DIGITAL POSITIONING SYSTEMS

SOKKI ELECTRONICS

INSTRUCTION MANUAL FOR DISPLAY UNIT

DU100 SERIES
DU000 SERIES

SOKKI ELECTRONICS CORPORATION

CONTENTS

[1] FEATURES

The Display Units, DU100/DU000, when used in conjunction with the JIKI SCALES, provide the following features:

- Increased efficiency:

  No scribing is necessary on workpiece before machining, providing considerable time saving.

- Higher machining accuracy:

  The feed value can be displayed digitally. The positioning is completed when the displayed value is sent down to zero. Errors due to incorrect readings of machine graduations are eliminated.

- High resolution:

  DU100 provides 5 μm/10 μm resolution and DU000 provides 0.5 μm/1 μm resolution, depending on required machining jobs. Complex machining dimensions can be set and displayed from the keyboard. When the displayed value is sent down to zero, a buzzer indicates that the correct position has been reached.

- Easy-to-read display:

  Large (15 mm) green fluorescent display prevents eyestrain.

- Compact size:

  Because of its small size and slim shape, the display unit can be used in confined spaces.

- Drit resistance:

  The flat keyboard protects the unit from access of oil or dust.

- Linear error compensation:

  The specific linear error value of a machine can be set to provide automatic compensation.

- Lost motion compensation:

  The lost motion value of a machine can be entered for automatic compensation.

- Error message:

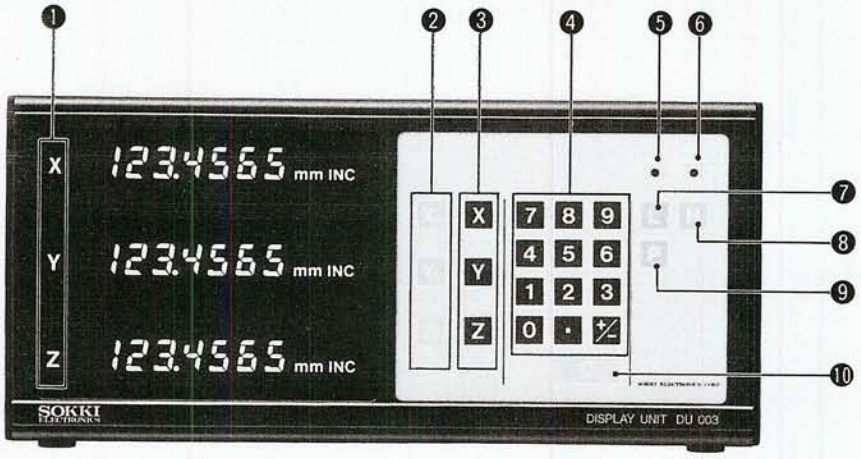
  Error codes are displayed when the scale unit is moved faster than the response speed or when faults occur in the display unit.

- Choice of display units:

  Select the unit suitable for the accuracy of the scale unit used. The DU100 series units are suitable for use with the standard accuracy scales, the DU000 series units are used with the high accuracy scales.

[2] NAMES AND FUNCTIONS OF PARTS AND INSTALLATION PRECAUTIONS

1. FRONT PANEL



❶ X-axis display tube
Y-axis display tube
Z-axis display tube

❷ Axis reset key [Xc] [Yc] [Zc] :
Clears display and function on each axis.

❸ Axis select key [X] [Y] [Z] :
Selects axis for key entry.

❹ Numeral setting keys [0] ~ [9] [·] [+/-]

❺ LOAD lamp:
Lights when the LOAD function using the touch probe is being used.

❻ HOLD lamp:
Lights when the HOLD function using the touch probe is being used.

