _ mm INC
[1/2] Press the 1/2 key. The INC indicator lights.	5.0000 mm INC
	↓ Counting
Move the machining table until the display reads "0". This position is the center.	0.0000 mm INC
To make the center position the datum point, operate as follows.	
[X] Select the X-axis.	→ _ _ _ _ _ _ _ mm INC
([0]) "0" input can be omitted.	(→ 0. mm INC)
[S] Press the datum point setting key. The ABS indicator lights.	0.0000 mm ABS
Note Caution is required, since the previously set datum point is canceled at this time. Moreover, multiple datum points No. 1 to No. 9 also move in accordance with the change of the datum point. (See the next section for multiple datum points.)	

3-9. Multiple datum point memory function

With datum point 0 as the reference, up to 9 points can be stored in memory for each axis.

Example: When 3 datum points are to be set on the X-Y plane.



Select datum point 0 coordinates.

Set datum point 0 (P_0).

Setting datum point 1.

Move the scale a distance of $\Delta\ell x1$ and $\Delta\ell y1$ on X and Y axes, respectively from P_0.

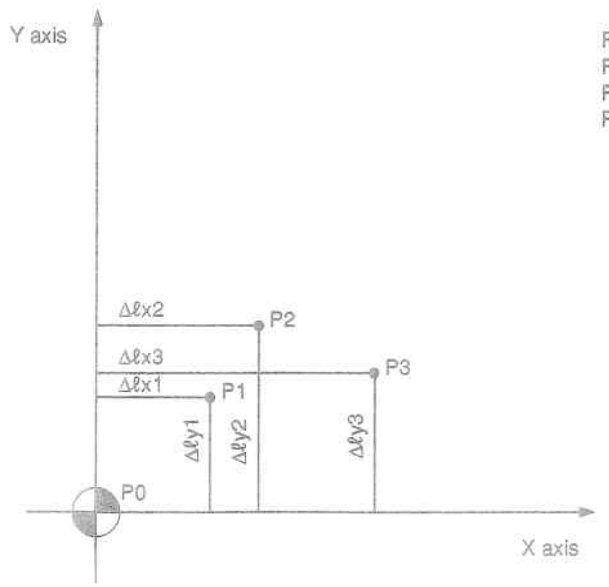
Select datum point 1 coordinates.

Set datum point 1 on X and Y axes.

Setting datum points 2 and 3.

Select datum point 0 coordinates.

Set the diplayed value to 0 for both the X and Y axes (datum point 0).
The other steps are the same as for datum point 1.



P_0 is datum point 0
P_1 is datum point 1
P_2 is datum point 2
P_3 is datum point 3

Multiple datum point No. confirmation and modification can be performed with the following operation procedure.

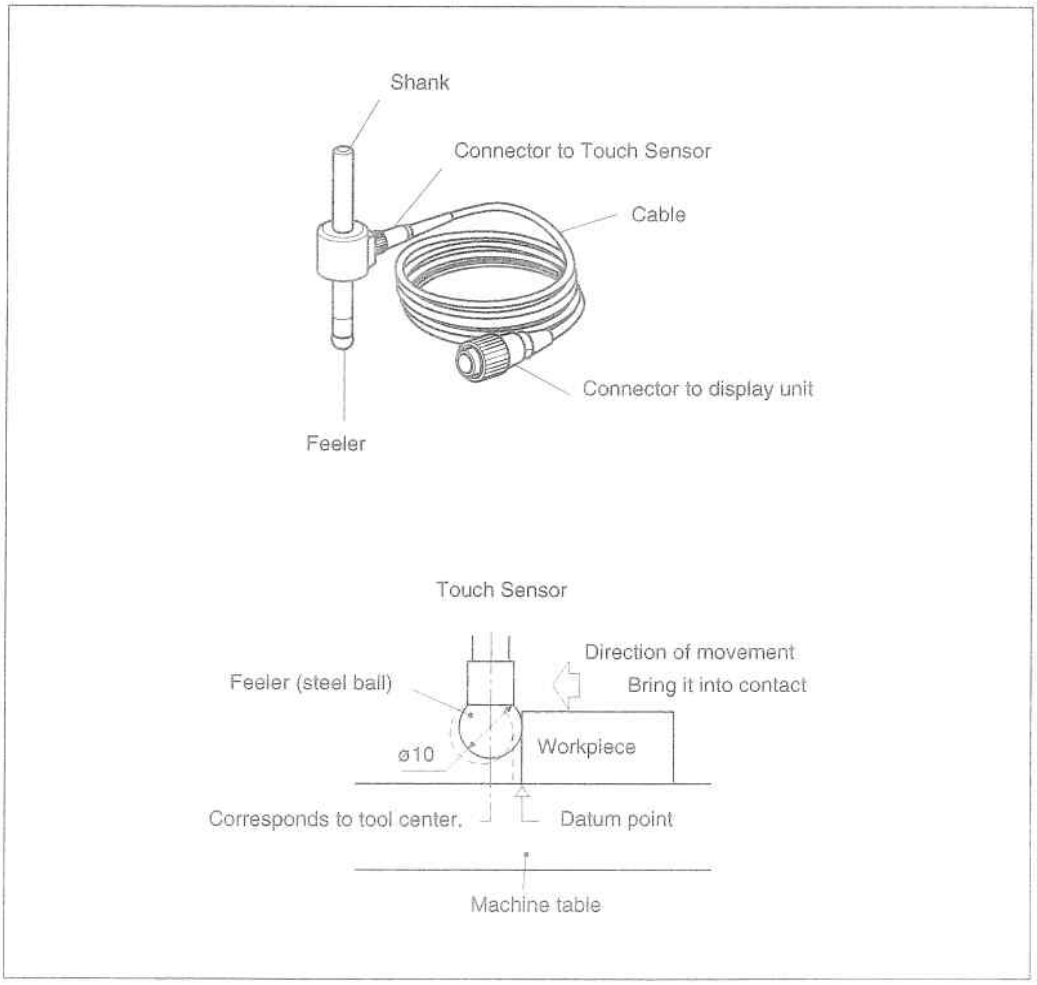
Operating Procedure	Display
Confirming multiple datum point No. S The datum point No. is displayed.	No. 1
Canceling the confirmation. /// The display returns to the original indication. The ABS indicator flashes.	Flashes 10.0000 ABS Present value display
Changing multiple datum point No. S The datum point No. is displayed.	No. 1
2 Enter the number you wish to chamge.	Lights → No.2
SET / L The present value display is returned to. The ABS indicator flashes.	Flashes 10.0000 ABS Present value display

Note

- The ABS/INC indicator flashes while multiple datum points are in use.
- When the datum point is returned to 0, the indicator changes from flashing to steady illumination.
- The arrow indicator lights during number input, and goes out when the Function setting key is pressed to confirm the number.

5-10. Touch Sensor (Option)

- Attach the Touch Sensor on the main spindle of a milling machine, for example, and use it in combination with the display unit.
- The feeler ball of the Touch Sensor is semi-fixed by a spring and its flexible construction can absorb shock when pressed against the datum plane, which enables accurate datum point detection without causing a deflection on the axis.
- The feeler ball, which has been forced aganist the workpiece, returns to the center of the axis when the workpiece is moved off.
- Move off the Touch Sensor immediately from the workpiece when it touches the workpiece. Do not bring the shaft into contact with the workpiece as doing so will decrease precision and may cause damage.
- The Touch Sensor can operate only with an electroconductive workpiece. Check the workpiece material before use.

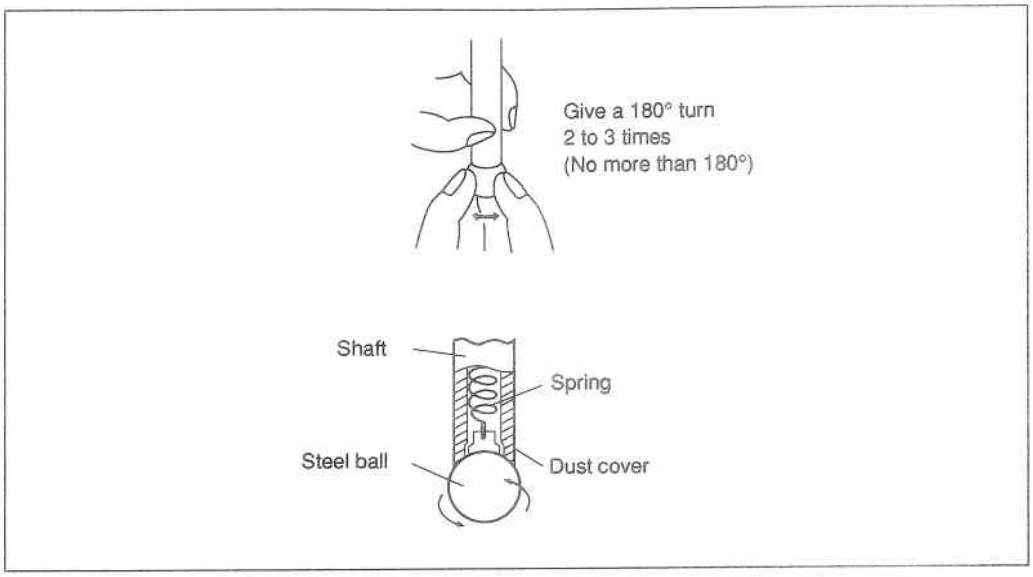


5-10-1. Cautions

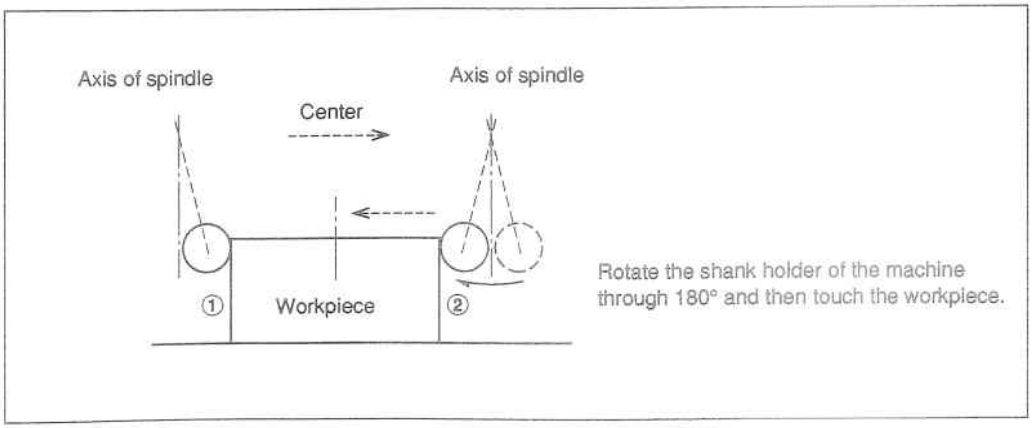
- Before use, be sure to turn the steel ball with the fingers about the axis of the shaft 2 or 3 times both clockwise and counterclockwise so that the steel ball rests properly on the end of the shaft.
  If this not done, the rust-preventive grease between the steel ball and shaft might cause a detection error.

Note

1. Do not turn the steel ball more than 180° in either direction since a spring is connected to it.
2. Do not pull the steel ball and let it spring back sharply against the end of the shaft.



- Fix the shank to the main spindle in such a way that the shank is not inclined against the axis of the spindle, since inclination of the shank will cause errors in the measurement.
- For more precise positioning at the center of the workpiece: Touch the workpiece with the feeler ball ①. Then, move the touch sensor to the other side of the workpiece, rotate the shank holder of the machine through 180° and then touch the workpiece ②. Half the measured value is the center of the workpiece.



- There are two ways to use theTouch Sensor: one is for establishing the datum point and the other is for measuring a workpiece without destroying the datum point.

Absolute mode (ABS)

This is a mode for establishing a datum point. A datum point can be established or a distance from the datum point can be measured by the LOAD/HOLD operation.

Incremental mode (INC)

In this mode, a datum point can not be established.
Pitch measurement of a workpiece can be performed by the LOAD/HOLD operation without destroying the datum point which has been already established.

- Depending on usage, set the display mode to INC or ABS with display mode switching controls before starting the actual controls.
- In the following examples , the resolution is 0.0005mm, and the feeler ball of the touch sensor is 10mm across.
- If a load or hold operation has been erroneously performed, depress the relevant Axis selector key and the [ø] key to cancel the operation, and perform the load or hold operation again.
- Be sure to touch the machine table with the touch sensor feeler ball gently. If the feeler ball touches the table roughly, the feeler ball and the table may be damaged.

