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Find the *Keyence LC-2100* at our website: ***Click HERE***

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High-speed sampling

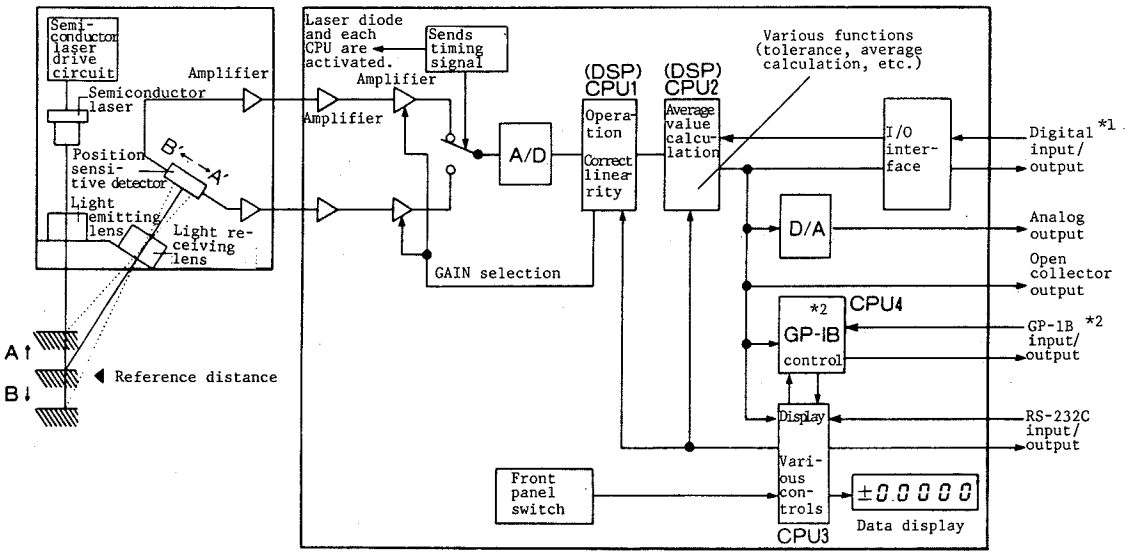
40 kHz sampling has been realized through the enhanced processing speed of the processor circuit. Thus, objects moving at high speed can be measured.

Application of visible laser

The system (LC-2220, 2320) utilizes a semiconductor laser with a 670 nm wavelength. The light spot can be clearly observed, allowing you to easily set the measurement position of even an extremely small workpiece.

High-precision measurement

The combination of optical technology and analog/digital technology has realized measurement to a resolution of 0.2 µm(LC-2210, 2220). The long range type sensor having a ±8 mm measurement range also provides a resolution of 0.5 µm. In addition, linearity of ±0.1% of full scale is provided for all types of sensors.



*1 and *2: either one of these factory-installed options is available.

If the object to be measured moves (A and B in the figure above), the semiconductor laser spot (A' and B' in the figure) also moves by means of the position sensitive detector in the sensor head. Then, the electric signal generated by this spot movement is converted to a digital signal. Finally, the system carries out data processing, such as linearity compensation and average value calculation, displaying and outputting the measured results.

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2. NOTES ON USE (Precautions prior to starting operation)

(1) This system has beeen subjected to a thorough inspection before shipment. Be sure to check your system for damage due to transportation immediately after you receive it. Should any abnormality be found, please contact your dealer.

(2) Prior to starting operation, be sure to carefully study this instruction manual in order to use this system correctly.

(3) Precision optical components are used in the sensor head. Be careful not to subject the system to strong physical shocks.

(4) The sensor head was precisely adjusted before being shipped. Never remove the cover.

(5) Ambient conditions for normal operation of this system are as follows; temperature range: 0 to 50°C (LC-2220 and 2320: 0 to 35°C), humidity: 85% RH, maximum. Operation under conditions other than those specified herein may cause failures.

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3. PRIOR TO MEASUREMENT

3-1 SAFETY

The laser optical displacement sensor LC-2210/2310 and 2220/2320 are classified as a Class IIIb laser product class II laser product respectively, and are identified as such by the warning logotype shown in Figure below, which also shows other warning labels affixed to the covers.
The LC series are not hazardous in normal usage due to the low power laser beams. However it is up to the operator to observe the follow all safety labels. If the operator started directly into the beam, conceivable damage could be caused to the operator's eyes.

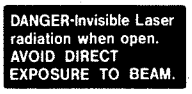
Depending on the model, the laser wavelength is 780 nm (LC-2210, 2310) or 670 nm (LC-2220, 2320).

Warning label

① Class IIIB: Warning logotype (LC-2210, 2310)



② Class IIIB: Protective housing label (LC-2210, 2310)



③ Class IIIB: Aperture label (LC-2210, 2310)



④ Class II: Warning logotype (LC-2220, 2320)



⑤ Class II: Protective housing label (LC-2220, 2320)

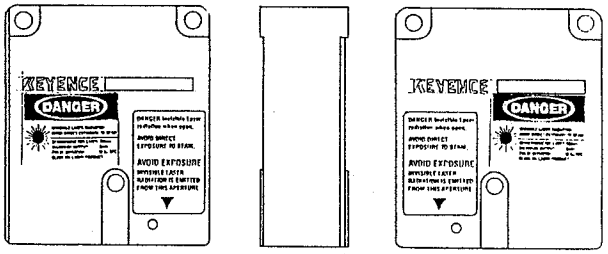


⑥ Class II: Aperture label (LC-2220, 2320)

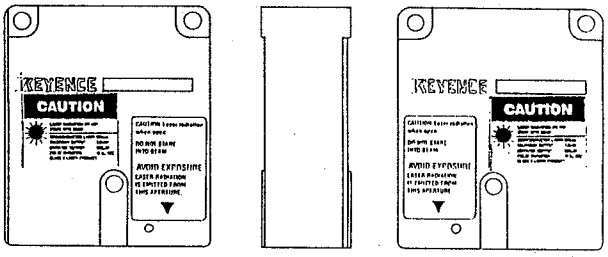


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Location of labels



Class III B (LC-2210, 2310)



Class II (LC-2220, 2320)

Safety considerations:

LC-2100 uses a low-power pulse semiconductor laser. The laser generates an invisible beam (wavelength: 780 nm) with LC-2210/2310 and visible beam (wavelength: 670 nm) with LC-2220/2320. The emitted laser beam power is less than 3 mW and 1.9 mW respectively.
The laser beam will not cause any sort of damage to the operator's skin. There is no danger in exposing arms or hands to the laser beam. The only possible health hazard is exposure of the eyes to the laser beam. Damage to the eyes could occur if the operator stared directly into the laser beam.

Following the safety considerations below will assure safety to the operator:

1. Do not stare directly into the laser beam.
2. Exercise caution when detecting extremely reflective parts. Do not stare into the reflected laser light.
3. Observe all warning labels.
4. CAUTION: Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.
5. Do not attempt to open the unit for repair. A defective unit has to be returned to the manufacturer for repair service.
6. All laser products must conform to the requirements of 21 CFR Sub-chapter J. This federal regulation is administered by the Center for Devices and Radiological Health (CDRH) under the Food and Drug Administration.
7. It is necessary for the Original Equipment Manufacturers (OEMs) to certify the products or system which the OEMs sell to end users to conform to all opertinent CDRH requirements.

For further information, contact: Center for Devices and Radiological Health (HFZ-300)
Rockville, Maryland 20857

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1) Laser safety precautions

1. The sensor head uses a semiconductor laser of 780 nm or 670 nm wavelength as it light source. Although the peak output of this laser is 3 mW or 1.9 mW in the sensor head, the average output is 1.5 mW or 0.95 mW because it is activated in a pulse form.

2. Maximum Permissible Exposure
   The laser output level of the sensor head exceeds the MPE level to human eyes. Never look at the laser beam either directly or by mirror reflection. The laser beam makes a minimum spot at the reference distance, then the beam diffuses. Therefore, the greater the distance from the sensor head, the lower the laser strength per unit area. The strength at 3.0 m or greater is below the MPE level to human eyes.
   * The MPE level means the maximum laser emission level to which a human being can be exposed without damaging eyes or skin.
   * Avoid exposing your eyes to a laser beam even when the laser strength is below the MPE level.

3. Safety features provided with the LC series
   The LC series is provided with the following safety features. Be sure to make sure these features function correctly prior to making any measurement.

   I LASER ON alarm LED
   A visible LED that informs you that the laser beam is being emitted or is about to be emitted is provided on the controller panel and the sensor head.
   * You can see whether the LED is lit even while wearing tinted lenses.

   II Delaying laser emission
   The laser emission starts 3 to 12 seconds after the LED lights, thus decreasing the possibility of laser exposure.

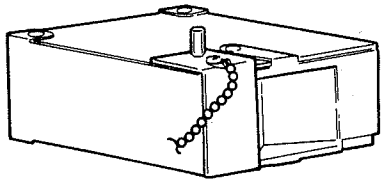
   III Laser emission control remote terminal
   A remote terminal for remotely controlling laser emission is provided on the rear of the controller. You can remotely control laser emission using the terminals.

   IV Key power switch
   You can lock the controller power switch using the supplied key, which can be removed only when set to the OFF position.

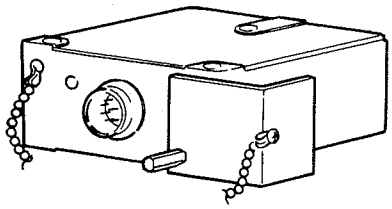
   V Laser beam shielding cover
   A laser beam shielding cover is supplied. This cover is to be attached to the laser beam emitting side of the sensor head. If an operator must work in front of the sensor head and there is risk to the eyes from the laser beam, be sure to attach this cover.

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When the shielding cover is used:
Attach the concave portion of the shielding cover to the front surface of the light source lens and secure it using the supplied screws.



When the shielding cover is not used:
Secure the shielding cover to the screw hole on the rear of the sensor had using the supplied screw.



4. Protective fence
When using the LC-2100 and the sensor head, install a protective fence. If an operator should get close to the sensor head during operation, he/she may be exposed to laser emission.

5. Warning indicator panel
When using this sensor head, install a warning, indicator panel on which a warning equivalent to Class IIIb is described.
* Install the panel in the vicinity of the measurement location so that the panel is not exposed to the laser beam.

6. Protective glasses
When you approach the sensor head 3.0 m or nearer, be sure to wear protective glasses.

7. Prevention of laser beam reflection
It is preferable to place a material having high light absorbency and scattering power at the end of the laser beam path. If a reflective material such as a mirror is placed at the end of the laser beam path, the laser beam may be reflected into your eyes.

8. Disassembly of sensor head
Never disassemble the sensor head.
The sensor head is not provided with a function that automatically stops laser beam emission when the sensor head is disassembled. Therefore, if you should disassemble the sensor head, youmay be exposed to laser beam emission.

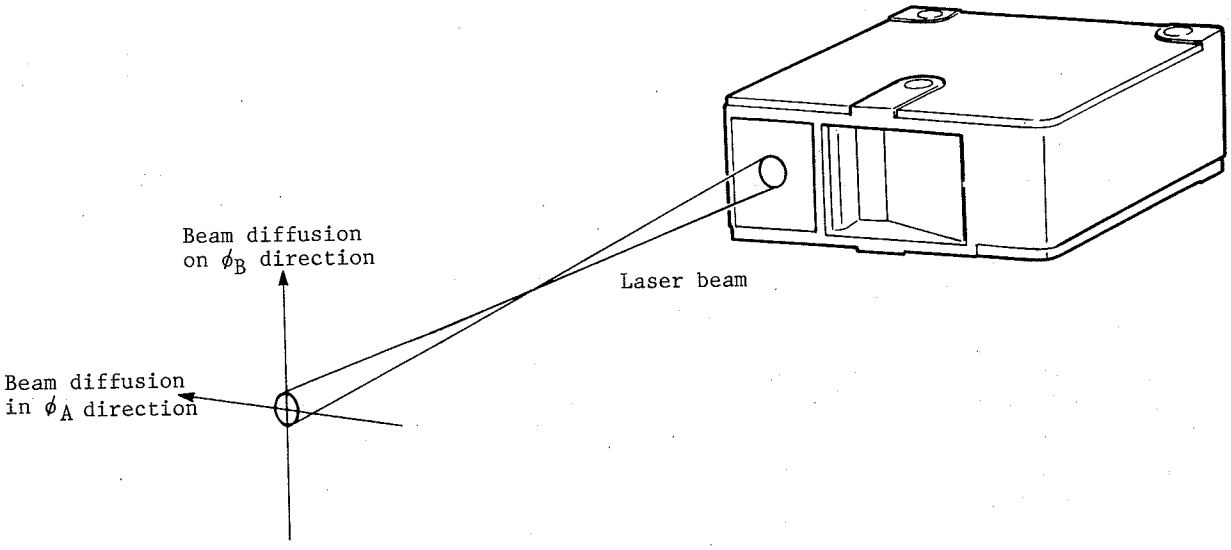
9. Warning
Strictly observe the caution described in this manual, otherwise you may be subjected to the risk of laser beam exposure.

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2) Laser beam safety

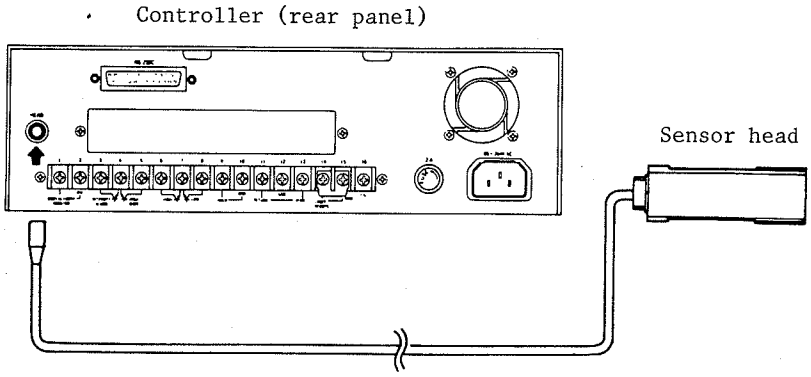
The laser beam emitted from this system is not harmful to your skin. However, since the emission quantity exceeds the maximum permissible exposure (MPE) quantity for your eyes, never look directly at the laser beam emitted from the laser source. The laser beam of this system forms the minimum spot around the center of the measurement range, and diffuses gradually as the distance from the center increases. The greater the distance the beam travels from the center of the measurement range, the lower the laser power per unit area becomes.
Accordingly, at a sufficient distance from the sensor head, the laser power value will be less than the MPE value.
The following table shows the laser beam diffusion and the distance (nominal hazardous distance "NOHD") where the value of the laser beam power becomes less than the MPE value.