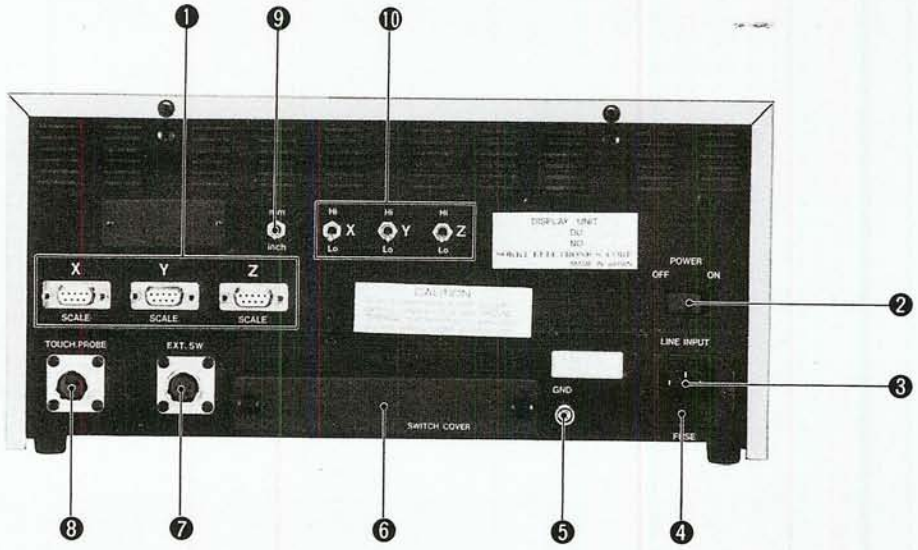
❼ LOAD key [L] :
Used when performing the LOAD function with the touch probe.

❽ HOLD key [H] :
Used when performing the HOLD function with the touch probe.

❾ Preset key [P] :
Used when presetting numerals on the selected axis.

❿ Clear key [C] :
Clears entry of numerals and function keys.

2. REAR PANEL



❶ X-axis scale input connector
Y-axis scale input connector
Z-axis scale input connector

❷ POWER switch

❸ LINE INPUT

❹ Fuse holder:
Midget fuse 2A F-7142 (2A).

❺ Ground terminal

❻ Parameter switch cover:
Removed to set parameter switches for various modes.

❼ EXT SW:
Connector with remote switch for using [Xc], [Yc] and [Zc] keys.

❽ Touch probe input:
Connection for the optional touch probe.

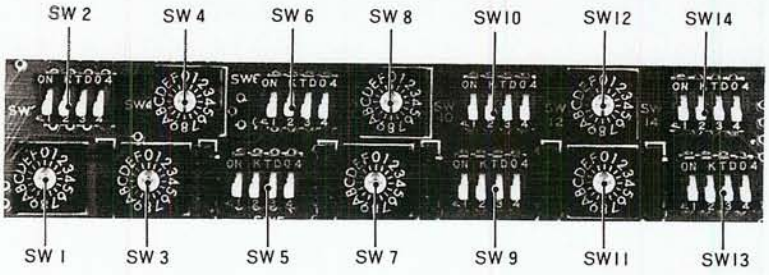
❾ Inch/mm selector switch

❿ Display resolution selector switch:
Hi: 0.5 μm (DU000), 5 μm (DU100)
Lo: 1 μm (DU000), 10 μm (DU100)

3. PARAMETER SWITCHES

Located under cover on rear panel.

Used to set resolution of X-, Y- and Z-axis, polarity, lost motion compensation and linear error compensation.



SW1: Usually set to 3.

SW2: Usually all set to OFF.

SW3: X-axis linear error compensation value setting.

SW7: Y-axis linear error compensation value setting.

SW11: Z-axis linear error compensation value setting.

SW4: X-axis lost motion compensation value setting.

SW8: Y-axis lost motion compensation value setting.

SW12: Z-axis lost motion compensation value setting.

SW6: X-axis linear error/lost motion compensation sign and magnitude setting.

SW10: Y-axis linear error/lost motion compensation sign and magnitude setting.

SW14: Z-axis linear error/lost motion compensation sign and magnitude setting.

Refer to section [5] for linear error/lost motion compensation.