5-10-2. Specifications

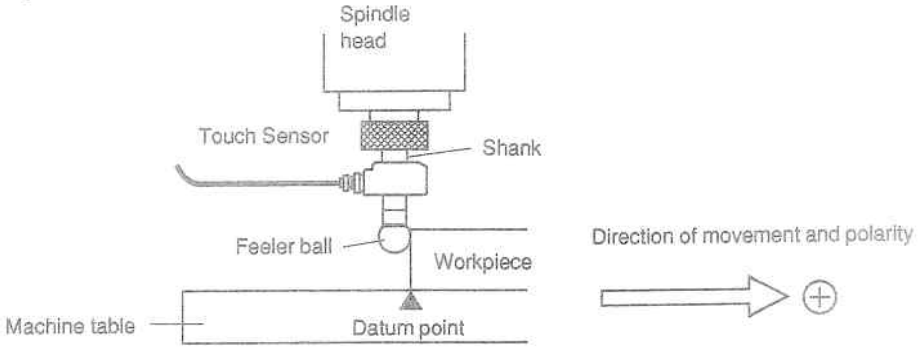
Model	TS-103A	TS-105A	TS-110A	TS-203A	TS-205A	TS-210A	TS-303A	TS-305A	TS-310A
Shank dia. and length	ø10 × 45 mm or 0.3937 in dia. × 1.772 in			ø12.7 × 45 mm or 0.5 in dia. × 1.772 in			ø32 × 55 mm or 1.260 in dia. × 2.165 in		
Detection direction	± X, ± Y								
Feeler	Steel ball, ø 10 mm or 0.3937 in dia.			Steel ball, ø12.7 mm or 0.5 in dia.			Steel ball, ø10 mm or 0.3937 in dia.		
Accuracy	0.002 mm or 0.0001 in			0.002 mm or 0.0001 in			0.002 mm or 0.0001 in		
Overall length	110 mm or 4.331 in			110 mm or 4.331 in			120 mm or 4.724 in		
Cable length	3m or 10 ft	5m or 16.7 ft	10m or 33.3 ft	3m or 10 ft	5m or 16.7 ft	10m or 3.3 ft	3m or 10 ft	5m or 16.7 ft	10m or 33.3 ft
Remarks	The cable and the Touch Sensor itself are connected/disconnected through the connector.								

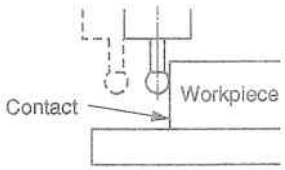
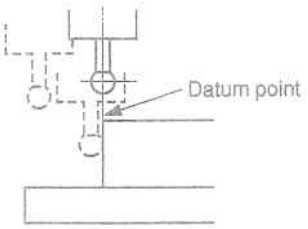
5-10-3. Maintenance

If the sensor is left unused for a long period, be sure to apply a rust-preventive. Especially, if the steel ball or shank rusts, the accuracy will be affected.
Rust Veto Heavy by E. F. Houghton & CO. is recommended as a rust preventive oil.

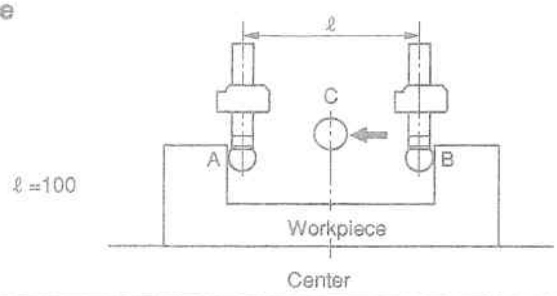
5-10-4. Touch sensor operations

1) Setting of datum point

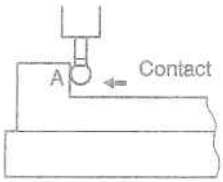
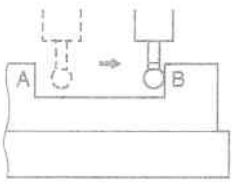
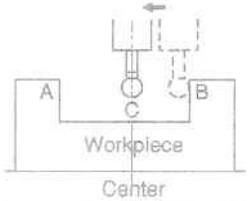


Operating Procedure		Display
X	Select the X-axis.	INC mm
ABS	Set the absolute mode (ABS). (The spot position is displayed.) The ABS indicator lights.	0.0000 mm ABS
X	Select the X-axis again.	ABS mm
SET / L	Depress the LOAD key to prepare for setting the datum point. The arrow indicator flashes.	Flashes -5.0000 mm ABS
	Bring the feeler of the Touch Sensor into contact with the workpiece. Upon contact, the buzzer sounds and counting starts. The LED (LOAD) goes off.	Buzzer -5.0000 mm ABS Counting
	Move the Touch Sensor. The position where the displayed value is "0" is the datum point. Depress the in/mm selector switch, if necessary, to perform inch operation.	0.0000 mm ABS

2) Centering of workpiece



Direction of movement and polarity

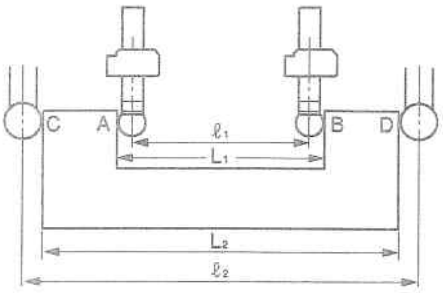
Operating Procedure	Display
X Select the X-axis.	INC mm
SET/L Set the absolute mode (ABS). (The spot position is displayed.) The ABS indicater lights.	0.0000 mm ABS
X Select the X-axis again.	ABS mm
SET/L Depress the LOAD key. The arrow indicater flashes.	Flashes 5.0000 mm ABS
 Touch the surface A of the workpiece with the feeler of the Touch Sensor. On contact the buzzer beeps and counting starts. The arrow indicater goes off.	Buzzer -5.0000 mm ABS
X Select the X-axis.	Buzzer
START/H Depress the HOLD key. It is ready for holding the display "ℓ". The arrow indicater goes off.	Counting (The arrow indicator flashes.)
 Move the Touch Sensor to touch the surface B. On contact the buzzer beeps and the display is held. The arrow indicater lights.	Llights 100.0000 mm ABS
℄  Depress the 1/2 key. The HOLD mode is released. The value displayed hereupon is the distance from the workpiece center C. The arrow indicater goes off. It is ready for centering. Move the Touch Sensor toward the workpiece center C. The position where the displayed value is "0" is the center.	45.0000 mm ABS Counting 0.0000 mm ABS

3) Inside and outside measurements of workpiece

Inside measurement $L_1=\ell_1+10mm$

Outside measurement $L_2=\ell_2-10mm$

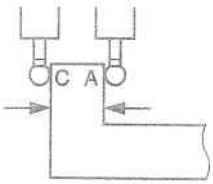
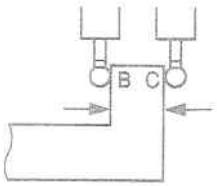
Example: $L_1=100$



⊕direction
Direction of movementand polarity

The display below shows the inside measurement.

Note
Make following measurements in millimeter operation.
Depress the in/mm selector key if necessary.

Operating Procedure		Display
X	Select the X-axis.	ABS mm
	Set the incremental mode (INC). (The spot position is displayed.) The INC indicater lights.	2.3400 mm INC
X	Select the X-axis again.	
SET / L	Depress the LOAD key. It is ready for setting the datum point on the side A (side C). The arrow indicater flashes.	Flashes 5.0000 mm INC
	Touch the side A (side C) with the feeler. On contact the buzzer beeps and counting starts. The arrow indicater goes off.	Buzzer 5.0000 mm INC
	Before touching the side B (side D), select the X-axis and depress the HOLD key.	Buzzer Counting starts
X START / H	It is ready for finding L_1 (L_2). The arrow indicater flashes.	Flashes 100.0000 mm INC
	Touch the side B (side D) of the workpiece with the feeler. The buzzer beeps and the displayed value is held, which is the value L_1 (L_2). The arrow indicater lights.	
X	Select X-axis again and depress the cancel key. The hold is canceled and the display will show the present value. The arrow indicater goes off.	123.6780 mm INC
//		

5.11 Detecting Function of Absolute Zero Point of Scale

- This function is valid in combination with a scale with built-in absolute zero point.
  Once the distance L between the machining datum point and the absolute zero point of the scale is found, the machining datum point can be relocated easily for repeated machining.
- When the unit is set to the detecting mode of the absolute zero point of the scale, the "⊥" mark and the ABS mark are displayed.
- If a load or hold operation has been erroneously performed, depress the relevant Axis selector key and the [⌀] key to cancel the operation, and perform the load or hold operation again.

Fig.1 Scale with built-in absolute zero point and machine movement

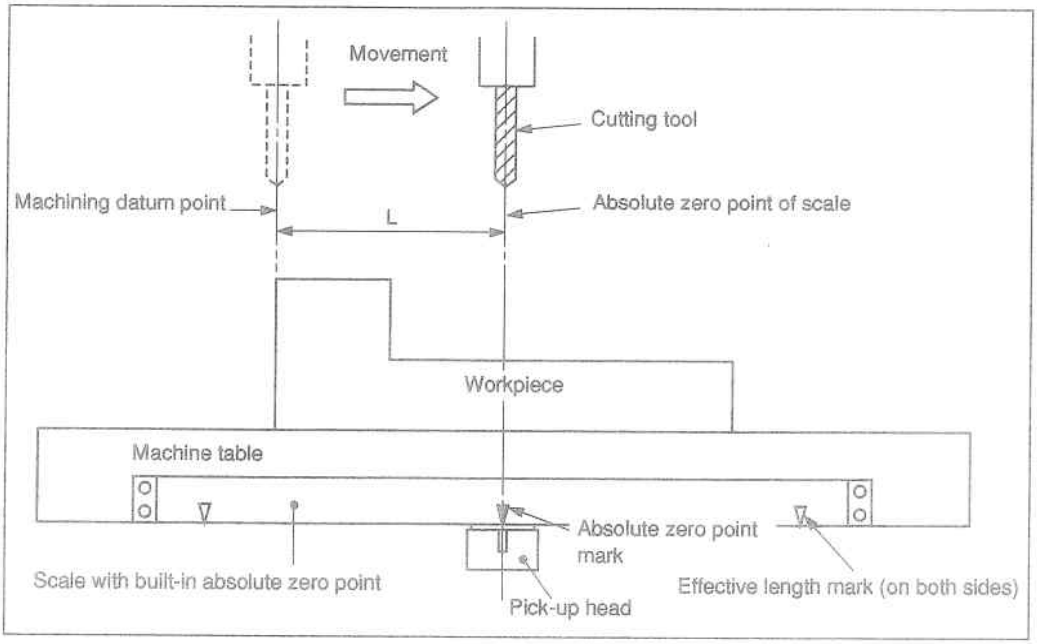


Fig.2 Setting of datum point

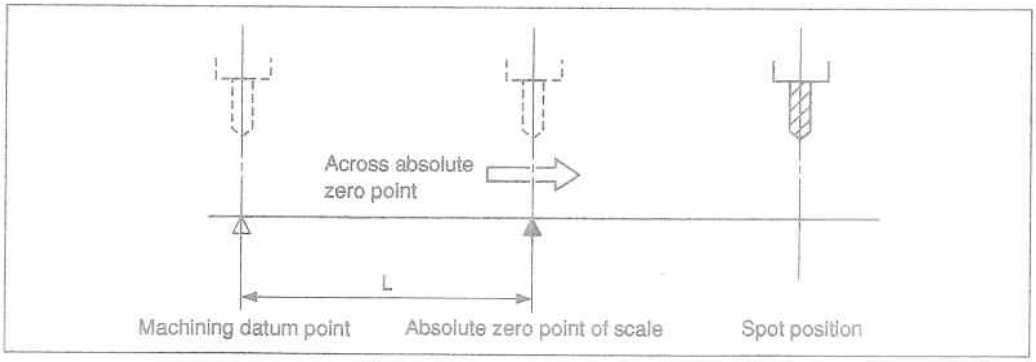
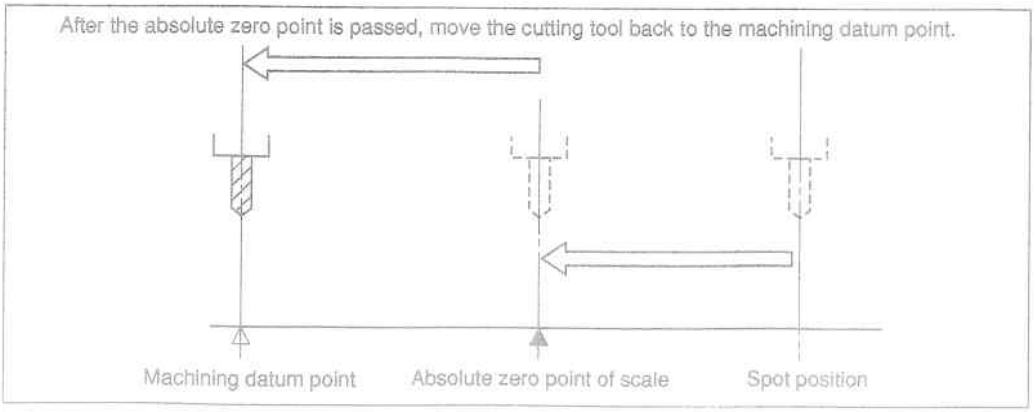


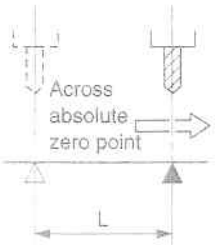
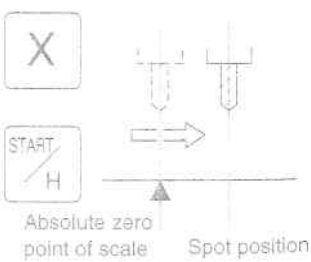
Fig.3 Relocation of datum point



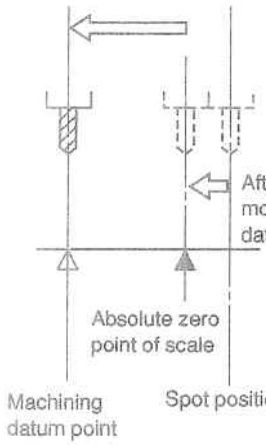
Note

- The display example shows the case where the resolution is set to 0.0005 mm.
- When operations are performed using remote control, the [F][F][F] operation can be executed by a single depression of the [↘] key.
- The same applies in the case of RS232C commands.
  Also, when an operation is performed using RS232C commands, there is a command that performs absolute zero point processing directly without setting the absolute zero point mode.