Model	Laser beam diffusion angle (degree) $\phi_A \times \phi_B$	Nominal hazardous distance N O H D (m)
LC-2210	0.5 × 1.2	1.0
LC-2220	0.2 × 1.6	2.5
LC-2310	0.4 × 1.0	1.5
LC-2320	0.2 × 1.3	3.0

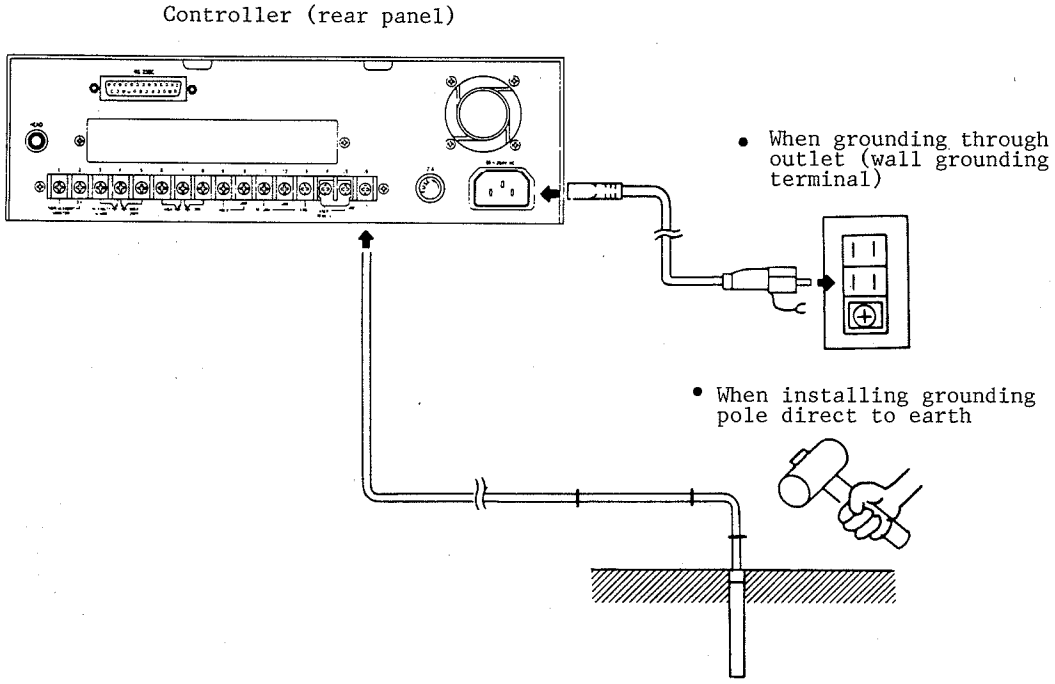


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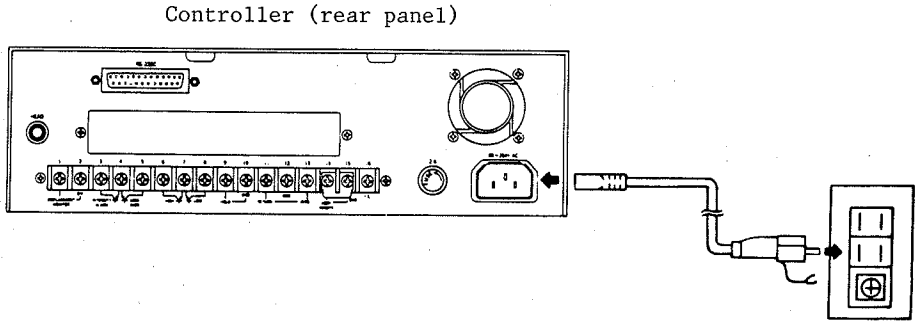
1) Connect the controller to the sensor head using the attached connecting cord.



2) Ground the system through the frame ground terminal.



3) First, verify that the power is OFF. Then, connect the attached power cord to the power input connector or power source.

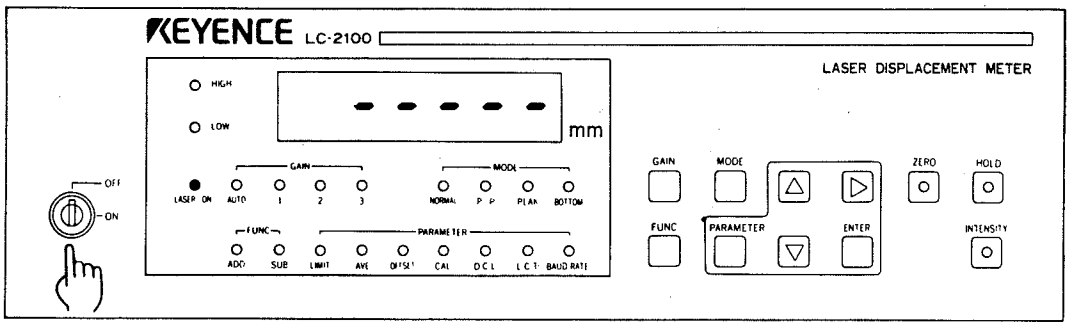


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4) Verify that the laser safety measures are in effect (refer to P. 3) and turn the power switch to the ON position.

Note: After the LASER ON alarm LED lights, warm-up for approximately 30 minutes.

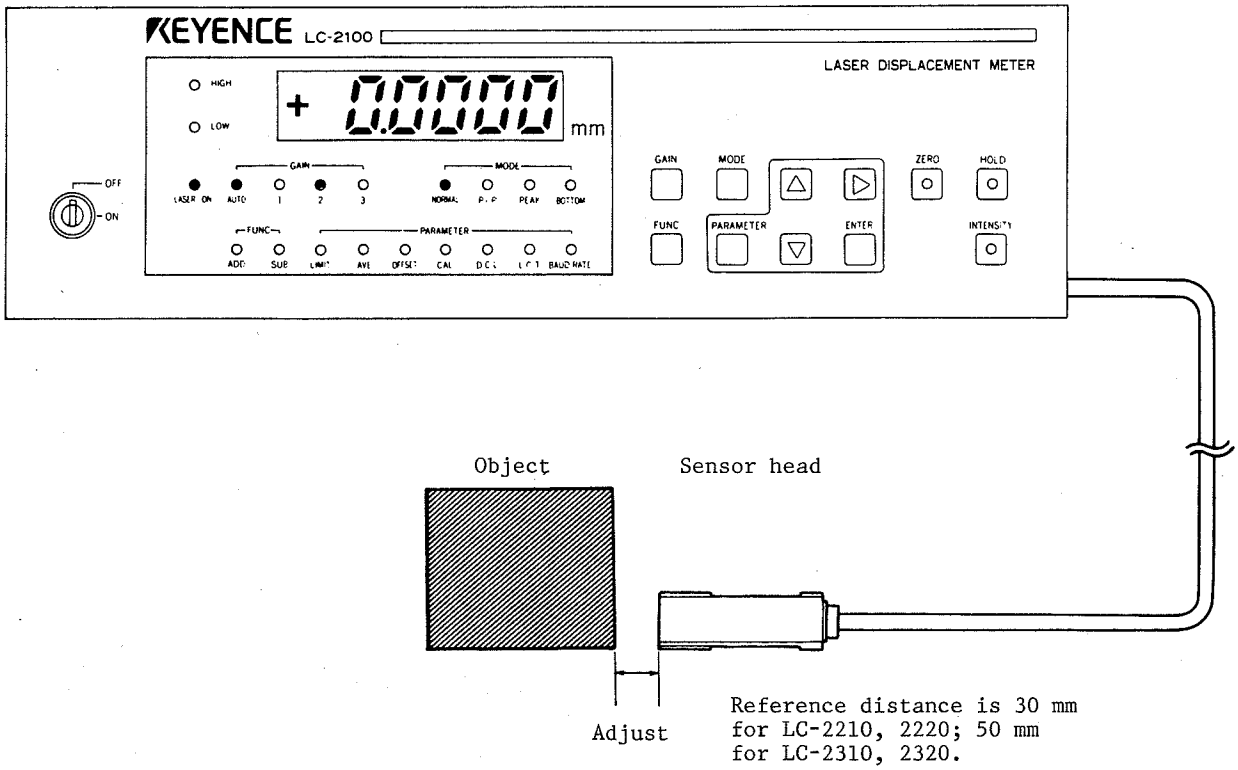
Controller (front panel)



5) Adjust the position of the sensor head so that the panel display indicates approximately zero.

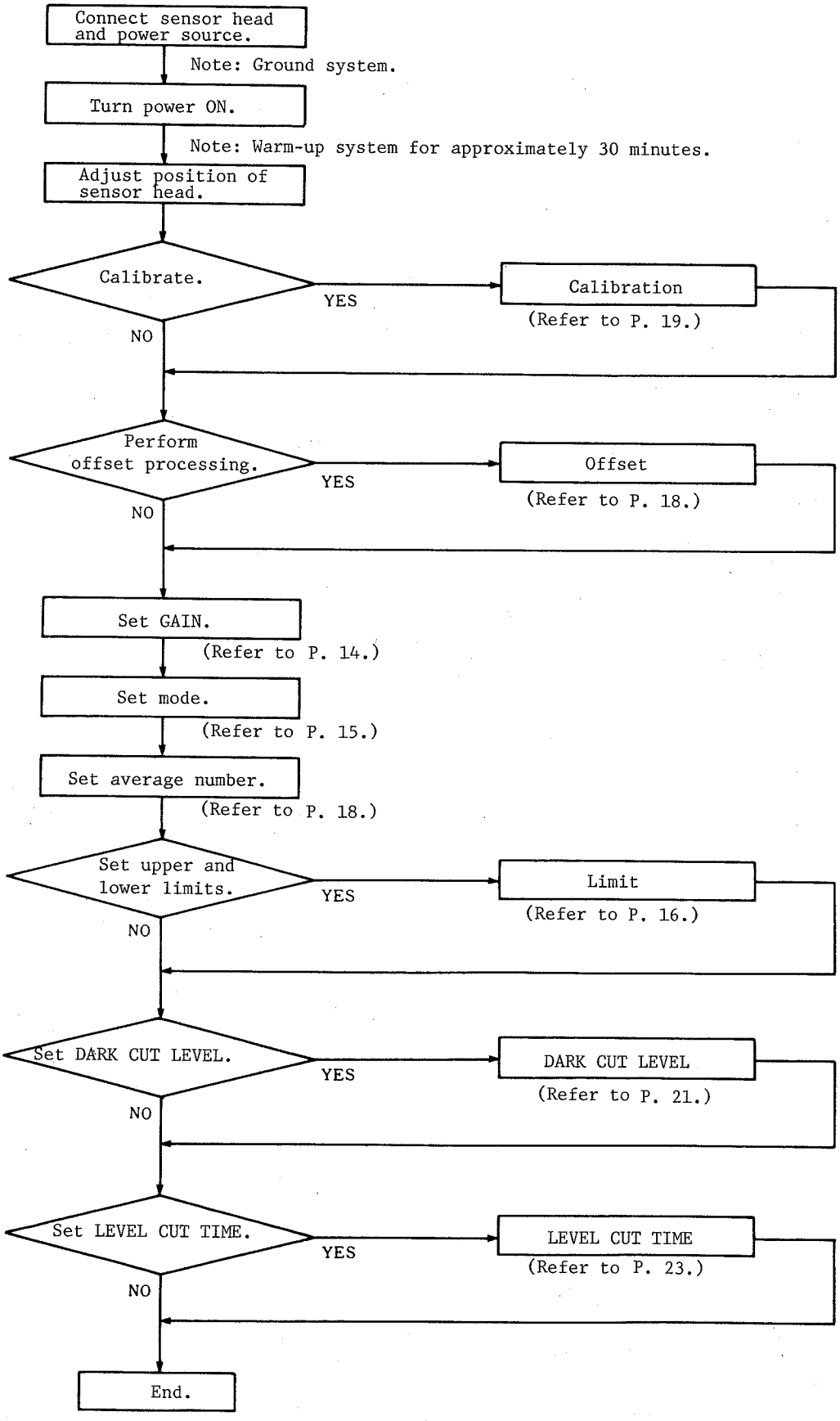
Note: Adjust the position of the sensor head in NORMAL measurement mode.

Controller (front panel)



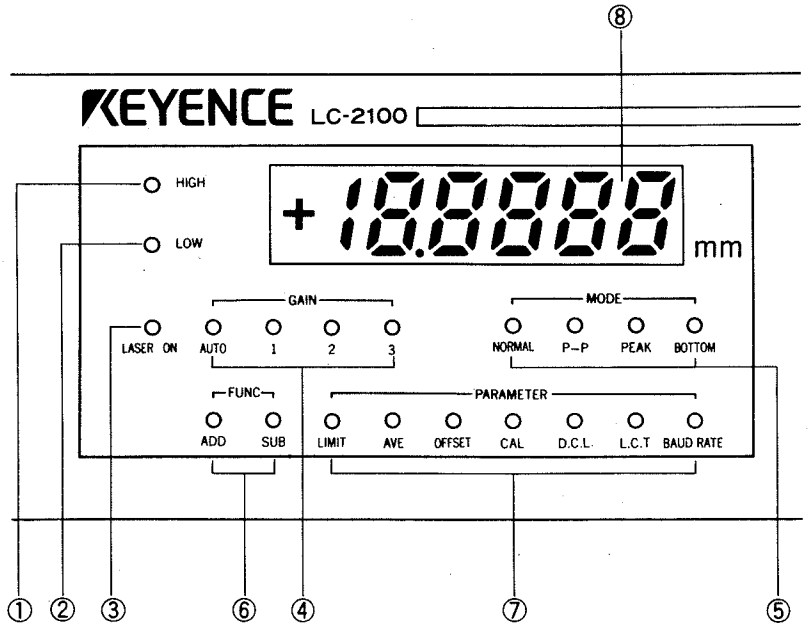
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4. PROCEDURES



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Indicators

① HIGH (UPPER) LIMIT output LED indicator
② LOW (LOWER) LIMIT output LED indicator
③ LASSER ON alarm LED indicator
④ GAIN LED indicator
⑤ MODE LED indicator
⑥ FUNCTION LED indicator
⑦ PARAMETER LED indicator
⑧ Display panel

① HIGH (LOWER) LIMIT output LED indicator

Lights when measured results exceed the upper limit value set in each measurement mode.

② LOW (LOWER) LIMIT output LED indicator

Lights when measured results fall below the lower limit value set in each measurement mode.

③ LASER ON alarm LED indicator

Lights at start of laser beam emission or immediately before. The laser will be emitted at a response delay time of three seconds.
Note: The LED is visible even if you are wearing laser-protective goggles.

④ GAIN LED indicator

Indicates light-receiving sensitivity. The LED appropriate to the set light receiving sensitivity lights.
Note: When set to the 'AUTO' mode, both the 'AUTO' LED and any of the LEDs from 1 to 3 light.

⑤ MODE LED indicator

Indicates the measurement mode. The LED of the set mode lights.

⑥ FUNCTION LED indicator

Lights when measuring thickness (ADD) or difference in object level (SUB).
(Digital input/output function is available at the time of installation.)

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⑦ PARAMETER LED indicator

Lights when setting upper and lower limits, average number, offset, calibration, dark cut level, level cut time, and baud rate. The set PARAMETER LED lights.

⑧ Display panel

Indicates measured results, each set value, or error message.

Measured results display

5 1/2 digits, display updating rate: 10 times/sec.

Maximum display value: ±3.2998 mm (LC-2210, 2220), ±8.7995 mm (LC-2310, 2320)
(When OFFSET is "0".)

Measured results to be displayed

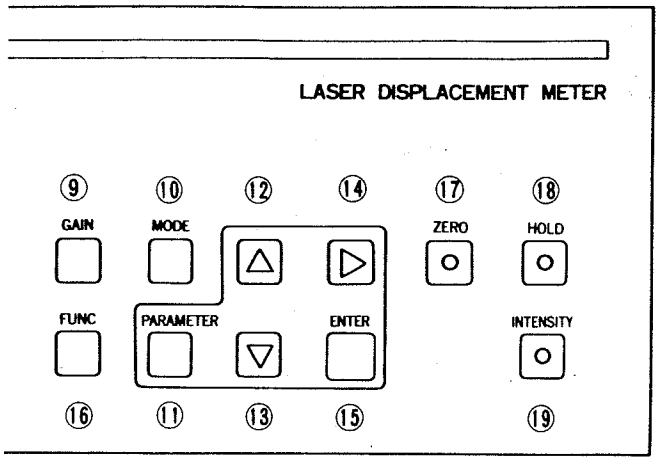
When the measurement mode is set to 'NORMAL', the average value of 2,048 measurements is displayed, regardless of the set average number. When the mode is set to P-P (Difference), PEAK, or BOTTOM, measured results according to the set average number are displayed.