SW5: Selection of X-axis resolution, sign and diameter display.

SW9: Selection of Y-axis resolution, sign and diameter display.

SW13: Selection of Z-axis resolution, sign and diameter display.

◎ Display resolution selection

Set of parameter switches

SW5 (X-axis) SW9 (Y-axis) SW13 (Z-axis)

1	ON	Low	Resolution (Note 1)
	OFF	Outer	
2	ON	–	Polarity (Note 2)
	OFF	+	
3	ON	Diameter	Diameter (Note 3)
	OFF	Standard	
4	ON	Do not use	
	OFF	Do not use	

Note 1: Low: 10μm (DU100) or 1μm (DU000) is set without using the ⑩ outer resolution selector switch.

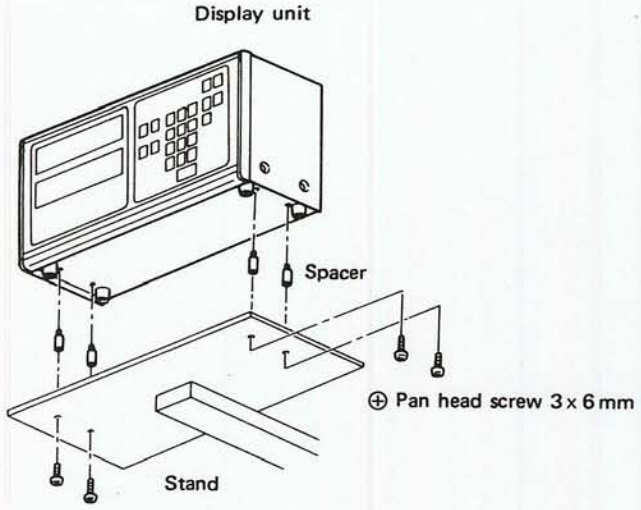
Outer: Display resolution selectable by the ⑩ outer resolution selector switch.

Note 2: Polarity: The display sign of + or – can be selectable according to a direction of the scale.

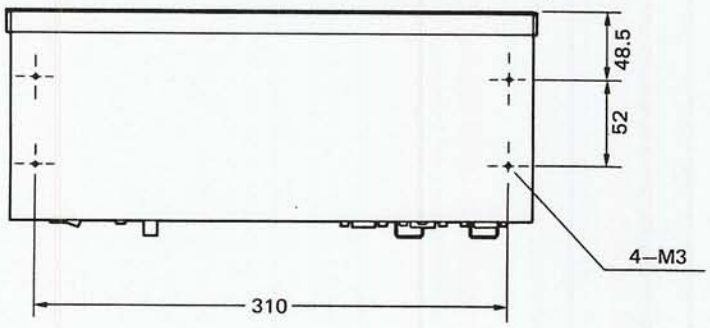
Note 3: Diameter/Radious: Displays double length of the actual travelling distance.

4. INSTALLATION PRECAUTIONS

- Use a power supply in the range of 90 to 130V AC, 50/60 Hz (200 to 260V AC, 50/60 Hz). Never use a higher voltage.
- Make sure to connect the ground terminal of DU and the machine tool with the attached grounding wire. (The machine tool should be grounded.)
- Install the signal and unit power cables at a distance from the machine power cable.
- Do not expose to coolant, swarf, etc.
- Maintain the ambient temperature in the range of 0° to 40°C (32° to 104°F). Do not expose to radiation from direct sunlight or other heat source.
- Mount the display unit on the stand (option) with screws provided.

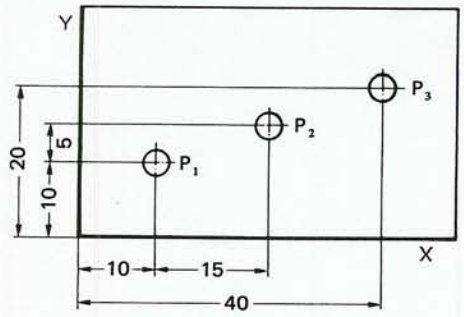


Dimension for Mounting Hole of Display Unit (Unit: mm)



[3] OPERATION

Following are step by step instructions for a simple drilling job as shown below:



① Turn on the power to the display unit. All segments will light briefly as shown at right. This indicates that all functions are operating normally.

