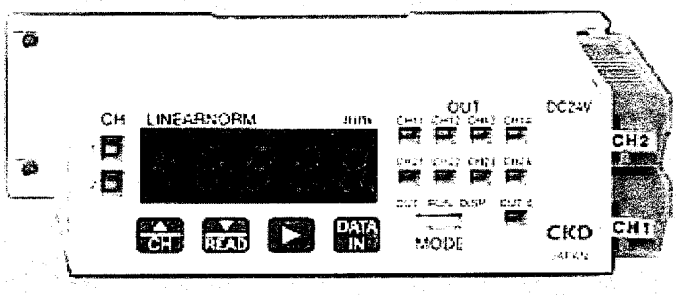
CKD

SM-308781-A

Instruction manual

Cylinder and Gripper Equipped With LINEARNORM Sensor Display Unit Type LN-DN



- Read these instruction manual without fail before starting operation.
- Keep these instruction manual at a place where the operator can refer to it at any time.

Ver. 3

CKD Corporation

Contents

Prepared on February 21, 2002
Revised on February 1, 2004

For safe operation of product

Read without fail before starting operation.

To design or manufacture a system equipped with our product, you must manufacture a safe system while checking that the safety of the system is assured through the mechanism of the system, pneumatic or water control circuit, and electric control for controlling these.
Product selection, operation and handling, and adequate maintenance and control are important for safe operation of our product.
Observe the warnings and cautions for assurance of the safety of the system.
We hope that the user checks for assurance of the safety of the system to create safe systems.

⚠ WARNING

1 This product is designed and manufactured as equipment or a component for general industrial machines. It must be handled by those who have sufficient knowledge and experience.

2 Use the product within the specification range.
Contact us if you are going to use our product under conditions deviating from the specifications characteristic to the product, outdoors, or under the following conditions or environment. Never remodel or machine our product.

❶ Use for applications requiring extra consideration for safety such as nuclear, railroad, aeronautics, vehicle, medical machines, devices or applications making direct contact with beverage or foods, amusement devices, emergency shutoff circuit, press, and safety measures for brake circuit
❷ Use for applications requiring extra consideration for safety causing probable effects on personnel and assets

3 For the safety related to the design, control and so on of the system, be sure to observe local regulations and laws.
ISO 4414, JIS B 8370 (general rules for pneumatic system), JIS B 8368 (pneumatic cylinder), JPAS 005 (guideline for use and selection of pneumatic cylinder), High Pressure Gas Safety Law, Labor Safety and Hygiene Law, and other safety rules, local regulations, laws and so on

4 Never handle the product or never remove piping or devices before safety is assured.

❶ Perform inspection or maintenance of the machine or system after checking that safety is assured in all systems related to the product.
❷ Be careful even if operation is stopped because there may be hot or charged parts.
❸ Stop the energy sources such as compressed air, water and power supply of the corresponding equipment and release compressed air out of the system and take care of water leaks and grounding faults before performing inspection or maintenance of devices.
❹ To start or restart machines or systems using pneumatic devices, check that the safety of the system is assured with measures for avoiding jumping out, and be careful.

5 Observe warnings and cautions described on the following pages to avoid accidents.

■ The safety precautions described here are divided into the "DANGER," "WARNING" and "CAUTION" categories.

⚠ DANGER: Negligence of description will cause deaths or serious injuries and probability of the danger (degree of imminence) is high.

⚠ WARNING: Negligence of description will cause deaths or serious injuries.

⚠ CAUTION: Negligence of description will cause injuries or material losses.

Description given under the CAUTION category may cause serious results in some circumstances. Observe the description without fail because they are important.

Pneumatic device

For safe operation of product

Be sure to read before starting operation.

For general cylinders and cylinder switches, refer to Pneumatic Cylinders Ⅰ or Ⅱ.

Individual precautions

Actuator of cylinder and gripper equipped with LINEARNORM sensor

⚠ CAUTION During design and selection

Gripper

1. The gripping force of the gripper may vary depending on the length of the claw to be mounted on the master-jaw, applying press force, and/or bore diameter. The gripping force is adjusted to an appropriate level corresponding to the workpiece to be gripped. The holding characteristics are the same as those of the standard product. Refer to "Pneumatic Cylinder Ⅱ" (catalog No. CB-030S).
2. Do not operate the gripper in an outdoor place.
3. The optimal ambient temperature range of the gripper is 5 to 60°C. If the ambient temperature exceeds 60°C, this may cause the gripper to be damaged or to malfunction. Do not operate the gripper in a temperature range beyond this specified level. Additionally, if the ambient temperature is 5°C or less, the moisture in the circuit may be frozen, causing the gripper to be damaged or to malfunction. If such case is foreseen, take appropriate freezing prevention measures.
4. Do not operate the gripper in a corrosive atmosphere. If the gripper is operated in such atmosphere, this may cause the gripper to be damaged or to malfunction.
5. When the clamp is operated gently at as low a speed as possible, this ensures high accuracy, as well as stable repetition accuracy.
6. Operate the master-jaw with an excessive load not applied to it.

Cylinder

1. To select LN-B Series cylinders, refer to LCS Selection Guide in "Pneumatic Cylinder Ⅰ" (catalog No. CB-029S).

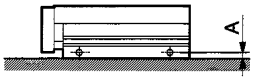
⚠ CAUTION During mounting, installation or adjustment

Cylinder

1. Avoid applications where a rotation torque is added on the piston rod of LN-A Series. Otherwise the retainer bushing will be deformed to shorten the service life substantially.
2. Always use so that the load is applied on the piston rod in the axial direction of the piston rod.
3. When fixing the workpiece at the end of the piston rod of LN-A Series, shorten the piston rod fully up to the stroke end and engage the wrench at a part exposed outside parallel to the rod so that the tightening torque is not added on the main body of the cylinder.
4. The piping joint that can be used varies according to the cylinder bore.

·LN-A Series

Item / Tube bore mm	Port dia.	Port position dimensions A	Port position dimensions B	Joint that can be used	O.D. of joint	Joint that cannot be used
φ12·16	M5×0.8	5.5	5.5	SC3W-M5-4 SC3W-M5-6 GWS4-M5-S GWS4-M5 GWL4-M5 GWL6-M5	φ11 or less	GWS6-M5
φ20		8	5.5			
φ32	Rc1/8	8	8	SC3W-6-4·6·8 GWS4-6 GWS6-6 GWS8-6 GWL4-6 GWL6-6	φ15 or less	GWS10-6 GWL8-6 GWL10-6
φ50	Rc1/4	10.5	10.5	SC3W-8-6·8·10 GWS4-8 GWS6-8 GWS10-8 GWL4~12-8	φ21 or less	GWS-12-8



·LN-B Series

Item / Tube bore mm	Port dia.	Port position dimensions A	Joint that can be used	O.D. of joint
φ12	M5×0.8	5.5	SC3W-M5-4 SC3W-M5-6 GWS4-M5-S GWS4-M5	φ11 or less
φ16		6.5	SC3W-M5-4 SC3W-M5-6 GWS4-M5-S GWS4-M5 GWL4-M5 GWL6-M5 GWS6-M5	φ13 or less
φ20	Rc1/8	8	SC3W-6-4·6·8 GWS4-6 GWS8-6 GWL6-6 GWS6-6 GWL4-6	φ15 or less
φ25		9		

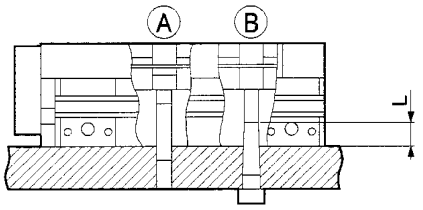
⚠ CAUTION During mounting, installation or adjustment

Cylinder

5 To change the position of the piping port of LN-B Series, apply adhesive on the M3 and M5 plugs (hexagon socket head cap screws).
(Recommended adhesive: Loctite 222/221, Three Bond 1344 or other low strength adhesive)

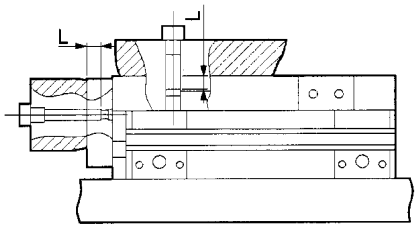
6 Do not allow dents or scratches, which may obstruct the degree of flatness, on the mounting face of the main body (tube) or slide table face of LN-B Series.
The degree of flatness of the other party to be installed on the slide table must be within 0.05mm.

7 Observe the screwing length and tightening torque when mounting the LN-B Series to the main body.
<Fig. 1>



Item	Ⓐ		Ⓑ		
	Bolt to be used	Tightening torque (N·m)	Bolt to be used	Tightening torque (N·m)	Screwing length L (mm)
LN-B-12	M4×0.7	1.4 to 2.4	M5×0.8	2.9 to 5.1	5 to 8
LN-B-16	M4×0.7	1.4 to 2.4	M6×1.0	4.8 to 8.6	6 to 9
LN-B-20	M5×0.8	2.9 to 5.1	M6×1.0	4.8 to 8.6	6 to 9
LN-B-25	M6×1.0	4.8 to 8.6	M8×1.25	12.0 to 21.6	8 to 12

8 Observe the following screwing length and tightening torque when installing a jig to the slide table or end table of LN-B Series.
<Fig. 2>



Item	Slide table and end plate		
	Bolt to be used	Tightening torque (N·m)	Screwing length L (mm)
LN-B-12	M4×0.7	1.4 to 2.4	4 to 6
LN-B-16	M5×0.8	2.9 to 5.1	5 to 7.5
LN-B-20	M5×0.8	2.9 to 5.1	5 to 7.5
LN-B-25	M6×1.0	4.8 to 8.6	6 to 9

Gripper

1 It is recommended to install an air drier and/or a filter to remove the moisture from the piping.
Additionally, install a filter at a position close to the directional control valve (primary side) to remove the rust, foreign matter, and drain.

2 For piping materials, always use the zinc plated pipe, stainless pipe, nylon pipe, and/or rubber pipe, which are difficult to be rusted.

3 Make sure that the pipe connecting the gripper and directional control valve has the effective cross sectional area to obtain the specified piston speed.

4 Blow the air and clean the inside of the pipe to remove foreign matter and cutting chips before starting the piping work.

5 To connect piping to device products (filters, direction control valves, cylinders,grippers/chucks, etc.), pay special attention so that any seal tape or glue does not enter the pipe. When any seal tape or chips are entangled, the malfunction will be caused.

6 By taking the effect on the gripper main body into consideration, when mounting the claw on the master-jaw, support it using a spanner, and tighten it so that the master-jaw is not twisted.
The recommended tightening torque (N·m) is as follows.

BHA·BHG·BHE−01 : 0.59
BHA·BHG·BHE−03, 04 : 1.4
BHA·BHG·BHE−05 : 2.8

Pneumatic device

For safe operation of product

Be sure to read before starting operation.

For general cylinders and cylinder switches, refer to Pneumatic Cylinders Ⅰ or Ⅱ.

Individual precautions

Actuator of cylinder and gripper equipped with LINEARNORM sensor

⚠ CAUTION During operation or maintenance

Cylinder

1. Use adequate pliers (C-shaped snap ring installation tool) when installing or removing the rod metal.

2. Even if adequate pliers are used, the snap ring may jump out of the end of the pliers, possibly causing injuries or damage to you or peripheral devices. Be careful.
   When installing, check that the snap ring fits the groove securely before supplying compressed air.

Gripper

1. Apply the grease to the oscillating part of the master-jaw periodically. Periodic lubrication may extend the service life of the gripper.

2. Do not apply an excessive force to the master-jaw, small claw, and bearing guide due to dropping of the product or collision with other object. Doing so may produce a large play in the master-jaw, causing the repetition accuracy of the gripper to lower and the stop position of the piston, a sensor detection element, to deviate largely, resulting in significant lowering of the repetition accuracy.

Individual precautions

Sensor, amplifier and display unit

⚠ CAUTION During design or selection

1. Use only the DC stability power supply as power supply to this product.
   Do not connect the motor or valve, which may produce the noise, to this product.

2. When wiring the cables, do not run the cables in the same pipe or conduit as that used for the power cable (multi-core cable, etc.), such as motor cable so that any inductive noise is not applied to the LINEARNORM SENSOR. Additionally, carefully check the inverter power supply and its wiring. (The frame ground of the inverter power supply is grounded correctly to discharge the noise.)

3. The sensor and output stage cables uses a bending resistant cable.
   However, to obtain the maximum bending performance level, pay special attention to the wiring so that any local bending or tensile force is not applied.
   Additionally, the lead-out port from the sensor case or amplifier unit case, or M8 connector has less bending resistance when compared to the intermediate part of the lead wire since the lead wire is secured.
   Therefore, take appropriate measures so that the wire is not bent repeatedly with the lead-out port or the connector used as fulcrum.

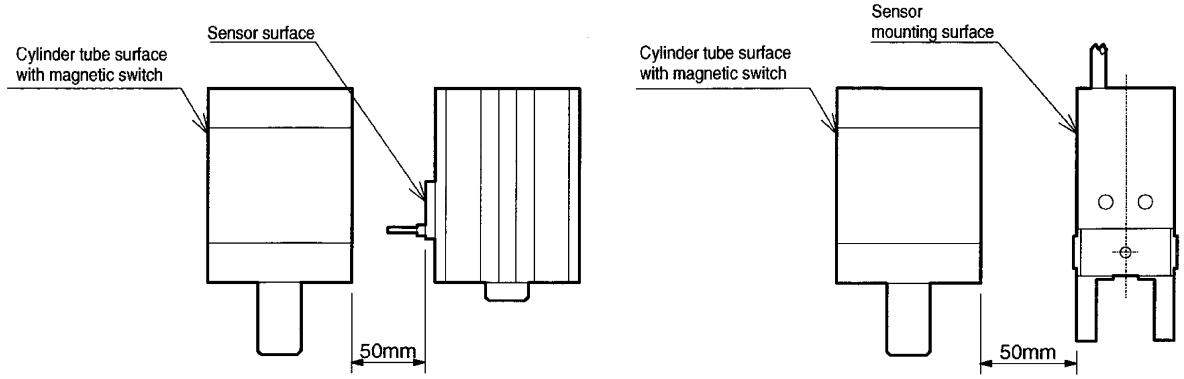
4. Do not use at a place where the operating ambient temperature changes abruptly (example: place subject to air sent from air conditioner).

5. Do not use outdoors or in the atmosphere where corrosion may be caused.

6. The value displayed at the 7-segment LED of the display unit and analog output voltage may not attain linear accuracy in the actual field due to the sensor mounting accuracy, effects of magnetic bodies, deviation of the display unit input from actual span or the like because the analog sensor signal is linearly corrected under certain conditions.
   Therefore the measurement, the value displayed at the 7-segment LED among all, should be used as a measure.

⚠ CAUTION During mounting, installation or adjustment

1. The sensor detection accuracy may lower significantly in an environment where the strong magnetic field is generated (spot welding machine, etc.). Therefore, do not operate the sensor in such environment.
   Additionally, take great care when the cylinder or gripper is located adjacent to other cylinder with the magnetic switch.
   For reference, it is thought that there are no problems when the distance between the sensor surface and cylinder tube surface is 50 mm or more.



Pneumatic device

For safe operation of product

Be sure to read before starting operation.

For general cylinders and cylinder switches, refer to Pneumatic Cylinders Ⅰ or Ⅲ.

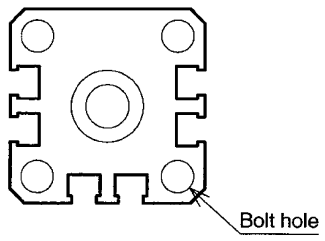
⚠ CAUTION During mounting, installation or adjustment

2 If the surface of the sensor (where the sensor nameplate is installed) is covered with an iron plate or a similar magnetic body, the magnetic field is disturbed to make the sensor unable to detect the magnetic field. Be careful when installing the actuator.

3 Take care of the following points, too, in case of cylinder installation.

- When fixing the cylinder, use stainless steel bolts to install the cylinder, to maintain the characteristics of the sensor.
  If iron bolts are used, distortion is caused in the sensor output voltage waveform, increasing errors in the value displayed at the display unit and deteriorating linearity of the analog output voltage.
  (The repeatability is not affected, but check the performance during actual use.)
  Similar phenomena may be observed if a part of the cylinder body is in contact with a magnetic body.
  In particular, the tendency is more apparent if the part near the LN sensor face or iron plate is shorter than the actuator body; be careful.

  <Example: LN-A type>



- The LINEARNORM sensor may be installed on the same plane with the analog output voltage ON/OFF changeover T0H/V or LN-TH/V switch or other cylinder switches if the mounting positions do not interfere with each other.
- Be sure to connect a cylinder switch (LN-TH/V) for obtaining the analog output voltage in an arbitrary 10mm interval over the full stroke of the cylinder.
- The tightening torque of the sensor is 0.1 or 0.2N·m. Install the sensor so that the sensor mounting screws are on the cylinder head side.

4 Take care of the following points, too, in case of gripper installation.

- If the gripper is installed at the top face, using the faucet part, and if the base is an iron plate or a similar magnetic body, distortion is caused in the sensor output waveform, increasing errors displayed at the display unit, or deteriorating the linearity of the analog output voltage.
  (The repeatability is not affected, but check the performance during actual use.)
  Similar phenomena may be observed if a part of the front or side face of the gripper is in contact with a magnetic body.
  In particular, if the part near the LN sensor face or iron plate is shorter than the actuator body, the tendency is more apparent; be careful.
  Use stainless steel bolts in case of gripper fixing, to maintain the characteristics of the sensor, without relation to the top, side or front face installation.
- The tightening torque of the sensor is 0.1 or 0.2N·m. Install the sensor so that the sensor mounting screws are on the master jaw side.