Display panel error message

Panel display		Contents
dAr	DARK	Received light quantity is insufficient.
br ı	BRIGHT	Received light quantity is excessive.
FAr	FAR	Beyond measurement range (more than +3.3 mm*1, +8.8 mm*2)
nEAr	NEAR	Beyond measurement range (less than -3.3 mm*1, -8.8 mm*2)
-----		Measurement error Note: Display flashes for approx. 10 seconds after power-up.
C-Err	C-ERROR	Calibration error

*1: LC-2210, 2220 *2: LC-2310, 2320

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FUNCTION keys

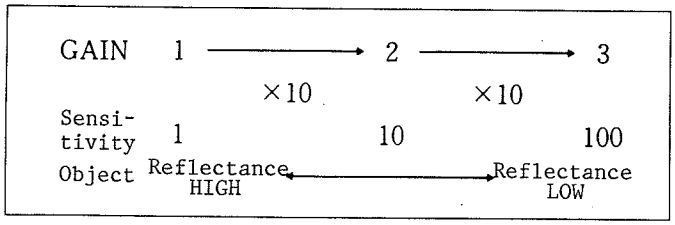
⑨ GAIN selector key
⑩ MODE selector key
⑪ PARAMETER selector key
⑫ UP key
⑬ DOWN key
⑭ DIGIT SHIFT key
⑮ ENTER key
⑯ FUNCTION selector key
⑰ AUTO ZERO key
⑱ HOLD key
⑲ LIGHT INTENSITY monitor key

GAIN

⑨ GAIN selector key

Switches light receiving sensitivity.
Press the GAIN key on the front panel. Then, GAIN LED indicators (4) light from AUTO, 1, 2, to 3 in order. Then, sensitivity is set to the level of the lit LED.

Note: When 'AUTO' is specified, the sensitivity is automatically switched to the appropriate level (from 1 to 3) according to the received light quantity.



1. Set sensitivity to 'AUTO' using the GAIN key on the panel.

   Note: At this time, one of the LEDs from 1 to 3 will light.

2. Use the GAIN key again to set the sensitivity to the same level as that of the LED than lit in the 'AUTO' mode.

   Note: To measure an object whose received light quantity varies greatly, set the sensitivity mode to 'AUTO'.
   However, in 'AUTO' mode, measured results may slightly vary when the sensor switches sensitivities.

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MODE

⑩ MODE selector key

Switches measurement modes.
Press the MODE key on the panel. The MODE LEDs will then light in order from NORMAL, P-P, PEAK, to BOTTOM, indicating the mode you have set.

Measurement mode	Model
NORMAL	Measures displacement from reference point.
P - P	Measures displacement within the preset range.
PEAK	Measures maximum value.
BOTTOM	Measures minimum value.

Note: In the P-P, PEAK, or BOTTOM modes, you can reset measured results using the HOLD key (18).
Pressing and then resetting the HOLD key allows you to reset the measured results.

PARAMETER

⑪ PARAMETER selector key

Switches set parameter.
Press the PARAMETER key on the front panel. Then, the PARAMETER LEDs light in order, from LIMIT, AVERAGE, OFFSET, CAL, D.C.L., L.C.T. to BAUD RATE, allowing you to set the parameter whose LED is lit.
The following keys are usable when the set mode is specified by pressing the PARAMETER selector key.

⑫ UP key

Used in each set mode; changes (increases) incrementally the flashing digit on the display panel.

⑬ DOWN key

Used in each set mode; changes (decreases) incrementally the flashing digit on the display panel.

⑭ DIGIT SHIFT key

Used in each set mode and moves the flashing digit on the display panel to the right.

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⑮ ENTER key

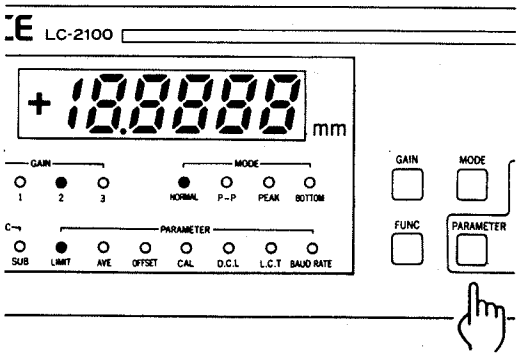
Used in each set mode. In each set mode, if setting of value is completed, press this key to enter values.

The following explains how to set each item of the parameter.

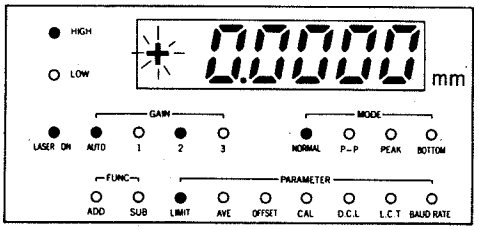
LIMIT

Sets upper and lower limits in each measurement mode.

1. Press the PARAMETER key to specify the limit value.
   (At this time, the PARAMETER LIMIT LED lights, showing the system is in the set mode.)



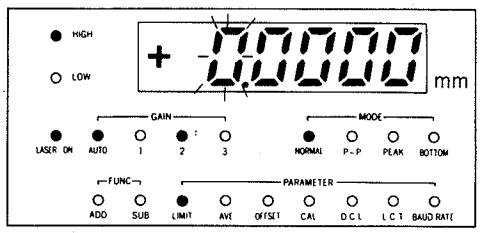
2. When the set mode is specified, first, the HIGH LED lights, advances you to the upper limit setting process. Then, the upper limit value is displayed on the display panel and the '+' symbol flashes.
   If you press the ▲ or ▼ key under this condition, the symbol will change from "+", "-", to "All digit bar lighting" (for LC-2210 and 2220), and from "+", "-", "-1", "+1", to "All digit bar lighting" (for LC-2310 and 2320). Therefore, make the desired mark flash and press the ▶ key.



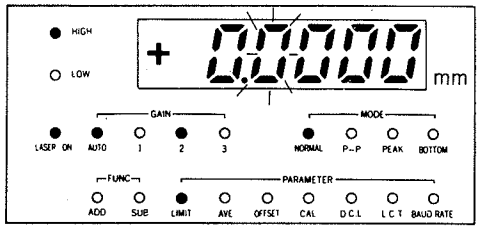
   Note: "All digit bar lighting" means cancelling the LIMIT value setting.

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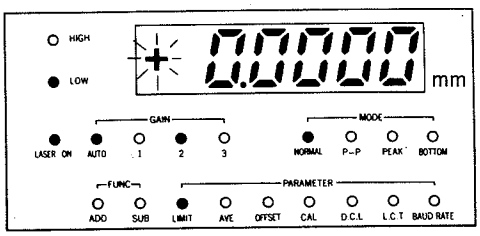
3. Pressing the ▶ key, while the '+' symbol is flashing, causes the 10^0 digit to flash. Specify values by using the ▲ or ▼ key.



4. In the same manner, set the value of each digit in order by using the ▶, ▲, or ▼ key. When you finish setting, press the ENTER key.



5. Pressing the ENTER key with the upper limit value set causes the HIGH LED to go off and the LOW LED to light, advancing you to the lower limit setting process. On the display panel, the lower set value is displayed and the '+' symbol flashes. Then, follow the same procedures as those of the upper limit setting. When you finish setting, press the ENTER key.



6. Pressing the ENTER key with the lower limit set allows you to set upper and lower limit values. At the same time, the LIMIT LED of the PARAMETER goes off and the display panel returns to the measurement mode.

Note:

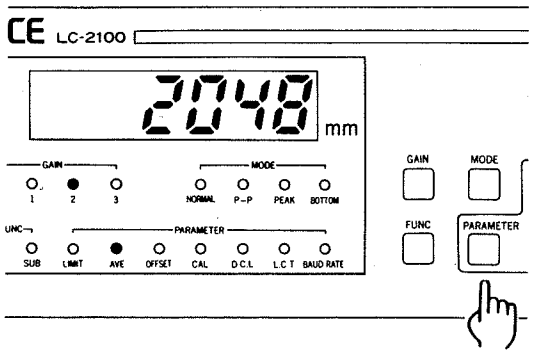
- If you do not press the ENTER key with lower limit set, you cannot set either the upper or lower limit.
- Pressing the PARAMETER key in the set mode advances you to the succeeding item without performing setting.
- Setting of upper and lower limits is possible in each measurement mode.

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AVERAGE

Sets average number value of the measured results.
Setting of average number from 1 to 2,048 is possible.

1. Press the PARAMETER key to select 'AVE'. (At this time, the PARAMETER AVE LED lights, indicating the system can be set to the set mode.)



2. If set mode is specified, the display panel will indicate the currently set average number.
Specify the desired average number using the ▲ or ▼ key and press the ENTER key.

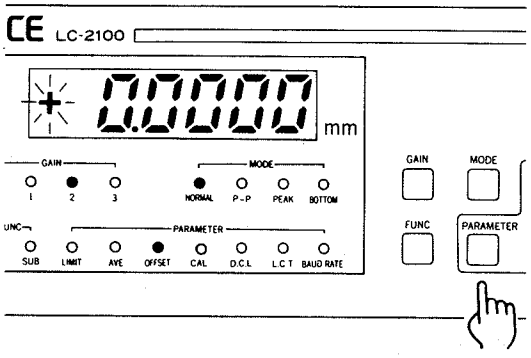
3. By pressing the ENTER key, average number can be set. Simultaneously the PARAMETER AVE LED goes out and the display panel returns to the measurement mode.

Note: If you press the PARAMETER key in the set mode, the system advances you to the succeeding item without performing setting.

OFFSET

Adjusts zero point.
Set value is added to the measured results.
Setting within the range of ±2.9998 mm (LC-2210, 2220) or ±7.9995 mm (LC-2310, 2320) is possible.

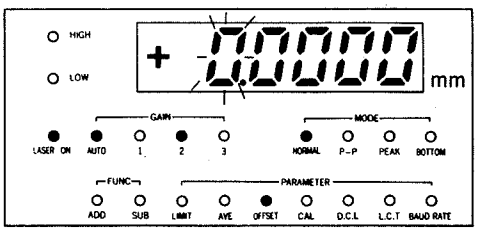
Example:
To adjust +1.246 mm to 0, set -1.246 mm



1. Press the PARAMETER key to select 'OFFSET'. (At this time, the PARAMETER OFFSET LED lights, indicating the system can be set to the set mode.)

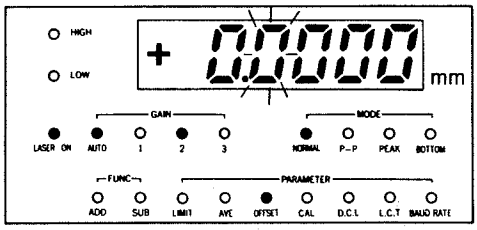
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2. If the set mode is specified, the display panel will indicate the currently set offset value and the '+' symbol will flash. Pressing the ▲ or ▼ key with the symbol flashing changes the display from "+" to "-". Specify the desired symbol to make it flash, and press the ▶ key.



3. Pressing the ▶ key with the symbol flashing causes the 10^0 digit of the display to flash. Specify the desired value using the ▲ or ▼ key.

4. In the same manner, set each digit value using the ▶, ▲, or ▼ key. When you finish setting, press the ENTER key.



5. Pressing the ENTER key sets the OFFSET value. Simultaneously, the PARAMETER OFFSET LED goes off and the display panel returns to the measurement mode.

   Note: If you press the PARAMETER key in the set mode, the system advances you to the succeeding item without performing setting.

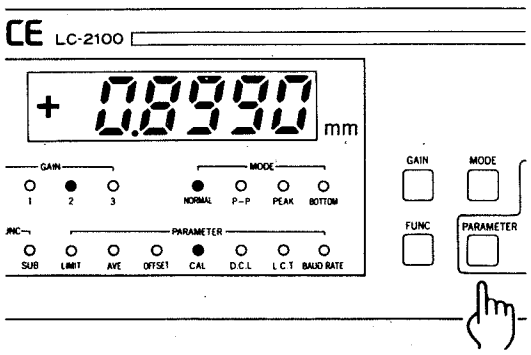
CAL

Calibrates proportional coefficient.
Measured results of actual displacement vary according to object color and material. Therefore, measured results are calibrated using the CAL key.

1) Calibration by moving the object

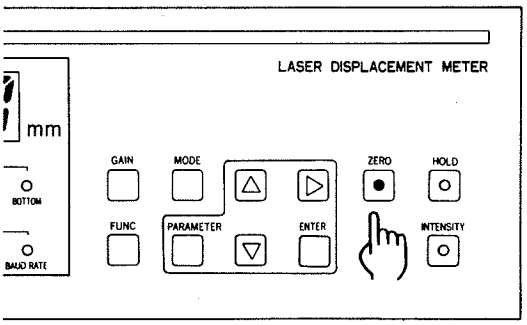
1. Press the PARAMETER key to select 'CAL'. (Normally, measurement is performed with the PARAMETER CAL LED lit.)

2. Set the measurement mode to NORMAL and position the object to be measured. If the display indicates measured results, adjust the displayed value to "0.0000 mm" using the AUTO ZERO key (17).



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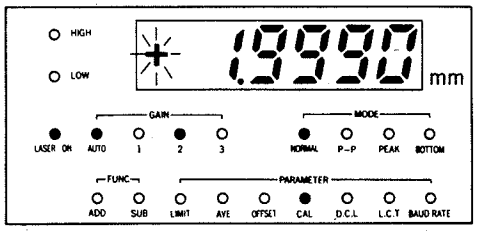
3. Move the object to any position. The display panel will indicate almost the same value as the displacement value.



Note:
- Calibration is performed only within the range the object was moved.
- Object measurement in any direction is possible.
- Moving the sensor head instead of an object is permissible.

4. When you finish moving the object, press the ENTER key. Then the system will be in the calibration mode.

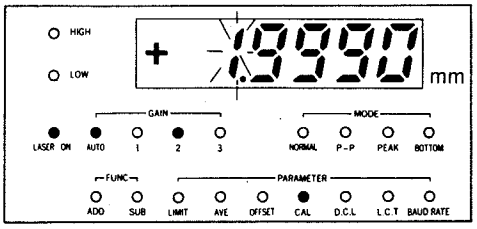
5. When the calibration mode is specified, measured results are held and the "+" symbol flashes.



Note: The display shown to the right is an example of the object being moved by 2 mm (from -1.000 mm to +1.0000 mm).

Pressing the [▲] or [▼] key under this condition changes the display symbols from "+", "-", "-1", to "+1".
Specify the desired symbol and value.

6. Pressing the [▶] key with the symbol flashing causes the 10^0 digit of the display to flash. Pressing the [▲] or [▼] key under this condition changes the flashing digit value. Pressing the [▶] key moves the flashing digit.
Adjust the display to the displacement using the [▶], [▲], or [▼] key.
When you finish setting, press the ENTER key.



7. Pressing the ENTER key finishes calibration. Simultaneously, the PARAMETER CAL LED goes out and the display panel returns to the measurement mode.

Note:
- Pressing the PARAMETER key in the calibration mode advances you to the succeeding item without performing calibration.
- Be sure to calibrate measured results within the measurement range.

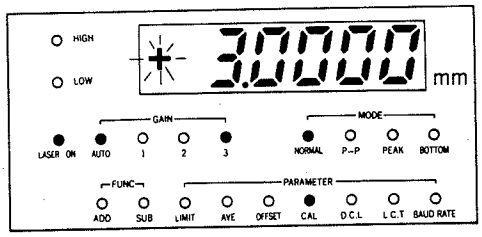
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- If the calibrated measured results are not correct, the message C-Err (calibration error) appears after you press the ENTRY key.
  C-Err can be reset by pressing the PAREMETER key.

2) Calibrating by inputting numerals

Calibration by inputting numerals without using an object is also possible.

1. Select CAL and press the ENTRY key when the display panel indicates dAr. Then, the calibration set value appears and the '+' symbol starts to flash.



(In the case of LC-2210 and 2220)

2. Change the display using the ▶, ▲, ▼ key and press the ENTER key. Then the calibration set value will be changed.

If you confirm the calibration set value using this method after calibration by moving the object, the next calibration is available only by inputting numerals. Therefore, this method is useful for measuring more than one object.

Note: Setting a calibration set value to "3.0000 mm" (LC-2210, 2220) or "8.0000 mm" (LC-2310, 2320) returns the system to the factory-set condition.