Press any of [Xc] [Yc] keys to start.

The display indicates the value which has been input before switching off. Press the key again to indicate the 0.000 display.

X . . . . . .mm
Y . . . . . .mm

X 12.345 mm INC
Y 67.890 mm INC

② Determine the X- and Y-axis datum planes (X_0, Y_0) by machining the workpiece, and position the P_1 point. Key in the tool radius (5 mm) and the dimension on the drawing.

[X] [+/-] [1] [5] [P]
[Y] [+/-] [1] [5] [P]

X -15.000 mm INC
Y -15.000 mm INC

The displayed values indicate that the present position is −15 mm away from the P_1 position on the X and Y axes.

Feed the machine table so that the X and Y displays become "0". A buzzer beeps at one count before "0" to warn of completion of the P_1 positioning.

X 0.000 mm INC
Y 0.000 mm INC

③ Positioning of the P_2 point.

[X] [+/-] [1] [5] [P]
[Y] [+/-] [5] [P]

X -15.000 mm INC
Y -5.000 mm INC

As the P_2 point is entered in relation to the P_1 point, no key-in of the tool radius.

Proceed as ②.

X 0.000 mm INC
Y 0.000 mm INC

④ Positioning of the P_3 point.

[X] [+/-] [1] [5] [P]
[X] [+/-] [5] [P]

X -15.000 mm INC
Y -5.000 mm INC

Proceed as ②.

This completes the positioning of the points P_1 to P_3.

These instructions allow you to perform the machining operation. The following section [4] will explain in detail the principles behind each operation.

[4] BASIC OPERATION

1. OUTLINE OF OPERATION

(1) ABS Coordinate Display and INC Coordinate Display

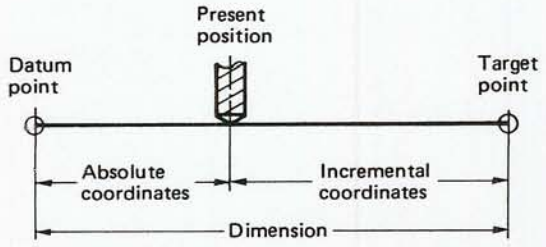
This unit provides ABS (absolute) coordinate display and INC (incremental) coordinate display.

ABS coordinate display:

For displaying a distance from the datum point set by the touch probe.

INC coordinate display:

For displaying a distance from the target point to the present point when positioning by use of the [P] key.

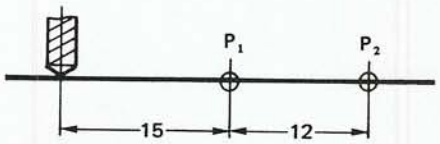


- The distance between the datum point and the target point is usually specified on the machining drawing.
- The position of the target point is set by depressing the [P] key.
  INC coordinate is reset by depressing the [Xc], [Yc] and [Zc] keys.

(2) Positioning Operation

Preset positioning

Input the dimensions on the drawing through a keyboard, using the preset function.



P1 positioning. [X] [+/-] [1] [5] [P]

Input the distance between P1 and the present position, −15 mm.

⬇

Positioning is completed by moving the tool so that the displayed value, −15 mm, becomes zero.

⬇

P2 positioning. [X] [+/-] [1] [2] [P]

⬇

Displayed value → zero. Positioning is completed.

To perform the preset positioning, input the travel distance between the target point and the present position (sign is reversed) and position the target point by zero chasing.
If an error occurs from P_1 positioning, the P_1 error may be accumulated when −12.000 mm is input for P_2 positioning.