5 Take care of the following points when connecting.

- If the load short-circuiting current flows in the switch output stage transistor due to a wiring error, connection or the like, the internal protective circuit functions to cut the short-circuiting current.
  (At this time, the output indicator (yellow) is unlit and the short circuit indicator (red) lights up.)
  To cancel short circuit protection, turn the supply current off, correct the fault such as the wiring error, and turn the power on again.
- Because the display unit is of a two-channel specification, two sets of +24V and 0V terminals are provided at the connector. They are connected inside the display unit; connect either set to activate.
- If only one model of the amplifier unit is connected to the display unit, either channel may be used at the connector.
- Turn the power off before connecting cables.
- When connecting the cable at the connector of the display unit, leave the female side unconnected.
- The cable size of the connector of the display unit is 0.08 to 1.5mm^2, and the tightening torque of the terminal screw is 0.25N·m.
- Do not connect or disconnect connectors when the power is on.
- Use the screw of the female side to fix the male side for the prevention of disconnection of the connected male and female connectors.

⚠ CAUTION During mounting, installation or adjustment

6 When installing the amplifier unit case of the separate amplifier type, using the side through-hole, use M3 Phillips pan head screw, and tighten the screw to 0.5 to 0.7N·m.

7 To install the display unit using the through hole at the bottom, use M3 Phillips pan head screw and tighten the screw to 0.5 to 0.7N·m.

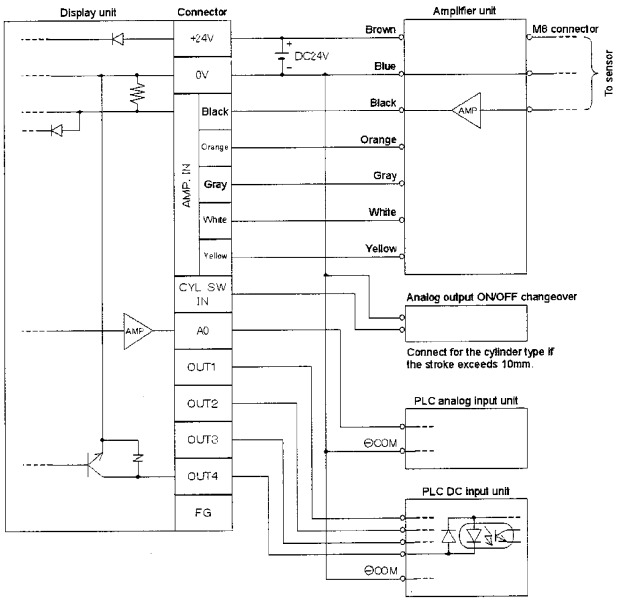
8 The lead wire connection example is shown in the figure on the right.

(Note) With a cylinder type with strokes exceeding 10mm, connect the special switch for analog output ON/OFF changeover to the display unit. Connect the brown cable to the CYL SW IN terminal and connect the blue cable to 0V.

9 Give initial settings of the display unit in the order of the 7-segment LED display value setting and switch output position data.

10 When fixing the piston or master jaw in the predetermined position for sensor position and output voltage adjustment and display unit setting, add the actual air pressure to the actuator.

11 The switch output does not include the hysteresis. If chattering is caused when the output is issued, set a slightly wider action range (activation interval).



⚠ CAUTION During operation and maintenance

1 Because the output voltage of the LINEARNORM sensor corresponds to the position of the cylinder piston, the offset may vary according to deformation, wear or others of the fixture with the elapse of operation time.
(In case of the gripper, play of the master jaw in the opening direction and deformation and wear of the small claw can be the cause of fluctuation.)
This causes fluctuation of the value displayed at the display unit, analog output voltage, and switch output position without relations to the model. Periodic correction is recommended.
After operation, the displayed value, analog output voltage and switch output position similar to those obtained upon initial setting will be automatically restored.
(For the operation procedure, refer to Section 6-4-4 "Adjustment of Change in Value Displayed at 7-Segment LED According to Change in Operating Ambient Temperature.")

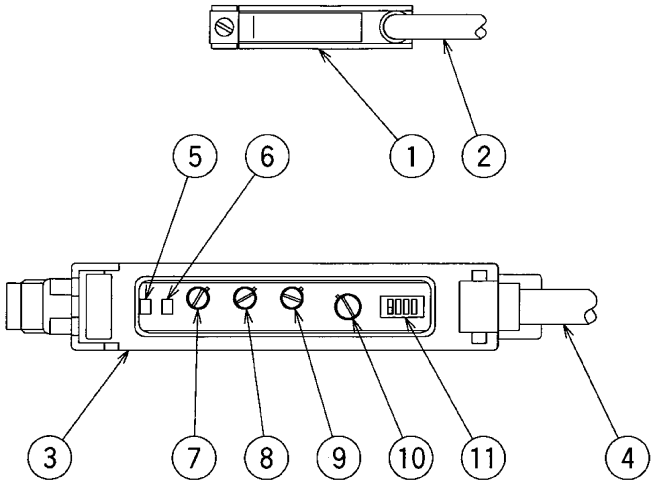
2 The output voltage of the LINEARNORM sensor varies as the density of the magnetic flux of the piston magnet according to the operating ambient temperature. The variation is minimized at the compensatory circuit installed in the sensor. If there is a large error in the displayed value, analog output voltage or switch output position during operation of the display unit type that aims at more fine judgment, periodic correction through simple key operation (teaching function) of the display unit is recommended.
(For the operation method, refer to Section 6-4-4 "Adjustment of Change in Value Displayed at 7-Segment LED According to Change in Operating Ambient Temperature.")

3 For the operation of the display unit, refer to Section 6 "Display Unit Operation Method."

4 If the sensor-integrated actuator for a certain channel is changed (or, the 4-bit switch at the amplifier unit is changed) after initial setting of the display unit, the switch output position having been entered up to the timing is reset to zero.

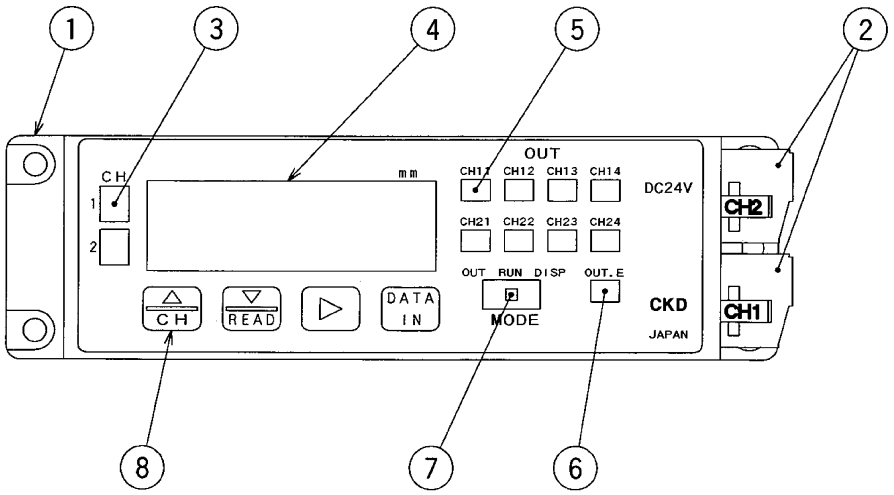
1. Name and Function of Each Section

1-1. Sensor and Amplifier Unit



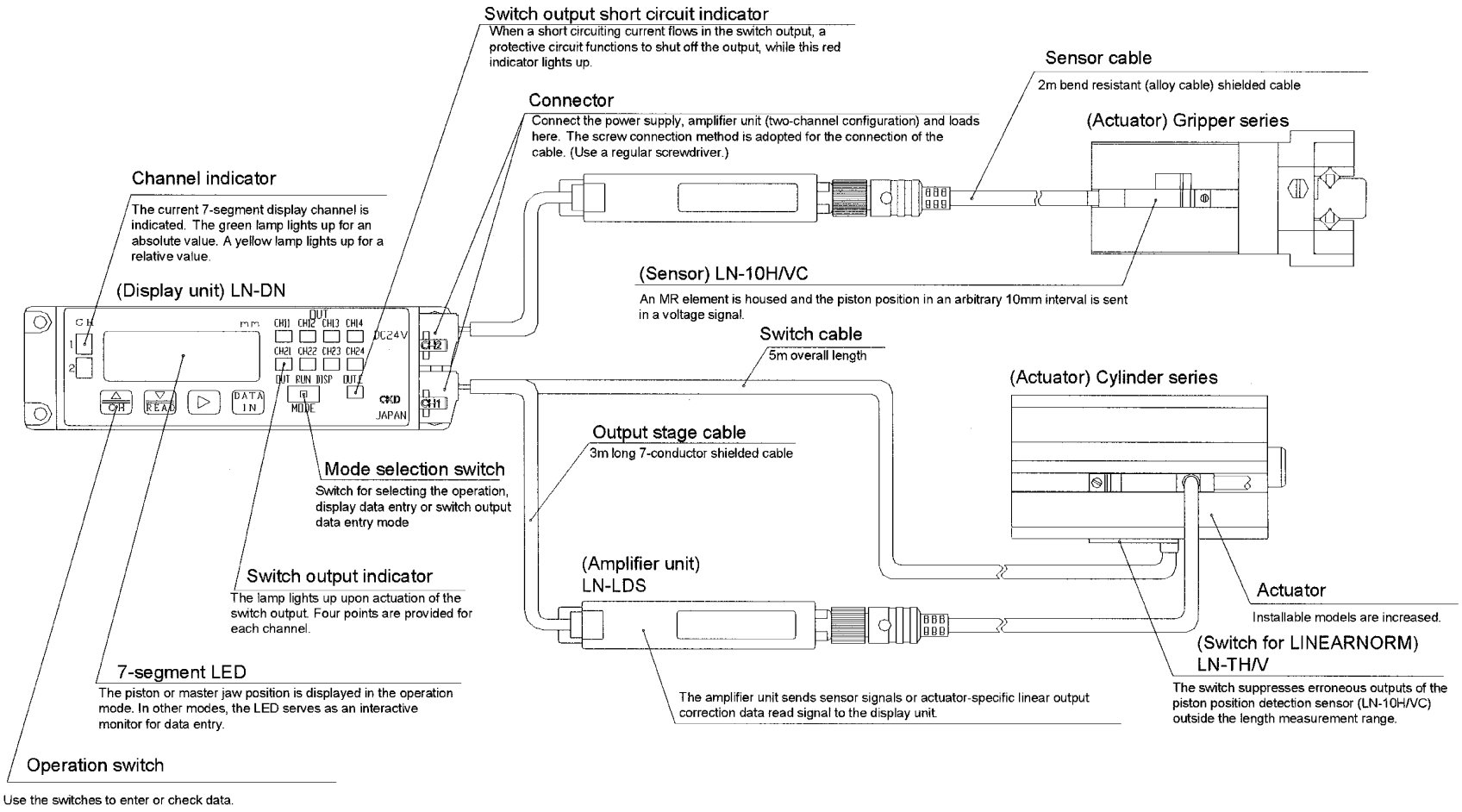
No.	Name	Function, etc.
1	Sensor case	The magnet sensor and temperature compensation circuit are housed. The case is fixed to the cylinder or gripper with a screw.
2	Sensor cable	3-conductor cable connecting the sensor and main circuit. An M8VA connector is used for connection.
3	Amplifier unit case	The main circuit is contained and the case is fixed on a DIN rail. The case can be fixed with a screw, using a side through hole.
4	Output stage cable	7-conductor cable for power supply and output signals
5	Power indicator	The green LED lights up if 24VDC is supplied across the brown and blue output stage cables.
6	Sensor mounting position indicator	The best sensor mounting position is indicated with a yellow LED.
7	Adjusting trimmer for sensor mounting position indicator	Trimmer for adjusting the lighting position of the indicator to the best position during installation of the sensor on the gripper. (Adjustment is made at the best position before shipment from the factory.)
8	Analog output zero point adjusting trimmer	Trimmer for adjusting the zero point of the analog output voltage. (Adjustment is made at the factory before shipment so that the output is 1 to 4.5V along an arbitrary 10mm stroke of the cylinder or along the full stroke of the master jaw of the gripper.)
9	Analog output span adjusting trimmer	Trimmer for adjusting the span of the analog output range. (Adjustment is made at the factory before shipment so that the output is 1 to 4.5V along an arbitrary 10mm stroke of the cylinder or along the full stroke of the master jaw of the gripper.)
10	Analog output span changeover switch	Change the setting if the span deviates from the adjustment range of the trimmer ⑨ during adjustment of the span of the analog output voltage. Set the switch in the direction shown in the figure above during regular operation.
11	Analog output correction data reading switch	To correct linearity of the sensor output voltage at the microcomputer built in the display unit, select the actuator-specific data, using this 4-bit switch. For models shipped together with an actuator, the switch is preset at the factory. In other cases, adjustment is necessary.

1-2. Display Unit



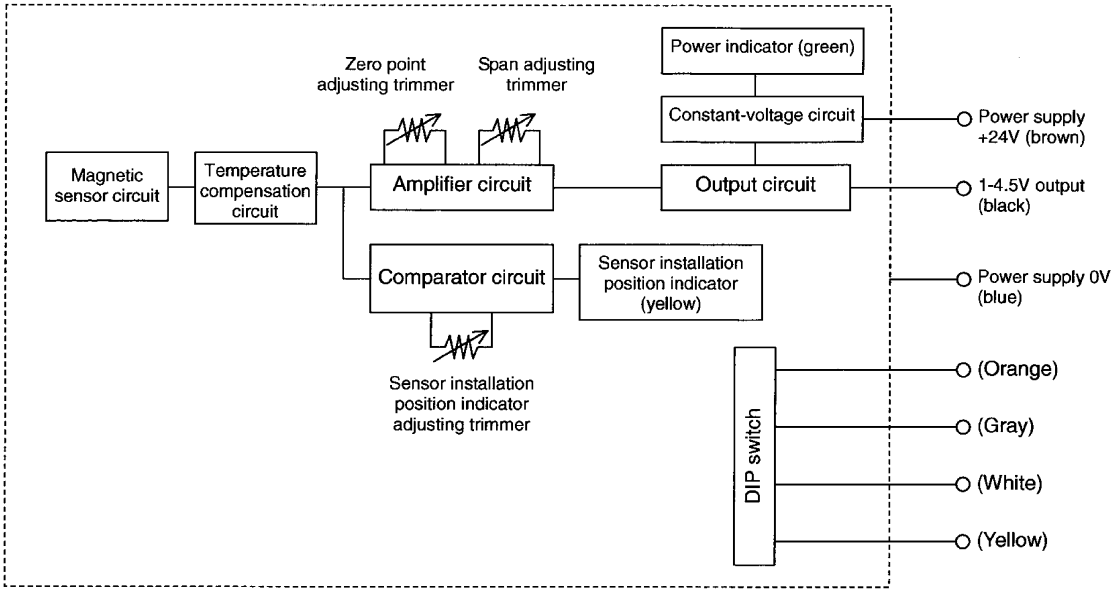
No.	Name	Function, etc.
1	Case of display unit	The main circuit of the display unit is housed. The case is fixed on a DIN rail. Or, the case may be fixed with a screw, using the through-hole at the bottom of the case.
2	Connector	Connect the power supply, amplifier unit and load here. Because there are two channels for the sensor input, there are two rows of connectors. The screw connection method is adopted for the connection of the cable. (For precautions of wiring, refer to Section 4 "Connection Circuit Diagram.")
3	Channel indicator	The current channel displayed at the 7-segment display is indicated with a lit lamp. A green lamp lights up for an absolute value, and a yellow lamp lights up for a relative value.
4	7-segment LED	The position of the piston or master jaw is digitally displayed in the operation mode. In other modes, the display serves as an interactive monitor for data entry or the like.
5	Switch output indicator	The switch output state is indicated with a lit lamp in the operation mode. There are four output points for each channel. The entry work channel is indicated with a lit lamp in the switch output data entry mode.
6	Switch output short circuit indicator	If a short circuiting current flows through the switch output, a protective circuit functions to shut off all switch outputs while this red indicator lights up. To cancel short circuit protection, turn the power supply off temporarily, correct a wiring error or the like, and turn the power on again.
7	Mode selection switch	Mode selection switch for the operation, display data entry, and switch output data entry modes. RUN: Operation, DISP: Display data entry, OUT: Switch output data entry mode
8	Operation switches	Use to enter or check data.