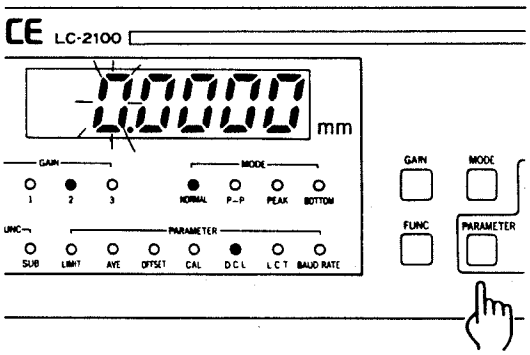
D.C.L. (DARK CUT LEVEL)

Sets received light level to detect the DARK condition (insufficient received light quantity). When the INTENSITY (received light quantity) value falls below the set value, the system determines this as the DARK condition.
This function is usable only when you measure the specific portion.
Setting from 0 to 4.9995 (0.0005 STEP) is available.

1. Press the PARAMETER key to select D.C.L.
   (The PARAMETER D.C.L. LED lights, indicating the system can be set to the set mode.)

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2. If the set mode is specified, the display panel will indicate the currently set dark cut level value. Then, the 10^0 digit will start to flash.



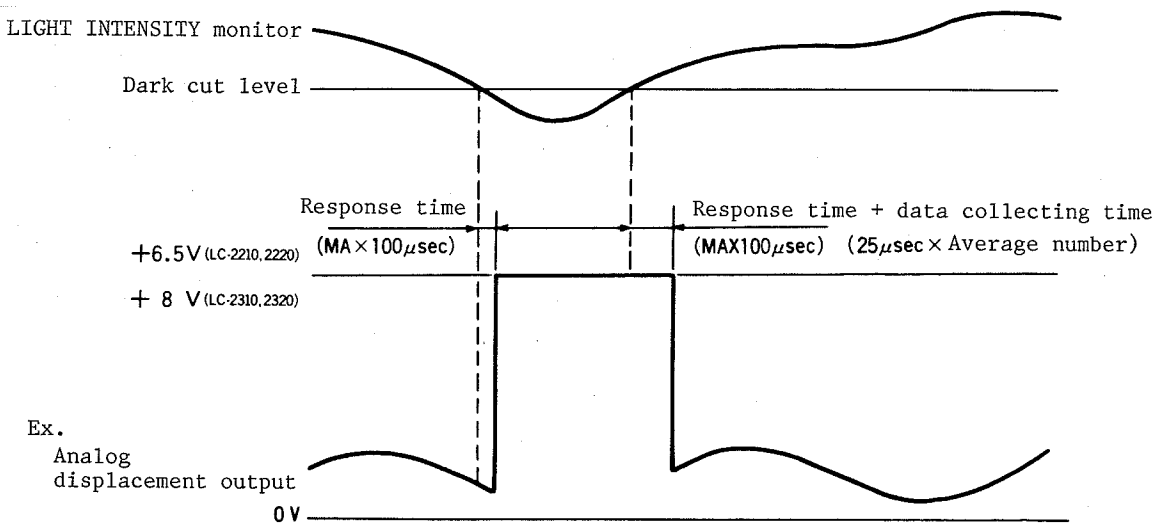
Pressing the ▲ or ▼ key under this condition, the numeral of the flashing digit changes. Pressing the ▶ key causes another digit to flash. Set each digit value in order using the ▶, ▲, or ▼ key. When you finish setting, then press the ENTER key.

Note: Before setting the dark cut level value, be sure to check the received light quantity of the portion to be detected as the DARK condition, in advance.

3. Pressing the ENTER key sets the dark cut level. Simultaneously, the PARAMETER D.C.L. LED goes out and the display panel returns to the measurement mode.

Note: Pressing the PARAMETER key in the set mode advances you to the succeeding item without performing setting.

Level cut time set value = t DARK condition = t'



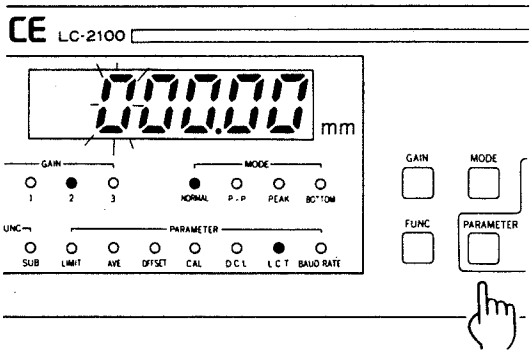
If the received light quantity monitor detects that the light quantity has fallen below the dark cut level, the system will be in the DARK condition at a response delay time of 100 μsec., max. After that, if the received light quantity monitor detects that the light quantity has exceeded the dark cut level, the system will return to the measurement mode at a response delay time of 100 μsec + (25 μsec. multiplied by average number), maximum.

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L.C.T. (LEVEL CUT TIME)

Cancels the DARK (insufficient light quantity) condition and BRIGHT (excessive received light quantity) condition.
Even if the DARK or BRIGHT condition is detected during measurement, the value measured immediately before the DARK/BRIGHT condition will be kept during the time set using the level cut time function.
This function is used to cancel to detect these conditions of the hole or groove of an object. Setting from 0 to 999.95 msec. (0.05 msec. STEP) is available.

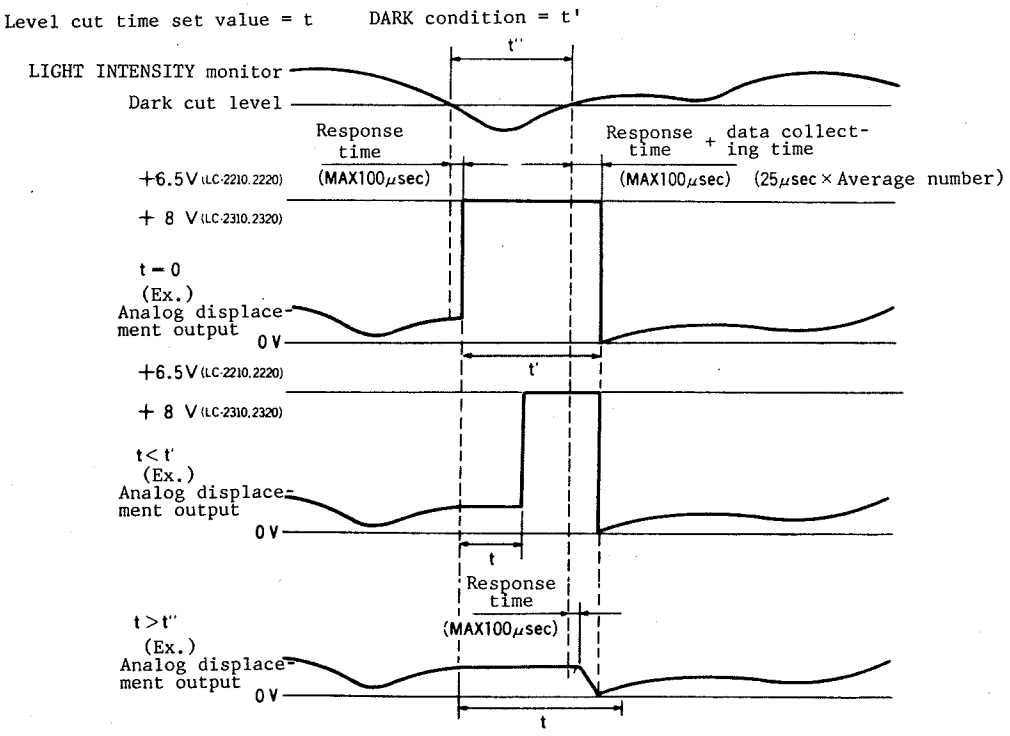
1. Press the PARAMETER key to select 'L.C.T.'.
   (At this time, the PARAMETER L.C.T. LED lights, indicating the system can be set to the set mode.)



2. If the set mode has been specified, the display panel will indicate the currently set level cut time and the numeral of the 10^2 digit will start to flash.
   Pressing the ▲ or ▼ key in this condition changes the numeral of the flashing digit. Pressing the ▶ key causes another digit to flash.
   Set each digit numeral in order using the ▶, ▲, or ▼ key.
   If you finish setting, then press the ENTER key.

3. Pressing the ENTER key allows you to set level cut time. Simultaneously, the PARAMETER L.C.T. LED goes off and the display panel returns to the measurement mode.

   Note: Pressing the PARAMETER key in the set mode advances you to the succeeding item without setting the set value.



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In case that the level cut time is longer than the period "t" while the LIGHT INTENSITY monitor shows the value less than the dark cut level, the system returns to the measurement mode at a response delay time of maximum 100 sec.

Note: The level cut time function works in the BRIGHT condition.

FUNCTION

⑯ FUNCTION selector key

Is usable to switch functions for measurement of object thickness (ADD) or difference in object level (SUB) by using two LC sensors.

Note: However, unless the optionally available board for digital input/output is assembled in the controller, this key does not function.

Regarding how to use this key or set the switching, refer to the attached "Instruction Manual for Expansion of Input/output".

ZERO

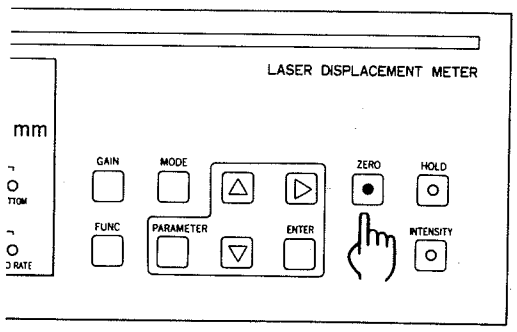
⑰ AUTO ZERO function

Adjusts measured results to be displayed or output to 0.0000 mm. Adjustment can be performed within a range of ±2.9998 mm (LC-2210, 2220) or ±7.9995 mm (LC-2310, 2320).

Note: Remote control is also available using the terminal on the rear panel. (Refer to P. 43.)

1. Press the AUTO ZERO key on the panel. The LED mounted at the center of the key lights and the display shows an output value of 0.0000 mm. After this processing, displacement from that point will be displayed and output.

2. Re-press the AUTO ZERO key on the panel. The LED at the center of the key goes off and the display and output returns to the normal condition.



Note: When the measurement is performed in the P-P mode, the AUTO ZERO function does not function.

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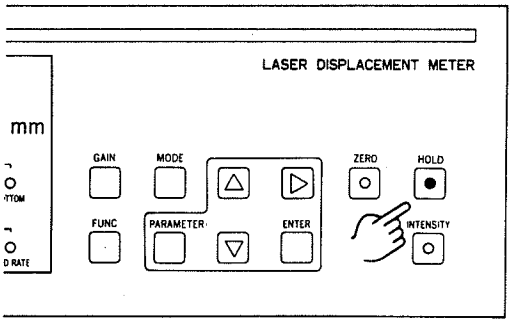
HOLD

⑱ HOLD key

Hold function
Hold displayed values and all output values.

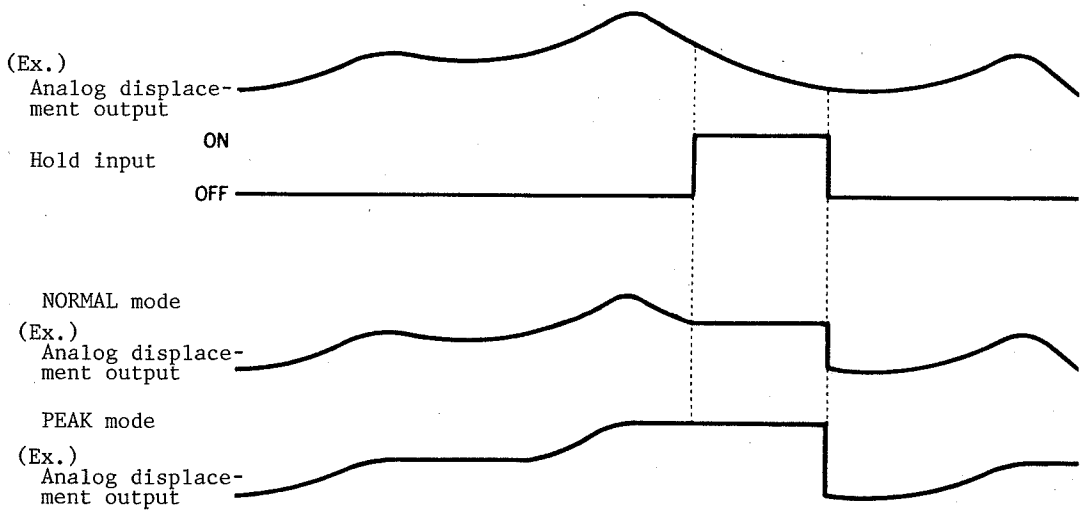
Note: Remote control using the terminal on the rear panel is available. (Refer to P. 43.)

1. Press the HOLD key on the panel. The LED mounted at the center of the key lights and the values and output displayed immediately before pressing the HOLD key is retained.



2. Re-press the HOLD key on the panel. The LED mounted at the center of the key goes off and the system returns to the measurement mode.

Note: When the measurement is performed in the P-P, PEAK, or BOTTOM mode, the measured results obtained up to this moment will be reset simultaneously with the resetting of the HOLD function.



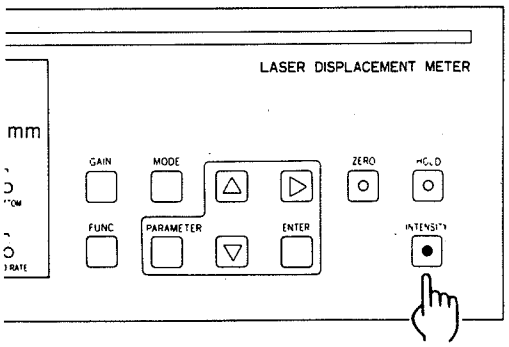
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INTENSITY

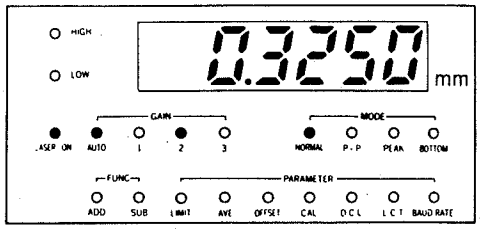
⑲ LIGHT INTENSITY monitor key

Displays received light quantity in numerals from 0 to 5.0000.
The analog voltage (0 to 5 V) corresponding to the displayed value is provided through the terminal mounted on the rear panel.
(Refer to P. 41.)

1. Press the INTENSITY key on the panel. The LED mounted at the center of the key lights and the display panel indicates the currently received light quantity.



2. Re-press the INTENSITY key on the panel. The LED at the center of the key goes off and the displayed panel returns to the measurement mode.



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Input/output terminals

⑳ RS-232C input/output terminals
㉑ Analog DISPLACEMENT output terminals
LIGHT INTENSITY monitor terminal
㉒ LIGHT INTENSITY alarm output terminals
㉓ AREA OVER alarm output terminals
㉔ HIGH (UPPER) LIMIT output terminals
㉕ LOW (LOWER) LIMIT output terminals
㉖ HOLD input terminals
㉗ AUTO ZERO input/reset terminals
㉘ LASER REMOTE control input terminals

⑳ RS-232C input/output terminals

Makes it possible to communicate between a computer and the LC-2100 (hereinafter called 'LC') through the RS-232C interface. Also, remote control of data transmission and changing of each setting, etc. are possible.

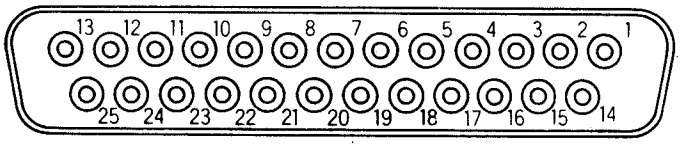
SPECIFICATIONS

LC-2100 conforming to the EIA (Electronic Industries Association) RS-232C shall be used as the modem.