1) Setting of datum point

Operating Procedure		Display
[X]	Select the X-axis.	→ _ _ _ _ _ _ _ mm INC
([0])	"0" input can be omitted.	(→ 0. mm INC)
[S]	Depress the datum point setting key.	0.0000 mm ABS
[F] [F] [F]	When the "F" key is pressed three times, the absolute zero point mode LED lights.	0.0000 mm ABS REF Lights up
[X]	Select the X-axis again. The mark " ⊥ " ligths.	⊥ _ _ _ _ _ _ _ mm ABS REF Lights up Lights
[START/H]	Depress the HOLD key. (It is ready for holding the displayed value of the distance L between the machining datum point and the absolute zero point of scale.) Absolute zeropoint mode LED and arrow indicator flash.	Flashes 0.0000 mm ABS REF Flashes
	When the scale absolute zero point is passed, the buzzer sounds, the mark " ⊥ " and the arrow indicator light, and the display value is held. The absolute zero point mode LED lights.	Buzzer Lights 10.0000 mm ABS REF Lights
	Select the X-axis. Depress the HOLD key to release the HOLD mode. The spot position is displayed and the marks "→" and " ⊥ " go out. Here, the hold value is stored internally. **Note** When this processing is performed with an RS232C command, "H" is replaced by "S".	⊥ _ _ _ _ _ _ _ mm REF Lights (Example) 12.0000 mm ABS REF Lights

2) Relocation of datum point

Operating Procedure	Display
F F F Press the "F" key three times to set the absolute zero point mode. Set to the Absolute zero point mode.	0.0000 mm INC REF ● Lights
X Select the X-axis again.. The mark " ⊥ " ligths.	⊥ - - - - - - - mm INC Lights REF ● Lights
SET/L Depress the LOAD key. "L=10.0000 mm/0.39370 in," the distance between the machining datum point and the absolute zero point of scale, is dsiplayed, and the arrow and absolute zero point mode LED flash.	Flashes 10.0000 mm ABS REF ● Flashes
 As soon as the absolute zero point of scale is passed, the buzzer beeps, counting starts, the mark " ⊥ " and absolute zero point mode LED lights up. The position where the displayed value is "0" is the datum point. After the absolute zero point is passed, move the cutting tool back to the machining datum point.	Buzzer Counting starts 0.0000 mm ABS REF ● Lights

5-12. Offset Zero Point

The offset zero point function is to set the distance (offset value) between the absolute zero point of scale and the datum plane of the machine table in the display unit beforehand, which makes zero point setting on a boring machine and the like easy and effective.

Note

Also notice that, in the offset zero point function, the memorized L value in the datum point setting is changed to the offset value ΔY.
On the other hand, when L is stored into memory when setting the datum point, the offset value ΔY is changed to L.

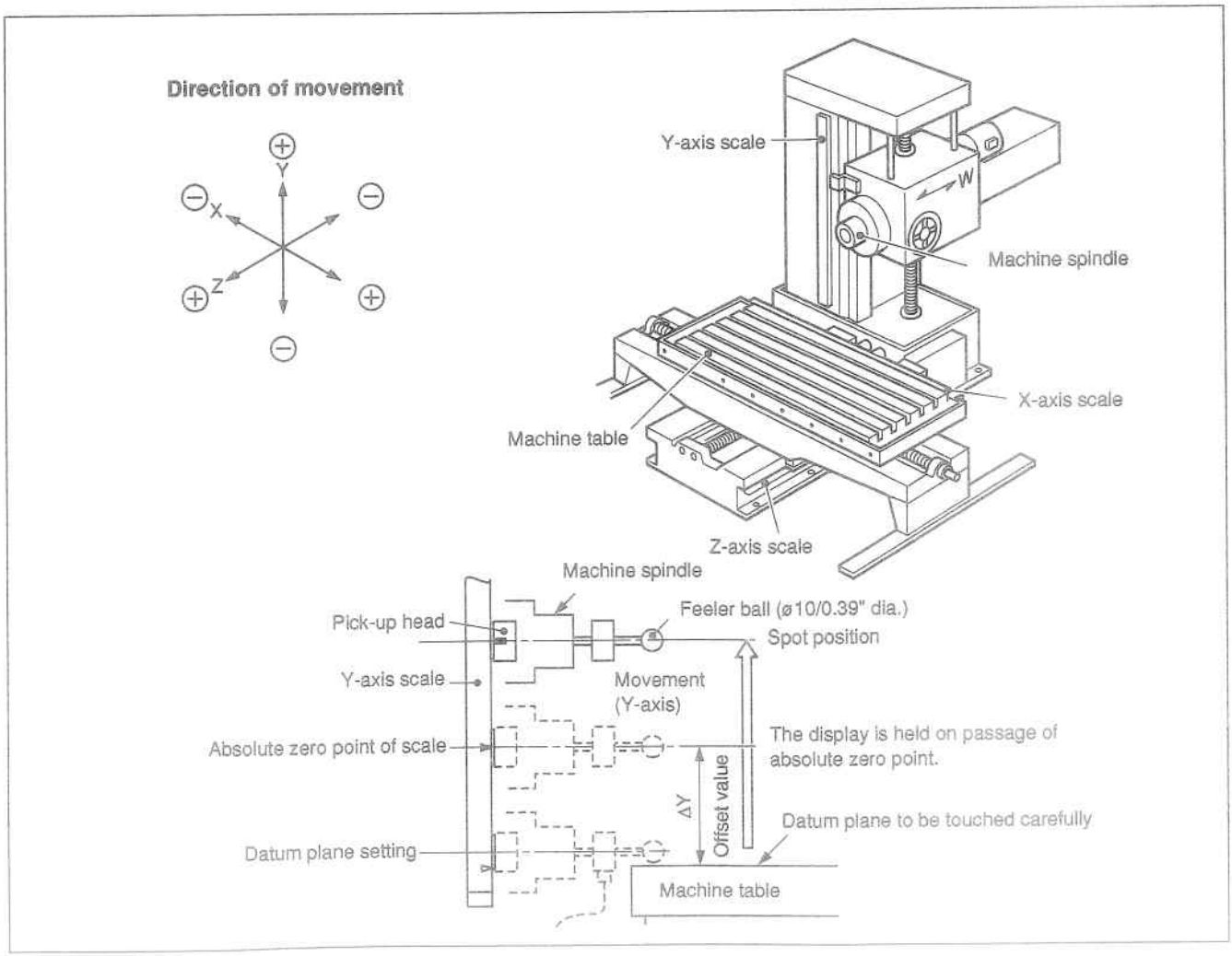
Measurement of offset Value

Using the Touch Sensor (option), measure the distance ΔY (offset value) between the absolute zero point of the scale and the datum plane of the machine table.
This is the most suitable method for obtaining a high-accuracy offset value without damaging the machine table surface.
This section describes the method which uses our Touch Sensor. See page 5 for Touch Sensor connection and page 33 for the specifications. Measuring examples are shown below.

Notes on measurement

Do not bring the machine spindle directly into contact with the machine table surface for measurement, as this may cause damage to the spindle and the table surface.

Example: Y-axis maching on the horizontal boring machine



5-12-1. Measurement of the offset value ΔY

Note

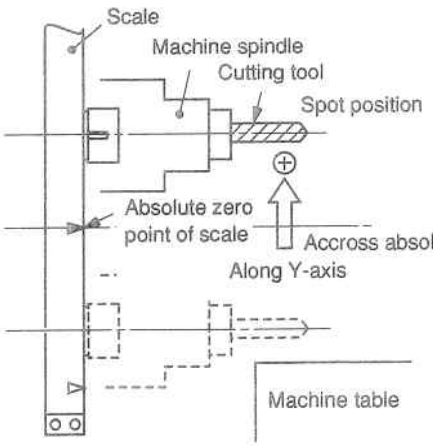
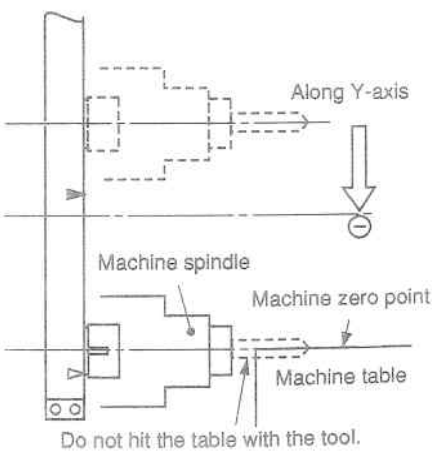
- In the example shown below, the resolution is set to 0.0005 mm.
- When operations are performed using remote control, the [F][F][F] operation can be executed by a single depression of the [½] key.
- The same applies in the case of RS232C commands.
  Also, when an operation is performed using RS232C commands, there is a command that performs absolute zero point processing directly without setting the absolute zero point mode.

Operating Procedure		Display
[Y]	Select the Y-axis. **Note** If it is in the INC mode, switch to the ABS mode.	ABS - - - - - - - mm Flashes
[SET/L]	Depress the LOAD key. The arrow indicator flashes.	5.0000 mm ABS
Touch the machine table carefully. Setting of datum plane Machine table	On contact of the feeler to the machine table, the buzzer beeps and the counting starts at the loaded display value. When the feeler touches the machining table, the buzzer sounds and the counting starts from the loaded display value. The arrow indicator is off.	Buzzer Counting starts
[F][F][F]	Depress the "F" key three times to set the absolute zero point mode. Set to the absolute zero point mode.	
[Y]	Select the Y-axis. The mark " ⊥ " lights up.	Buzzer
[START/H]	Depress the HOLD key. The "➡" mark and absolute zero point mode LED flash. (It is ready for holding the value of the distance ΔY to the absolute zero point of scale)	REF Flashes
Note/ 102.4070 mm or 4.03424 in Offset value ΔY	Move the machine spindle and make it pass over the absolute zero point of the scale. The buzzer beeps, the mark " ⊥ " and the arrow indicator light and the offset value ΔY is held. The absolute zero point mode LED also light. * By storing the held offset value ΔY in memory, ΔY can be set easily when the display unit is replaced. Refer to "5-1-5. Setting offset value ΔY.	Lights 102.4700 mm ABS REF Lights
[Y]	Select the Y-axis.	Display of Spot position
[START/H]	Depress the HOLD key. The mark " ⊥ " and arrow indicator go out, the held display is released, and the spot position is displayed. At this time, the hold value is stored internally. **Note** When this processing is performed with an RS232C command, "H" is replaced by "S".	123.6750 mm ABS REF Lights or 4.86908 in ABS REF Lights

5-12-2. Operation of offset zero point

Note
In the example shown below, the resolution is set to 0.0005 mm.

The following is an example of Y-axis operation. For X-, Z-axis, perform the same key operation for each axis.

Operating Procedure	Display
F F F Depress the "F" key three times to set the absolute zero point mode. Set to the Absolute zero point mode. Y Select the Y-axis. The mark " ⊥ " lights up.	0.0000 mm INC REF Lights mm INC REF Lights
SET/L Depress the LOAD key. The offset value ΔY in the display unit is displayed. The offset value ΔY stored in the display unit is displayed. The arrow indicator and Absolute zero point mode LED.	Flashes 102.4700 mm ABS REF Flashes
 When the machine spindle is moved in the + direction along the Y-axis, and the absolute zero point of the scale is passed, the buzzer sounds, the " ⊥ " count is started, and the spot position is displayed. The mark " ⊥ " and arrow indicator go out. The absolute zero point mode LED lights.	Buzzer Counting starts
 Next, move the machine spindle toward the (–) side along the Y-axis. Theposition where the displayed value is "0" is the machine zero point. **Caution** Be carefull not to hit the machine table with the tool when moving the machine spindle inthe (–) direction.	0.0000 mm ABS REF Lights

5-13. RS232C Input/Output

When RS232C input/output is used, the following input/output operations are possible.
- Display data output
- Basic key operation input
- Program data input/output (see 5-14-7 Inputtin and outputting the program via the RS232C".

5-13-1. Display data output

If the [P] key is pressed when the present values are displayed, the displayed data is output to the RS232C in accordance with the format specified in the initial settings.

Operating Procedure	Display
(Present values displayed) Press the Preset key. P	(Present values displayed) Data output

Note
If the [P] key is pressed consecutively, it should be released for one second or longer. Data will not be output if it is pressed within one second.

