

LM10

SERIES

Micro Laser Sensor



* Original **NAIS** Sensor

Displacement Sensing with Analog Output

CE Marked
Conforming to EMC Directive

High-precision measurements, comparative output function

Comparative output function (Intensity/displacement) gives this high-precision device the feel of a photoelectric sensor.

In addition to conventional analog output, the LM10 also comes with ON/OFF control output (single or window comparator) as a standard function. This gives the LM10 the feel of a photoelectric sensor, yet it still offers the "micro-spotting" and "high precision" that only come with a laser sensor.

• Setting modes and types of ON/OFF control

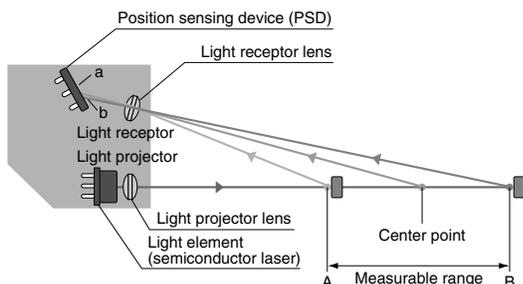
Type	Standard mode	Intensity mode
Window comparator	Displacement control (triple output)	No mode setting
Single comparator	Displacement control (double output)	Intensity control (double output)

Displacement control: ON/OFF control on the basis of distance measurement.

Intensity control: ON/OFF control on the basis of received light level.

• Measurement principle of the LM10 (optical triangulation)

Part of the light rays which come from the target object by means of diffuse reflection produce a light spot on the position sensing device (PSD). This light spot varies depending on the displacement of the target object. By measuring the fluctuations in the light spot, the LM10 can measure the displacement of the target object.

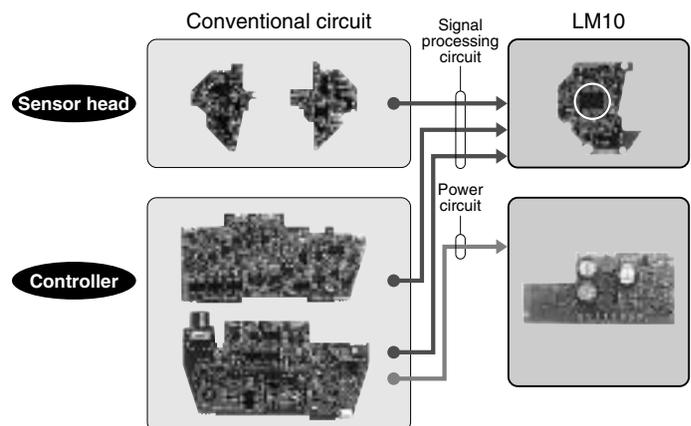


New circuitry lowers costs.

Incorporates our own unique built-in single-channel IC.

The LM10 uses the first single-channel IC (patent pending) ever produced in the industry,* which reduces the dual-channel processing requirement of conventional products to a single channel. Building the arithmetic circuits into the IC has made it possible to reduce costs.

* As of November 1996.



Use the LM10 with confidence. It meets IEC standards for class 1 laser safety.

Products available in two series: laser class 1 and laser class 2.

In addition to our laser class 2 products, a full line of class 1 products have been added. Development of a high-precision aspheric surface plastic lens has made it possible to maintain both high precision and class 1 safety. The visible light spot makes it easy to see and safe to use.

• Basic IEC classification criteria (IEC standard 825)

	Level of risk	Required labeling	User precautions
Class 1	Fundamentally safe	Explanatory label	No precautions necessary
Class 2	Closing the eyelids will protect the eyes.	Warning label	Avoid the laser beam
Class 3B	Direct observation is dangerous.	Remote interlock connector	Safety manager, Remote safety device
Class 4	High output, danger of skin damage	Key switch, Beam cut-off device, Laser leakage warning	Warning label, Safety goggles, Safety clothing, Employee training

Interchangeable sensor heads

Sensor head and controller can be managed separately.

Nine types of sensor heads and eight types of controllers can be freely combined in 72 different ways. Unlike with conventional sensors, these heads and controllers are completely interchangeable to meet any type of measuring and processing requirements, so there is no need for pair management of heads and controllers.

Excellent in the following circumstances...