2.Configuration Example

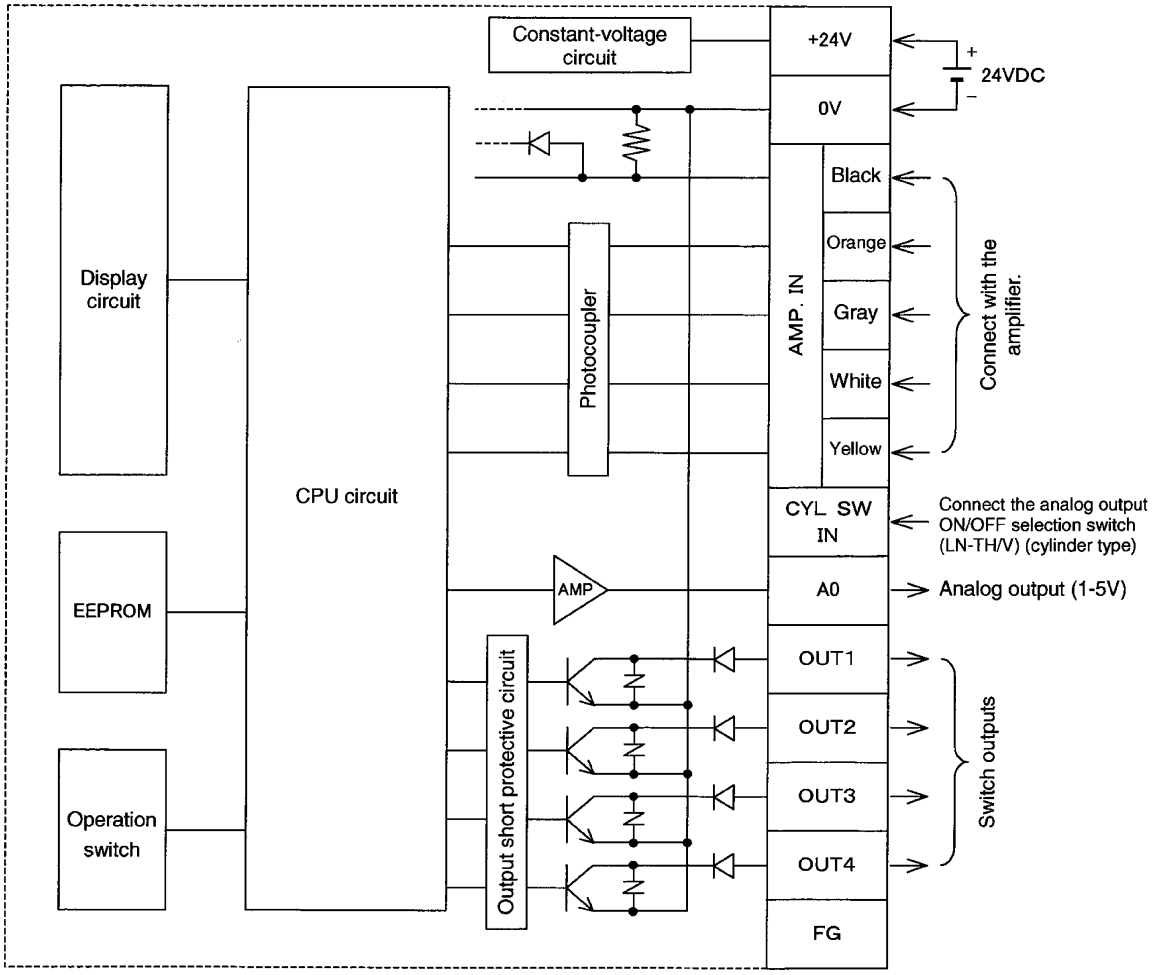


3.Block Diagram

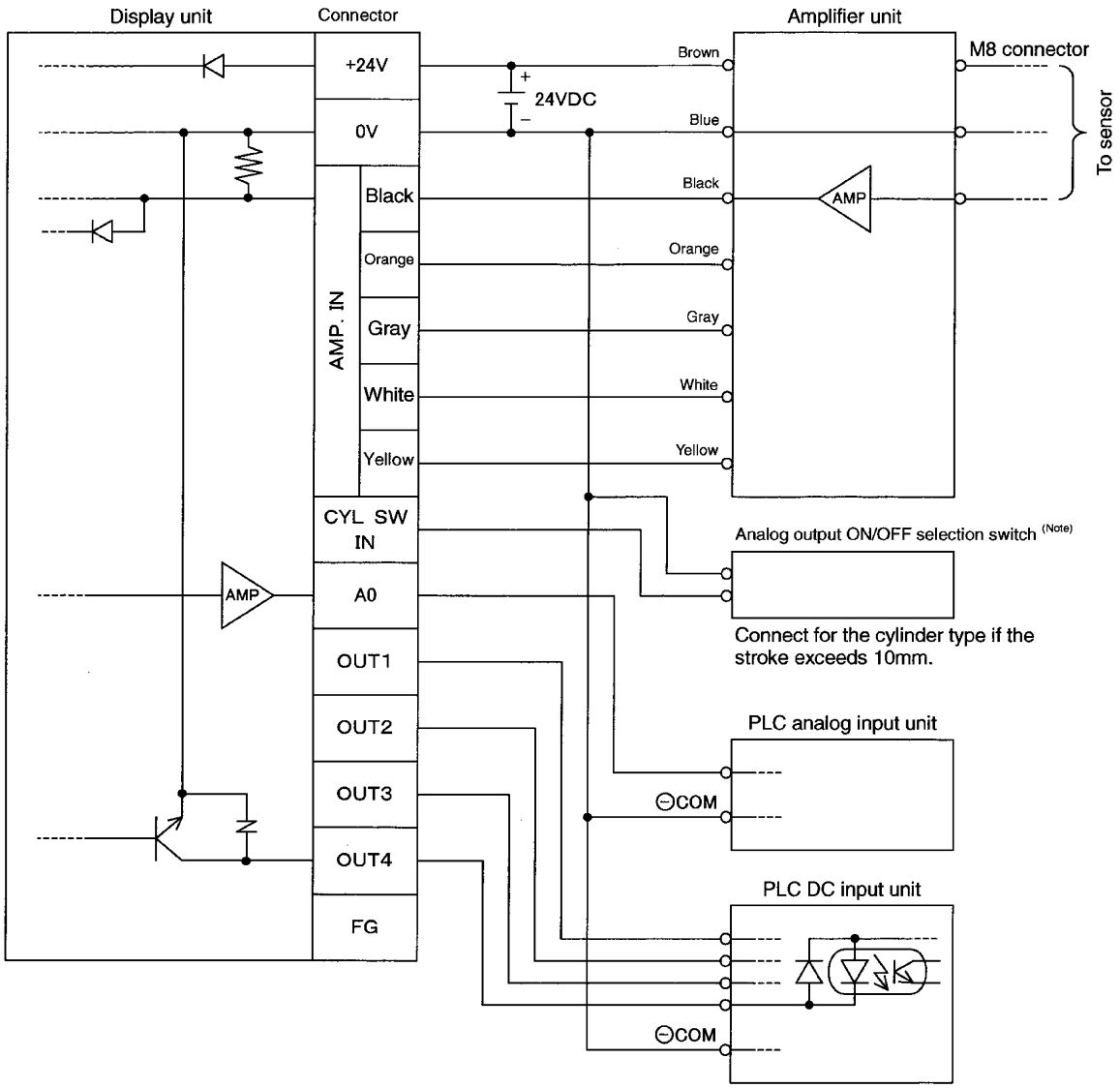
3-1. Sensor and Amplifier Unit



3-2. Display Unit



4. Connection Circuit Diagram



Notes

(1) Because the display unit is of a two-channel specification, two sets of +24V and 0V terminals are provided at the connector. They are connected inside the display unit; connect either set to activate.
(2) If only one model of the amplifier unit is connected, either channel may be used at the connector.
(3) Turn the power off before connecting cables.
(4) When connecting the cable at the connector of the display unit, leave the female side unconnected.
(5) The cable size of the connector of the display unit is 0.08 to 1.5mm, and the tightening torque of the terminal screw is 0.25N·m.
(6) Do not connect or disconnect connectors when the power is on.
(7) Use the screw of the female side to fix the male side for the prevention of disconnection of the connected male and female connectors.
(8) If the stroke of the cylinder type exceeds 10mm, connect the special switch for analog output ON/OFF selection (LN-TH/V) to the display unit. Connect the brown cable to the CYL SW IN terminal and connect the blue cable to 0V.

5. Adjustment Method

5-1. Cylinder Adjustment Method

For adjustment of the sensor mounting position and analog output voltage, it is recommended to prepare a workpiece (reference tool), the piston of which stops in the center of the length measurement range, at 5mm on the extension side, and at 5mm on the return side.
Use the actual air pressure for the adjustment of these and display unit setting.

5-1-1. Sensor Installation Position

The sensor is installed in the length measurement range designated by the customer (for example, in case from 10mm before the extension limit of the piston up to the extension limit, the sensor is installed in the center of the range). To change the sensor installation face or the length measurement range, follow the procedure below.

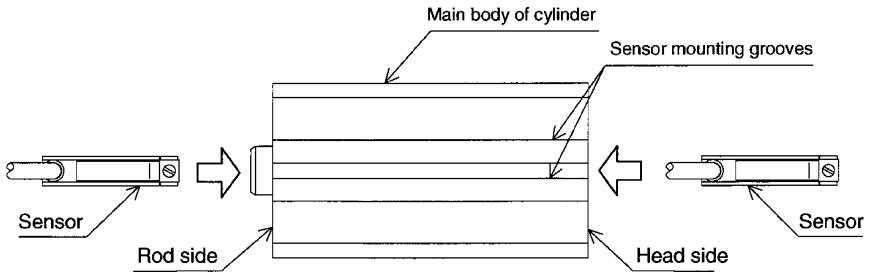
(1) Adjust the sensor installation position indicator adjusting trimmer so that the sensor installation position indicator (yellow LED) is always lit without the sensor, and set the trimmer in the center of the interval where the yellow LED is lit.
(This adjustment is made before shipment of the product from the factory; perform adjustment if the trimmer is touched inadvertently.)

(2) Place the piston of the cylinder in the center of the length measurement range.

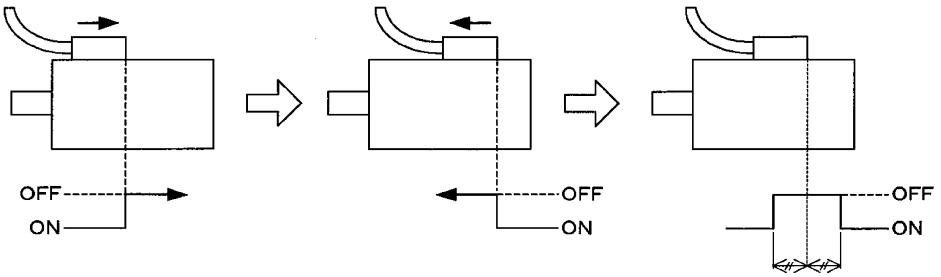
(3) Install the sensor to the cylinder. During the procedure, fix the sensor in a position satisfying the following conditions.
The sensor tightening torque is 0.1 or 0.2N·m.
Install the sensor case without fail so that the sensor mounting screw
(M2.5; set screw with a slot) is on the cylinder head side.

① During insertion from rod
Fix the sensor in the center of the interval where the sensor installation position indicator lights up for the second time, including the timing described in (1).
(The second lighting interval is as short as about 1mm when converted into the piston stroke.)

② During insertion from head
Fix the sensor in the center of the interval where the sensor installation position indicator lights up for the second time, including the timing described in (1).
(The second lighting interval is as short as about 1mm when converted into the piston stroke.)



(4) If the stroke of the piston of the cylinder, on which the sensor is installed, is longer than 10mm and the length is measured in the 10mm stroke range, connect LINEARNORM switch LN-TH/V across the CYL SW IN and 0V terminals of the display unit.
(If the stroke is 10mm or shorter, short circuit across the CYL SW IN and 0V terminals.)
Place the switch, after step (2), in the center of ON points, similarly to earlier cylinder switches.
The tightening torque of the switch is 0.1 or 0.2N·m.
<Installation procedure of LINEARNORM switch LN-TH/V>



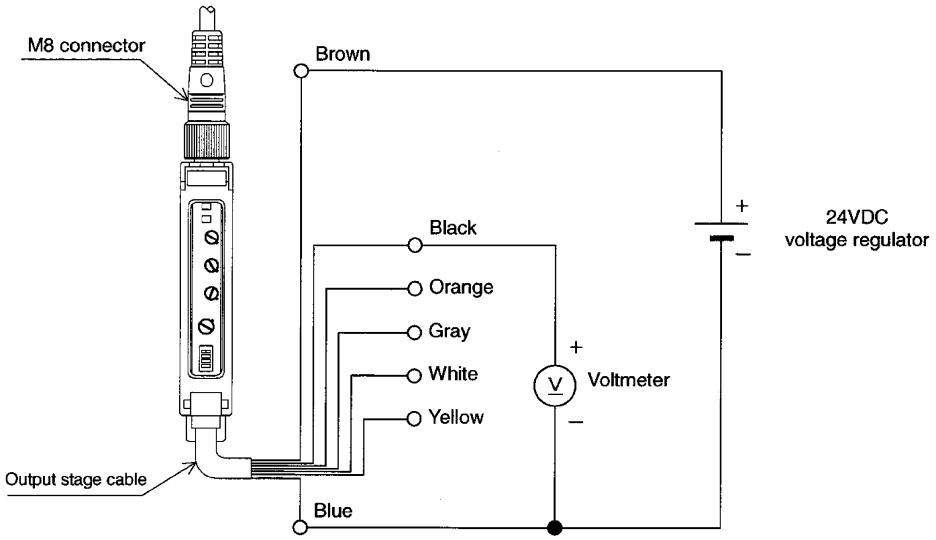
(Reference)

- Refer to the mating mark on the cylinder (marked on assumption for length measurement range designated by the customer) for the approximate mounting positions of the sensor and switch described above.
  Place the sensor in a position where the red line on the cylinder meets that on the sensor.
  Place LINEARNORM switch LN-TH/V in a position where the end face on the mounting screw side is aligned with the red alignment mark on the cylinder face. (Only for LN-A and AO Series)
- If the length measurement range is changed, calculate the difference from the previous position and, based on the red line on the cylinder for the previous position, obtain the approximate installation positions of the sensor and cylinder switch.
- The above-mentioned alignment mark is indicated on the cylinder face only if the cylinder equipped with a LINEARNORM sensor is ordered in a set. (Only for LN-A and AO Series)

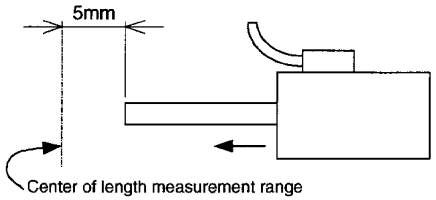
5-1-2. Sensor Output Voltage

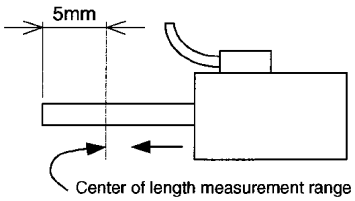
The sensor voltage issued from the amplifier unit is adjusted in the factory before shipment so that outputs are obtained in the length measurement range designated by the customer (that is, for example, 4.5V is obtained at 10mm before the extension end and 1V is obtained at the extension end for the length measurement range from 10mm before the extension end up to the extension end). There may be a certain error according to the operating environment due to the effect of surrounding magnetic bodies. Perform fine adjustment in the following procedure.

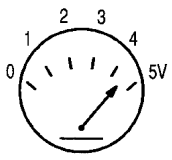
(1) Connect the brown cable to the (+) terminal and connect the blue cable to the (-) terminal of the 24VDC voltage regulator.
Next, connect the black cable to the (+) terminal of the voltmeter and connect the blue cable to the (-) terminal.



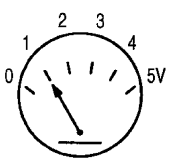
(2) Move the piston of the cylinder and read the voltage measurement at the starting end and the last point of the length measurement range (at 10mm before the extension end and at the extension end, for example).





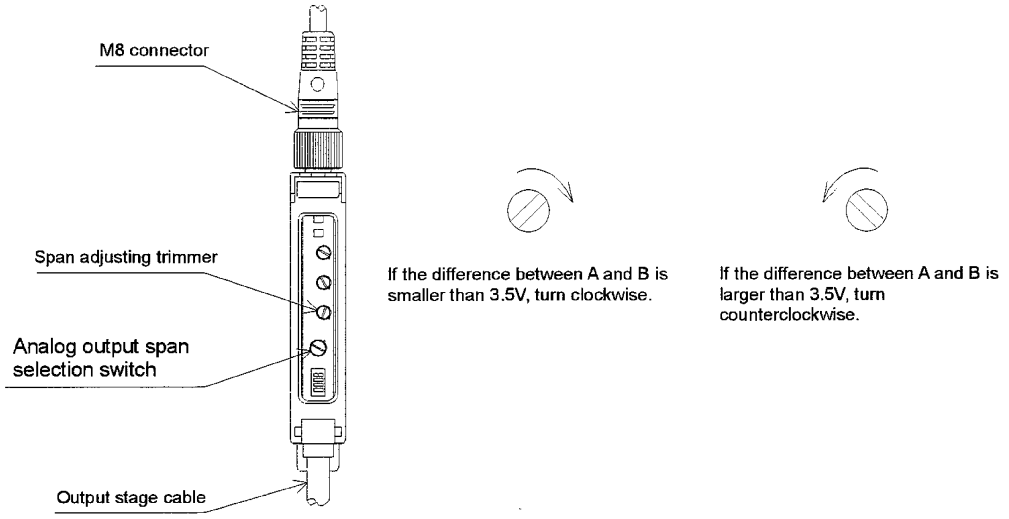


Voltmeter
Value at starting point of length measurement range: A

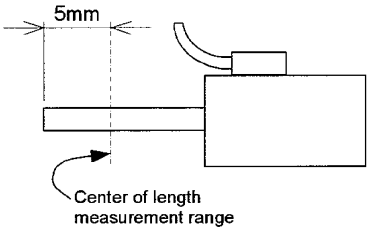


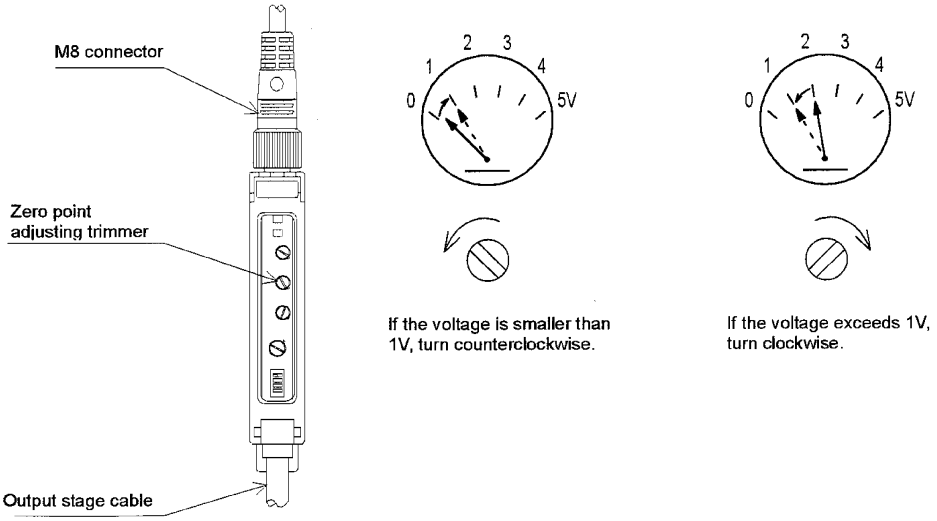
Voltmeter
Value at last point of length measurement range: B

(3) If the difference in the voltage measured in step (2) is smaller than 3.5V, turn the span adjusting trimmer clockwise.
On the contrary, if it is larger than 3.5V, turn the trimmer counterclockwise.
(If the span adjusting trimmer is turned but the adjustment range is deviated from, change the analog output span selection switch and execute again.)