In computer communication mode

Continuous output mode

[X][①][②][=][Data][Space][Y][①][②][=][Data][Space][Z][①][②][=][Data][CR][LF]

or

New line output mode

[X][①][②][=][Data][CR][LF]
[Y][①][②][=][Data][CR][LF]
[Z][①][②][=][Data][CR][LF]

[Data] The data is signed zero-suppressed 7-digit data (space when sign is positive)
[①] : Display status (N: normal, D: double display)
[②] : Display mode (I: INC, A: ABS)
[③] : Unit (M: mm, I: inch)

Note
In the case of two axes, there is no Z-axis data.

In P30 mode

[R][③][①][Space][Data][CR][LF]

The [Data] is signed zero-suppressed 6-digit X-axis data (space when the sign is positive), and the 7th digit is not output.

5-13-2. Basic key operation input

Basic key operations can be input as RS232C commands.
Remote operations are possible via RS232C. Program, bolt hole circle, and similar application functions and initial settings cannot be performed with RS232C.

Description of input commands (X-axis example)

Reset (display zero):	x CR LF
Preset:	X Number P CR LF
Datum point setting:	X Number M CR LF
ABS display setting:	X A CR LF
INC display setting:	X I CR LF
Touch sensor load:	X I CR LF
Touch sensor hold:	X h CR LF
Touch sensor hold 1/2:	X D CR LF
Scale absolute zero point load:	X Number L CR LF
Scale absolute zero point hold:	X H CR LF
Scale absolute zero point hold value save:	X S CR LF
Scale absolute zero point load (offset zero point):	X L CR LF
Display value (INC) 1/2:	X D CR LF
Preset value recall:	X Q CR LF
Cancel:	X C CR LF
X-axis data request:	X r CR LF

Note
Ensure that numbers are set correctly in accordnace with the resoultion setting so that they do not overrun the display. If the format is not appropriate, processing will not be performed correctly. See the number setting example below.

When data is requested, the data is output in the form X ① ② Data CR LF.
The data is signed zero-suppressed 7-digit data (space when the sign is positive).

Note
① and ② are as described in the previous section.

Example of correct setting with 0.005 mm resolution

OK, since least significant digit is 5

[X] [—] [1] [6] [.] [4] [3] [5] [M] [CR] [LF]

OK, since there is no overflow in 4 digits before decimal point

[X] [9] [8] [7] [6] [.] [4] [3] [5] [P] [CR] [LF]

OK, since there is no overflow, and resolution is appropriate

[X] [1] [0] [P] [CR] [LF]

[X] [—] [5] [.] [5] [P] [CR] [LF]

Example of incorrect setting with 0.005 mm resolution

NG, since least significant digit is 1 rather than 5

[X] [9] [8] [7] [6] [.] [4] [3] [1] [P] [CR] [LF]

NG, since there is overflow in 5 digits before decimal point

[X] [9] [8] [7] [6] [2] [.] [3] [1] [P] [CR] [LF]

- Processing can be performed in the same way for the [Y] and [Z] axes if [X] is replaced with Y or Z.
- If data is required for all axes, the following applies.
  [#] [CR] [LF] or [R] [CR] [LF]
  When data is requested for all axes, the data is output in the same format as when the [P] key is pressed.
  (In P30 mode, only X-axis data is output.)
- Absolute zero point/touch sensor mode switching is as follows.
  [F] [CR] [LF]

The above command and data exchanges are possible. See the next section for ASCII codes.

5-13-3. Program data input/output codes

Character ASCII codes handled by the LH41 are shown below.

Operation		Corresponding ASCII
Numbers	0	0 ($30)
	1	1 ($31)
	2	2 ($32)
	3	3 ($33)
	4	4 ($34)
	5	5 ($35)
	6	6 ($36)
	7	7 ($37)
	8	8 ($38)
	9	9 ($39)
	•	• ($2E)
Polarity	+	+ ($2B)
	–	– ($2D)
Preset		P ($50)
Datum point setting		M ($4D)
ABS display		A ($41)
INC display		I ($49)
Cancel		C ($43)

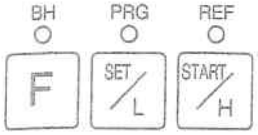
Operation	Corresponding ASCII
Store	S ($53)
Preset value recall	Q ($51)
Load with touch sensor	l ($6C)
Hold with touch sensor	h ($68)
Load at absolute zero point	L ($4C)
Hold at absolute zero point	H ($48)
1/2	D ($44)
X-axis reset	x ($78)
Y-axis reset	y ($79)
Z-axis reset	z ($7A)
Each axis data request	r ($72)
X-axis selection	X ($58)
Y-axis selection	Y ($59)
Z-axis selection	Z ($5A)
Absolute zero point/ touch sensor mode switching	F ($46)
All axes data request	# ($23) and R ($52)

As command delimiters, transmitted and received delimiters are CR ($0D) and LF ($0A). When commands are sent, they should be delimited by delimiters.

Transmission example:

X A CR LF Y A CR LF Z A CR LF

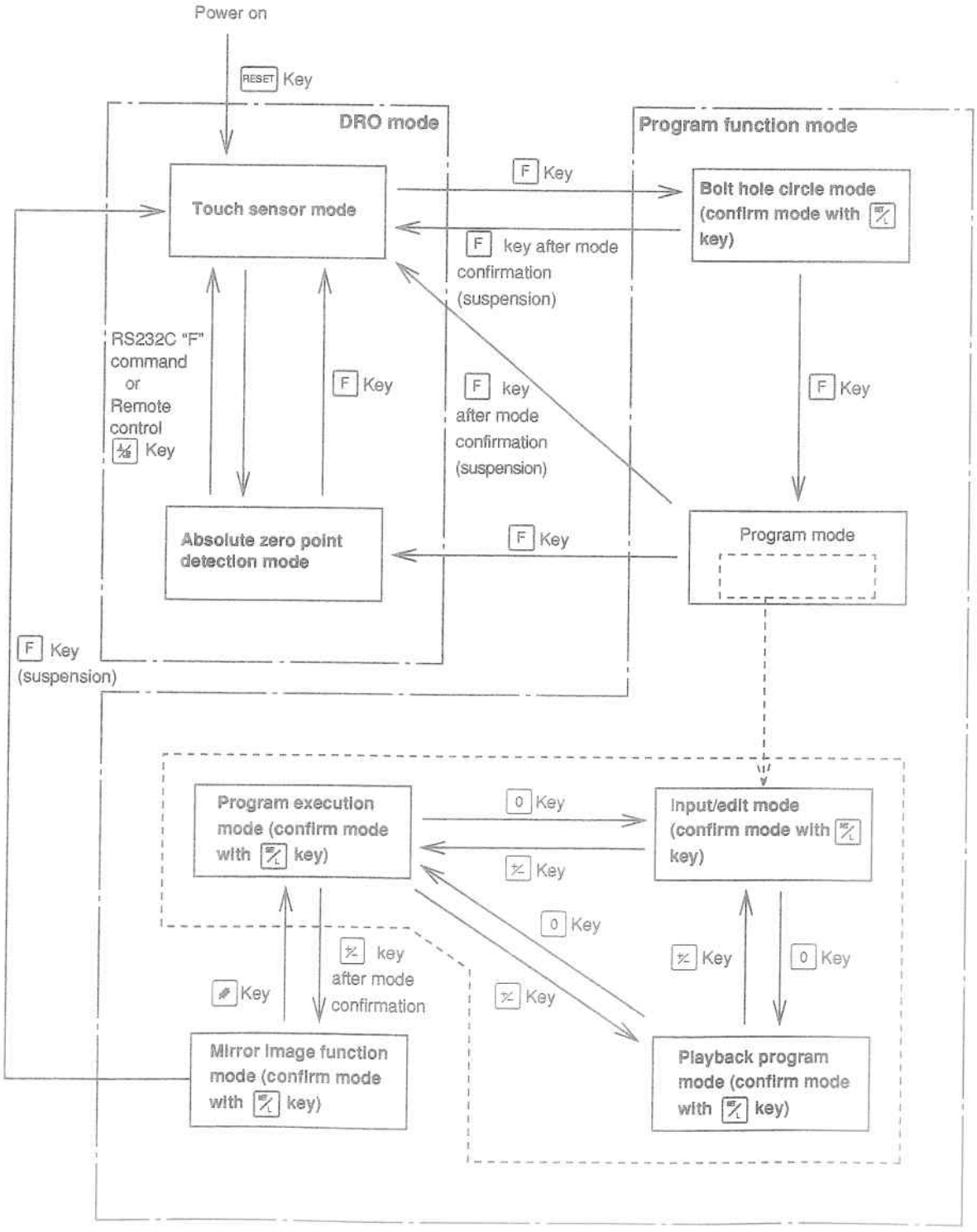
5-14. F Key Operations



Press the F key once .... Bolt hole circle mode is selected (BH lights up).
Press the F key twice .... Program mode is selected (PRG lights up).
Press the F key three times .... Absolute zero point detection mode is selected (REF lights up).
Press the F key four times .... Touch sensor mode is selected (all LEDs go off).

LH41 mode state transition diagram

Mode state transitions resulting from LH41 F key operations are shown below.



5-14-1. Program mode selection

There are three program modes: input/edit mode "Ed 17", playback program mode "PLAY", and program execution mode "EXEC". Before starting operations, you should select the mode and then perform the respective operations.

Operating Procedure	Display
[F] [F] Press the "F" key twice to select the program mode. The PRG mode LED lights.	→Ed 17 (Input/edit mode) BH ○ PRG ● Flashes REF ○
[0] Press the "0" key to advance the mode.	→PLAY (Playback program mode) BH ○ PRG ● Flashes REF ○
[+/−] Press the "+/-" key to restore the mode.	→EXEC (Program execution mode) BH ○ PRG ● Flashes REF ○
[SET/L] Press the Function setting key to set the mode. The arrow indicator goes out.	Ed 17 BH ○ PRG ● Flashes REF ○
When each mode is entered, the previous program No. is displayed.	No. 10 BH ○ PRG ● Lights REF ○
[1] [SET/L] When starting the No.1 program, press the "1" key and Function setting key.	→ No.= 1 BH ○ PRG ● Flashes REF ○
	No. 1 BH ○ PRG ● Lights REF ○
	Or
[SET/L] When not changing the program No. Press the Function setting key.	No. 10 BH ○ PRG ● Lights REF ○
	⇓ After approx. 2 seconds Lights
	0.000 mm ABS 0.000 mm ABS 0.000 mm ABS BH ○ PRG ● Lights REF ○
Note • If the datum points are not set, ("0" is displayed), set them as necessary. • Not necessary in the input/edit mode. All 0's are entered.	
(The operations for each mode follow.)	

5-14-2. Program input/edit mode operations

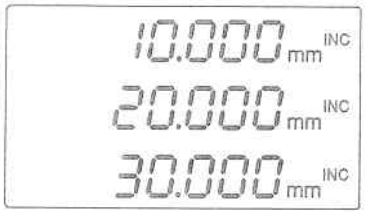
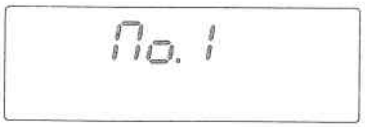
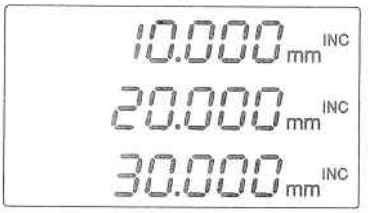
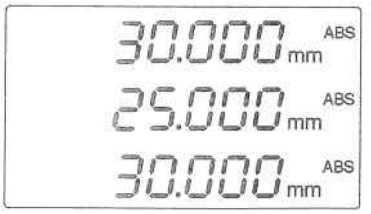
Select the program input/edit mode.