2. DATUM POINT SETTING

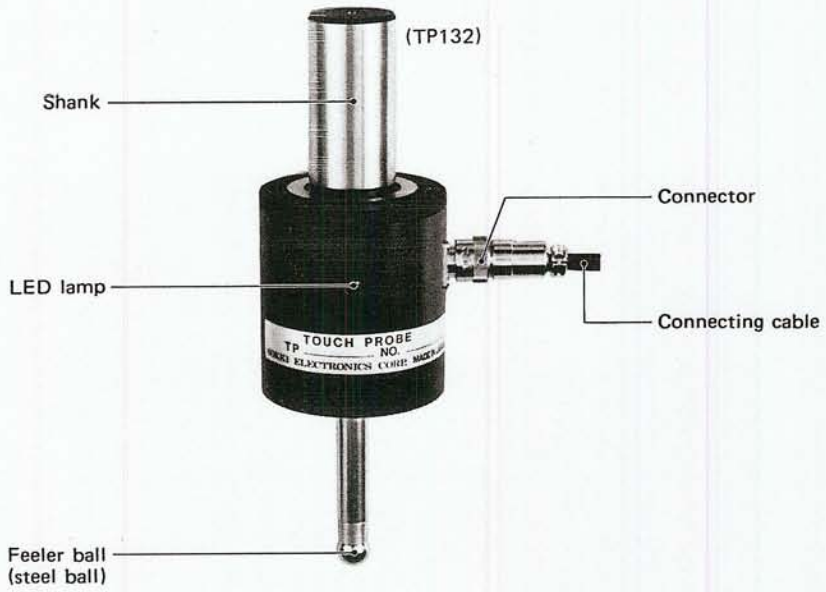
Setting of the Machining Datum Point by using the Touch Probe

(See the section about the Touch Probe.)

3. HOW TO USE THE TOUCH PROBE

This is the instruction for SOKKI TP100, TP200 and TP300 series. In case of using the other touch probe, refer to its own instruction.

(1) Names and Function of Parts



- Shank:
  For chucking to the machine tool spindle.
- Connector:
  For connecting the touch probe with the display unit by cable.
- LED lamp:
  Lights at the moment when the feeler ball touches the workpiece. A buzzer buzzes at the same time.
- Feeler ball:
  A steel ball of ϕ10 mm or 0.2 in. dia. which has movement allowance of 3 mm in vertical and ±5 mm in horizontal directions.

(2) Measurement by the Touch Probe (In case of ϕ10 mm feeler ball.)

1) LOAD function by using the touch probe

In the LOAD function, counting starts at the moment when the feeler ball touches the workpiece.

The position where the displayed value becomes zero is the datum point.

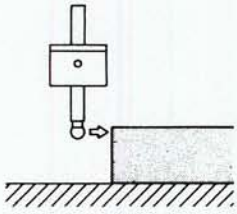
○ Setting of the machining datum point.

Put the touch probe to the tool.

⬇

Set the feeler ball radius to −5 mm.

[X] [+/−] [5] [L]

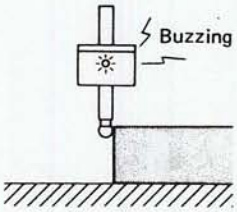


⬇

Move the tool until the feeler ball touches the datum plane of the workpiece.

⬇

The buzzer buzzes, LED lights and counting starts.



2) HOLD function by using the touch probe

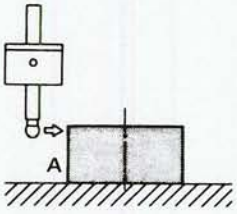
In the HOLD function, counting continues until the feeler ball touches the workpiece and stops at the moment of touch.

○ Setting of the outer diameter of the workpiece.

Set the datum plane A (by use of LOAD function).

[X] [+/−] [1] [0] [L]

Set the diameter of the touch probe, to −10 mm.



⬇

Move the tool until the feeler ball touches the datum plane A.