(4) Move the piston of the cylinder again and read the voltage at the starting and last points of the length measurement range. Turn the zero point adjusting trimmer to obtain 4.5V if the starting point is the basis. Turn it to obtain 1V if the last point is the basis.
(The figure below shows an example where the last point is the basis.)





(5) Further repeat steps (2), (3) and (4) several times to adjust finely.

5-2.Gripper Adjusting Method

Perform sensor installation position adjustment, analog output voltage adjustment and display unit setting at the actual air pressure.

5-2-1.Sensor Installation Position

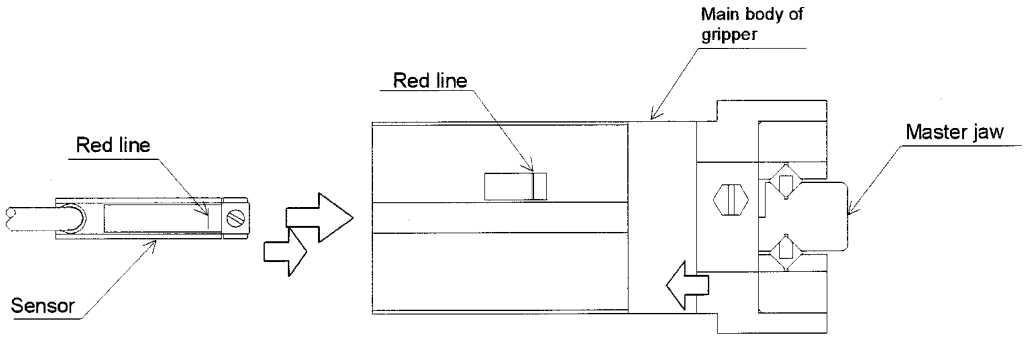
The sensor is installed in the center of the master jaw stroke. To change the sensor mounting face or to change the gripper, follow the procedure below.

(1) Turn the sensor installation position indicator adjusting trimmer so that the sensor installation position indicator (yellow LED) is always lit without the sensor, and set the trimmer in the center of the interval where the yellow LED lights up.
(This adjustment is made at the factory before shipment. Perform this step, only if the trimmer is touched inadvertently.)

(2) Place the master jaw of the gripper in the center of the stroke.

(3) Install the sensor on the gripper. During the procedure, fix the sensor in the position satisfying the following conditions.
The tightening torque of the sensor is 0.1 or 0.2N·m.
Be sure to install the sensor case so that the sensor mounting screw (M2.5; set screw with slot) is on the master jaw side.

① Sensor installation position
Fix the sensor in the center of the interval where the sensor installation position indicator lights up for the second time, including the timing described in (1).
(The second lighting interval is as short as about 1mm when converted into the piston stroke.)



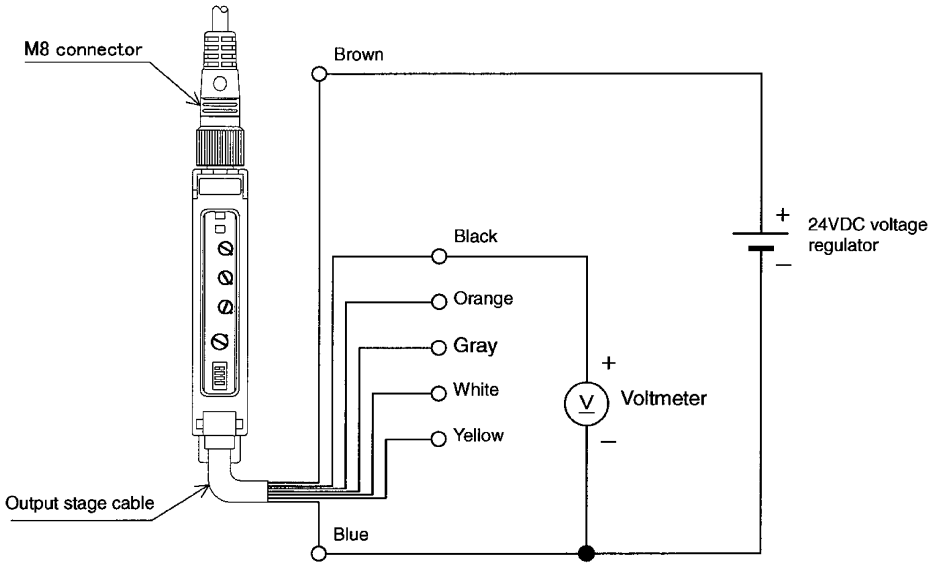
As an approximate positioning method, align the sensor installation position mark (red line) on the sensor with that marked on the gripper. However, prepare a workpiece (reference tool) for step (2) and perform steps (1), (2) and (3) whenever possible.

5-2-2. Sensor Output Voltage

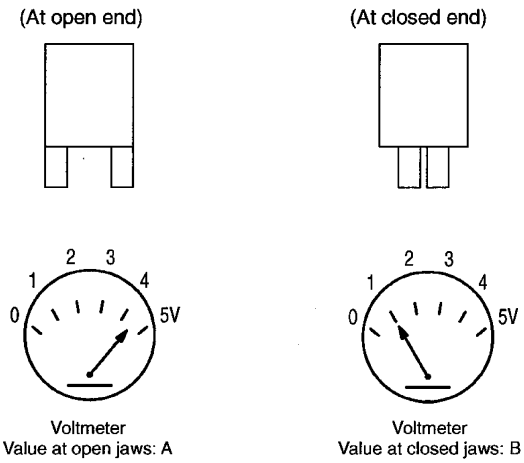
Adjustment is made at the factory before shipment so that the sensor voltage issued from the amplifier unit is 4.5V at the open end of the full stroke of the master jaw and 1V at the closed end. There may be a slight error according to the operating environment due to the effect of the surrounding magnetic bodies. Perform fine adjustment in the following procedure.

Make similar adjustment, too, when changing the sensor mounting face or changing the gripper.

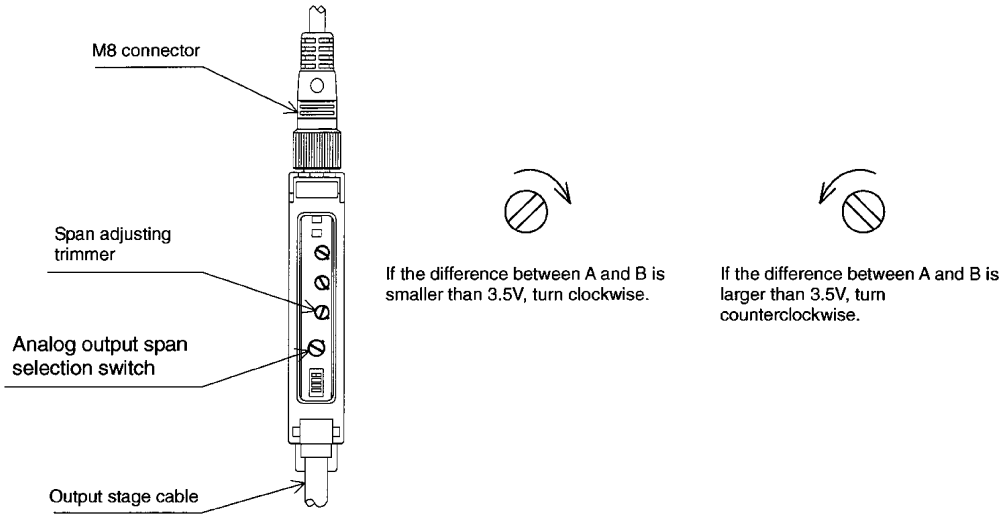
(1) Connect the brown cable to the (+) terminal and connect the blue cable to the (-) terminal of the 24VDC voltage regulator. Next, connect the black cable to the (+) terminal and connect the blue cable to the (-) terminal of the voltmeter.



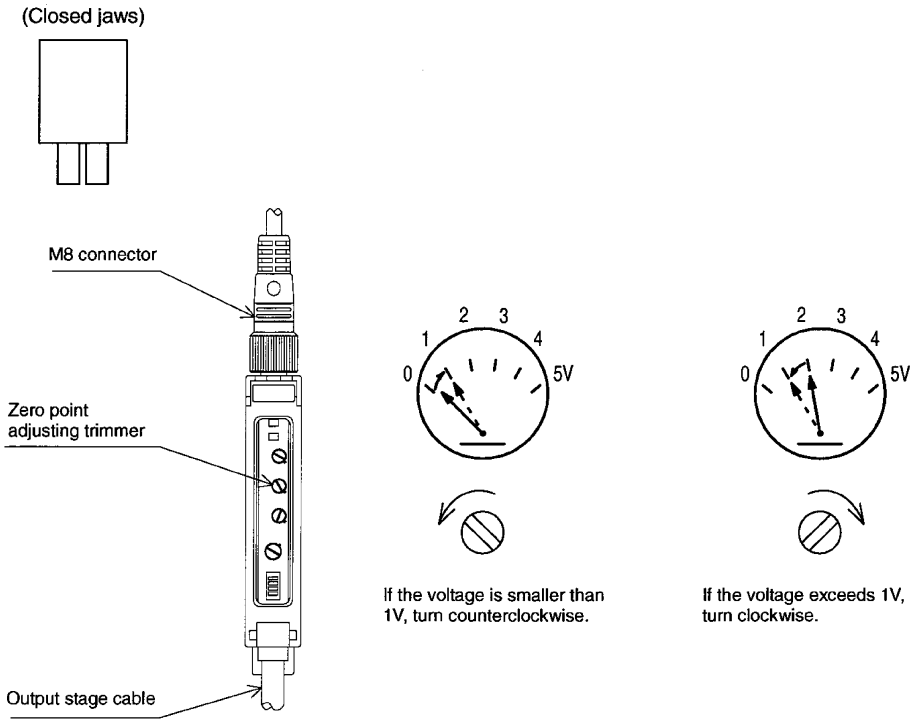
(2) Move the master jaw and read the voltage at the open and closed ends.



(3) If the difference in the voltage measured in above step (2) is smaller than 3.5V, turn the span adjusting trimmer clockwise.
On the contrary, if it is larger than 3.5V, turn the trimmer counterclockwise slightly.
(If the adjustment range is deviated from when the span adjusting trimmer is turned, change the analog output span selection switch and perform again.)



(4) Move the master jaw again and read the voltage at the starting and last points of the length measurement range with the open and closed jaws. Turn the zero point adjusting trimmer to obtain 4.5V if the starting point is the basis, or turn to obtain 1V if the last point is the basis.
(The figure below shows the example where the last point is the basis.)



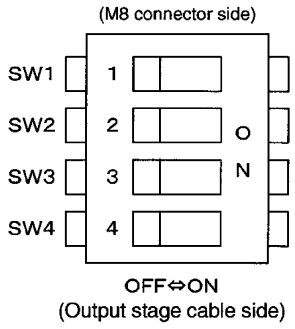
(5) Further repeat steps (2), (3) and (4) several times to adjust finely.

5-3. Setting the Analog Output Correction Data Reading Switch

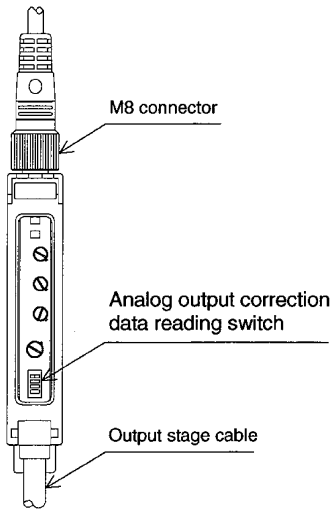
Because there is no linearity in the sensor voltage issued from the amplifier unit in relation to the stroke of the piston or master jaw, linear correction is made in the microcomputer built in the display unit.
The correction table varies according to the model of the sensor-integrated actuator. The 4-bit switch installed on the amplifier unit must be properly set so that adequate correction data is read out of the ROM of the microcomputer.
This switch is set at the factory for models shipped in a set of the actuator, sensor and amplifier unit and you may visually check the setting to confirm. To change the model of the actuator or amplifier unit, give the setting specified in the table below.

Model / SW No.	LN-A12□ LN-AO12□	LN-A16□ LN-AO16□	LN-A20□ LN-AO20□	LN-A32□ LN-AO32□	LN-A50□ LN-AO50□	LN-B12□ LN-BQ12□	LN-B16□ LN-BQ16□	LN-B20□ LN-BQ20□	LN-B25□ LN-BQ25□
SW1	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON
SW2	ON	ON	OFF	OFF	ON	ON	OFF	OFF	ON
SW3	ON	ON	ON	ON	OFF	OFF	OFF	OFF	ON
SW4	ON	ON	ON	ON	ON	ON	ON	ON	OFF

Model / SW No.	BHA-LN-04CS BHG-LN-04CS	BHA-LN-05CS BHG-LN-05CS	BHE-LN-04CS	BHE-LN-05CS
SW1	OFF	ON	OFF	ON
SW2	ON	OFF	OFF	ON
SW3	ON	ON	ON	OFF
SW4	OFF	OFF	OFF	OFF



Enlarged view of analog output correction data reading switch

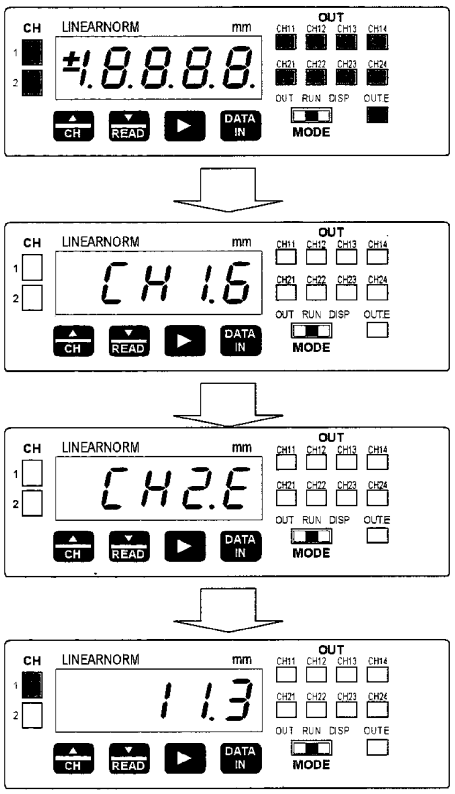


6.Display Unit Operation Method

6-1.Power-On

After cable connection described in Section 4 "Connection Circuit Diagram" and adjustment of the sensor amplifier unit described in Section 5 "Adjustment Method" have been finished, turn the display unit and amplifier unit on.
After the power is turned on, all the segments of the 7-segment LED display and LEDs light up, and the 7-segment LED shows the connected actuator in a code ("3" to "F" or "-" shown in <Table 1>), then the channel LED lights up and the 7-segment LED shows certain span and offset that are automatically entered. The data displayed at the display unit according to the connection type of the amplifier unit is shown in <Table 2>.

As an example, **the case where the MODE selection switch is fixed in the RUN position** is shown below.



① After the power is turned on, the 7-segment LED display and LEDs light up for about two seconds.

② Indicates that the cylinder or gripper is connected at CH1 of the display unit.
[Example]
Code "6": LINEARNORM gripper (BHA-LN-04CS)

③ Indicates that the cylinder or gripper is connected at CH2 of the display unit.
[Example]
Code "E": LINEARNORM cylinder (LN-A16□)

④ The CH1 channel indicator LED lights up in green and the length measurement is displayed at the 7-segment LED. [Example: "11.3"]

<Table 1> Actuator-specific code for 7-segment LED

Sensor-integrated actuator	7-segment LED display
LN-A12□,AO12□	F
LN-A16□,AO16□	E
LN-A20□,AO20□	d
LN-A32□,AO32□	c
LN-A50□,AO50□	b
LN-B12□,BQ12□	A
LN-B16□,BQ16□	9
LN-B20□,BQ20□	8
LN-B25□,BQ25□	7
BHA-LN-04CS ,BHG-LN-04CS	6
BHA-LN-05CS ,BHG-LN-05CS	5
BHE-LN-04CS	4
BHE-LN-05CS	3
No connection of sensor	-

<Table 2> 7-segment LED display of amplifier unit connection type

Channel of display unit at which the amplifier unit is connected		7-segment LED display
CH1	CH2	
○		The data of CH1 is displayed.
	○	The data of CH2 is displayed.
○	○	The data of CH1 is displayed immediately after the power is turned on, then **the channel before shutoff** is displayed.

○: Indicates the connected channel.

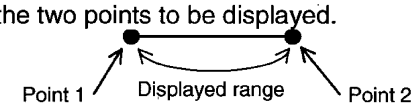
6-2. Setting the Value Displayed at 7-Segment LED

6-2-1. Initial Setting of Value Displayed at 7-Segment LED

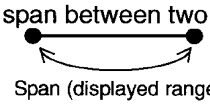
Enter the initial setting value displayed at the 7-segment LED, which follows movement of the cylinder piston or master jaw of the gripper, in the following procedure.
Perform the procedure in an arbitrary 10mm interval for the cylinder, or at the fully open and closed points for the gripper.

An outline of entry is as follows.

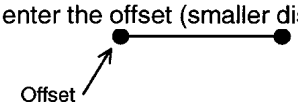
(1) Enter the two points to be displayed.

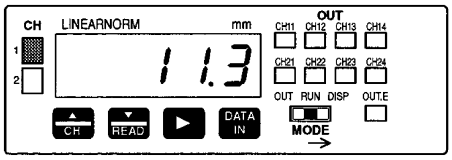


(2) Next, enter the span between two points.