Communication method	Full duplex
Synchronization method	Start/stop system
Transmission code	ASCII
Data bit length	7/8 bit*
Stop bit length	1/2 bit*
Parity check	Even/odd/none*
Baud rate	75/150/300/600/1200/2400/4800/9600/19200 bps*

* According to setting

Pin alignment



Note: Pull-up is performed for pin 20 inside the LC-2100. Therefore, you can output measured results without connecting this terminal and the external equipment.

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Pin No.	Signal corres-ponding to modem	Description	Signal direction
1	FG (GND)	Frame ground	—
2	SD (TXD)	Data to be input from external equipment	Input
3	RD (RXD)	Data of measured results to be output	Output
5	CS (CTS)	ON at power-up (High)	Output
6	DR (DSR)	ON at power-up (High)	Output
7	SG (GND)	Signal ground	—
8	CD (DCD)	ON at power-up (High)	Output
20	ER (DTR)	Measured results output is possible when this pin is ON (High).	Input

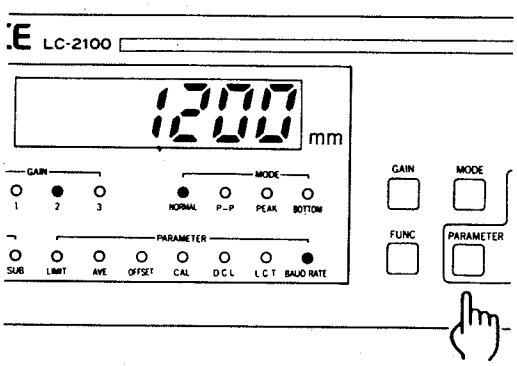
Setting of baud rate and data format

Set the same baud rate and data format as those of the commputer to be connected.

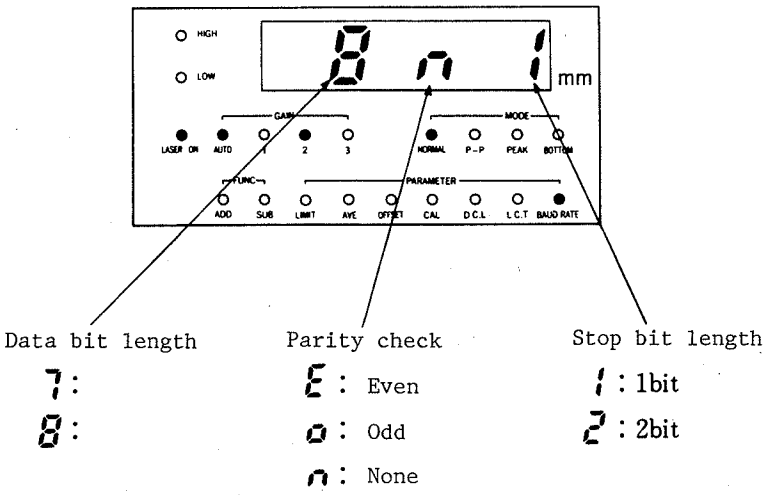
1. Press the PARAMETER key to select "BAUD RATE".
   (At this time, the PARAMETER BAUD RATE LED lights, allowing the system to be in the set mode.)

2. If the set mode is specified, the display panel indicates the current baud rate.
   Adjust baud rate to the desired value using the ▲ or ▼ key and press the ENTER key.

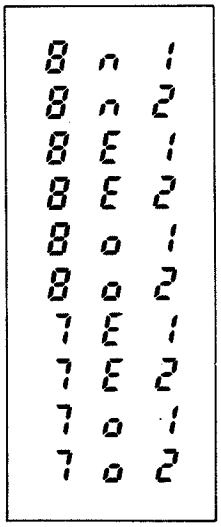
3. Pressing the ENTER key with the baud rate indicated permits the display panel to indicate the currently used data format.



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Setting-available data bit format 7-segment LED display



Note: Combination other than those shown above cannot be set.

4. Select the data format to be displayed using the ▲ or ▼ key and press the ENTER key.

5. Pressing the ENTER key with the data format displayed sets both baud rate and data format. Simultaneously, the BAUD RATE LED goes off and the display panel returns to the measurement mode.

Note:
- Unless you press the ENTER key with the data format displayed, neither baud rate nor data format can be set.
- Pressing the PARAMETER key in the set mdoe takes you to the succeeding item without performing setting.

Remote control

Remote control of each setting of LC is available by transmitting the ASCII code from the external equipment (such as a computer).

Note: The character code corresponding to the ASCII code is also acceptable for this purpose.

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1) Selection of GAIN, mode and the average number

RS-232C Code Table I

Function	Receiving code		Setting parameters
	Charactor cord	ASCII cord	
GAIN selector	SP	20H	AUTO
	!	21H	GAIN 1
	"	22H	GAIN 2
	#	23H	GAIN 3
MODE selector	%	25H	NORMAL
	&	26H	P-P
	'	27H	PEAK
	(	28H	BOTTOM
Average number	)	29H	1 time
	*	2AH	2 times
	+	2BH	4 times
	,	2CH	8 times
	–	2DH	16 times
	.	2EH	32 times
	/	2FH	64 times
	0	30H	128 times
	1	31H	256 times
	2	32H	512 times
	3	33H	1,024 times
	4	34H	2,048 times
	5	35H	AUTO ZERO
	6	36H	Resets AUTO ZERO.
	7	37H	HOLD
	8	38H	Resets HOLD.
	9	39H	Makes panel invalid.
	:	3AH	Resets 'panel invalid'.
	;	3BH	Makes intensity monitor.
	<	3CH	Resets intensity monitor.

Note: 'Panel invalid' is a function that makes operation from the controller panel impossible.
In the 'panel invalid' mode, the PARAMETER BAUD RATE LED flashes.

If the ASCII code (corresponding character code) described in the Code Table I is transmitted to the LC from the external equipment (such as a computer), the LC will send a response "PASS C_R" to the external equipment, and performs the specified action. In the case of a receiving error, the LC sends a response "ERROR C_R", and does not perform the specified action.

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2) Setting of each function

RS-232C Code Table II

Function	Receiving cord		Setting parameters
	Charactor cord	ASCII cord	
Limit setting	@	40H	Upper limit in NORMAL mode
	A	41H	Lower limit in NORMAL mode
	B	42H	Upper limit in P-P mode
	C	43H	Lower limit in P-P mode
	D	44H	Upper limit in PEAK mode
	E	45H	Lower limit in PEAK mode
	F	46H	Upper limit in BOTTOM mode
	G	47H	Lower limit in BOTTOM mode
	H	48H	Offset
	I	49H	Calibration
	J	4AH	Dark cut level
	K	4BH	Level cut time

If the ASCII code (corresponding character code) described in the Code Table II is transmitted from the external equipment to the LC, the LC will be in the received set mode and waits for set value input.

Example: When setting the lower limit in the PEAK mode to -1.246 mm

1. Transmit the ASCII code 45H to the LC from the external equipment.
2. The LC having received the ASCII code 45H sends back "PASS C_R" and waits for set value input.
3. Verify that "PASS C_R" was received and transmit "-1.246 C_R" from the external equipment.
4. The LC having received the value of "-1.246 C_R" sends back "PASS C_R", simultaneously setting the lower limit in the PEAK mode to -1.246 mm.

Note: 1. In the case that a receiving error occurs in the LC, the LC sends back "ERROR C_R", and returns to the measurement mode.

2. How to carry out calibration
Calibration carried out using the RS-232C is the same as the one done by inputting numerals (P.21).
With the calibration using the RS-232C, a displayed value such as 3.0000 mm or 8.0000 mm is converted to the value input by calibration.
For example, assume that the LC displays 2.0000 mm when you moves an object by +2.0000 mm. If +2.0000 mm is input using

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the calibration function, the LC will display a value of +2.0000 mm against a mvoement of +2.0000 mm from that time. In the same manner, measurement precision is obtainable within a range of ±2.0000 mm.

Example: Calibration procedures described on the previous page

1. Transmit the ASCII code 49H to the LC from the external equipment.
2. The LC having received the ASCII code 49H sends back "PASS C_R" and waits for the set value input.
3. Verify that "PASS C_R" is received and transmit "+2.0000 C_R" from the external equipment.
4. The LC having received "+2.0000 C_R" sends back "PASS C_R", simultaneously setting the calibration.

Note: In the case that a receiving error occurs in the LC, the LC sends back "ERROR C_R", and returns to the measurement mode.

3) Measured values output

RS-232C Code Table III

Function	Receiving cord		Setting parameters
	Charactor cord	ASCII cord	
Measured values output	M	4DH	Outputs measured value one time.
	N	4EH	Continuously outputs measured value.
	O	4FH	Stops continuous output of measured value.

If the ASCII code (corresponding character code) described in the Code Table III is received, the measured value at that time are transmitted at one time or continuously at a response delay time of 50 μsec., maximum.

Note: 1. In the continuous output mode, receiving codes other than "O" (4FH) will not be effective.

2. In modes other than the continuous output mode, receiving "O" (4FH) will not be effective.

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[Data format]

- In the NORMAL measurement mode

Example: When outputting +2.0000 mm

1st data	2nd data	3rd data	4th data	5th data	6th data	7th data	8th data	9th data
+	SPACE	2	.	0	0	0	0	CR
Mark	10^1 digit	10^0 digit	Decimal point	10^{-1} digit	10^{-2} digit	10^{-3} digit	10^{-4} digit	

Example: When outputting -0.2340 mm

1st data	2nd data	3rd data	4th data	5th data	6th data	7th data	8th data	9th data
−	SPACE	0	.	2	3	4	0	CR

Note: In the case of a digit without data in the NORMAL measurement mode, space will be output.

- When a measurement error occurs

1st data	2nd data	3rd data	4th data	5th data	6th data	7th data	8th data	9th data
+	9	9	.	9	9	9	9	CR

- Light intensity

Example: When light intensity is 0.3450

1st data	2nd data	3rd data	4th data	5th data	6th data	7th data
0	.	3	4	5	0	CR

Note: In the case of the light intensity, no marks are provided to the first data.

Outputting measured values

When the NORMAL measurement mode is specified and the average number is less than 128 times, the value averaged by 128 measurements will be output.
In the case of the P-P, PEAK, or BOTTOM mode, the measured values corresponding to the set average number will be output.

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4) Information output

RS-232C Code Table IV

Function	Receiving code		Setting parameters
	Charactor code	ASCII code	
Information output	P	50H	Alarm output mode
	Q	51H	Set GAIN
	R	52H	Set mode
	S	53H	Upper/lower limits in NORMAL mode
	T	54H	Upper/lower limits in P-P mode
	U	55H	Upper/lower limits in PEAK mode
	V	56H	Upper/lower limits in BOTTOM mode
	W	57H	Set value of average number
	X	58H	Offset set value
	Y	59H	Calibration set value
	Z	5AH	Dark cut level set value
	[	5BH	Level cut time set value
	¥	5CH	AUTO ZERO ON/OFF
	]	5DH	Hold ON/OFF
	^	5EH	LIGHT INTENSITY ON/OFF

If the ASCII code (character code) described in the Code Table IV is received, the setting parameters and set value corresponding to the code are transmitted.

[Data format]

• Alarm output mode

1st data	2nd data	3rd data	4th data	5th data	6th data	7th data	8th data	9th data
H	L	D	B	E	F	N	A	CR
HIGH	LOW	DARK	BRIGHT	ERROR	FAR	NEAR	AREA OVER	

Note: If no alarm output is provided, "-"(2DH) will be transmitted.

Example: When outputting HIGH FAR alarm

1st data	2nd data	3rd data	4th data	5th data	6th data	7th data	8th data	9th data
H	-	-	-	-	F	-	-	CR

• Set GAIN

Example: When setting AUTO GAIN 1

1st data	2nd data	3rd data	4th data	5th data	6th data
A	U	T	0	1	CR

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Example: When setting GAIN 1

1st data	2nd data	3rd data	4th data	5th data	6th data
G	A	I	N	1	CR

Note: When GAIN 2 or 3 is set, the fifth data is changed.

[Data format]

- Set mode
- NORMAL

1st data	2nd data	3rd data	4th data	5th data	6th data	7th data
N	O	R	M	A	L	CR

- P-P

1st data	2nd data	3rd data	4th data
P	–	P	CR

- PEAK

1st data	2nd data	3rd data	4th data	5th data
P	E	A	K	CR

- BOTTOM

1st data	2nd data	3rd data	4th data	5th data	6th data	7th data
B	O	T	T	O	M	CR

- Upper/LOWER limits

Example: When setting the upper limit to +2.500 mm and the lower limit to -0.1500 mm in the NORMAL mode

1st data	2nd data	3rd data	4th data	5th data	6th data	7th data	8th data	9th data
+	SPACE	2	.	5	0	0	0	CR

10th data	11th data	12th data	13th data	14th data	15th data	16th data	17th data	18th data
–	SPACE	0	.	1	5	0	0	CR

- Set value of average number

Example: When performing 128 times

1st data	2nd data	3rd data	4th data
1	2	8	CR

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Example: When 2,048 times

1st data	2nd data	3rd data	4th data	5th data
2	0	4	8	CR

- OFFSET set value

Example: When setting value SET -1.567 mm

1st data	2nd data	3rd data	4th data	5th data	6th data	7th data	8th data	9th data
−	SPACE	1	.	5	6	7	0	CR

Note: Data output method is the same as the measured value output method.

- Calibration set value

Example: When setting value to +1.0000 mm

1st data	2nd data	3rd data	4th data	5th data	6th data	7th data	8th data	9th data
+	SPACE	1	.	0	0	0	0	CR

Note: Data output method is the same as the measured value output method.

- Dark cut level set value

Example: When setting value to 0.2460

1st data	2nd data	3rd data	4th data	5th data	6th data	7th data
0	.	2	4	6	0	CR

- LEVEL CUT TIME set value

Example: When setting value to 456.75 msec.

1st data	2nd data	3rd data	4th data	5th data	6th data	7th data
4	5	6	.	7	5	CR

- AUTO ZERO ON/OFF

(1) When AUTO ZERO is ON

1st data	2nd data	3rd data	4th data	5th data	6th data	7th data	8th data
Z	E	R	O	−	O	N	CR

(2) When AUTO ZERO is OFF

1st data	2nd data	3rd data	4th data	5th data	6th data	7th data	8th data	9th data
Z	E	R	O	−	O	F	F	CR

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• HOLD ON/OFF

(1) When HOLD is ON

1st data	2nd data	3rd data	4th data	5th data	6th data	7th data	8th data
H	O	L	D	—	O	N	C_R

(2) When HOLD is OFF

1st data	2nd data	3rd data	4th data	5th data	6th data	7th data	8th data	9th data
H	O	L	D	—	O	F	F	C_R

• LIGHT INTENSITY ON/OFF

(1) When LIGHT INTENSITY is ON (in the light intensity measurement mode)

1st data	2nd data	3rd data	4th data	5th data	6th data	7th data
I	N	T	-	O	N	C_R

(2) When LIGHT INTENSITY is OFF (in the NORMAL measurement mode)

1st data	2nd data	3rd data	4th data	5th data	6th data	7th data	8th data
I	N	T	-	O	F	F	C_R

5) Function selection

RS-232C Code Table V

Function	Receiving code		Setting parameters
	Charactor code	ASCII code	
FUNCTION selection	_	5FH	FUNCTION mode
	a	61H	ADD
	b	62H	SUB
	c	63H	Sets/resets FUNCTION

If the ASCII code (corresponding character code) described in the Code Table V is transmitted to the LC from the external equipment (such as a computer), the LC will send back "PASS C_R" to the external equipment, and performs the specified action. In the case of a receiving error, the LC sends a response "ERROR C_R", and does not perform the specified action.
"FUNCTION mode" (5HF) transmits current function.

[Data format]

• FUNCTION mode

Example: When measuring with ADD (thickness) function

1st data	2nd data	3rd data	4th data
A	D	D	C_R

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Example: When measuring with SUB (step difference) function

1st data	2nd data	3rd data	4th data
S	U	B	CR

Example: When resetting function mode

1st data	2nd data	3rd data	4th data	5th data	6th data	7th data	8th data	9th data
F	U	N	C	–	0	F	F	CR

Note: If optionally available digital input/output terminals are not incorporated, function selection is not available.