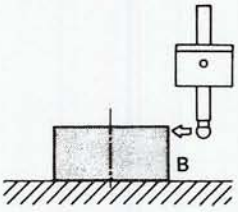
(The buzzer beeps, LED lights and counting starts.)

⬇

Measure the distance to the point B.

[X] [H]

(Counting continues until the feeler ball touches the plan B. As soon as it touches, the buzzer buzzes, LED lights and counting stops.)

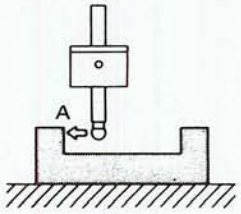


⬇

The displayed value at which counting stops is the outer diameter of the workpiece.

○ Setting of the inner diameter of the workpiece.

Set the datum point A (by use of LOAD function).
[X][1][0][L]
Set the diameter of the touch probe, to 10 mm.

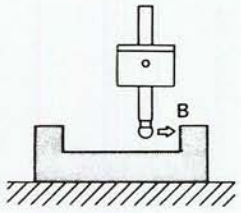


⬇

Touch the feeler ball with the plane A.

⬇

Measure the distance to the point B.
[X][H]



⬇

Touch the feeler ball with the plane B.

⬇

The displayed value at which counting stops is the inner diameter of the workpiece.

Note: When setting the Touch Probe radius or diameter, determine the sign according to the direction of the tool movement. (See the section about settings of the outer diameter and inner diameter.)

[5] SETTING OF THE LINEAR ERROR COMPENSATION AND LOST MOTION COMPENSATION

1. LINEAR ERROR COMPENSATION

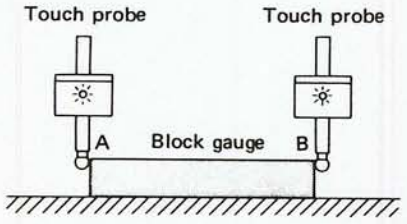
Machine tools possess a linear error due to the deflection peculiar to the individual machine. By measuring the compensation value beforehand and setting the value per meter to the parameter switch, the compensation value can be added to or subtracted from the actually measured value. This function is called linear error compensation.
The value (L_D) after the linear error compensation is displayed based on the following equation.

$$L_D = ls + \frac{ls}{1000} \cdot k$$

L_D: displayed value
ls: measured value before compensation (mm)
k: compensation value per 1 m

(1) Measurement of the Compensation Value

Put a block gauge having a predetermined length, and measure the length, using the touch probe.



Setting the datum plane A.
* In case of ϕ10 mm feeler ball.
[X] [+/-] [1] [0] [L]
(The diameter of the touch probe is subtracted beforehand.)

⬇

Measure the length.
[X] [H]

⬇

Contact the plane B with the touch probe.
The measured value is displayed.

(See the section about the touch probe.)

After measuring the length as described above, find the value for k, using the following equation.

$$k = \frac{L_D - ls}{ls} \times 1000$$

L_D: length of block gauge
ls : measured value before compensation (mm)
k : linear error compensation value per meter

(2) Setting of the Compensation Value, k

The compensation value, k, is set by the parameter switch on the rear panel.

1) Setting of the absolute value of the compensation value

Set value of SW3 (X-axis), SW7 (Y-axis), SW11 (Z-axis)	SW6-2 (X-axis), SW10-2 (Y-axis), SW14-2 (Z-axis)	
	OFF	ON (double)
0	0μm/m	0μm/m
1	4	8
2	12	24
3	16	32
4	20	40
5	25	50
6	35	70
7	60	120
8	80	160
9	100	200
A	110	220
B	130	260
C	140	280
D	180	360
E	230	460
F	250	500

2) Setting of the sign

Set the sign to the above absolute value as follows.

SW6-1 (X-axis), SW10-1 (Y-axis), SW14-1 (Z-axis)	Sign for the absolute value
ON	−
OFF	+

Example: Input the compensation value, −12μm/m to X-axis.