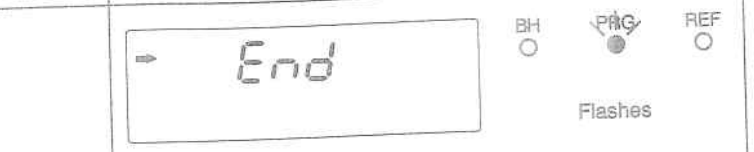
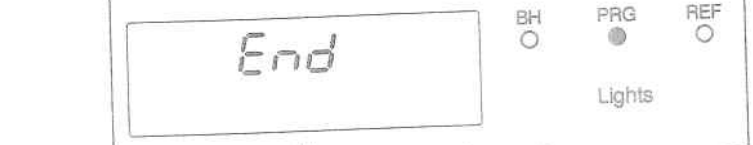
Operating Procedure	Display
[I] Preset value program input X 1 0 P Y 2 0 P Z 3 0 P SET/L X, Y, Z preset data is stored as incremental positioning data. **Program No. 1:** X← −10.000/Y← −20.000/Z← −30.000	10.000 mm INC 20.000 mm INC 30.000 mm INC BH ○ PRG ● (Flashes) REF ○ No. 1 BH ○ PRG ● (Lights) REF ○
	⇓ After approx. 1 second
	No.2 BH ○ PRG ● (Lights) REF ○
	⇓ After approx. 1 second
	0.000 mm INC 0.000 mm INC 0.000 mm INC BH ○ PRG ● (Flashes) REF ○
X 2 0 S Y 5 S Z 1 0 S SET/L X, Y, Z preset data is stored as absolute positioning data. **Program No. 2:** X← −20.000/Y← −5.000/Z← −10.000	20.000 mm ABS 5.000 mm ABS 10.000 mm ABS BH ○ PRG ● (Flashes) REF ○ No.2 BH ○ PRG ● (Lights) REF ○
	⇓ After approx. 1 second
Note In the program input/edit mode, incremental positioning data and absolute positioning data can be selected and stored.	No.3 BH ○ PRG ● (Lights) REF ○
	⇓ After approx. 1 second
	0.000 mm ABS 0.000 mm ABS 0.000 mm ABS BH ○ PRG ● (Flashes) REF ○

Operating Procedure	Display
⫽ End (termination) input SET/L Store End. **Program No. 3:** [End]	→ End BH ○ PRG ● REF ○ Flashes End BH ○ PRG ● REF ○ Lights ⇓ After approx. 1 second
Displays the present values. (Program mode end) **Note** • Input End in the final program step. • The maximum number of program steps is 480. (No. 1 to No. 480)	Present value display BH ○ PRG ○ REF ○ Off
[II] Program confirmation/amendment (When displayed from No. 1) 0 When the "0" key is pressed, the step advances.	No. 1 BH ○ PRG ● REF ○ Lights No.2 BH ○ PRG ● REF ○ Lights ⇓ After approx. 1 second 20.000 mm ABS 5.000 mm ABS 30.000 mm ABS BH ○ PRG ● REF ○ Lights
+/− When the "+/-" key is pressed, the step returns. **Note** When making an amendment, display the No. of the program to be amended, and perform input again using operating procedure [I].	No. 1 BH ○ PRG ● REF ○ Lights ⇓ After approx. 1 second 10.000 mm ABS 20.000 mm ABS 30.000 mm ABS BH ○ PRG ● REF ○ Lights

5-14-3. Playback program mode operations

Select the playback program mode.

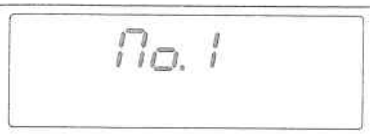
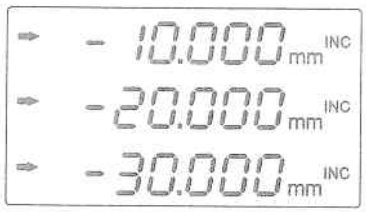
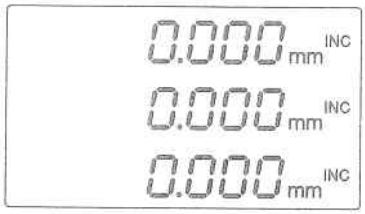
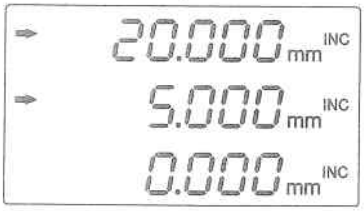
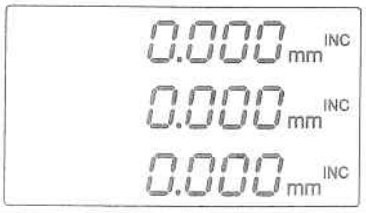
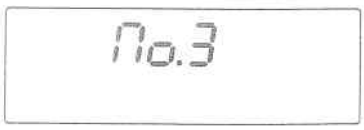
Operating Procedure	Display
Move the playback program operation scale. X: 10 mm Y: 20 mm Z: 30 mm	 BH ○ PRG ● Flashes REF ○
SET/L Store the data. **Program No. 1:** X← −10.000/Y← −20.000/Z← −30.000	 BH ○ PRG ● Lights REF ○
	After approx. 1 second
	 BH ○ PRG ● Lights REF ○
	After approx. 1 second
	 BH ○ PRG ● Flashes REF ○
	 BH ○ PRG ● Flashes REF ○
Move the scale again X: 20 mm Y: 5mm	
SET/L Store the data. **Program No. 2:** X← −30.000/Y← −25.000/Z← −30.000	 BH ○ PRG ● Lights REF ○
	After approx. 1 second
Note In the playback program mode, absolute data is stored.	 BH ○ PRG ● Lights REF ○
	After approx. 1 second
	 BH ○ PRG ● Flashes REF ○

Operating Procedure	Display
End (termination) input	
Store End. **Program No. 3:** [End]	
	After approx. 1 second
Displays the present values. (Program mode end)	

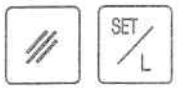
Note
Input End in the final program step.

5-14-4. Program execution

Select the program execution mode.

Operating Procedure	Display
START/H Call the program.	 BH ○ PRG ● REF ○ Flashes
	After approx. 2 seconds
Move the scale so that the X, Y and Z axes display "0". An arrow indicator appears on the moved axis. When the value approaches "0", the arrow indicator flashes. When the value is equal to "0", the arrow indicator goes out. (Determination of equality to "0" is within 3 counts.)	 BH ○ PRG ● REF ○ Flashes
	 BH ○ PRG ● REF ○ Lights
Note • If the scale is moved at high speed, the arrow indicator may not go out even though "0" is passed. • See 5-14-8 for the range in which the arrow indicator starts to flash.	
START/H Call the program.	 BH ○ PRG ● REF ○ Flashes
	After approx. 2 seconds
Move the scale so that the X, Y and Z axes display "0".	 BH ○ PRG ● REF ○ Flashes
	 BH ○ PRG ● REF ○ Lights
START/H Call the program.	 BH ○ PRG ● REF ○ Flashes
	After approx. 2 seconds
End of the program.	 BH ○ PRG ● REF ○ Lights
// Press the Cancel key to end the program.	Present value display BH ○ PRG ○ REF ○ Off

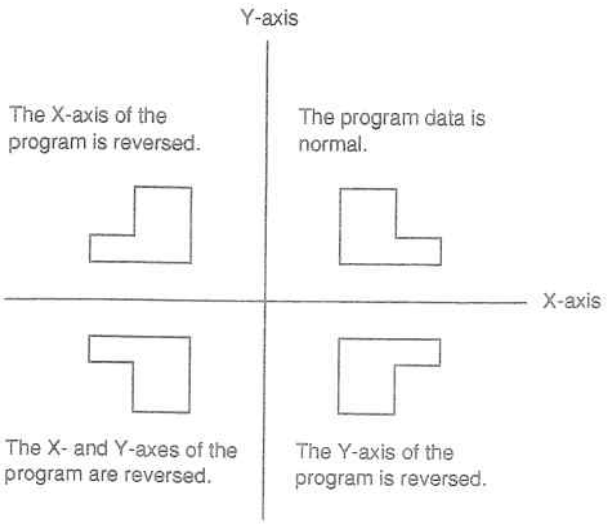
5-14-5. Other operations and displays

Operating Procedure		Display	
	Input program End in the input/edit mode or playback mode.	End	BH ○ PRG ● REF ○ Lights
	If the Cancel key is pressed when End or FULL is displayed, the program mode is canceled and the display shows the present values (INC).	0.000 mm INC 0.000 mm INC 0.000 mm INC	BH ○ PRG ○ REF ○ Off
	If End is stored in the memory in the program execution mode, End is displayed when the Excecute key is pressed.	End	BH ○ PRG ● REF ○ Lights
	If storage is attempted when the program memory is full in the program input/edit mode or playback program mode, FULL is displayed.	FULL	BH ○ PRG ● REF ○ Lights
	To cancel the program mode during an operation, press the "F" key. The display shows the present values (INC).	br-Ert	BH ○ PRG ○ REF ○ Off

5-14-6. Mirror image function

The data for each axis can be reversed with the mirror image unction. Mirror image machining can be executed by reversing the program data.

Operating Procedure	Display
Setting and confirmation [+/-] Select the program execution mode. If the "+/-" key is pressed when the data for each axis is displayed, the present status will be displayed. (Perform this operation before pressing the [CAN] key.)	X -1 Y -1 Z -1 BH ○ PRG ● REF ○
[CAN] Press the Cancel key, and the confirmation display will be canceled.	
Reverse the X-axis [X] Select the X-axis. Depressing the "X" key once reverses the X-axis. Depressing the "X" key again returns the X-axis to normal.	X 1 Y -1 Z -1 BH ○ PRG ● REF ○
[SET/L] Press the Function setting key to end the setting.	
[START/H] Press the Execute key to execute the mirror image operation.	



Note

Mirror image data is lost when the power is turned off. It should be set before use after the power is turned on. As the settings remain while power is on after settings have been made, you should confirm the previous settings before use when running a program.

5-14-7. Inputting and outputting the program via the RS232C

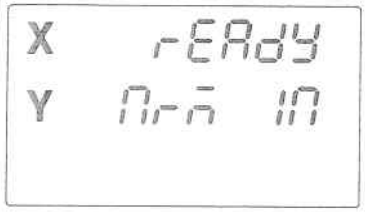
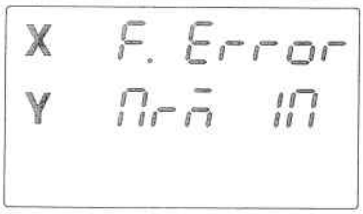
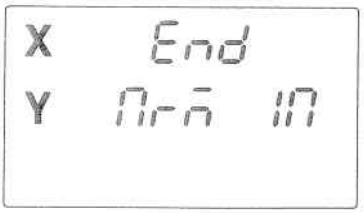
Program data can be exchanged via the RS232C by using a personal computer or our company's NF12. Prepared programs can be sent to and stored in a personal computer or the NF12, and programs created on a personal computer can be received and executed.

Note

The communication format should be selected in the initial settings. Program input/output is not possible if the RS232C is in P30 mode. See "8. RS232C Input and Output" for connection details, including the connector pin configuration.

Select the program input/edit mode.

Operating Procedure	Display
Set and confirm the program transfer mode. [P] Press the Preset key. Perform this operation while the program No. is being displayed.	X NORMAL Y OUT BH ○ PRG ● REF ○ Lights
[//] Press the Cancel key, and the program transfer mode is canceled. This key can be pressed at any time other than during communication. (The program input/edit mode is returned to.)	X 10.0000 mm INC Y 5.0000 mm INC BH ○ PRG ● REF ○ Lights
Set the data format. [X] Select the X-axis.	X→ NORMAL Y OUT BH ○ PRG ● REF ○ Lights
[0] [+/−] Switch the data format with the "0" and "+/-" keys. Normal ⇔ NF12	X→ NF 12 Y OUT BH ○ PRG ● REF ○ Lights
Set input or output. [Y] Select the Y-axis.	X NORMAL Y→ OUT BH ○ PRG ● REF ○ Lights
[0] [+/−] Switch between input and output with the "0" and "+/-" keys. OUT ⇔ IN	X NORMAL Y→ IN BH ○ PRG ● REF ○ Lights

Operating Procedure	Display
Confirming the settings SET / L Press the Function setting key after the settings are completed.	 BH ○ PRG ● REF ○ Lights
Starting the communication START / H Press the Execute key.	 BH ○ PRG ● REF ○ Lights
Interrupting the communication Press the Cancel key. (The communication is simply interrupted, and the mode does not change. The program transfer mode is retained.)	 BH ○ PRG ● REF ○ Lights (Displayed for approx. 2 seconds)
Data format error If the data format is wrong, a format error will result. Check the data, and start the communication over again.	 BH ○ PRG ● REF ○ Lights
Finishing the communication After finishing the communication, return from the transfer mode by pressing the / key (Cancel key).	 BH ○ PRG ● REF ○ Lights

Input and output format

For the NF12: [%] [CR] [LF] [Data] [%]

For NORMAL: [Data]

Data

N	O	.	※	X	Number	Unit	$$	CR	LF
				Y	Number	Unit	$$	CR	LF
				Z	Number	Unit	$$	CR	LF
N	O	.	※	E	N	D	CR	LF	

Note

※: Program number, Unit: in/mm, and $$: INC/ABS
The end of input is identified by "END" or "%" (for the NF12).
If output mode is interrupted, "%" will be output in NF12 mode.

5-14-8. Arrow indicator flashing range when program is executed

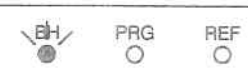
The range in which the arrow indicator starts flashing when the display value approaches "0" duri
program execution or bolt hole circle execution depends on the resolution.

(mm/inch)

Resolution	Arrow Indicator Flashing Range
0.0005/0.00002	Approx. ± 0.8000/± 0.03150
0.001/0.00005	Approx. ± 2.000/± 0.07875
0.005/0.0001	Approx. ± 8.000/± 0.3150
0.01/0.0005	Approx. ±20.00/± 0.7875

5-15. Bolt Hole Circle Function

When the bolt hole circle function is used, holes can easily be made on the same circumference on the X-Y plane simply by inputting the diameter, number of divisions, and starting angle.