RS-232C Code Table

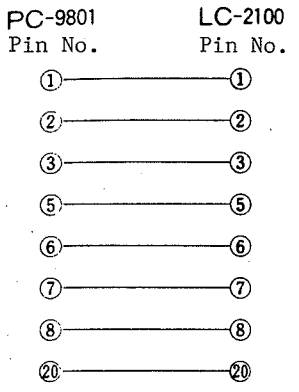
Function	Receiving code		Setting contents
	Character code	ASCII code	
GAIN selection	SP	20H	AUTO
	!	21H	GAIN 1
	"	22H	GAIN 2
	#	23H	GAIN 3
Mode selection	%	25H	NORMAL
	&	26H	P-P
	'	27H	PEAK
	(	28H	BOTTOM
Average number	)	29H	1 time
	*	2AH	2 times
	+	2BH	4 times
	,	2CH	8 times
	–	2DH	16 times
	.	2EH	32 times
	/	2FH	64 times
	0	30H	128 times
	1	31H	256 times
	2	32H	512 times
	3	33H	1024 times
	4	34H	2048 times
	5	35H	AUTO ZERO
	6	36H	Resets AUTO ZERO
	7	37H	HOLD
	8	38H	Resets HOLD
	9	39H	Panel invalid
	:	3AH	Resets 'Panel invalid'
	;	3BH	Measures light intensity
	<	3CH	Resets light intensity measurement
Limit setting	@	40H	Upper limit in NORMAL mode
	A	41H	Lower limit in NORMAL mode
	B	42H	Upper limit in P-P mode
	C	43H	Lower limit in P-P mode
	D	44H	Upper limit in PEAK mode
	E	45H	Lower limit in PEAK mode
	F	46H	Upper limit in BOTTOM mode
	G	47H	Lower limit in BOTTOM mode

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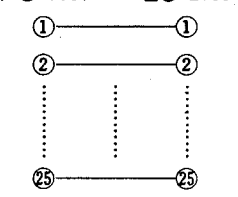
Function	Receiving code		Setting contents
	Character code	ASCII code	
	H	48H	Offset
	I	49H	Calibration
	J	4AH	Dark cut level
	K	4BH	Level cut time
Measured value output	M	4DH	Outputs measured value at one time.
	N	4EH	Continuously outputs measured results.
	O	4FH	Stops continuous output of measured value.
Informatin output	P	50H	Alarm output condition
	Q	51H	Set GAIN
	R	52H	Set mode
	S	53H	Upper/lower limits in NORMAL mode
	T	54H	Upper/lower limtis in P-P mode
	U	55H	Upper/lower limits in PEAK mode
	V	56H	Upper/lower limits in BOTTOM mode
	W	57H	Set value of average number calculation
	X	58H	OFFSET set value
	Y	59H	CALIBRATION set value
	Z	5AH	DARK CUT LEVEL set value
	[	5BH	LEVEL CUT TIME set value
	¥	5CH	AUTO ZERO ON/OFF
	]	5DH	HOLD ON/OFF
	^	5EH	LIGHT INTENSITY ON/OFF
FUNCTION selection	_	5FH	FUNCTION mode
	a	61H	ADD
	b	62H	SUB
	c	63H	Resets function setting.

When connecting computer (Typical)

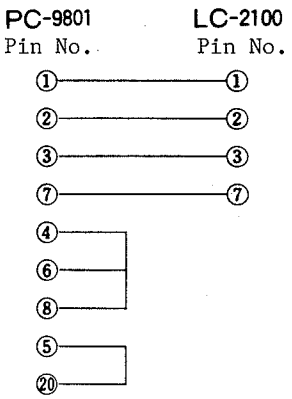
[Example 1]



Note: Regarding pins having numbers other than specified on the left, connection is permissible only between pins with the same number.



[Example 2]



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[Program 1]

Typing "M" on the computer keyboard allows the computer display to indicate the measured value obtained by the LC-2100. The following shows the program to execute this function.

```
100  OPEN "COM:N81NN" AS #1
110  ON COM GOSUB 170
120  COM ON
130  A$=INKEY$
140  IF A$<>"M" THEN 130
150  PRINT #1,A$;
160  GOTO 130
170  N=LOC(#1)
180  IF N=0 THEN RETURN
190  B$=INPUT$(N,#1)
200  IF RIGHT$(B$,1)=CHR$(13) THEN PRINT B$ ELSE PRINT B$;
210  RETURN
```

[Program 2]

Typing "S" on the computer keyboard allows the LC-2100 to continuously output the measured value to the computer, and also allows the computer display to indicate the maximum, minimum, and average values of 100 measurements. The following shows the program to execute this function.

```
100 DIM A$(100)
110 PRINT "START or END ? (Push [S] or [E] Key)"
120 PRINT
130 A$=INPUT$(1)
140 IF A$="E" OR A$="e" THEN END
150 IF A$<>"S" AND A$<>"s" THEN 130
160 OPEN "COM:N81NN" AS #1
170 PRINT #1,"N";
180 FOR I=1 TO 100
190   INPUT #1,A$(I)
200 NEXT I
210 PRINT #1,"O";
220 FOR I=1 TO 500 :NEXT I
230 IF EOF(1)=0 THEN INPUT #1,DAMMY$ :GOTO 230
240 CLOSE #1
250 MAX=-1000 :MIN=1000 :SUM=0
260 FOR I=1 TO 100
270   A=VAL(A$(I))
280   IF A>MAX THEN MAX=A
290   IF A<MIN THEN MIN=A
300   SUM=SUM+A
310 NEXT I
320 AVE=SUM/100
330 PRINT USING "MAX = ###.#### mm";MAX
340 PRINT USING "MIN = ###.#### mm";MIN
350 PRINT USING "AVE = ###.#### mm";AVE
360 PRINT
370 GOTO 110
```

Indicates measurement start/end selection.

Gives command of continuous data output.

Inputs data

Gives command for stopping continuous output.

Disposes of data input at same time as inputting command for stopping continuous output.

Calculates maximum, minimum, and average values.

Indicates maximum, minimum, and average values.

Note: Be sure to set the baud rate of the computer and the LC-2100 to the same.

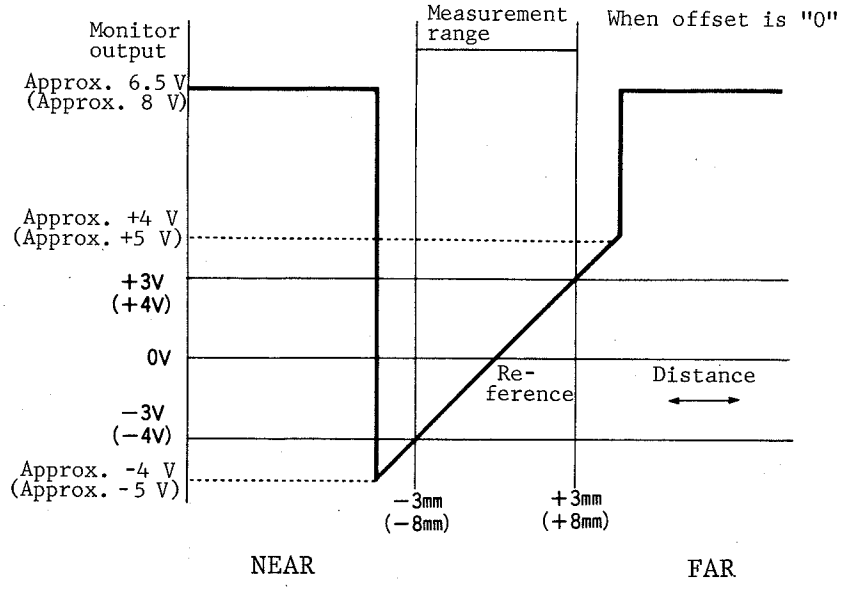
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Analog output

㉑ ■ Analog DISPLACEMENT Output terminal

Outputs analog voltage in proportion to displacement.
Output range: ±3 V/±3 mm (LC-2210, 2220) or ±4 V/±8 mm (LC-2310, 2320) (when offset value is "0"). Guaranteed accuracy range: ±6 V (LC-2210, 2220) and ±8 V (LC-2310, 2320) respectively.
Output impedance is 0 Ω, and current capacity is 10 mA.

Relationship between distance and output voltage
The values in ( ) are the values when using the LC-2310 or 2320.



■ LIGHT INTENSITY monitor output terminal (Interlocked with the LIGHT INTENSITY monitor key)

Pressing the INTENSITY key on the panel switches the displacement output mode to the analog voltage output mode in proportion to the received light quantity.

0 - 5 V output impedance: 0 Ω, current capacity: 10 mA

Control output

Open collector: 100 mA, max. (30 V max.)

Response speed: 100 μsec.

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㉒ LIGHT INTENSITY alarm output terminal

Turns output function to OFF in DARK or BRIGHT condition.

㉓ AREA OVER alarm output terminal

Turns output function to OFF when the object goes out of a measurement range of ±3 mm (LC-2100, 2220) and ±8.7995 mm (LC-2310, 2320).

Note: The display panel can display up to ±3.9998 mm (LC-2100, 2220) or ±8.7995 mm (LC-2310, 2320). Measured results are repeatedly output until the LC detects a DARK condition (when offset value is "0").

㉔ HIGH (UPPER) LIMIT output terminal

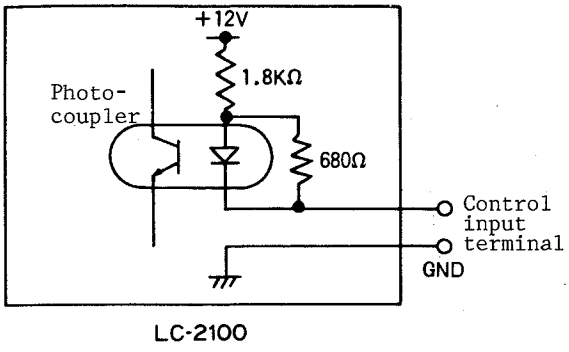
Provides output when measured results exceed the upper limit set in each measurement mode.

㉕ LOW (LOWER) LIMIT output terminal

Provides output when measured results are less than the lower limit set in each measurement mode.

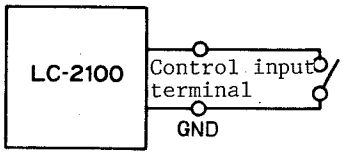
Control input

Internal circuit

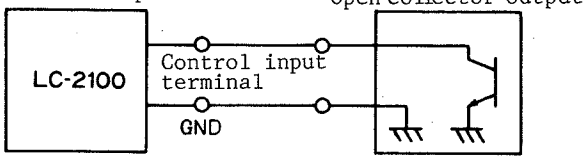


Example of connection

· In the case of the contact input



· In the case of the solid-state input



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㉖ HOLD input terminal

- When the circuit between terminals 9 and 10 are short circuited, this terminal retains the value displayed and the output immediately before the short circuiting.
- Making the short circuited portion open allows the LC sensor to be in the measurement mode.

Note: In the P-P (Difference), PEAK, and BOTTOM modes, short circuiting and opening between terminals 9 and 10 resets the previously obtained measured results.

㉗ AUTO ZERO input/reset terminal

- When the circuit between terminals 12 and 13 is short circuited, this terminal sets the measured results at that time to 0 mm and indicates and outputs the displacement from that time.
- Short circuiting between terminals 11 and 12 resets the 0 point you set.

Note: If you open the short circuit between both terminals, no effect can be provided.

㉘ Laser emission control remote input terminal

- Short circuiting between terminals 14 and 15 lights the LASER ON alarm LED on the display panel and the laser starts emission three seconds later.
- Opening between terminals 14 and 15 turns the LASER ON LED on the display panel to off, stopping the laser emission.

Note: A short circuit bar is inserted between terminals 14 and 15 when shipped.

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Power supply

(29) Key power switch
(30) Power input terminal
(31) Frame ground
(32) Fuse

Power supply

(29) Key power switch

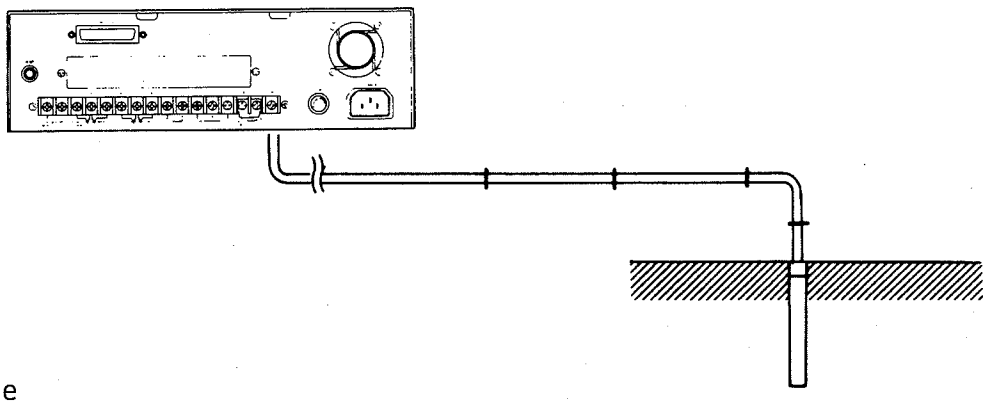
Allows the unit to operate when it is ON.
The key is removable only when this switch is set to the OFF position.

(30) Power input terminal

Connected via attached power cord.
Power voltage is 85 to 264 VAC, 50/60 Hz.

(31) Frame ground

Is used to ground the system. However, do not use this terminal in combination with other equipment.



(32) Fuse

A 2A miniature fuse is used as the power supply fuse.

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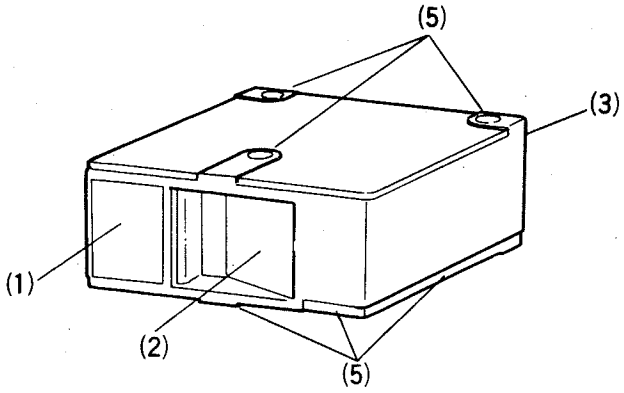
5-6 FUNCTIONS [SENSOR HEAD]

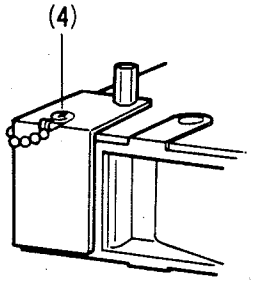
Part name function

① Light emitting/receiving unit
② LASER ON alarm LED indicator
③ Laser beam shielding cover
④ Reference plane

[Sensor head] (Part name function)

The following explains each part of the sensor head.





When using laser beam shielding cover

Light emitting/receiving unit

(1) Light emitting unit (Laser aperture)

Emits laser beam.

(2) Light receiving unit

Takes in light reflected from the object being measured.

Note: Be careful not to allow water, oil, or dust particles to adhere to the glass surface of the light emitting and receiving units. If the unit becomes contaminated, wipe off the contamination using a soft cloth moistened in alcohol.

LASER ON alarm LED indicator

(3) LASER ON alarm LED

Lights when the laser beam is being emitted or just before laser beam emission. The laser beam is emitted at least 3 seconds after the LED lights.

Note: You can check whether the LED is lit even while wearing protective goggles.