SW3 Set to 2. } 12μm/m
SW6-2 OFF }
SW6-1 ON −

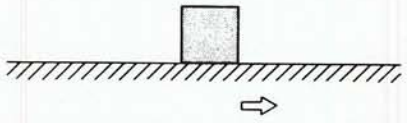
The linear error compensation value, -12μm, for X-axis is set by the above procedures.

2. LOST MOTION COMPENSATION

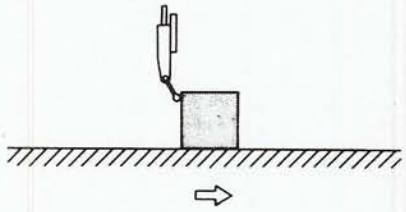
When the direction of scale movement changes, some machine tools yield different values according to the forward direction or backward direction because of yawing of the machine table. This error is compensated by the lost motion compensation. By measuring the compensation value beforehand and setting it to the parameter switch, the value after compensation is displayed.

(1) Measurement of the Lost Motion Compensation Value

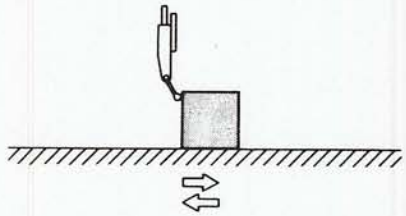
① Put a block gauge on the table and move the table slightly to the right.



② Touch the left side of the block gauge with the probe of the electrical comparator and adjust so that zero point is obtained.
Set the display to zero.



③ Move the table a few millimeters to the right. Then move it back to the left, while touching the left side of the block gauge with the probe of the electrical comparator again. Stop the table at the position where the electrical comparator indicates zero.



The value on the display unit becomes the lost motion compensation value. To set the lost motion value to the parameter switch, change the sign.

Displayed value −0.007 mm → set value +0.007 mm

(2) Setting of the Lost Motion Compensation Value

The compensation value is set by the parameter switch on the rear panel.
(See the section about the Parameter Switch.)

1) Setting of the absolute value of the compensation value

Set values of SW4 (X-axis), SW8 (Y-axis), SW12 (Z-axis)	SW6-4 (X-axis), SW10-4 (Y-axis), SW14-4 (Z-axis)			
	OFF		ON	
	DU100	DU000	DU100	DU000
0	0μm	0μm	0μm	0μm
1	5	0.5	10	1.0
2	15	1.5	30	3.0
3	20	2.0	40	4.0
4	25	2.5	50	5.0
5	35	3.5	70	7.0
6	45	4.5	90	9.0
7	55	5.5	110	11.0
8	75	7.5	150	15.0
9	100	10.0	200	20.0
A	125	12.5	250	25.0
B	175	17.5	350	35.0
C	225	22.5	450	45.0
D	250	25.0	500	50.0
E	275	27.5	550	55.0
F	300	30.0	600	60.0

2) Setting of the sign

Set the sign to the above absolute value as follows.

SW6-3 (X-axis), SW10-3 (Y-axis), SW14-3 (Z-axis)	Sign of the absolute value
ON	−
OFF	+

Example: Input the lost motion compensation value, −0.007 mm, to X-axis.
The display unit, DU400, is used.
When the measured value is −0.007 mm, the set value is +0.007 mm.

SW4	Set to 5.	7μm
SW6-4	ON	
SW6-3	OFF	+

The lost motion compensation value, +0.007 mm, is set to the X-axis by the above procedures.

[6] ERROR DISPLAY AND CLEARING OF THE WRONG OPERATION

1. ERROR DISPLAY

Display	Type of error	Cause
E ·····	Overspeed	When the travelling speed of the scale exceeds the maximum response speed.
F ·····	Overflow	When exceeding the maximum value to be displayed.
E01	Memory back-up error	When the memory is not backed up.
After all the displays light ·····	Power error	During operation, power is interrupted. (The same display as appears when the power is turned on.)
E02	Scale signal error	When the scale signal is not normal.