Operating Procedure	Display
[F] Press the F key to select the B.H mode.	d 1A=  Flashes
[SET/L] Press the Function setting key to set the B.H data input mode.	
For a diameter of 10.000 mm	
[1] [0] Press the number keys.	d 1A= 10.000 mm  Lights
[P] Press the Preset key.	
For a division number of 100	
[1] [0] [0] Press the number keys.	n= 100 An=45.0  Lights
[P] Press the Preset key. (Maximum 360 divisions, corresponding to 360°.)	
For a starting angle of 45°	
[4] [5] Press the number keys.	
[P] Press the Preset key. (0° to 359.9°, in 0.1° units)	
[START/H] Press the Execute key to start the B.H program.	001- 100  Lights
Note Align the scale position with the center of the circle before starting.	
The position of the No. 1 hole is displayed. The bolt hole circle mode LED flashes. Move the X- and Y-axis scales so that the display becomes "0". An arrow indicator appears on the moved axis. When the value approaches "0", the arrow indicator flashes. When the value is equal to "0", the arrow indicator goes out.	⇓ After approx. 2 seconds
Note • If the scale is moved at high speed, the arrow indicator may not go out even though "0" is passed. • See 5-14-8 for the range in which the arrow indicator starts to flash.	→ -3.535 mm → -3.535 mm 0.000 mm  Flashes
[START/H] Press the Execute key. The position of the No. 2 hole is displayed.	0.000 mm 0.000 mm 0.000 mm  Lights

Operating Procedure		Display	
Cancel B.H mode F	The PRG, B.H and REF-LEDs all go out. The display returns to the present values.	brEAK	BH ○ PRG ○ REF ○
End B.H mode ///	After processing of the last hole is finished, press the Execute key to End the operation. If an operation is performed when End is displayed, the display will return to the present values.	End	BH ○ PRG ○ REF ○

5-16. Data Backup

When power is switched to OFF, the display value and preset data values are automatically held in memory. Because of this function, it is possible to interrupt operation and switch the power OFF or even sustain a sudden power outage without losing data. Restoring data is thus greatly simplified.

Interrupting the operation

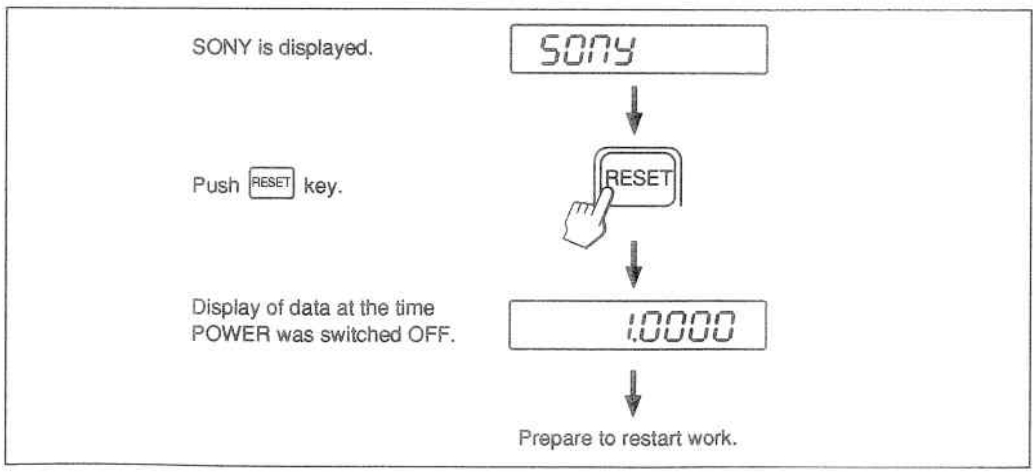
1 Lock the Machine.
Before interrupting the operation, be sure to lock the machine. Otherwise, correct restoration of the displayed value may be impossible.

2 Set the POWER Switch to OFF.
Data will be retained at the point the power is switched OFF.

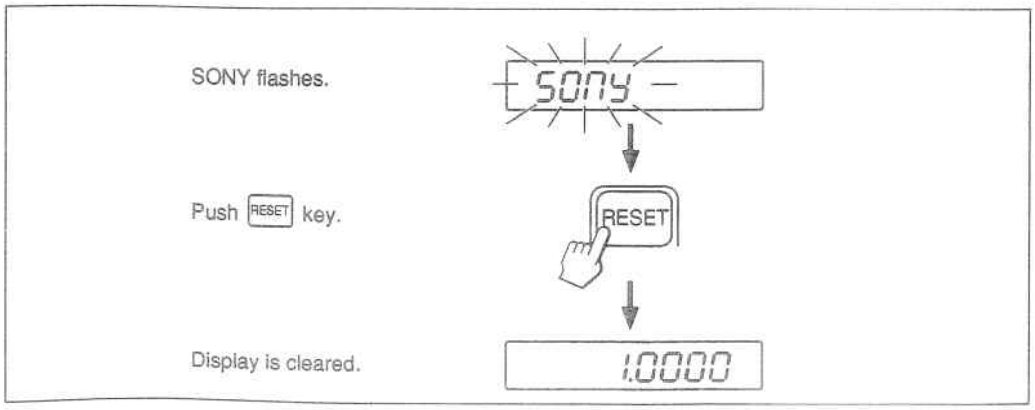
Note
If the machine table is moved after the power is switched OFF, the table movement is not tracked and when power is restored, the table position will not agree with the stored data which is displayed automatically.

Resuming operation

1 Set the POWER Switch to ON.
- Normal Restart



- When the stored data is erroneous



2 Unlock the Machine and Resume Operation

6. LINEAR COMPENSATION

Generally a machine tool has its inherent geometric error.
For example, with a knee type milling machine, the knee is slightly tilted as the table moves and the horizontal component of this inclination is added to the scale displacement as an error. When the displayed value is obtained by

Scale reading + Error compensation ➡ Displayed value

corresponding to the actual displacement, the mechanical error is compensated and the more accurate display is obtained for the actual displacement of the machine table, thus attaining more accurate machining.
The unit is factory-set so that the linear compensation function does not work.

6-1. Setting Linear Compensation

The error compensation is made by adding or subtracting a compensation amount to or from the scale reading for every given table displacement.

Notes on the setting

1) The compensation amounts in Table below apply to a displacement of 1m for the millimeter operation and 1" for the inch operation. Be sure to set the compensation amount in the relevant operation. Precision machining and accurate measurement are not possible if a wrong compensation amunt is set.

2) For a compensation amount not listed in the table, set the closest value.

3) Regarding the polarity, select a positive (+) compensation when the displayed value is smaller than the actual length and a negative (–) compensation when the displayed value is greater.

Linear compensation amount

Select any compensation amount per meter (or per inch) referring to the following table.
When initializing the compensation amount, its least significant three digits will be displayed. Select an appropriate value from the table.

	Compensation amount		Initial setting display
	Per meter	Per inch (inches)	
No compensation	0	0	LC 000
Plus (+) setting	0.002 mm	0.000002"	LC 002
	0.004 mm	0.000004"	LC 004
	0.006 mm	0.000006"	LC 006
	0.008 mm	0.000008"	LC 008
	0.010 mm	0.000010"	LC 010
	0.015 mm	0.000015"	LC 015
	0.020 mm	0.000020"	LC 020
	\ (0.005 mm step) \	\ (0.000005" step) \	LC \ (005 step) \
	0.600 mm	0.000600"	LC 600
Minus (–) setting	–0.002 mm	–0.000002"	LC –002
	–0.004 mm	–0.000004"	LC –004
	–0.006 mm	–0.000006"	LC –006
	–0.008 mm	–0.000008"	LC –008
	–0.010 mm	–0.000010"	LC –010
	–0.015 mm	–0.000015"	LC –015
	–0.020 mm	–0.000020"	LC –020
	\ (0.005 mm step) \	\ (0.000005" step) \	LC \ (005 step) \
	–0.600 mm	–0.000600"	LC –600

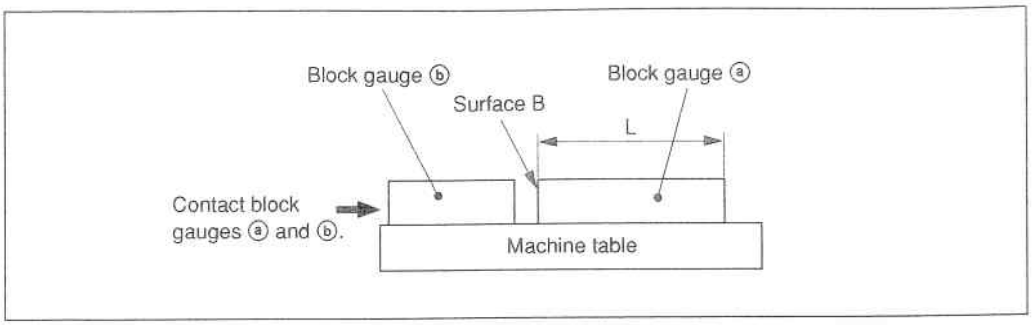
- When the error characteristics of the machine are known, select the most suitable compensation amount from the table, and perform setting of addition or subtraction referring to "5-1-3. Setting linear compensation."
- When the error characteristics of the machine are unknown, measure the error to be compensated according to the method described in 6-2. and select an appropriate compensation amount from the table. Set the selected amount according to "5-1-3. Setting linear compensation."

6-2. Measuring Linear Compensation Amount

Note
The following applies when the resolution is 0.0005mm (0.00002").

1 Place a block gauge ⓐ on the machine table until the block gauge ⓐ assumes the same temperature as the machine table. Then touch the surface B of the block gauge ⓐ with a block gauge ⓑ.

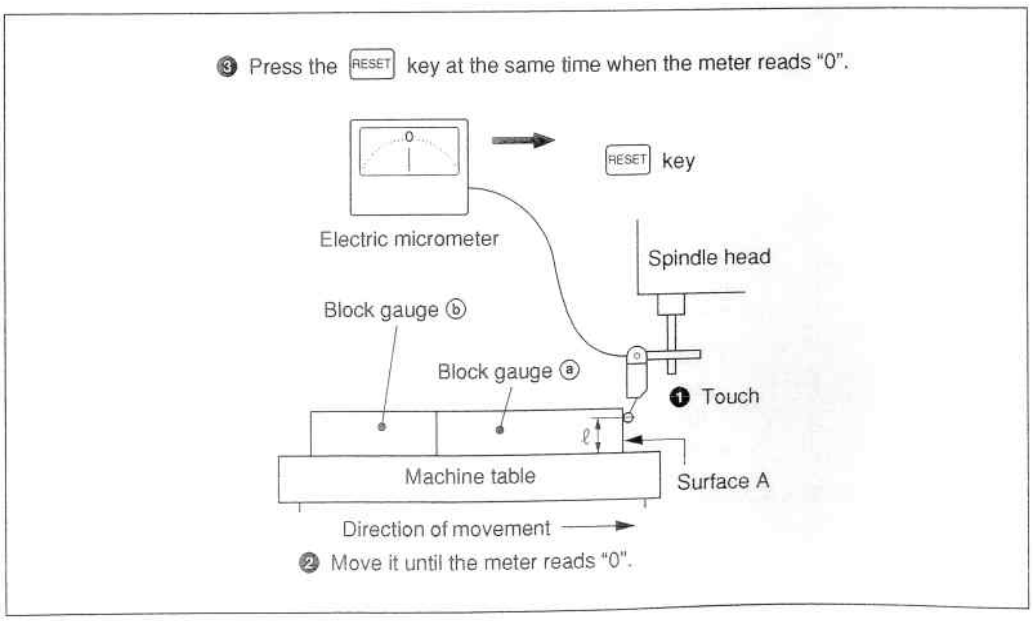
Example: L = 250 mm (L = 9.84250 inch)



2 Touch the surface A of the block gauge ⓐ with the probe of an electric micrometer or dial gauge and move the machine table until the meter of the micrometer or the dial gauge reads "0", where the datum point is obtained. Simultaneously reset the display unit.

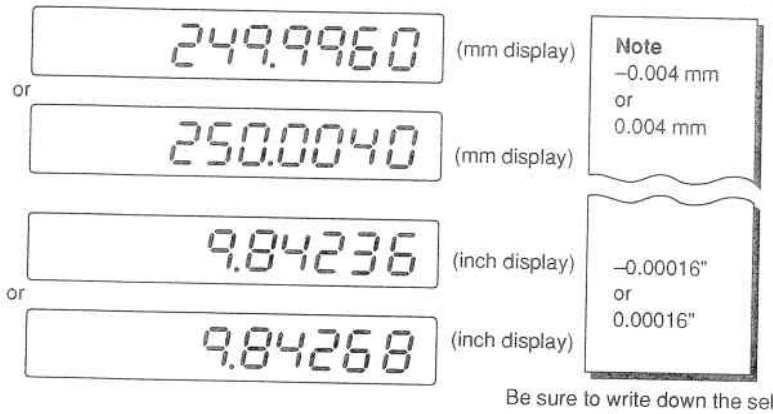
(mm display)

(inch display)



3 Next, move the table away from the probe and remove the block gauge ⓐ, move the machine table again, touch the surface C of the block gauge ⓑ with the probe of the electric micrometer or dial gauge, and move the machine table until the meter reads "0". The difference between the length L of the block gauge ⓐ and the displayed value on the display unit is the linear error to be compensated.