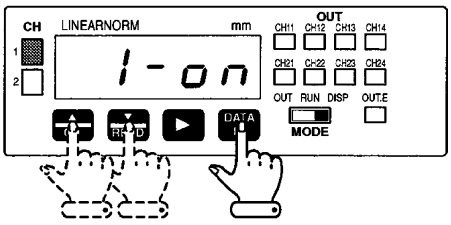


(3) Finally, enter the offset (smaller displayed value among two points).



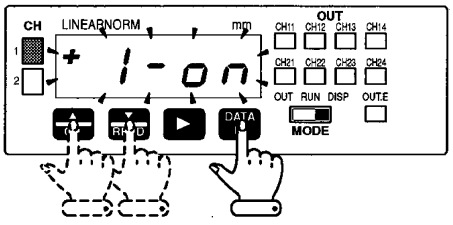


① In the state of step ④ described in Section 1 "Power-On," move the MODE selection switch from the RUN to the DISP position.



② Press the CH or READ key to select the channel to be set, and press the DATA IN key to determine.

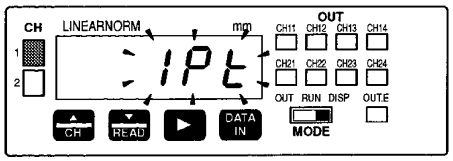
> Upon selection of CH1, 1-on is displayed. Upon selection of CH2, 2-on is displayed.
> If no amplifier unit is connected at the selected channel, no-□ blinks.

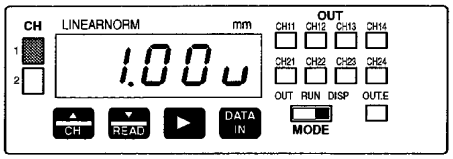


③ **Determine the sign of the displayed value.**
After the channel is determined, □-on blinks at the 7-segment LED.

> □: "+1," "-1," "+2" or "-2" is displayed.

The "+" sign displayed at the 7-segment LED means that the movement of the cylinder piston toward the extension limit (or, movement to close jaws, for the gripper) causes the displayed value to decrease.
For the analog output (1-5V voltage output) issued from the display unit, "1V" is the side of the smaller displayed value, and "5V" is the side of the larger displayed value.
Press the CH or READ key to select the sign and press the DATA IN key to store the setting.

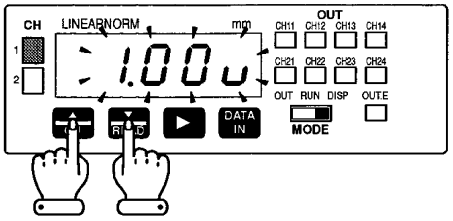




④ Determine the first point in the length measurement range.

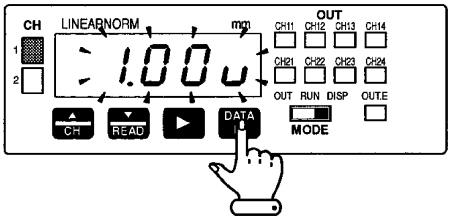
After determining the sign, 1PL blinks for about two seconds at the 7-segment LED, then the previous sensor voltage of the first point of the length measurement range lights up.

1.00u is displayed during initial entry of a setting.

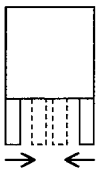


Move the piston of the cylinder or the master jaw of the gripper in the first point of the length measurement range, and press and hold the CH and READ keys simultaneously.

The first point may be either the extension end or contraction end of the cylinder, or it may be either the open or closed end of the gripper.
Select either one at your will.

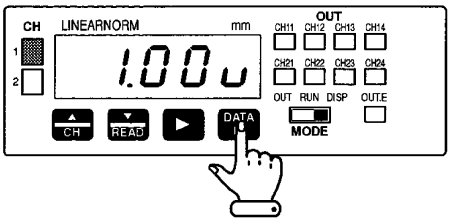


The sensor voltage (in volts) issued from the amplifier unit blinks at the 7-segment LED.

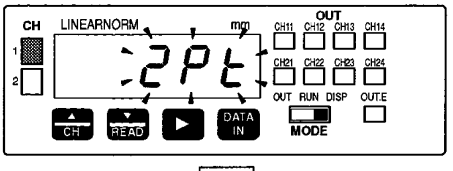


[Example]
To define the closed end of the gripper as the first point of the length measurement range, fully close the master jaw and fix it.
The sensor shows about 1V.

Next, press the DATA IN key to determine the first point.
The blinking 7-segment LED lights up.



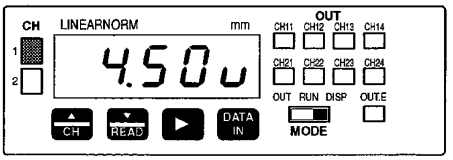
Next, press the DATA IN key again to store the setting.

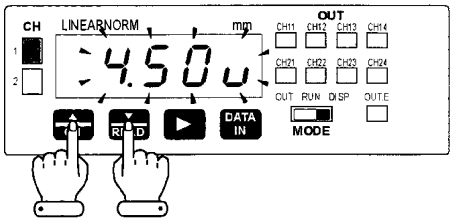


⑤ Determine the second point of the length measurement range.

After the first point is determined, the 7-segment LED blinks 2PL for about two seconds, then the sensor voltage of the previous second point of the length measurement range lights up.

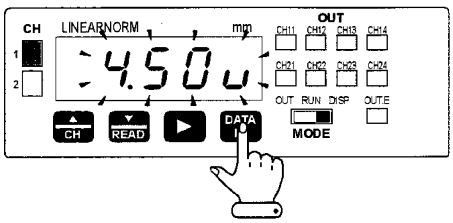
4.50u is displayed during initial entry of a setting.



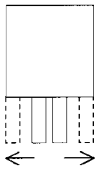


Move the piston of the cylinder or the master jaw of the gripper to the second point of the length measurement range and press and hold the CH and READ keys simultaneously.

Another point different from the previously determined first point is displayed.



The 7-segment LED blinks the sensor voltage (in volts) issued at the amplifier unit.

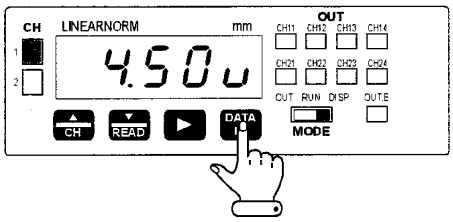


[Example]

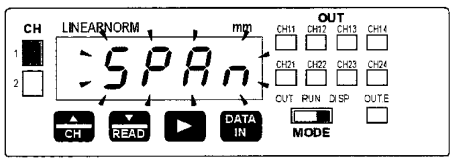
Open the mater jaw fully to define the open end of the gripper as the second point.

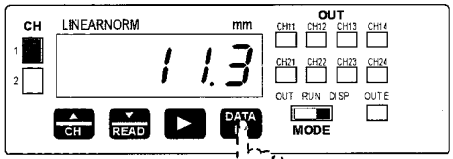
The sensor shows about 4.5V.

Next, press the DATA IN key to determine the second point. The blinking 7-segment LED lights up.



Next, press the DATA IN key again to store the setting.





Press to go to step (8) only.

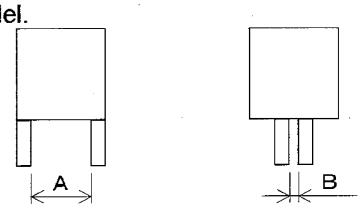
⑥ **Determine the span.**

After the second point is determined, SPAn blinks for about two seconds, then the automatically entered span lights up.

The displayed value is "10mm" for the cylinder type and it varies according to the model for the gripper type.

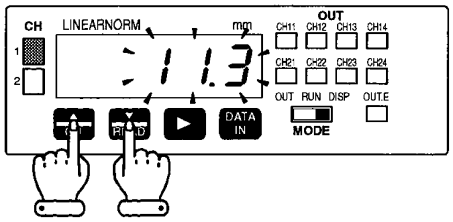
The value is "11.3mm" for BHA-LN-04CS."

In case of cylinder type, there is no need to change the value; simply press the DATA IN key to proceed to step ⑧. In case of the gripper type, measure the difference between the open and closed ends using calipers or the like, and change the setting according to the procedure described in step ⑦, because there is slight difference among even a single model.

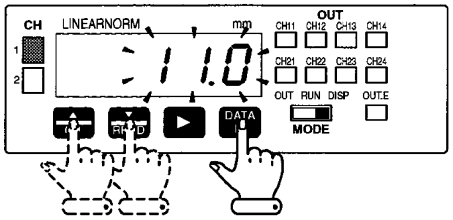


(Dimension A of open ends) - (Dimension B of closed ends) = (Span)

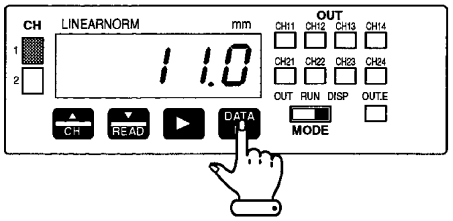
To skip step (7) and go to step (8), press the DATA IN key.



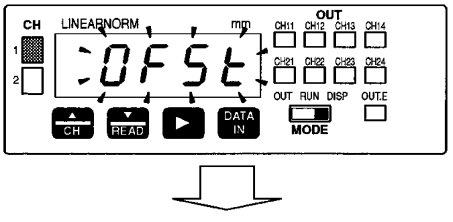
⑦ **Change the span.**
Press and hold the ▲ CH and ▼ READ keys simultaneously.
At this time, the previous span blinks.



Next, operate the ▲ CH (increase) or ▼ READ (decrease) key to change the value, and press the DATA IN key to determine the span.
The blinking 7-segment LED lights up.

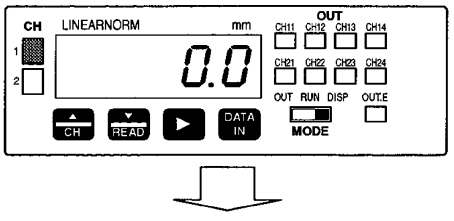


Next, press the DATA IN key again to store the setting.

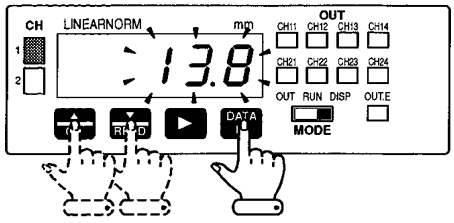


⑧ **Enter the offset.**
After the span is determined, OFSt blinks for about two seconds, then the automatically entered offset lights up.

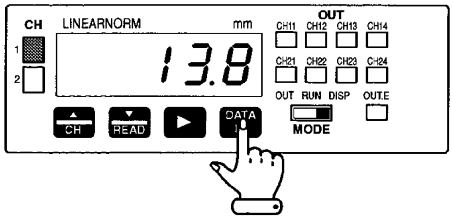
> The displayed value is "0" if the offset is entered for the first time. Or the value having been entered is displayed, if there is one.



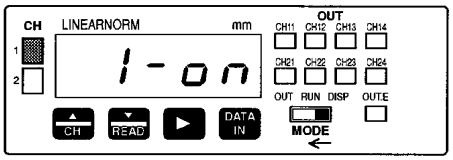
Press and hold the ▲ CH and ▼ READ keys simultaneously.
The previous offset blinks.



Operate the CH (increase) or READ (decrease) keys to change the value, and press the DATA IN key to determine the offset.
The blinking 7-segment LED light up.



Next, press the DATA IN key again to store the setting.



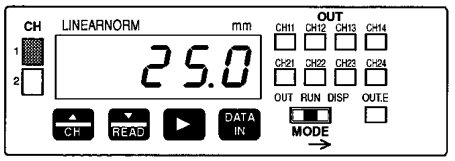
⑨ After the offset is determined, 1-on lights up at the 7-segment LED, indicating that data entry is finished.
Change the MODE selection switch from DISP to RUN to finish the procedure.

If there is an entry error in the series of operation (or, for example, if the same value is entered for the first and second points of the length measurement range of the master jaw of the gripper), change the MODE selection switch back from the DISP to the RUN position and change it to the DISP position again to return to step ① in the procedure, and enter again.

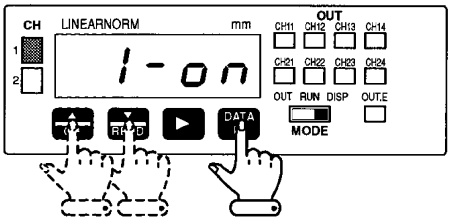
6-2-2. Changing Part of Values Displayed at 7-Segment LED

To change a part of values displayed at the 7-segment LED, select the channel to be changed, press the ▶ key to call up the corresponding item, change the setting according to the method described in Section 6-2-1 "Initial Setting of Value Displayed at 7-Segment LED," and press the DATA IN key as a last step to determine.

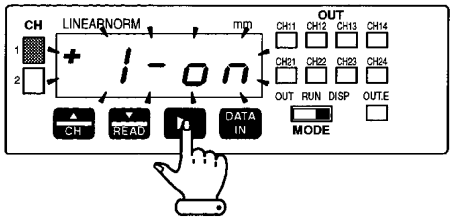
As an example, **the procedure for changing the offset from "13.8" to "14.0"** is described below.



① Change the MODE selection switch from the RUN to the DISP position.



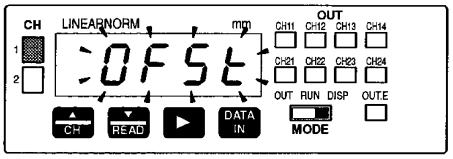
② Press the CH or READ key to select the channel to be changed, and press the DATA IN key to determine.



③ [□-on] blinks at the 7-segment LED.

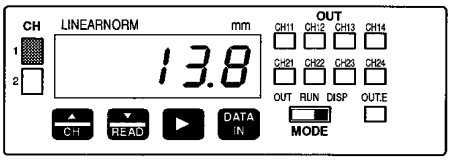
□: "+1," "-1," "+2" or "-2" is displayed.

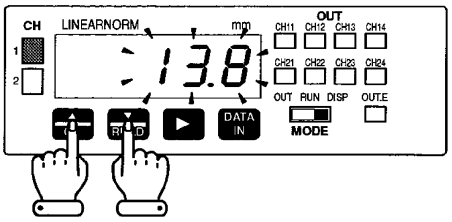
Press the ▶ key several times to go to the desired item.



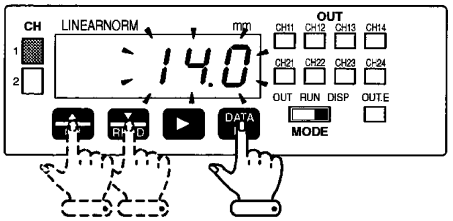
④ The offset is displayed.

After the offset is selected, [OFSt] blinks for about two seconds at the 7-segment LED, and the previous offset lights up.

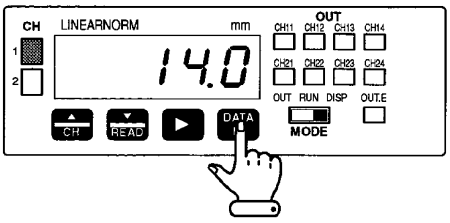




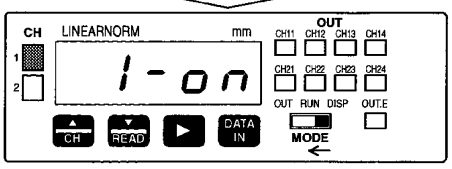
⑤ Press and hold the CH and READ keys simultaneously so that the previous offset [13.8] blinks.



⑥ Operate the CH (increase) or READ (decrease) key to change the blinking value to [14.0].
After changing to the desired setting, press the DATA IN key to determine the offset.
The blinking 7-segment display lights up.



Next, press the DATA IN key again to store the setting.



⑦ After the offset is determined, [□-on] lights up at the 7-segment LED, indicating that data change is completed.
Change the MODE selection switch from the DISP to the RUN position to finish the procedure.

6-3. Entering the Switch Output Position Data

If switch outputs are necessary, enter the settings in absolute values.

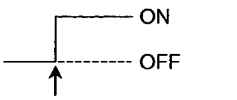
Four switch outputs are provided for each channel, and each can be entered independently.

There are six entry patterns shown in the table below, as well as pattern "0" for clearing all entered data. The flow of entry is shown below.

Entry pattern	Description
0	Clear all.
1	Boundary judgment method using one reference workpiece (entry with a reference workpiece)
2	Boundary judgment method using one 7-segment LED display value (value entry)
3	Upper/lower limit judgment method using two reference workpieces
4	Upper/lower limit judgment method using two 7-segment display values
5	Upper/lower limit judgment method using one reference workpiece (center value) and 7-segment display value (± tolerance)
6	Upper/lower limit judgment method using one 7-segment display value (center value) and 7-segment display value (± tolerance)

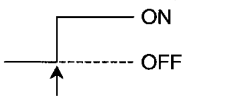
Note: The odd number entry patterns are entry methods using an actual workpiece. The even number entry patterns except for "0" are value entry methods using operation keys and 7-segment display values.

<Pattern 1>



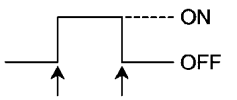
Determined by a workpiece

<Pattern 2>



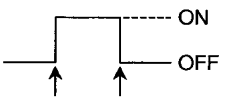
Determined by an entered value

<Pattern 3>



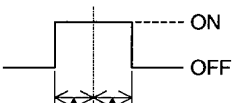
Two points are determined by workpieces.

<Pattern 4>



Two points are determined by entered values.

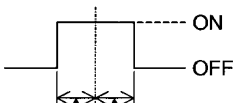
<Pattern 5>



The tolerance is determined by an entered value.