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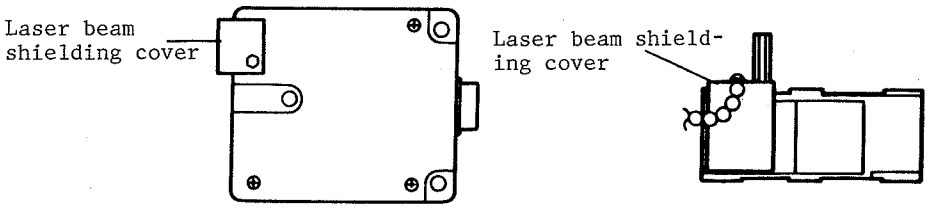
Laser beam shielding cover

(4) Laser beam shielding cover

Is to be attached to the light emitting unit of the sensor head. Be sure to use this device if you risk being subjected to laser beam exposure while working in front of the sensor head.

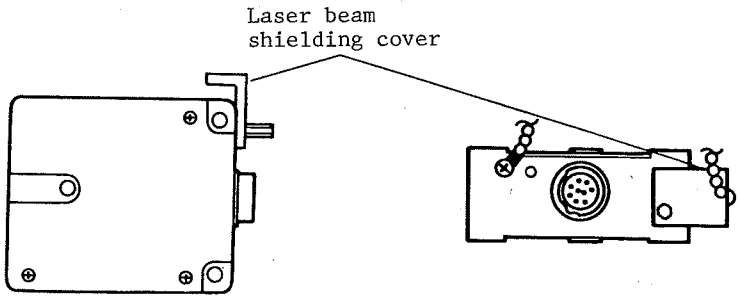
When using the shielding cover

Cover the front portion of the light emitting unit with the shielding cover and secure it to the sensor head using the attached screw.



When not using the shielding cover

Secure the shielding cover to the rear portion of the sensor head by screwing the attached screw into the screw hole.



Reference plane

(5) Reference plane

The following three planes are specified as a reference plane. Use these planes as a reference to install the sensor head.

- Three raised portions on both sides of the sensor head (Six legs in total)
- The plane provided on the side surface of the sensor head
- The plane provided on the front surface of the sensor head

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6 HINTS ON CORRECT USE

① Power supply and grounding
② Operating environment
③ Installation of sensor head
④ Calibration
⑤ Compatibility
⑥ Countermeasures against noise
⑦ RS-232C output
⑧ Holding of each set value
⑨ Warm up
⑩ Ventilation hole

1) Power supply and grounding

- The required power supply is 85 to 264 VAC, 50/60 Hz.
- Ground the system through the frame ground terminal on the rear panel.

2) Operating environment

- Ambient temperature is within a range from 0 to 50°C (visible type is 0 to 35°C.)
- Keep the ambient temperature constant. Changing the ambient temperature may cause a measurement error.

  Note: If the ambient temperature changes by 10°C, approximately 60 minutes are required until temperature distribution inside the sensor head becomes even.

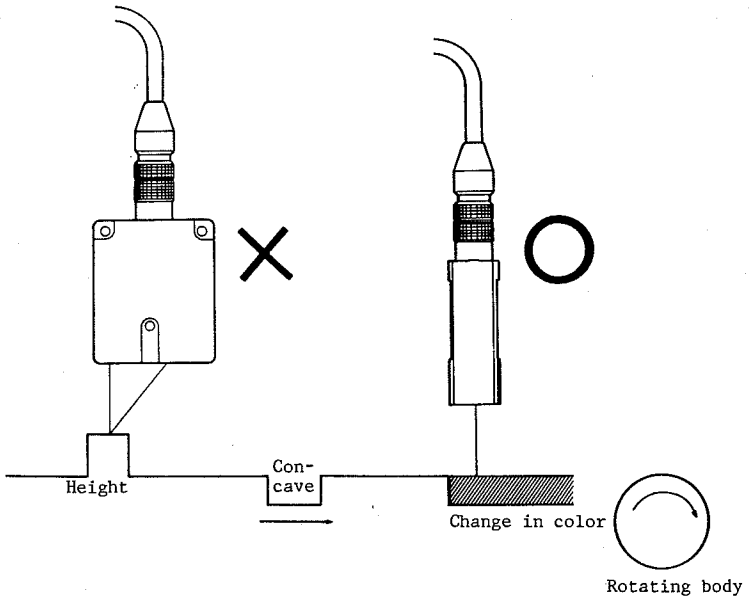
- Do not allow water, oil, or dust particles to adhere to the lens surface of the sensor head. An object which refracts light or attenuates the light quantity may cause a measurement error.

  Note: If the lens surface becomes soiled, wipe the soiled lens using a soft cloth moistened in alcohol.

3) Installing the sensor head

- To install the sensor head, be sure to correctly align the sensor head according to the reference planes. (Refer to P. 45.)
- The following conditions may cause measurement error if the orientation of the sensor head is incorrect.

1. Changes in the color or material of an object.
2. Difference in the height of an object.
3. Grooves in the object.
4. Rotating body



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4) Calibration

Perform calibration using the object to be measured. (Refer to P. 19.) If the object color and material are different, measured results corresponding to the actual displacement vary.

Note: The system has been adjusted using a while diffusive object before being shipped.

5) Compatibility

Be sure to use the system in combination with the same lot numbered controller and sensor head.
The controller and sensor head are calibrated in pairs. The use of different numbered controller and sensor head may not satisfy the rated specifications.

6) Countermeasures against noise

- Route the wiring of each sensor separately from high-tension cables and power cables.
  Laying two lines in one piping may cause the system to malfunction due to noise.
- To prevent the sensor head from being subjected to noise, insulate it when you install it.

7) RS-232C output

- To connect this system to a computer, use a straight type cord.
- If there is noise-generating equipment around the system, use a cord provided with a magnetic prevention device (such as twisted-pair line).
- First turn on the power supply of the computer peripherals and then turn this system ON.
  If you do not follow the correct power-up order, the system may malfunction due to noise at the time the system is activated.

8) Holding of each set value

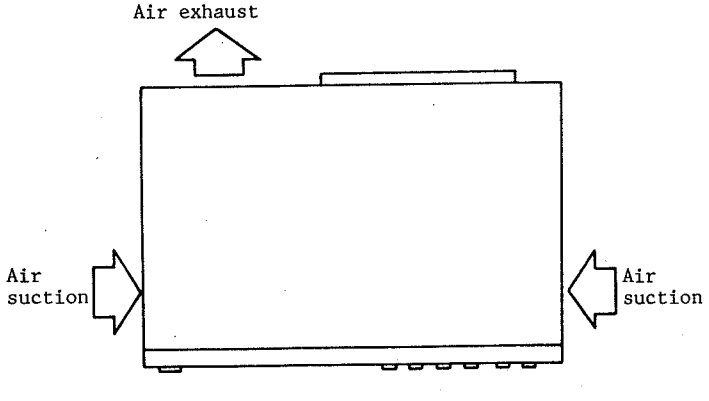
All controller settings (upper/lower limits, offset, calibration, etc.) are retained after power-off. If you perform different measurements, inspect whether each setting is appropriate.

9) Warm up

Wait 30 minutes after power-up before starting operation.
The circuit is unstable immediately after power-up: this may cause variance in measured results.

10) Ventilation holes

Do not block ventilation holes on the controller side surface.
Blocking them may cause malfucntion due to overheating.

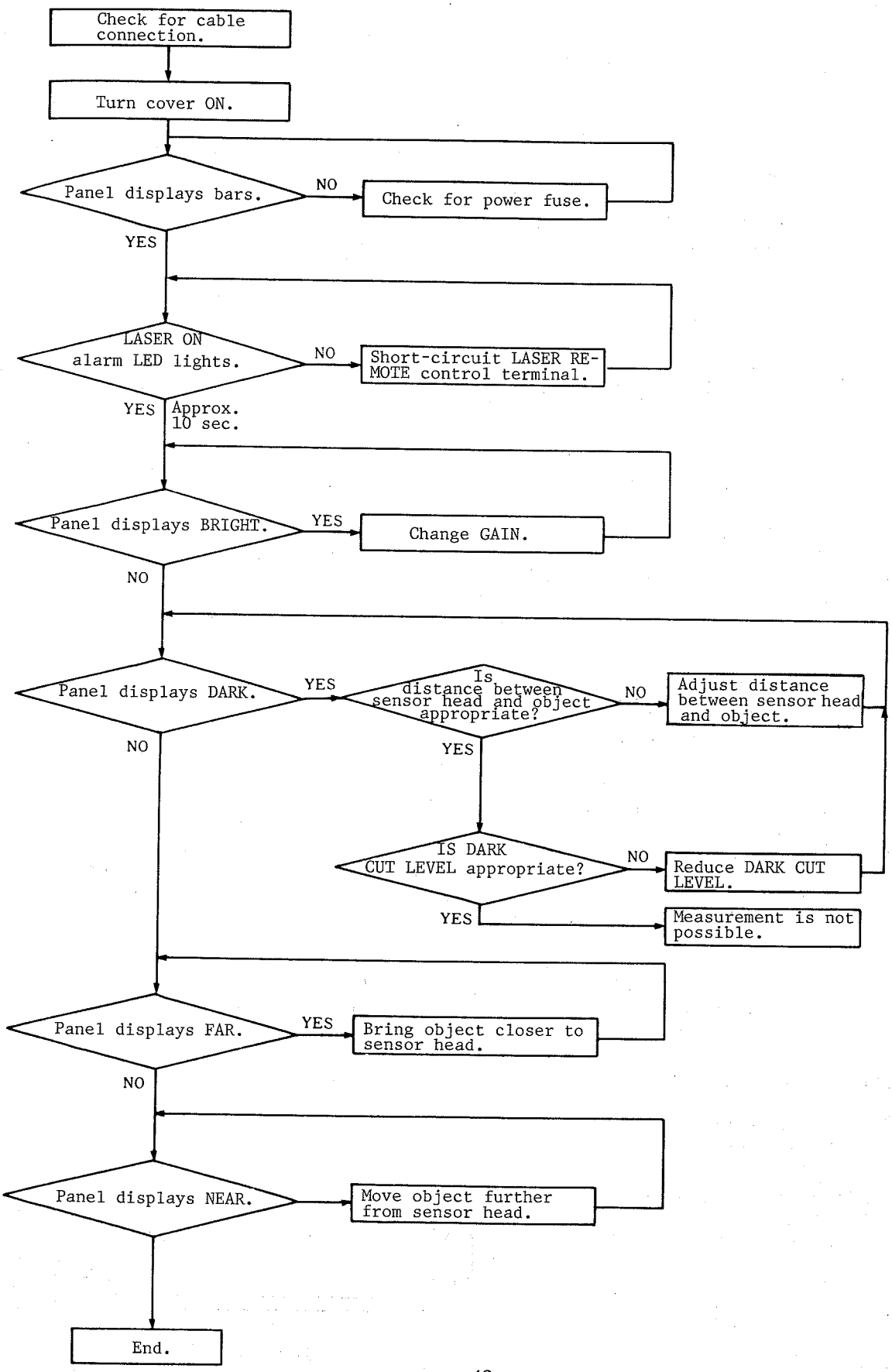


(Front face)

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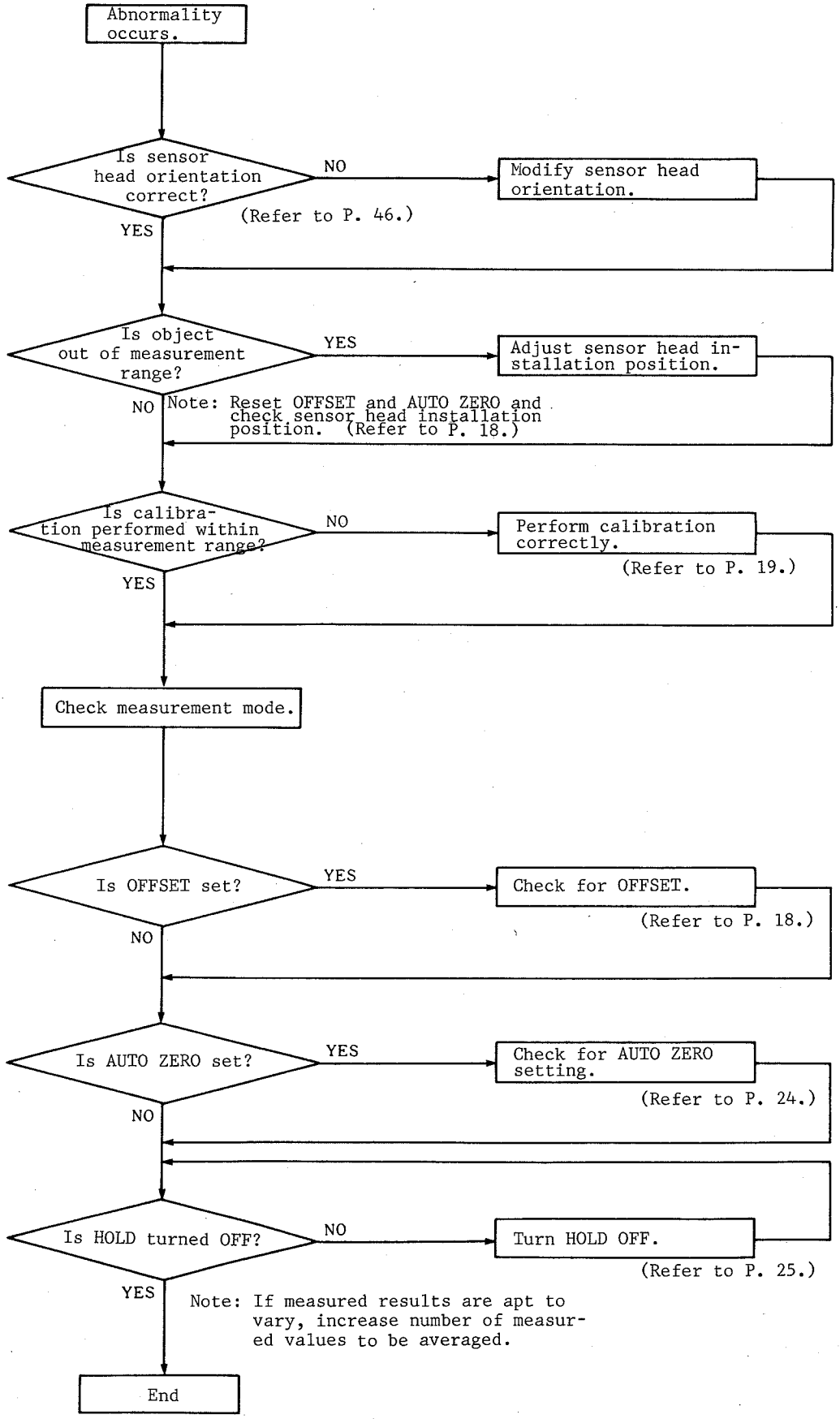
7. OPERATION CHECK LIST