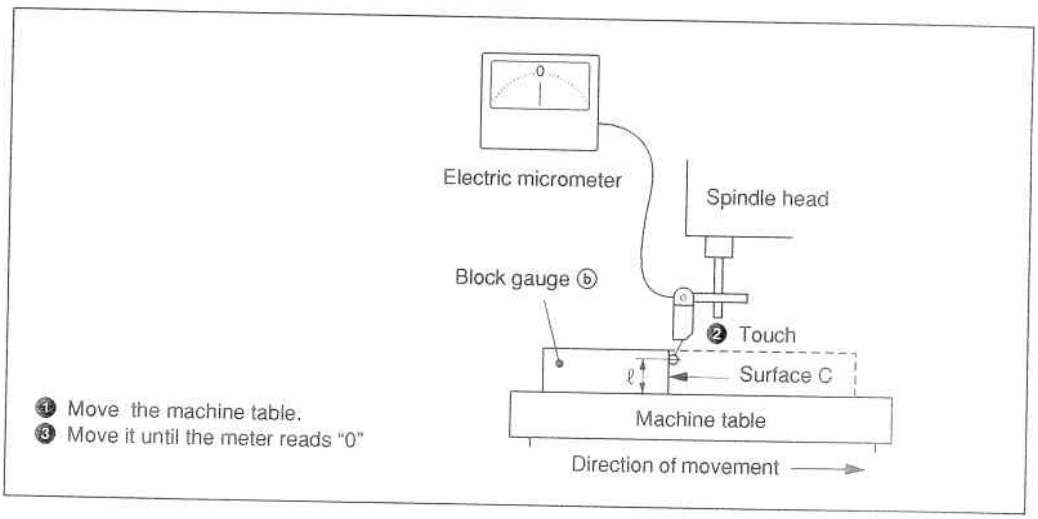
Examples of setting linear compensation amounts are shown on the next page.



Be sure to write down the selected compensation amount.

Note

When measuring surfaces A and C with the probe, the heights of the probe must be the same. Otherwise, the measurement error may increase.



Examples of setting linear compensation amounts.

As the mechanical error is measured, set the compensation amount with reference to the following examples.

Addition or subtraction to or from the displayed value for the displacement

L: Length of block gauge ⓐ
ℓ: Displayed value for the distance between the surfaces A and C

When L>ℓ, add a compensation amount to the displayed value.
Set an appropriate positive compensation amount.

- Example in millimeter operation
  Where L = 250 mm, ℓ = 249.9960 mm, the difference between L and ℓ is 0.004 mm. The amount χ to be compensated per meter (1000 mm) is:

$$\frac{0.004\text{mm}}{250\text{ mm}} \Rightarrow \frac{\chi}{1000\text{ mm}} \quad \chi = 0.016\text{ mm}$$

  The compensation amount, therefore, is 0.016 mm.
  Set "015" as the closest compensation amount.

- Example in inch operation
  Where L = 9.84252" and ℓ=9.84236", the difference between L and ℓ is 0.00016". The amount χ to be compensated per inch is:

$$\frac{0.00016"}{9.84252"} \Rightarrow \frac{\chi}{1"} \qquad \chi = 0.000016"$$

  The compensation amount, therefore, is 0.000016". Set "015" as the closest compensation amount.

When L < ℓ, subtract a compensation amount from the displayed value.
Set an appropriate negative compensation amount.

- Example in millimeter operation
  Where L=250 mm, ℓ=250.0040 mm, the difference between L and ℓ is 0.004 mm. The amount χ to be compensated per meter (1000 mm) is:

$$\frac{0.004\text{ mm}}{250\text{ mm}} \Rightarrow \frac{\chi}{1000\text{ mm}} \quad \chi = 0.016\text{ mm}$$

  Therefore the compensation amount is –0.016 mm.
  Set "–015" as the closest compensation amount.

- Example in inch operation
  Where L=9.84252" and ℓ=9.84268", the difference between L and ℓ is 0.00016". The amount χ to be compensated per inch is:

$$\frac{0.00016"}{9.84252"} \Rightarrow \frac{\chi}{1"} \qquad \chi = 0.000016"$$

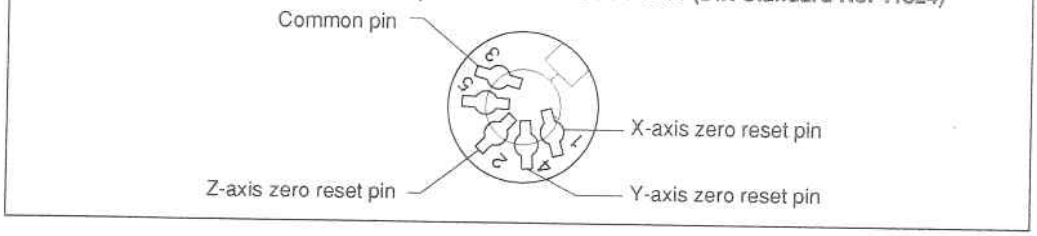
  The compensation amount, therefore, is –0.000040".
  Set "–015" as the closest compensation amount.

7. REMOTE RESET INPUT CONNECTOR

The display can be remote-reset to zero by connecting a mechanical or electronic (IC) switch to the remote reset input connector.
The input circuit of each axis is as shown below.

Pin numbers of remote reset input connector

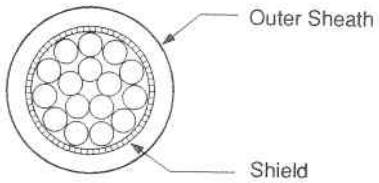
Connector plug (provided) Hosiden Corporation TCP 1354-71-5011 (DIN Standard No. 41524)



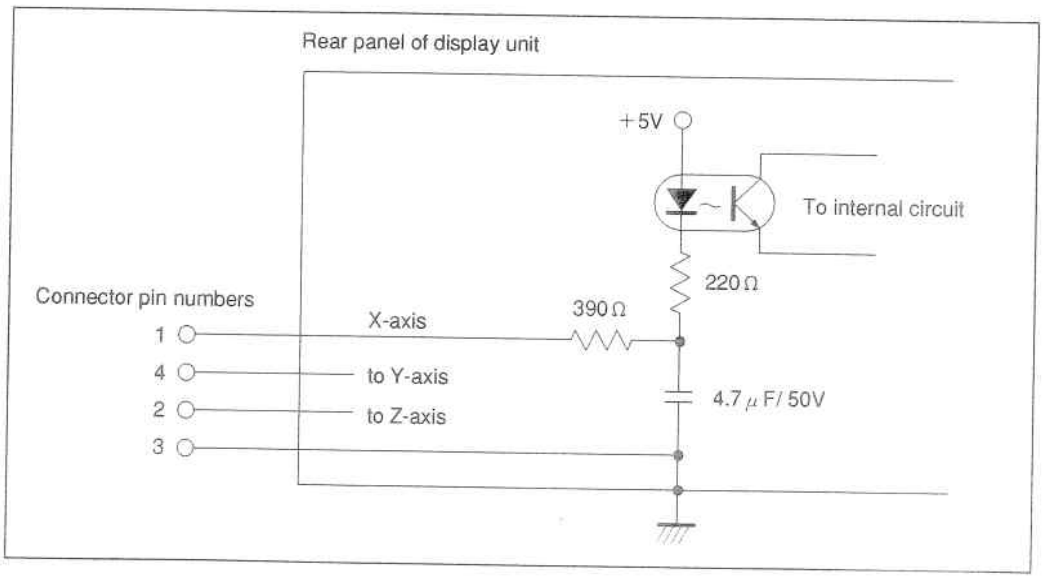
Interface Cable

The interface cable to be connected to the remote reset input connector must be shielded as follows. (The cable length should be no more than 30 m.)

Cross section of the cable



Remote reset input circuit



- When using the remote reset, connect the remote reset input terminal to the (GND) common terminal for at least 30 mS.
  Before inputting the remote reset a second time, set the unit to OFF for at least 30mS.
- Use SN75451or SN75452 for an electronic switch.
- Use a shielded cable for connection and connect the shield sheath to the shell of the supplied connector. The common pin should be wired separately from the shield sheath.
  (Prepare a proper switch and a shielded cable by yourself.)

8. RS232C INPUT AND OUTPUT

Signals

Conforming to EIA-RS232C

- Signals: Asynchronous, start-stop, half-duplex
- Communication speed: Switchable among 1200, 2400, 4800, or 9600 bps
- Stop bits: Switchable between 1 or 2 stop bits
- Parity: Switchable among even parity, odd parity, or no parity
- Data length: Switchable between 7 or 8 bits

Switching of the various parameters is performed in the initial settings.

Electrical Specifications

1) Driver side: Using MAX232 or equivalent product

Output voltage width	±5 V to ±10 V
Output resistance	300 Ω or more
Output short-circuit current	±10 mA

2) Receiver side: Using MAX232 or equivalent product

Input resistance	3 to 7 kΩ
Input allowable voltage	±30 V
Input threshold	Low 1.2 V, High 1.7 V

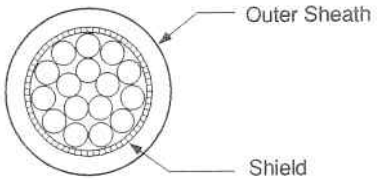
3) Input/output connector

Plug	DB-25P (JAE) or equivalent product
Receptacle	DB-25S (JAE) or equivalent product

4) Cable length

A cable length of no more than 15 m(50 feet) should be used.
A shielded cable should be used, and the shield must be connected to the connector housing.

Cross section of the cable



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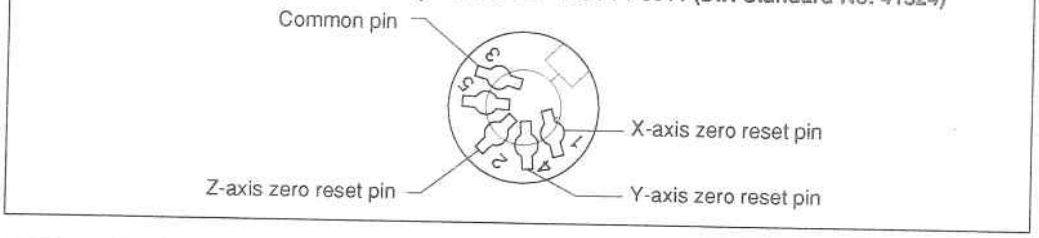
Pin numbers of remote reset input connector

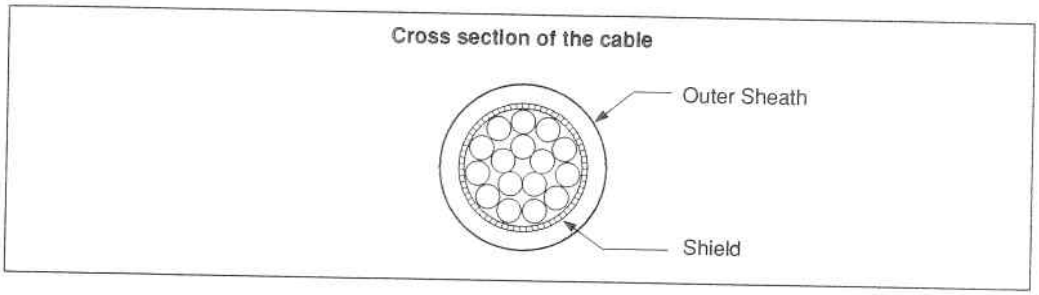
Connector plug (provided) Hosiden Corporation TCP 1354-71-5011 (DIN Standard No. 41524)



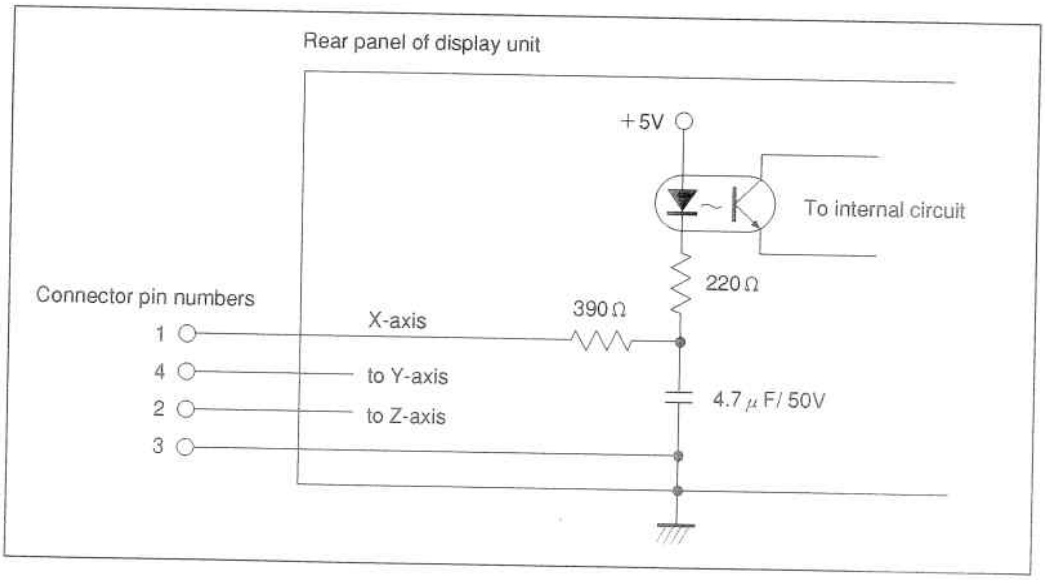
Interface Cable

The interface cable to be connected to the remote reset input connector must be shielded as follows. (The cable length should be no more than 30 m.)