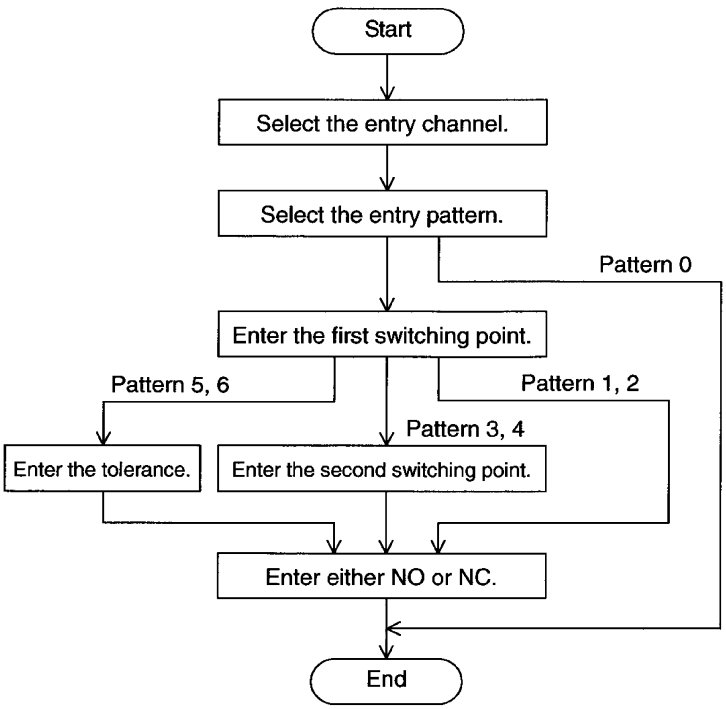
The center is determined by a workpiece.

<Pattern 6>

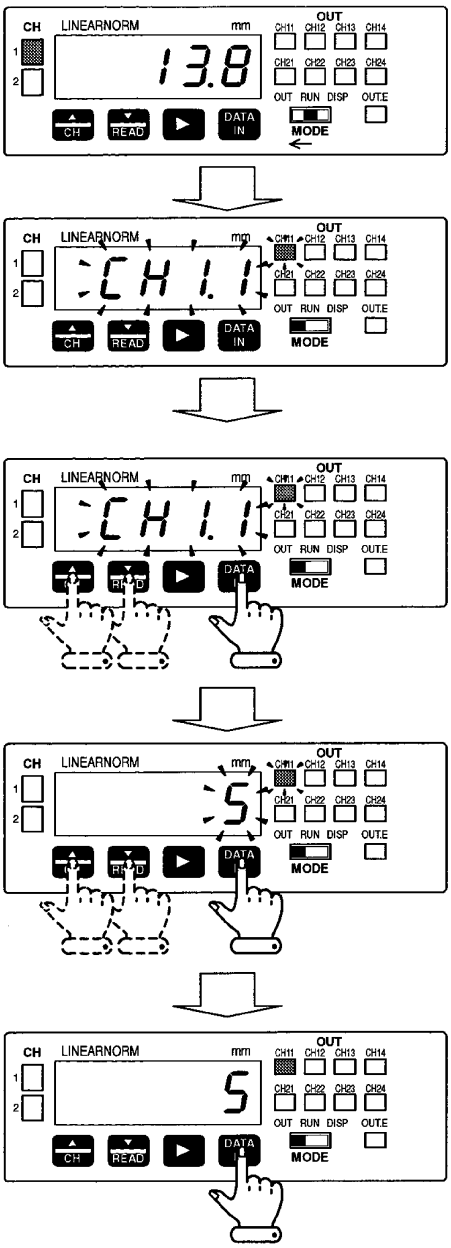


The tolerance is determined by an entered value.

The center is determined by a value.



6-3-1. Entry Procedure for New Setting



① Change the MODE selection switch from the RUN to the OUT position.

② The entry channel number appears at the 7-segment LED and the corresponding output indicator LED blinks after the mode is switched.

> If the sensor is connected only at channel 2, CH2.1 blinks after the mode is switched.
> In other cases, CH 1.1 blinks.

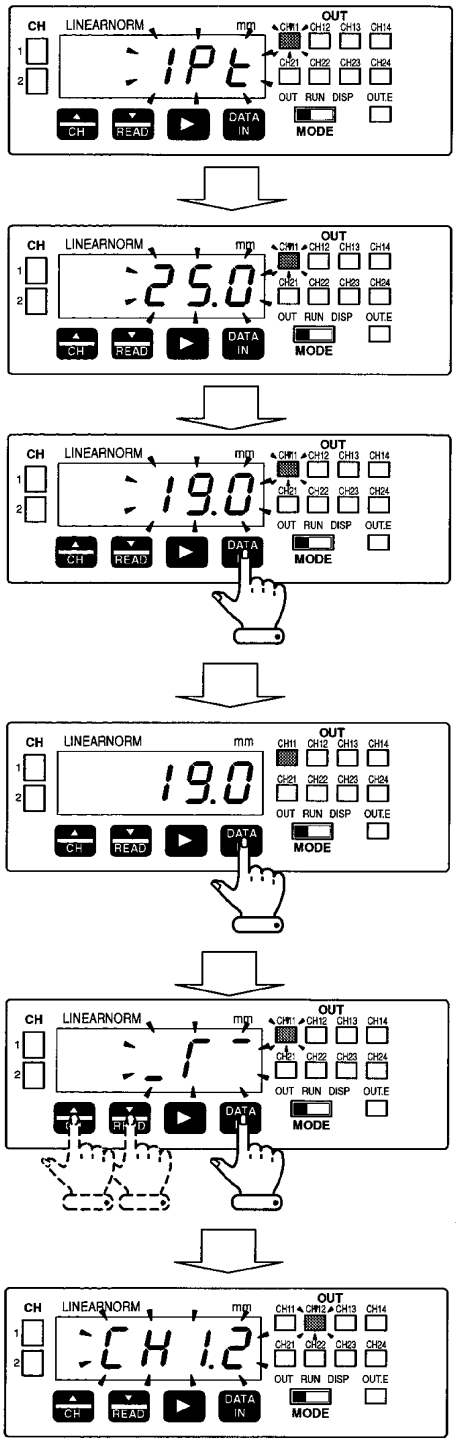
③ Press the CH or READ key to select the entry channel, and press the DATA IN key to determine.

④ Press the CH or READ key to select the entry pattern, and press the DATA IN key to determine.
The blinking 7-segment LED and output indicator LED light up.

Next, press the DATA IN again to store the pattern.

Next, the setting method for each pattern is described.

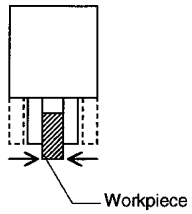
(1) Selecting pattern "1"



① After entry pattern "1" is selected and determined according to the procedure described on page 28, [IPt] blinks at the 7-segment LED for about two seconds, then an absolute value corresponding to the position of the piston or master jaw blinks.

② Move the piston or master jaw to catch a workpiece, and press the DATA IN key to determine the switching point.
The blinking 7-segment LED and output indicator LED light up.

<Example with gripper>



Press the DATA IN key again to store the setting.

③ [rEV] or [LEV] blinks at the 7-segment LED. Press the CH or READ key to select "NO" or "NC."

[rEV] indicates activation with an open gripper or returned cylinder, and [LEV] indicates the contrary case.

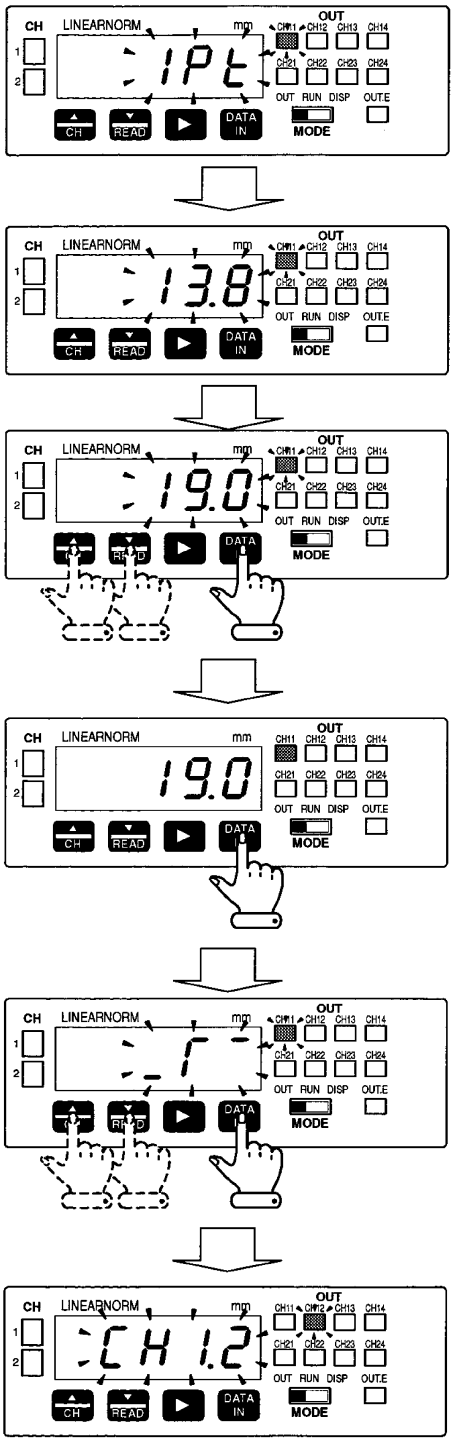
Next, press the DATA IN key to determine.
The blinking 7-segment LED and output indicator LED light up.

Next, press the DATA IN key again to store the setting.
After entry is finished, the next channel number blinks at the 7-segment LED.

After finishing entry of switch output position data, change the MODE selection switch from the OUT (switch output) to the RUN position.

If there is an entry error in the above series of operations, press the ▶ key several times to skip items to return to the top of the corresponding channel for which the switch output position data has been entered, or change the MODE selection switch from the OUT (switch output) to the RUN position and change it back to the OUT (switch output) position to return to the top of the corresponding channel, and enter again.

(2) Selecting pattern "2"



① After entry pattern "2" is selected and determined according to the procedure described on page 28, [1PE] blinks at the 7-segment LED for about two seconds, then the offset having been entered in Section 6-2-1 "Initial Setting of Value Displayed at 7-Segment LED" (minimum value in display range) blinks.

② Press the CH or READ key to enter the switching point and press the DATA IN key to determine.
The blinking 7-segment LED and output indicator LED light up.

Next, press the DATA IN key again to store the setting.

③ [-L-] or [-r-] blinks at the 7-segment LED. Press the CH or READ key to select "NO" or "NC."

> [-r-] indicates activation with an open gripper or returned cylinder, and [-L-] indicates the contrary case.

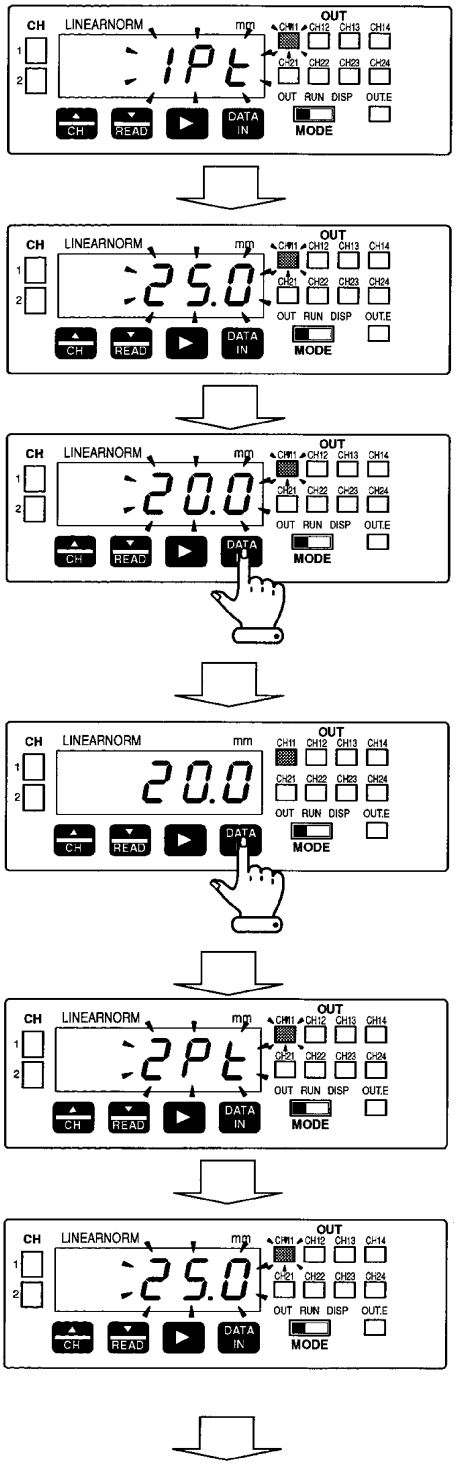
Next, press the DATA IN key to determine.
The blinking 7-segment LED and output indicator LED light up.

Next, press the DATA IN key again to store the setting.
After entry is finished, the next channel number blinks at the 7-segment LED.

After finishing entry of switch output position data, change the MODE selection switch from the OUT (switch output) to the RUN position.

If there is an entry error in the above series of operations, press the ▶ key several times to skip items to return to the top of the corresponding channel for which the switch output position data has been entered, or change the MODE selection switch from the OUT (switch output) to the RUN position and change it back to the OUT (switch output) position to return to the top of the corresponding channel, and enter again.

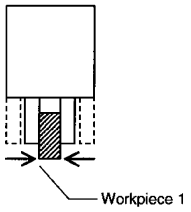
(3) Selecting pattern "3"



① After entry pattern "3" is selected and determined according to the procedure described on page 28, 1PE blinks at the 7-segment LED for about two seconds, then an absolute value corresponding to the position of the piston or master jaw blinks.

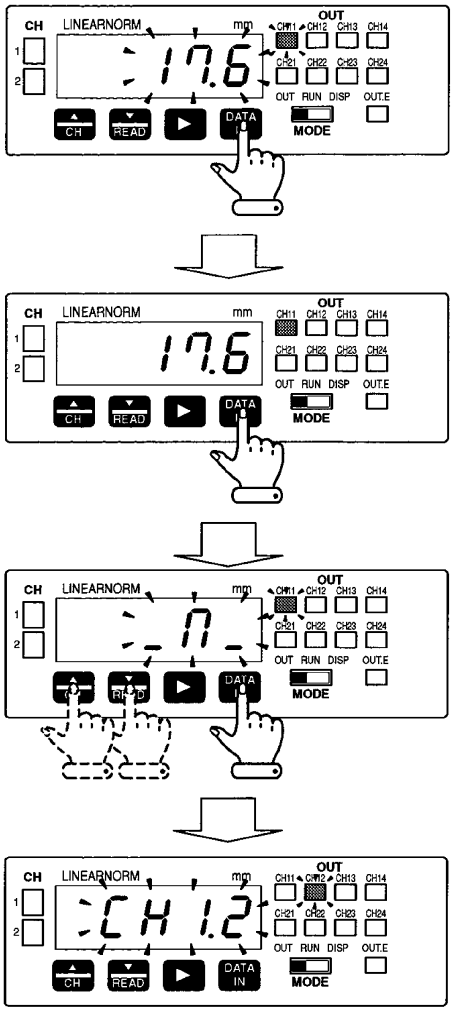
② Move the piston or master jaw to catch the first workpiece, and press the DATA IN key to determine the first switching point. The blinking 7-segment LED and output indicator LED light up.

<Example with gripper>



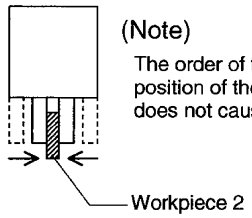
Next, press the DATA IN key again to store the setting.

③ 2PE blinks at the 7-segment for about two seconds, then an absolute value corresponding to the position of the piston or master jaw blinks.



④ Move the piston or master jaw to catch the second workpiece, and press the DATA IN key to determine the second switching point.
The blinking 7-segment LED and output indicator LED light up.

<Example with gripper>



(Note)
The order of the second stopping position of the piston or master jaw does not cause a problem.

Next, press the DATA IN key again to store the setting.

⑤ _n_ or -U- blinks at the 7-segment LED. Press the CH or READ key to select "NO" or "NC."

_n_ indicates a normally open contact ("NO"), while -U- indicates a normally closed contact ("NC").

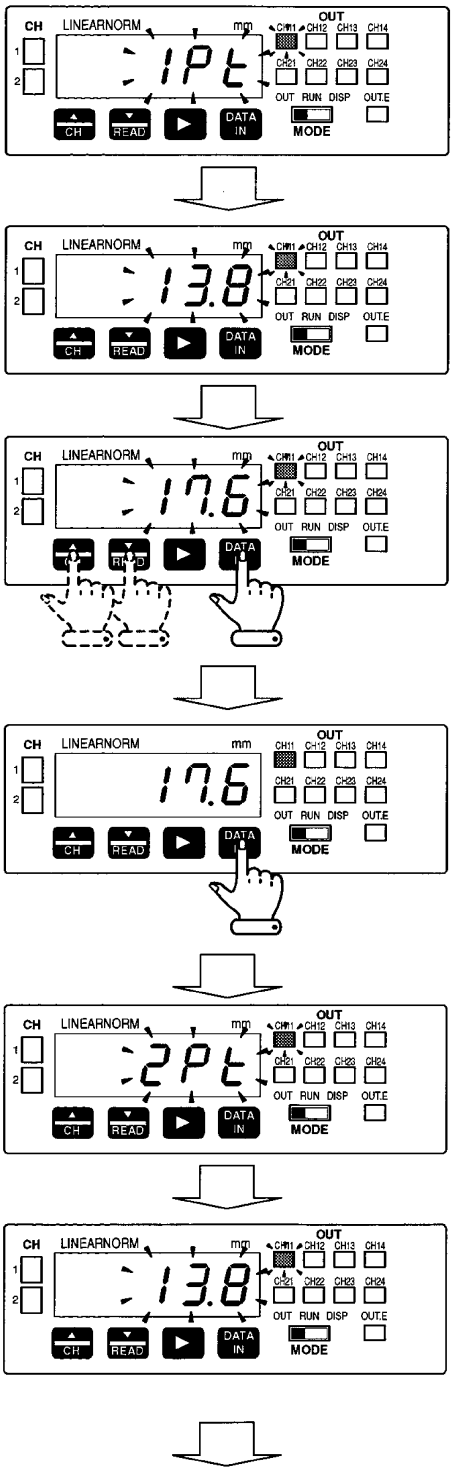
Next, press the DATA IN key to determine.
The blinking 7-segment LED and output indicator LED light up.