2. CLEARING OF THE WRONG OPERATION

- Wrong entry of numerals. — Press the [C] key to reenter the correct value.
- Wrong data input by [P]. — Reenter the correct data.

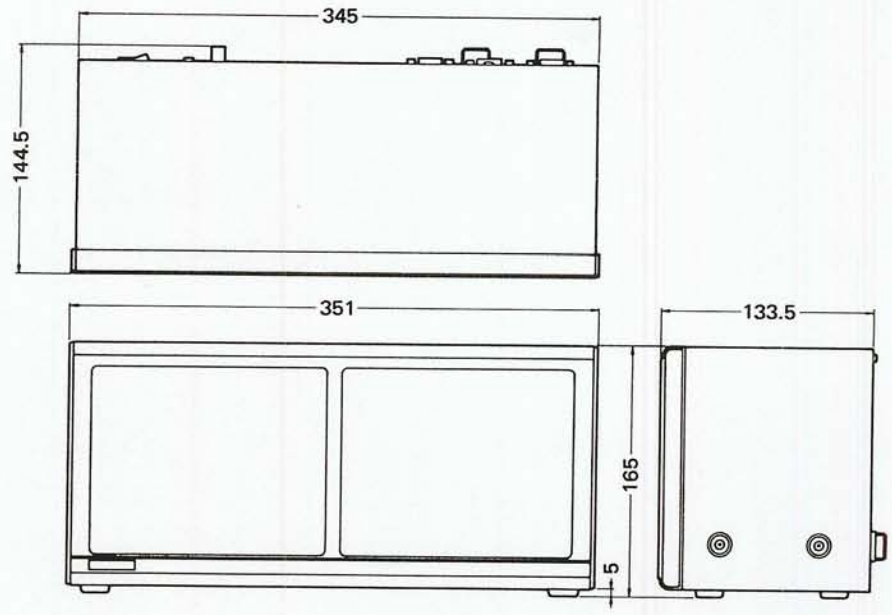
[7] SPECIFICATIONS

Type and function of the display unit

Type	Number of axis	Display resolution	Response speed
DU101	1-axis	5 μm/10 μm selection, diameter display	75 m/min.
DU102	2-axes	5 μm/10 μm selection, diameter display	75 m/min.
DU103	3-axes	5 μm/10 μm selection, diameter display	75 m/min.
DU001	1-axis	0.5 μm/1 μm selection, diameter display	18 m/min.
DU002	2-axes	0.5 μm/1 μm selection, diameter display	18 m/min.
DU003	3-axes	0.5 μm/1 μm selection, diameter display	18 m/min.

Specifications	DU100	DU000
Display	Green fluorescent display tube	
Number of digits	7-digits with – sign	
Reset of each axis	Provided	
Preset	Provided	
Positioning system	Incremental zero chasing system	
Touch probe loading and holding function	Provided	
Linear error compensation	Provided	
Lost motion compensation	Provided	
Resolution	5 μm/10 μm selection	0.5 μm/1 μm selection
Zero chasing	Indicated by buzzer	
Diameter display	Provided	
External reset	Provided	
Overspeed alarm	Provided	
Instantaneous power failure alarm	Provided	
Memory back-up	Provided	
Polarity selection	Provided	
Error display	Provided	
Power source	90–130 V AC, 50/60 Hz (200–260 V AC, 50/60 Hz)	
Size	351 x 160 x 134 mm 3.5 kg	
Ambient temperature	0°–40°C (32°–104°F)	

[8] EXTERNAL VIEW DRAWING (Unit: mm)



[9] ACCESSORIES

1)	Power cord	1 pc.
2)	Plug	1 pc.
3)	Grounding wire	1 pc.
4)	Spacer	4 pcs.
5)	Screws ⊕ pan head screw 3 x 6 mm	4 pcs.
6)	Axis display label	1 set
7)	Instruction manual	1 copy

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