Cross section of the cable



Remote reset input circuit



- When using the remote reset, connect the remote reset input terminal to the (GND) common terminal for at least 30 mS.
  Before inputting the remote reset a second time, set the unit to OFF for at least 30mS.
- Use SN75451or SN75452 for an electronic switch.
- Use a shielded cable for connection and connect the shield sheath to the shell of the supplied connector. The common pin should be wired separately from the shield sheath.
  (Prepare a proper switch and a shielded cable by yourself.)

8. RS232C INPUT AND OUTPUT

Signals

Conforming to EIA-RS232C

- Signals: Asynchronous, start-stop, half-duplex
- Communication speed: Switchable among 1200, 2400, 4800, or 9600 bps
- Stop bits: Switchable between 1 or 2 stop bits
- Parity: Switchable among even parity, odd parity, or no parity
- Data length: Switchable between 7 or 8 bits

Switching of the various parameters is performed in the initial settings.

Electrical Specifications

1) Driver side: Using MAX232 or equivalent product

Output voltage width	±5 V to ±10 V
Output resistance	300 Ω or more
Output short-circuit current	±10 mA

2) Receiver side: Using MAX232 or equivalent product

Input resistance	3 to 7 kΩ
Input allowable voltage	±30 V
Input threshold	Low 1.2 V, High 1.7 V

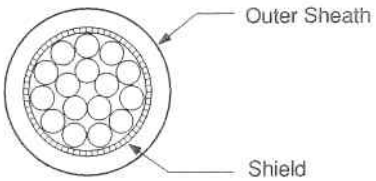
3) Input/output connector

Plug	DB-25P (JAE) or equivalent product
Receptacle	DB-25S (JAE) or equivalent product

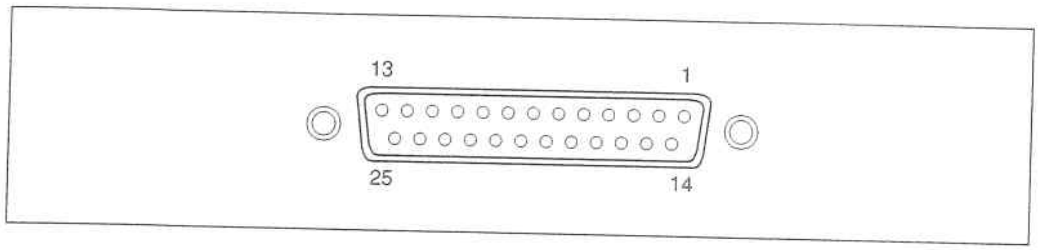
4) Cable length

A cable length of no more than 15 m(50 feet) should be used.
A shielded cable should be used, and the shield must be connected to the connector housing.

Cross section of the cable



RS232C Input/Output Connector



RS232C connector on display side

Pin No.	Signal	Abbreviation
1	Frame GND	FG
2	Received data	RXD
3	Transmit data	TXD
4	Clear to send	CTS
5	+10 V output	RTS
6	Pull up to +10 V	DTR
7	Signal GND	SG
8 to 12	Cannot be connected	—
13 to 25	—	NC

Connector on connected equipment side

Abbreviation
FG
TXD
RXD
RTS
CTS
DSR
SG
DTR

Note

- When TXD, RXD, FG and SG are connected, the display side operates, but other wiring should also be carried out in accordance with the connected side (computer) specifications.
- Pin number 6 is pulled up to +10 V inside the display.

9. ALARM DISPLAY

When any one of the displays described below appears, reset and perform the operation from the beginning.

Display	Trouble	Causes
Error	Excess speed	When the scale movement exceeds the maximum response speed of the display unit. (This alarm also functions when the machine receives a great shock.)
Flashes – Error –	Scale disconnected	**When the scale is not connected:** Turn the power off, connect the scale, and turn the power back on again. The display will be reset to "0".
F000000	Overflow	When the display overflows, "F" is indicated in the most significant digit.
SONY	Power failure	When the power fails momentarily during measurement.
Flashes – SONY –	Error in stored data	When the stored data has been changed by noise, etc.

Note

When an error in the stored data is shown by SONY flashing on the display, check the settings according to "5-1. Initial Settings". If any erroneous setting is found, make a correct setting again.

10. TROUBLESHOOTING

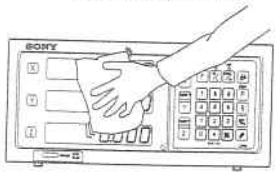
When the unit does not work properly, check the following before calling Sony Magnescale Representative for service.

The power cannot be turned on. (Unstable power connection)	• Turn off the power switch and turn it on 1 to 2 minutes later. • Check the connection and continuity of the power cable. • Check for the proper range of power voltage.
SONY **is displayed.** (Alarm)	• Check the connection and continuity of the power cable. • Check for high level noises. (Replace with a normal axis.) • Turn off the power switch and turn it on 3 seconds later. • Perform resetting operation.
Error **is displayed.** (Alarm)	• Check the scale signal connector is secured by screws. • Check the conduit cable is not damaged or disconnected. • Check to see if the scale has moved faster than the maximum response speed. • Check for any severe vibration. • Check for high level noises. (Replace with a normal axis.) • Turn off the power switch and turn it on 3 seconds later. • Perform resetting operation.
No counting	• Turn off the power switch and turn it on 3 seconds later. • Check to see if the scale signal connector is loosely coupled. (Replace with a normal axis.)
Erroneous counting	• Turn off the power switch and turn it on 3 seconds later. • Check to see if the scale signal connector is loosely coupled. • Check for poor grounding due to rust or breakage. • Check the power voltage is in the specified range. (To keep power voltage within the specified range, use an automatic AC voltage regulator.) • Check that the grounding is made correctly.
Accuracy cannot be obtained	• Check to see if the unit occasionally miscounts. • Check for any mechanical trouble that may affect accuracy. (Any trouble due to machine adjustment, deflection or play). • Check to see if the temperature difference between the scale, machine and workpiece is great.

Cleaning

To clean the display and casing:

Use dry cotton cloth



To remove heavy dirt:

Use diluted neutral detergent

Do not use

11. SPECIFICATIONS

Connectable scale Magnescale ×2 axes (LH41A-2)
Magnescale ×3 axes (LH41A-3)

No. of axes displayed 2 axes (LH41×-2)
3 axes (LH41×-3)

Display digits 7 digits and minus display, fluorescent character display tube (leading–zero suppression, floating minus sign system)

Resolution 0.0005 mm, 0.001 mm, 0.005 mm, 0.01 mm, and diameter display (0.00002", 0.00005", 0.0001", 0.0005" and diameter display)

Maximum response speed
60 m/min.
1.8 m/min when detecting absolute zero point.

Alarm display
- Temporary power failure
- Scale movement speed faster than the maximum response speed
- Error in stored data
- Scale disconnected

Reset Resettable at any point on the scale with key switch control or external reset.

Preset Preset with key switch control.

Recall Recall of the data stored by Preset with key switch.

Datum point memory Datum point can be set with key switch. (Max. 10 points)

ABS/INC conversion With the datum point set at any point on the scale, the absolute distance from the datum point can be displayed while machining in the ABS mode.

Touch sensor Combined with touch sensor (option), it performs detection of the datum plane.
- Hold function
- Load function
- Centering function

Halving When the INC mode display is selected, the displayed value can be halved with key and switch operations.

Data storage The value displayed before the power was turned tuned off and the preset value are stored. (Uses nonvolatile memory)

Machine error compensation
When the table moves a certain distance, a unit of compensation value is added or subtracted for linear compensation.
246 different compensation amounts are available.
Compensation amount:
Max. ±600 μm/m
(±0.0006 μinch/inch)

Advanced functions

Programming: Coordinates of machining points can be programmed.
- Manual programming by key switch
- Automatic programming by playback
- Mirror image function when program is executed

Number of program steps: Maximum 480 steps with data for 3 axes as one set

Bolt hole circle: Maching point coordinates can be set by entering the radius and number of divisions of a circle whose center is the spot position.

Scaling: Compensating ratio:
0.100000 to 9,999999.

In/mm conversion The displayed value is converted between inch and millimeter with a switch.

RS232C input/output Display data output / basic key operation input / program data input/output
1200/2400/4800/9600 bps switchable, parity (odd/even/none), stop bits (1, 2), data length (7, 8)

Power voltage ~AC100 – 240 V ± 10%, 50/60 Hz

Power consumption Max. 40 V A

Fuse 250 V 2 A MT4

Temperature
Operating: 0°C to 40°C (32°F to 104°F)
Storage: –20°C to 60°C (–4°F to 140°F)

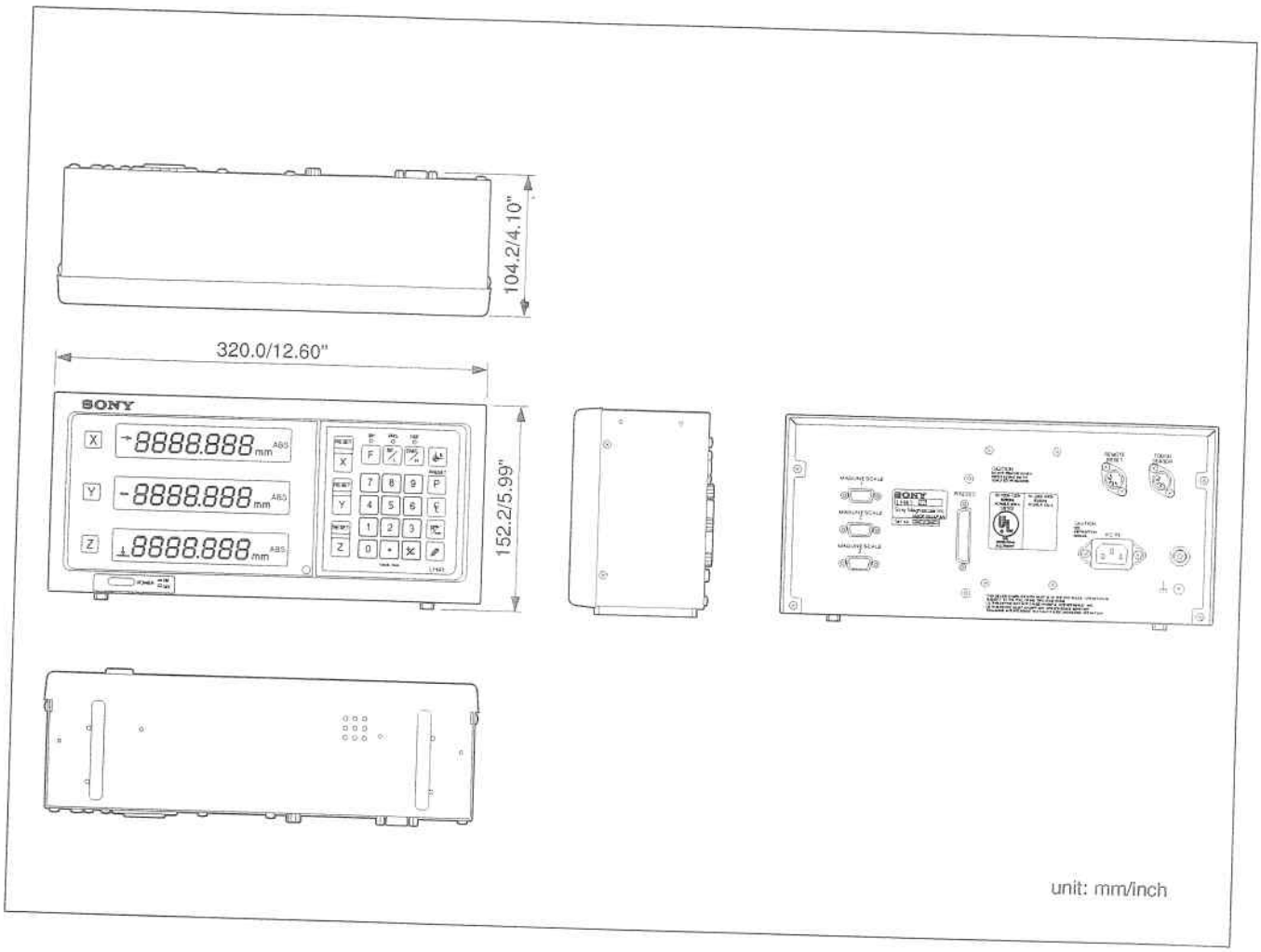
Outside dimensions 320 mm(W) × 105 mm(D) × 153 mm(H)

Mass Approx. 2.3 kg/5.1 Lbs

Accessories
Power cord (1 set)
Ground wire (1 pc.)
External reset connector (1 pc.)
⊕ M4×16 screws (2 pcs.)
Instruction manual (1 set)

12. DIMENSIONS

Specifications and appearances of the products are subject to change for improvement without prior notice.



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