Next, press the DATA IN key again to store the setting.
After entry is finished, the next channel number blinks at the 7-segment LED.

After finishing entry of switch output position data, change the MODE selection switch from the OUT (switch output) to the RUN position.

If there is an entry error in the above series of operations, press the ▶ key several times to skip items to return to the top of the corresponding channel for which the switch output position data has been entered, or change the MODE selection switch from the OUT (switch output) to the RUN position and change it back to the OUT (switch output) position to return to the top of the corresponding channel, and enter again.

(4) Selecting pattern "4"

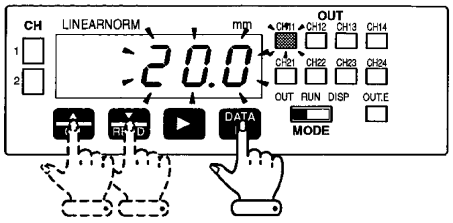


① After entry pattern "4" is selected and determined according to the procedure described on page 28, 1PE blinks at the 7-segment LED for about two seconds, then the offset having been entered in Section 6-2-1 "Initial Setting of Value Displayed at 7-Segment LED" (minimum value in display range) blinks.

② Operate the CH or READ key to enter the first switching point, and press the DATA IN key to determine.
The blinking 7-segment LED and output indicator LED light up.

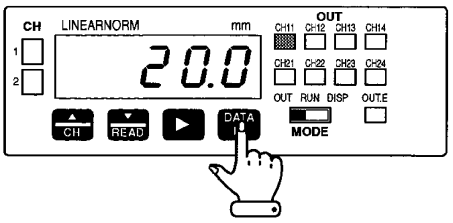
Next, press the DATA IN key again to store the setting.

③ 2PE blinks at the 7-segment LED for about two seconds, then the offset having been entered in Section 6-2-1 "Initial Setting of Value Displayed at 7-Segment LED" (minimum value in display range) blinks.

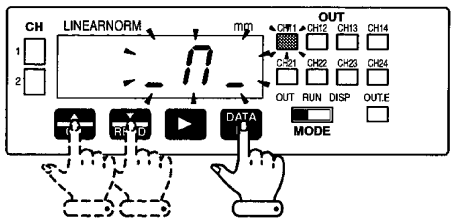


④ Operate the CH or READ key and enter the second switching point, and press the DATA IN key to determine.
The blinking 7-segment LED and output indicator LED light up.

> The order of entry of the two switching points does not cause a problem.

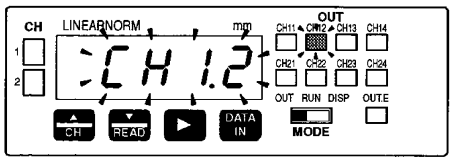


Next, press the DATA IN key again to store the setting.



⑤ _n_ or -u- blinks at the 7-segment LED. Press the CH or READ key to select "NO" or "NC."

> _n_ indicates a normally open contact ("NO"), while
> -u- indicates a normally closed contact ("NC").



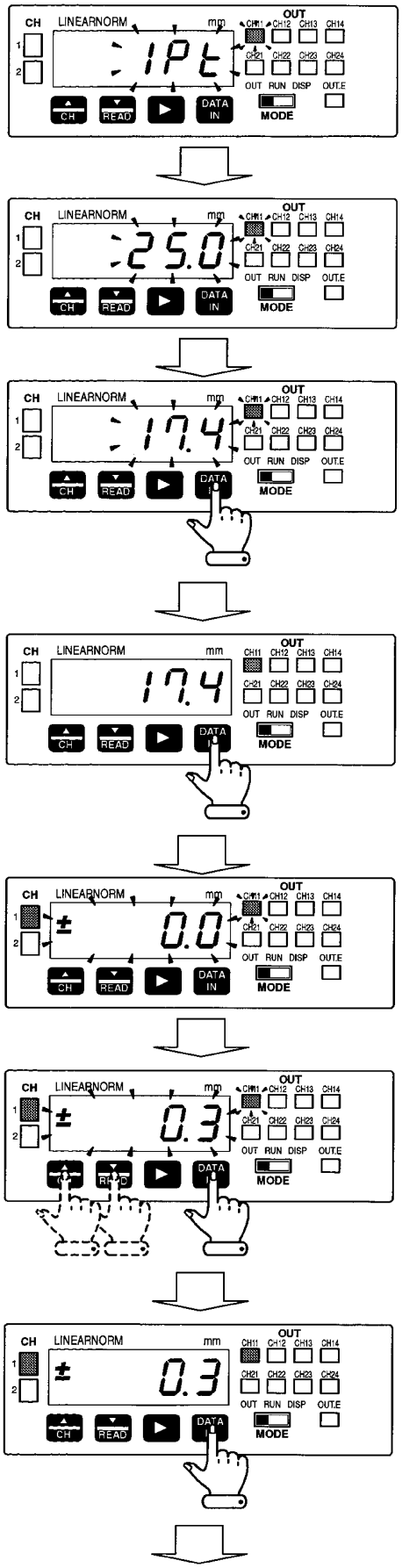
Next, press the DATA IN key to determine.
The blinking 7-segment LED and output indicator LED light up.

Next, press the DATA IN key again to store the setting.
After entry is finished, the next channel number blinks at the 7-segment LED.

After finishing entry of switch output position data, change the MODE selection switch from the OUT (switch output) to the RUN position.

If there is an entry error in the above series of operations, press the ▶ key several times to skip items to return to the top of the corresponding channel for which the switch output position data has been entered, or change the MODE selection switch from the OUT (switch output) to the RUN position and change it back to the OUT (switch output) position to return to the top of the corresponding channel, and enter again.

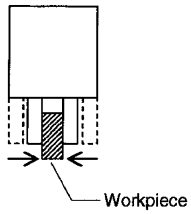
(5) Selecting pattern "5"



① After entry pattern "5" is selected and determined according to the procedure described on page 28, 1PE blinks at the 7-segment LED for about two seconds, then an absolute value corresponding to the position of the piston or master jaw blinks.

② Move the piston or master jaw to catch a workpiece, and press the DATA IN key to determine the switching point.
The blinking 7-segment LED and output indicator LED light up.

<Example with gripper>



Next, press the DATA IN key again to store the setting.

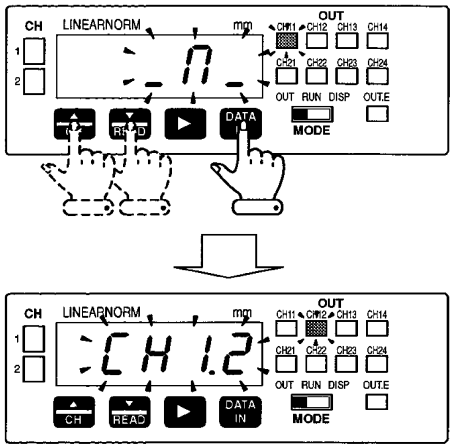
③ The previous tolerance at the switching point ± □ blinks at the 7-segment LED.

Operate the CH or READ key to enter the tolerance and press the DATA IN key to determine.

> The minimum tolerance is "±0.1."

The blinking 7-segment LED or output indicator LED light up.

Next, press the DATA IN key again to store the setting.



④ [_n_] or [‾u‾] blinks at the 7-segment LED. Press the CH or READ key to select "NO" or "NC."

_n_	indicates a normally open contact ("NO"), while
‾u‾	indicates a normally closed contact ("NC").

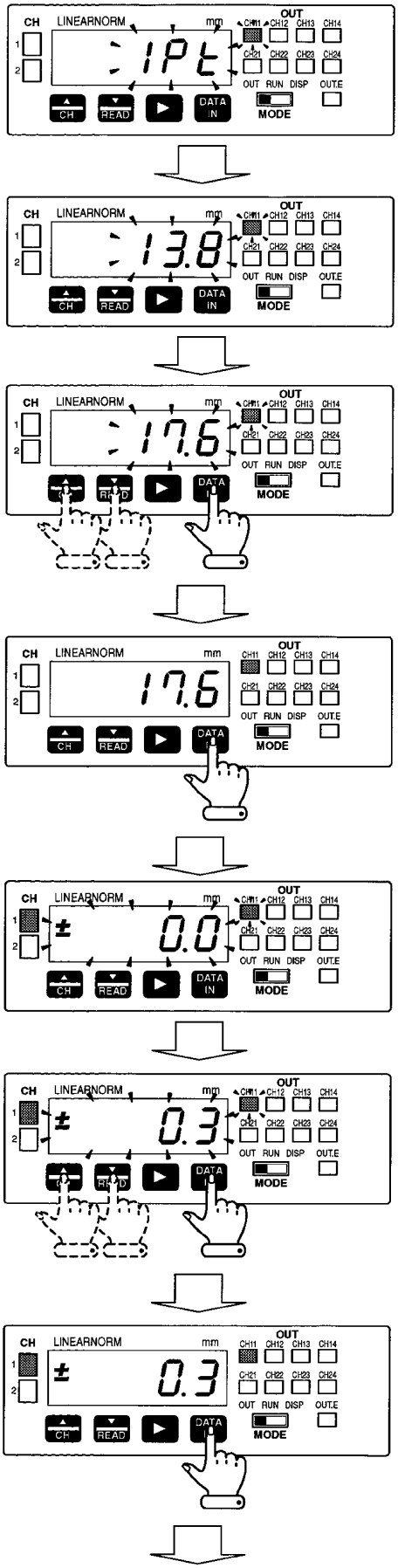
Next, press the DATA IN key to determine.
The blinking 7-segment LED and output indicator LED light up.

Next, press the DATA IN key again to store the setting.
After entry is finished, the next channel number blinks at the 7-segment LED.

After finishing entry of switch output position data, change the MODE selection switch from the OUT (switch output) to the RUN position.

If there is an entry error in the above series of operations, press the ▶ key several times to skip items to return to the top of the corresponding channel for which the switch output position data has been entered, or change the MODE selection switch from the OUT (switch output) to the RUN position and change it back to the OUT (switch output) position to return to the top of the corresponding channel, and enter again.

(6) Selecting pattern "6"



① After entry pattern "6" is selected and determined according to the procedure described on page 28, [1PE] blinks at the 7-segment LED for about two seconds, then the offset having been entered in Section 6-2-1 "Initial Setting of Value Displayed at 7-Segment LED" (minimum value in display range) blinks.

② Operate the CH or READ key to enter the switching point and press the DATA IN key to determine.
The blinking 7-segment LED and output indicator LED light up.

Next, press the DATA IN key again to store the setting.

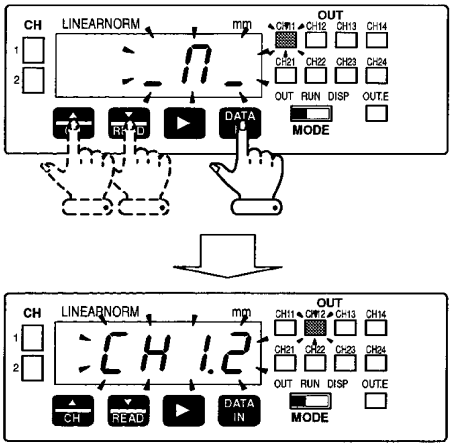
③ The previous tolerance at the switching point [±] blinks at the 7-segment LED.

Operate the CH or READ key to enter the tolerance, and press the DATA IN key to determine.

> The minimum tolerance is "±0.1."

The blinking 7-segment LED and output indicator LED light up.

Next, press the DATA IN key again to store the setting.



④ [_n_] or [⁻u⁻] blinks at the 7-segment LED. Press the CH or READ key to select "NO" or "NC."

[_n_]	indicates a normally open contact ("NO"), while
[⁻u⁻]	indicates a normally closed contact ("NC").

Next, press the DATA IN key to determine.
The blinking 7-segment LED and output indicator LED light up.

Next, press the DATA IN key again to store the setting.
After entry is finished, the next channel number blinks at the 7-segment LED.

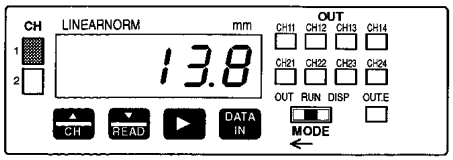
After finishing entry of switch output position data, change the MODE selection switch from the OUT (switch output) to the RUN position.

If there is an entry error in the above series of operations, press the ▶ key several times to skip items to return to the top of the corresponding channel for which the switch output position data has been entered, or change the MODE selection switch from the OUT (switch output) to the RUN position and change it back to the OUT (switch output) position to return to the top of the corresponding channel, and enter again.

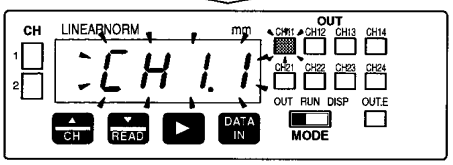
6-3-2. Changing a Part of Switch Output Position Data

To change a part of switch output position data, select and determine the channel to be changed, press the ▶ key to go to the corresponding item, and enter data according to the method described in Section 6-3-1 "Entry Procedure for New Setting," and press the DATA IN key at the last step to determine.

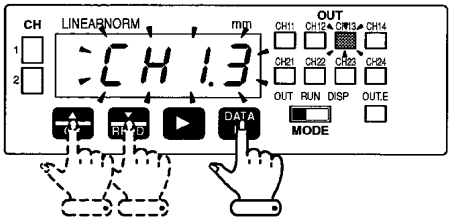
As an example, **the procedure for changing "NO" into "NC" in the switch output position data entered for pattern "5"** is described below.



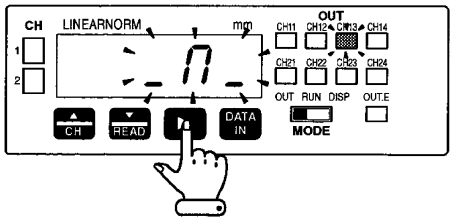
① Change the MODE selection switch from the RUN to the OUT position.



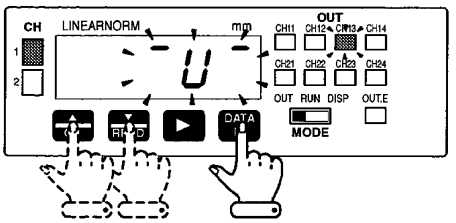
② After the mode is changed, the entry channel number appears at the 7-segment LED and the corresponding output indicator LED blinks.



③ Press the CH or READ key to change and select the channel, and press the DATA IN key to determine.

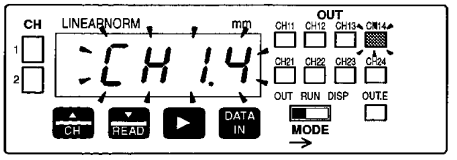


④ Press the ▶ key several times to go to the desired item, so that [n] blinks at the 7-segment LED.



⑤ Press the CH or READ key to change to [U], and press the DATA IN key to determine.
The blinking 7-segment LED and output indicator LED light up.

Next, press the DATA IN key again to store the new setting.



⑥ Change the MODE selection switch from the OUT (switch output) to the RUN position to finish the procedure.

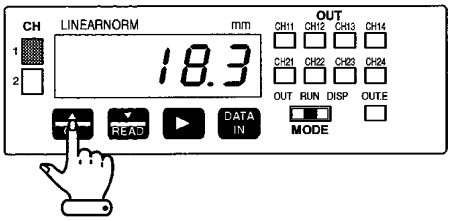
6-4. Operation in Operation Mode

6-4-1. Switching the 7-Segment Display Channel

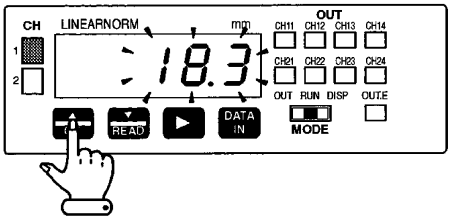
This display unit adopts a two-sensor-channel entry method with one 7-segment LED.

To change the 7-segment display channel, follow the procedure below.

For only one sensor entry channel, the operation described here does not change the channel.

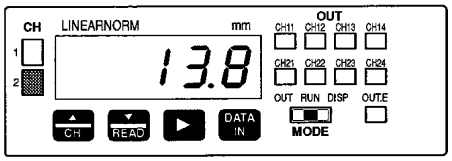


① Press and hold the ▲CH key.



② The 7-segment LED blinks.
Press and hold the ▲CH key further until the channel changes.

> If the ▲CH key is released before the channel changes, the state returns to step ①.



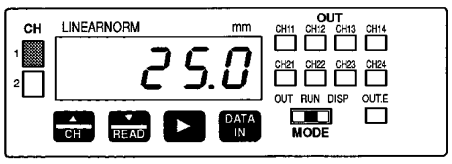
③ The channel LED changes from "1" to "2" and the value displayed at the 7-segment LED changes.
Further press and hold the ▲CH key to change back to channel "1."

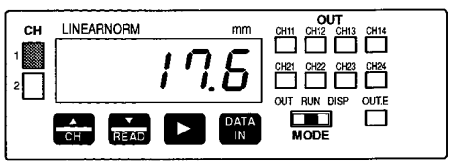
6-4-2. Switching From Absolute Value to Relative Value

With this display unit, the relative value from a point can be displayed, in addition to the absolute value entered in Section 6-2 "Setting the Value Displayed at 7-Segment LED."

Follow the procedure below to change.

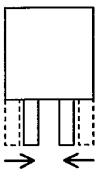
Perform the procedure after the operation described in 6-2 "Setting the Value Displayed at 7-Segment LED" is finished.