1. No measured results are displayed.



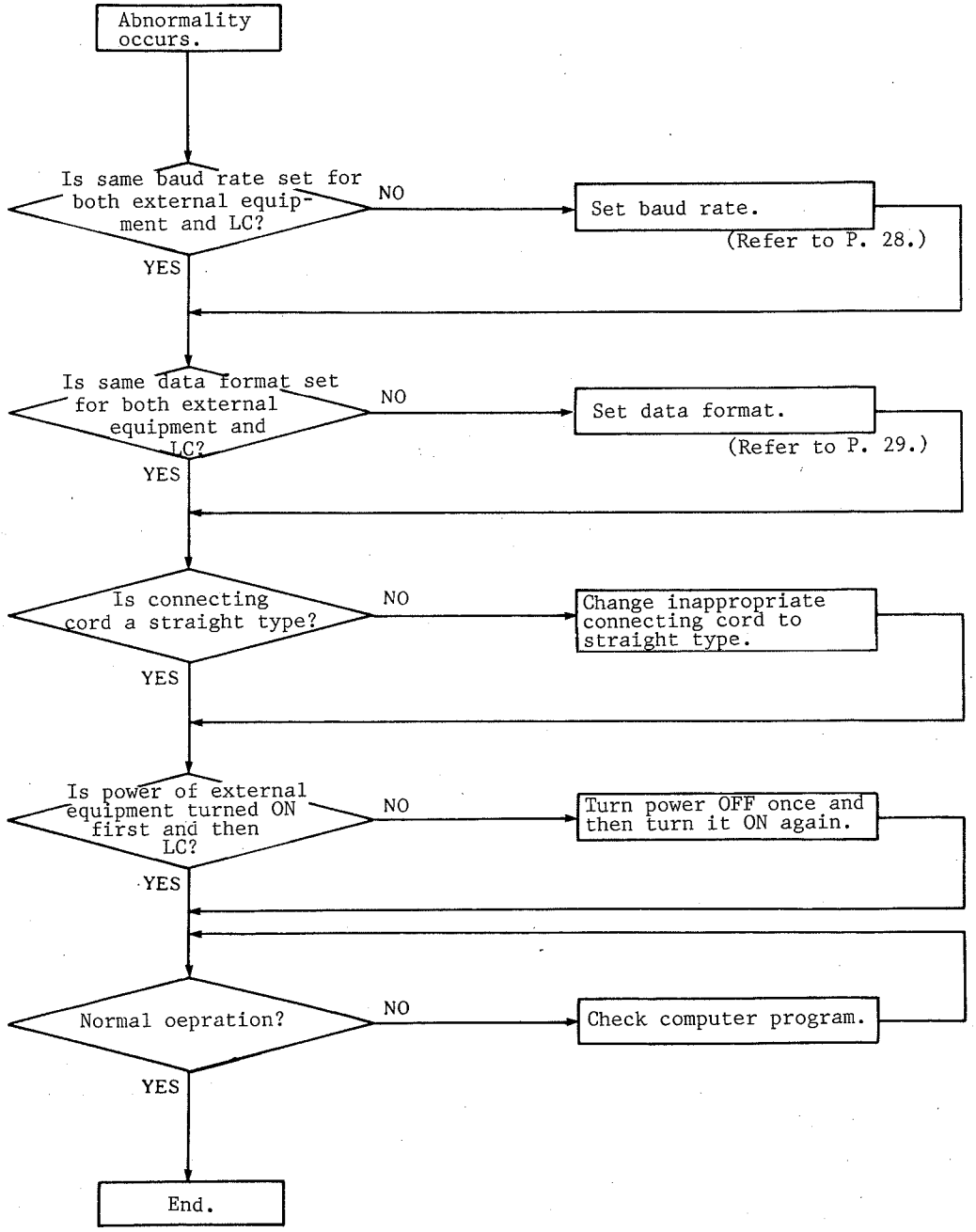
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2. Displayed values are not appropriate.



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3. Communication using RS-232C is not possible.



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8. ITEMS

① Specifications ③ Dimensions
② Characteristics

Specifications

Model	Controller	LC-2100			
	Sensor head	LC-2210	LC-2220	LC-2310	LC-2320
Measurement range		±3 mm		±8 mm	
Operation range		30 mm		50 mm	
Light source		Semiconductor laser			
	Wavelength	780 nm	670 nm	780 nm	670 nm
	Output	Maximum: 3 mW Average: 1.5 mW	Maximum: 1.9 mW Average: 950 W	Maximum: 3 mW Average: 1.5 mW	Maximum: 1.9 mW Average: 950 W
	Class	3B	2	3B	2
	Pulse width	12.5 µsec			
Min/max. spot diameter		70 - 90 µm	110 - 140 µm	80 - 140 µm	140 - 230 µm
Resolution *1		0.2 µm		0.5 µm	
Linearity *1		±0.1% of F.S.			
Sampling frequency		40 KHz			
Response frequency		16 KHz (-3 dB Number of measured values to be averaged: 1 time)			
Response time		100 µsec			
Number of measured values to be averaged		1 to 2,048 (12 levels switchable)			
OFFSET range		±2.9998 mm		±7.9995 mm	
GAIN adjustment		AUTO GAIN/MANUAL (3 levels) switchable)			
Output	Analog displacement output *2	±3V/±3 mm (Output impedance 0 Ω)		±4V/±8 mm (Output impedance 0 Ω)	
	Digital displacement output *3	16 bit parallel, TTL level, NPN open-collector			
		1 LSB = 0.2 µm		1 LSB = 0.5 µm	
Output: Control output	Upper/lower limit output	NPN open collector, 100 mA Max. (30 V, Max.)			
	LIGHT INTENSITY alarm output				
	OVER AREA alarm output				
Input	Digital displacement input *4	16 bit parallel/TTL level			
		1 LSB = 0.2 µm		1 LSB = 0.05 µm	
Input: Control input	HOLD timing input	Non-voltage input (contact, solid-state)			
	AUTO ZERO setting input				
	LASER EMISSION CONTROL REMOTE input				
Interface		RS-232C: Displacement data output and external control input (Baud rate: 75 to 19,200 bps selectable)			
		GP-IB: Displacement data output and external control input *5			
Temperature drift	Controller	±0.1 µm/deg			
	Head	±1.5 µm/deg			
Ambient operating illumination *6		2,000 ℓx, max.		1,000 ℓx, max.	
Ambient operating temperature		0 to 50°C	0 to 35°C	0 to 50°C	0 to 35°C
Ambient operating humidity		35 to 85% RH (No condensation allowable)			
Supply voltage		85 to 26 VAC 50/60 Hz			
Power consumption		45 VA max.			
Weight		Head: 170 g, Controller: 3.2 kg			

*1: When using a white diffusive object as an object and setting number of measured values to be averaged to 2,048 times

*2: When OFFSET is set to '0'. (According to OFFSET value, output of ±6 V (LC-2210, 2220) or ±8 V (LC2310, 2320) is available.)

*3, *4, *5: Optionally available

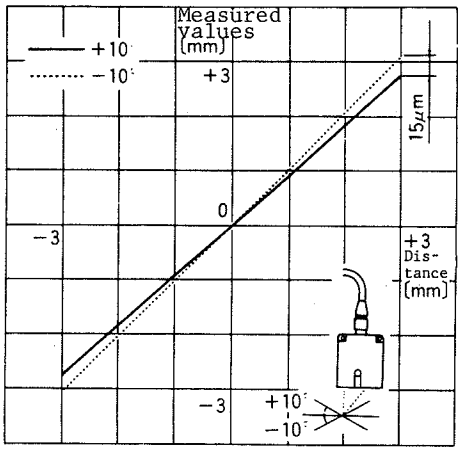
*6: Incondescent or floorescent lamp

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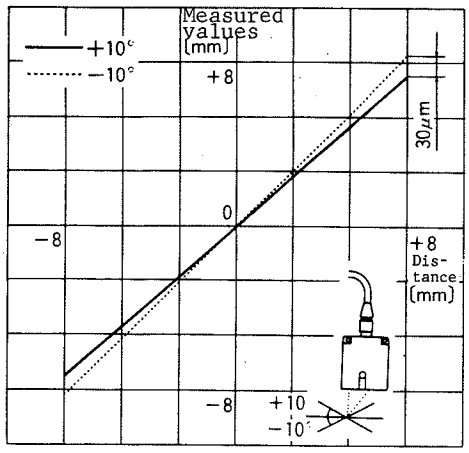
Characteristics

- Errors due to the lateral inclination of object

〈LC-2210, 2220〉

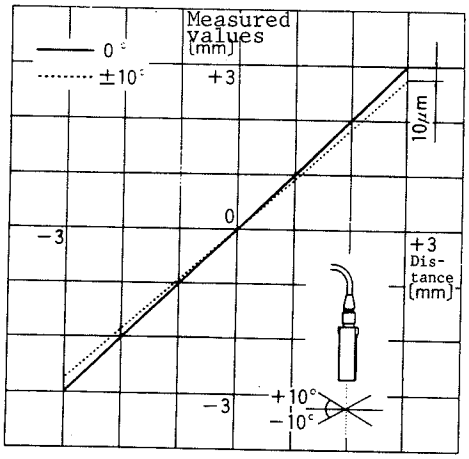


〈LC-2310, 2320〉

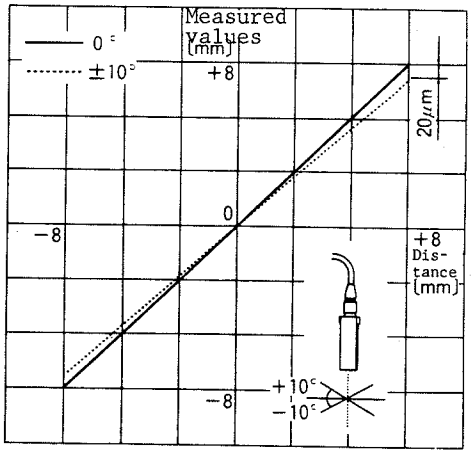


- Errors due to the vertical inclination of object

〈LC-2210, 2220〉

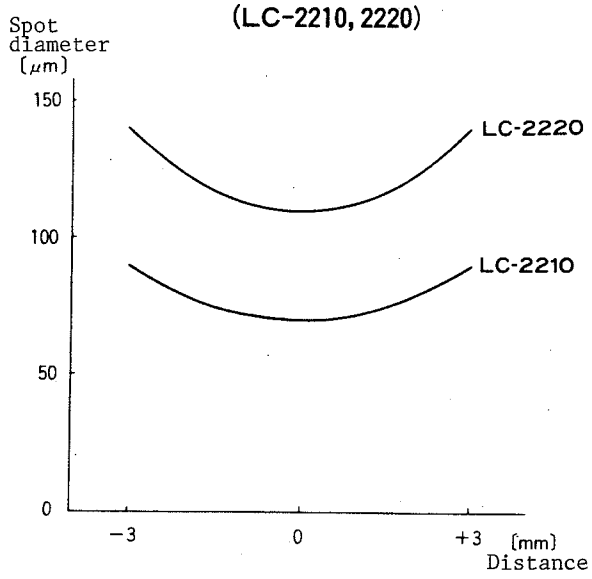


〈LC-2310, 2320〉

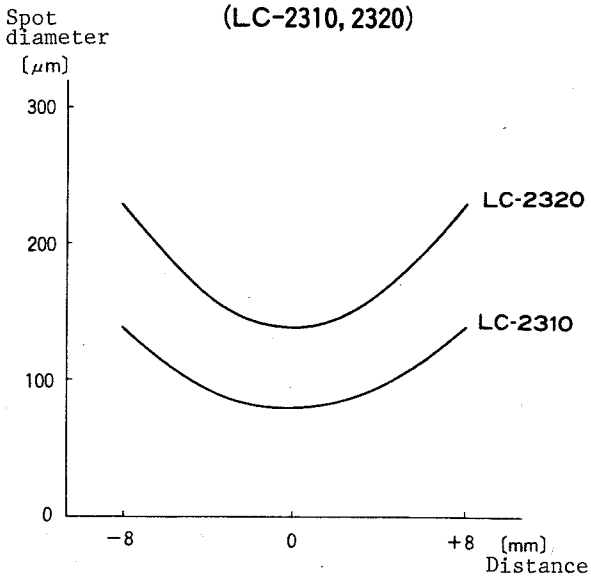


- Distance vs spot diameter (Typical example)

(LC-2210, 2220)

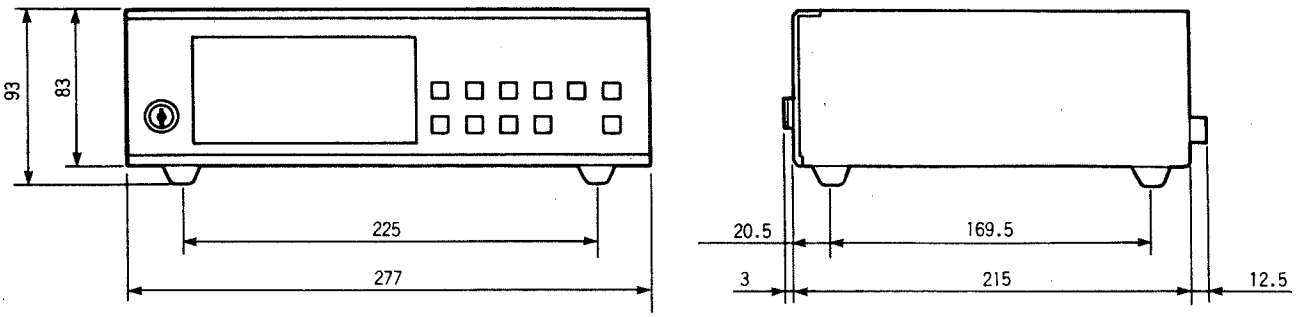


(LC-2310, 2320)

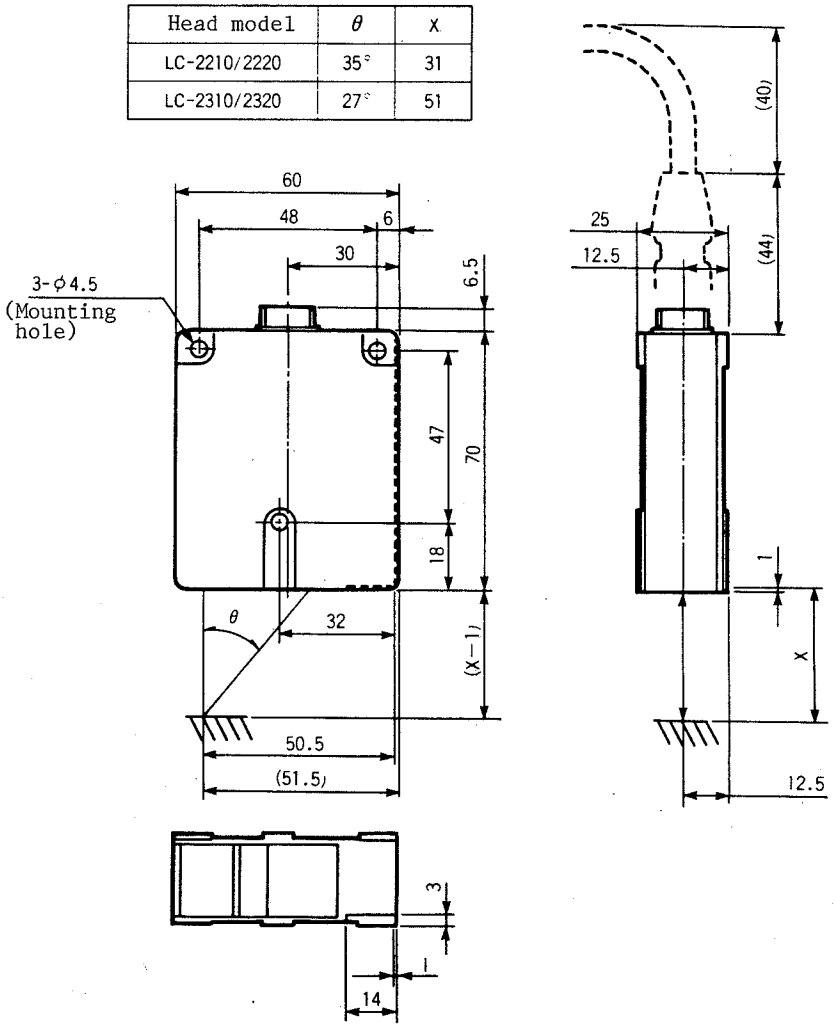


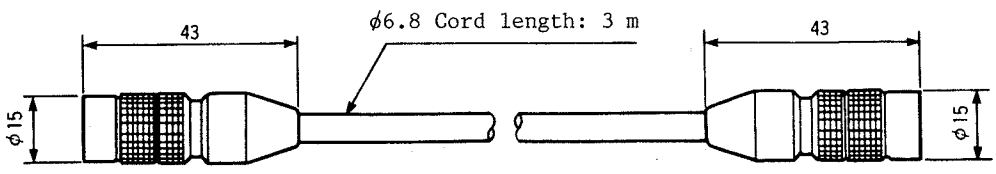
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Dimensions



Head model	θ	X
LC-2210/2220	35°	31
LC-2310/2320	27°	51





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