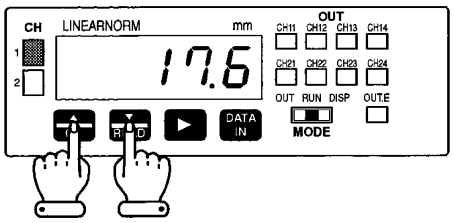




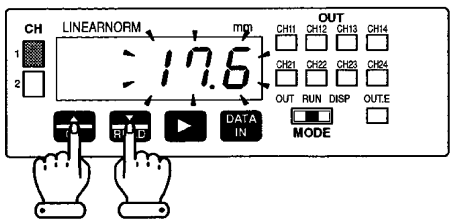
① Move the piston of the cylinder or master jaw to the desired position to be the zero point of the relative position.

<Example with gripper>



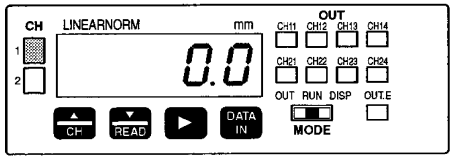


② Press and hold the CH and READ keys simultaneously.



③ The 7-segment LED blinks. Further press and hold the CH and READ keys until the displayed value changes to 0.0.

> If the CH and READ key is released before the value changes, the state returns to step ②.

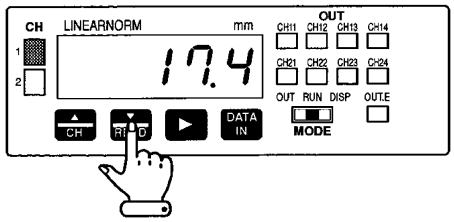


④ The color of the channel LED changes from green to yellow and the 7-segment LED shows 0.0.
Further press and hold the CH and READ keys to return to the absolute value display mode.
The sign displayed in the relative display mode agrees with that determined in the procedure described in Section 6-2-1 "Initial Setting of Value Displayed at 7-Segment LED."

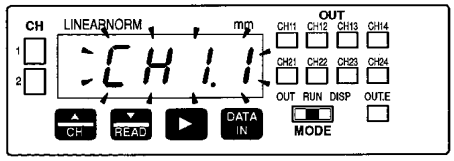
6-4-3. Reading the Switch Output Position Data (read mode)

To read data, which has been entered in the switch output position data entry mode, in the operation mode, follow the procedure below.

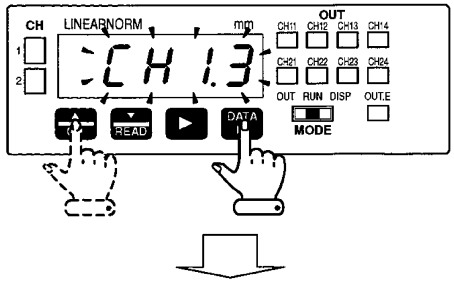
The analog voltage corresponding to the switching output and length measurement having been entered remains output.



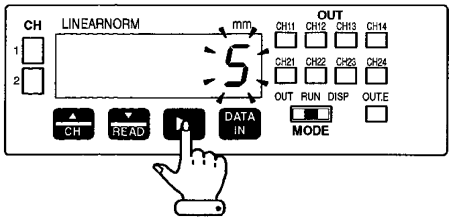
① Press and hold the READ key (for about two seconds).



② The channel LED is unlit and the entry channel number blinks at the 7-segment LED.



③ Press the CH key to select the channel to be displayed, and press the DATA IN key to determine.



④ Press the ▶ key several times while checking the entered data.

For pattern "0," entered data is not displayed even if the ▶ key is pressed, and the next channel number blinks.
If no operation is made for ten seconds in the read mode, the mode automatically changes back to the operation mode.
Or, press and hold the READ key for about two seconds to return to the operation mode.

6-4-4. Adjustment of Change in Value Displayed at 7-Segment LED According to Change in Operating Ambient Temperature

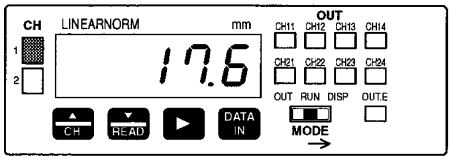
The output voltage of the LINEARNORM sensor (sensor input voltage of display unit) varies according to the temperature change of the magnetic flux density of the piston magnet.

The variation is minimized at the compensation circuit installed at the sensor. If there is a large error in the value displayed at the display unit, analog output voltage, or switch output position during actual use, conduct the operation described in this section.

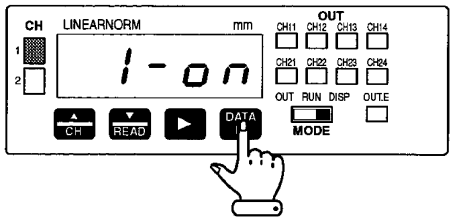
Conduct this operation, too, if the offset fluctuates (if the zero point fluctuates) due to a deformed or worn jig.

The necessary operation is only entry of two points to be displayed, as described in Section 6-2 "Setting the Value Displayed at 7-Segment LED."

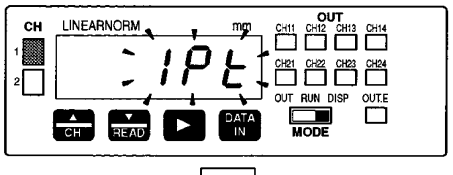
After the operation, the switch output position data having been entered is initialized to the position entered during initial setup, while the 7-segment display value and analog output voltage return to initial values.



① Change the MODE selection switch from the RUN to the DISP position.

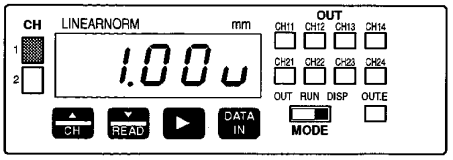


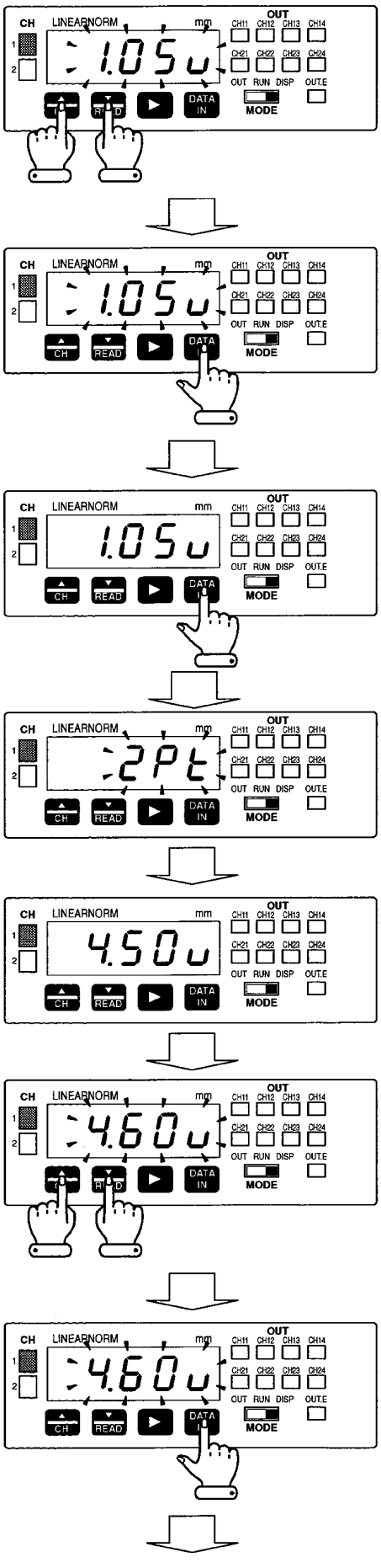
② Press the DATA IN key twice to skip items.



③ The first point of the length measurement range is displayed.

When the offset is selected, [IPt] blinks for about two seconds at the 7-segment LED, then the previously entered sensor voltage of the first point of the length measurement range lights up.



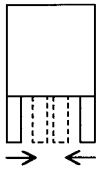


④ Determine the first point of the length measurement range again.

Move the cylinder piston or master jaw of the gripper to the first point of the length measurement range, and press and hold the CH and READ keys simultaneously.

> Either the extension end or contraction end of the cylinder can be defined to be the first point, or either the open or closed end of the gripper can be the first point.
> As well, there is no problem if the first and second points are entered differently from the settings given during initial 7-segment display data entry.

At this time, the sensor voltage (in volts) issued from the amplifier unit blinks at the 7-segment LED.



[Example]

To determine the closed end of the gripper as the first point of the length measurement range, close the master jaw and fix.

Next, press the DATA IN key to determine the first point again.
The blinking 7-segment LED lights up.

Next, press the DATA IN key again to store the setting.

⑤ The second point item of the length measurement range is displayed.

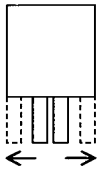
> When the offset is selected, 2PL blinks at the 7-segment LED for about two seconds, then the previously entered sensor voltage of the second point of the length measurement range lights up.

⑥ Determine the second point of the length measurement range again.

Move the cylinder piston or master jaw to the second point of the length measurement range, and press and hold the CH and READ keys simultaneously.

> Another point different from the first point having been determined is shown.

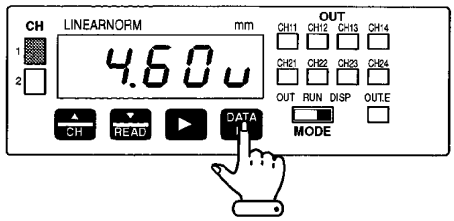
At this time, the sensor voltage (in volts) issued from the amplifier unit blinks at the 7-segment LED.



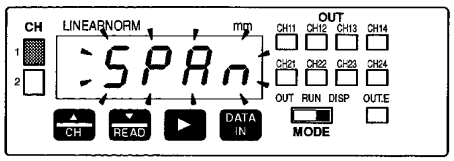
[Example]

To determine the open end of the gripper as the second point of the length measurement range, open the master jaw and fix it.

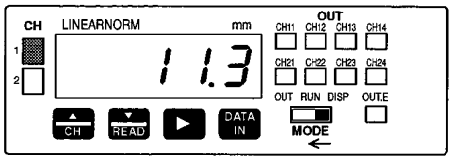
Next, press the DATA IN key to determine the second point again.
The blinking 7-segment LED lights up.



Press the DATA IN key again to store the setting.



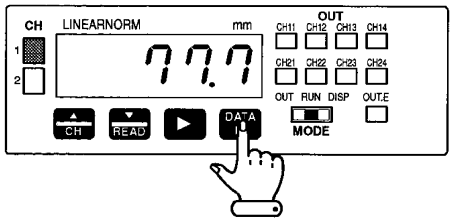
⑦ After the second point is determined, SPAn blinks at the 7-segment LED for about two seconds, then the previously entered span lights up, indicating that the change is finished.



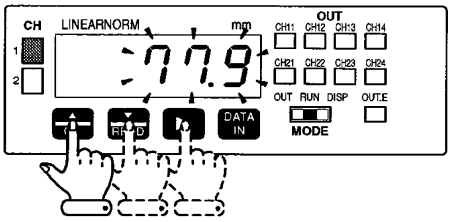
Change the MODE selection switch from the DISP to the RUN position to finish the procedure.

6-4-5. Finely Adjusting the Value Displayed at 7-Segment LED

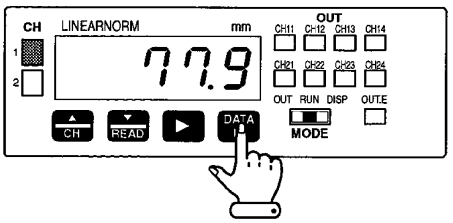
Use this method **to adjust the measurement to the one for a certain reference workpiece** after initial setup of the 7-segment display values is finished.



① Press and hold the DATA IN key in the operation mode.



② The 7-segment display blinks.
<To finely adjust>
Press the CH or READ key to the desired value.
<To cancel fine adjustment>
Press the ▶ key.



③ Press the DATA IN key to determine.

7. Troubleshooting

Phenomenon	Cause	Remedy
The 7-segment LED shows nothing.	Wiring error	Refer to Section 4 "Connection Circuit Diagram" to correct wiring.
	Low source voltage	Restore the source voltage to within 24VDC ±10%.
The 7-segment LED shows "Er01," "Er02" or "Er03."	There is a communication error between the microcomputer in the display unit and EEPROM due to noise or the like.	Turn the power off then on again. Reduce noise. Route wiring separately from power cables, inverter power supply cables or the like so that induction noise is not added.
The 7-segment LED shows "Er04."	No power supply to amplifier unit	Refer to Section 4 "Connection circuit Diagram" to correct wiring. After supplying power, check that the green power indicator is lit at the amplifier unit.
	All the elements of the analog output correction data read switch of the amplifier unit are in the OFF positions.	Refer to Section 5-3 "Setting the Analog Output Correction Data Reading Switch" to give a switch setting according to the sensor-integrated actuator.
	The "white, gray, orange or yellow" or "white, gray, orange, yellow or black" cable is not connected between the amplifier unit and the display unit.	Refer to Section 4 "Connection Circuit Diagram" to correct wiring.
The 7-segment LED shows "Er05."	The setting of the "analog output correction data read switch" of the amplifier unit is wrong.	Refer to Section 5-3 "Setting the Analog Output Correction Data Reading Switch" to give a switch setting according to the sensor-integrated actuator.
	The "white, gray, orange or yellow" cable between the amplifier unit and the display unit is erroneously connected or some cables are not connected.	Refer to Section 4 "Connection Circuit Diagram" to correct wiring.
The 7-segment LED shows "Er06."	The "black" cable between the amplifier unit and display unit is not connected.	Refer to Section 4 "Connection Circuit Diagram" to correct wiring.
	The minimum analog input voltage setting is 0.3V or lower.	Refer to Section 5 "Adjustment Method" to adjust the zero and span of the amplifier unit.
The value displayed at the 7-segment LED, which changes according to movement of the piston or master jaw, starts at a certain value, jumps, and changes again.	The two points of the length measurement range are set at the same point during data entry of the 7-segment display value.	Refer to Section 6-2 "Setting the Value Displayed at 7-Segment LED" to enter again.
As the operation proceeds, the 7-segment display value and switching points have changed.	The stopping position of the piston or master jaw has changed due to a deformed piston rod or small claw or a worn jig or tool. (Fluctuation of offset)	Refer to Section 6-4-4 "Adjustment of Change in Value Display at 7-Segment LED According to Change in Operating Ambient Temperature" to adjust.
	The analog input voltage acquired from the amplifier unit to the display unit fluctuates due to the change in the operating ambient temperature. (Fluctuation of offset or span)	Refer to Section 6-4-4 "Adjustment of Change in Value Display at 7-Segment LED According to Change in Operating Ambient Temperature" to adjust.
The displayed value or analog output value corresponding to a certain piston or master jaw stopping position deviates from the target value immediately after the 7-segment LED display value is adjusted.	The actual span is different from that of the display unit. Or vice versa.	Refer to Section 6-2 "Setting the Value Displayed at 7-Segment LED" to adjust again.
	The setting of the analog output correction data read switch of the amplifier unit is wrong.	Refer to Section 5-3 "Setting the Analog Output Correction Data Reading Switch" to give a switch setting according to the sensor-integrated actuator.
	The sensor signal drifts due to a magnetic body such as iron existing in the stroke of the piston or master jaw.	Remove the magnetic body as far as possible.
	There is another cylinder equipped with a switch nearby.	Reserve at least 50mm between the LINEARNORM sensor and the tube of the cylinder equipped with a switch.
	The LINEARNORM sensor has deviated from the mounting position.	Refer to Section 5 "Adjustment Method" to adjust the mounting position of the LINEARNORM sensor.

Phenomenon	Cause	Remedy
While the yellow switch output indicator is lit, the indicator sometimes instantaneously goes out and the red short circuit indicator lights up.	There is noise.	Reduce noise. To reduce induction noise, do not route wiring along power cables, inverter power supply cables or the like in the same pipe.
The red switch output short circuit indicator always lights up.	There is a short circuiting current in one among eight switch outputs.	Refer to Section 4 "Connection Circuit Diagram" to correct wiring.
Though the yellow switch output indicator lights up, the load does not accept the output.	There is an error in the wiring up to the load.	Refer to Section 4 "Connection Circuit Diagram" to correct wiring.
	The load is not turned on.	Connect the power supply to the load.
	The input specification of the load does not match the output specification of the display unit switch.	Select a correct load again.
There is chattering in the switch output immediately after the setting procedure.	The action range of the switch is too narrow.	Refer to Section 6-3 "Entering the Switch Output Position Data" to adjust again.
The analog output is not issued.	Wiring error	Refer to Section 4 "Connection Circuit Diagram" to correct wiring.
Though the analog output is issued, the output is too small.	The load impedance does not match.	Design the impedance of the connected load at 500kΩ or above.
The analog output drifts though the piston or master jaw is stopped.	There is noise.	Reduce noise. To reduce induction noise, do not route wiring along power cables, inverter power supply cables or the like in the same pipe.

(Note) For troubles not described above or if the remedy does not remove the problem, contact the manufacturer.

8. Notation of Production Lot Number of Product

The production lot number of the product (year, month and day of manufacture) is indicated in four digits on the affixed nameplate.

The first digit indicates the year, the second digit indicates the month ("X" to "Z" for October through December), and the third and fourth digits indicate the day.

Revision History

Date	Page	Description of revision
February 28, 2002	21 to 23	The unit of the settings of points 1 and 2 described in "Setting the Value Displayed at 7-Segment LED" is changed from the position (mm) into sensor voltage issued from the amplifier unit (V).
	25 to 26	Correction of error
	44 to 47	The page is edited to add the revision history.
March 26, 2002	General	The operation methods concerning "Setting the Value Displayed at 7-Segment LED" and "Entering the Switch Output Position Data" are changed and pages are edited.
February 1, 2004	6	Description of notes is changed.
	44	The initialization function of adjustment values in "Finely Adjusting the Value Displayed at 7-Segment LED" is added (implemented to products manufactured on and after February 1, 2004)
	46	"Notation of Production Lot Number of Product" is added.