• When carrying out repairs

Suppose an accident on the production line damages the sensor head.

With the MICRO LASER SENSOR LM10...

...all you have to do is replace the sensor head. As long as there is a spare sensor available, the problem can be solved without stopping the production line.

• When changing to a different model.

Suppose that after purchasing the LM10 it becomes necessary to switch to a different model due to changes in the object you are measuring.

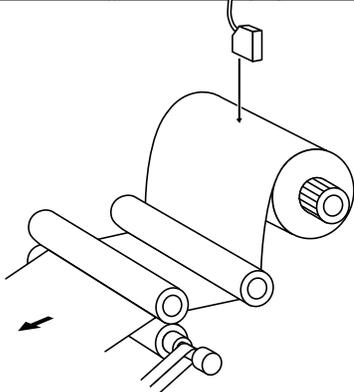
With the MICRO LASER SENSOR LM10...

...all you have to do is buy a new sensor head. The current controller need not be replaced.

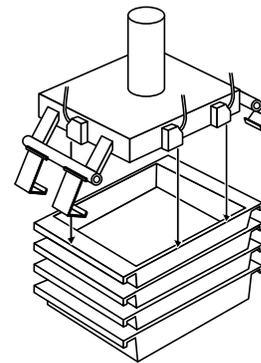
TYPICAL APPLICATIONS

■ Automated assembly

Detection of remaining amount of paper wall

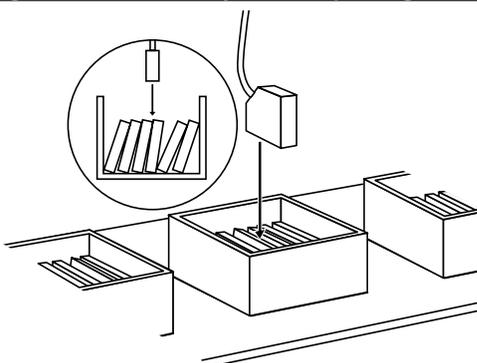


Detection of pallet orientation



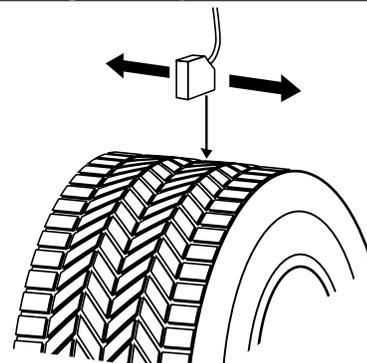
■ Food processing/Packaging

Counting the number of objects in a package



■ Auto industry applications

Inspection of tire groove depth



LM10

Product types

• Sensors

Laser class	Type	Measurement range	Resolution	Spot diameter	Part No.
Class 1	LM10-50-1	50 ±10 mm 1.969 ±.394 inch	5 μm .0002 inch	0.6 × 1.1 mm .024 × .043 inch	ANR1150
	LM10-50S-1	50 ±10 mm 1.969 ±.394 inch	5 μm .0002 inch	0.09 × 0.05 mm .004 × .002 inch	ANR1151
	LM10-80-1	80 ±20 mm 3.150 ±.787 inch	20 μm .0008 inch	0.7 × 1.2 mm .028 × .047 inch	ANR1182
	LM10-130-1	130 ±50 mm 5.118 ±1.969 inch	100 μm .0039 inch	0.7 × 1.4 mm .028 × .055 inch	ANR1115
Class 2	LM10-50-2	50 ±10 mm 1.969 ±.394 inch	1 μm .00004 inch	0.6 × 1.1 mm .024 × .043 inch	ANR1250
	LM10-50S-2	50 ±10 mm 1.969 ±.394 inch	1 μm .00004 inch	0.09 × 0.05 mm .004 × .002 inch	ANR1251
	LM10-80-2	80 ±20 mm 3.150 ±.787 inch	4 μm .0002 inch	0.7 × 1.2 mm .028 × .047 inch	ANR1282
	LM10-130-2	130 ±50 mm 5.118 ±1.969 inch	20 μm .0008 inch	0.7 × 1.4 mm .028 × .055 inch	ANR1215
	LM10-250-2	250 ±150 mm 9.843 ±5.906 inch	150 μm .0059 inch	0.8 × 1.5 mm .031 × .059 inch	ANR1226

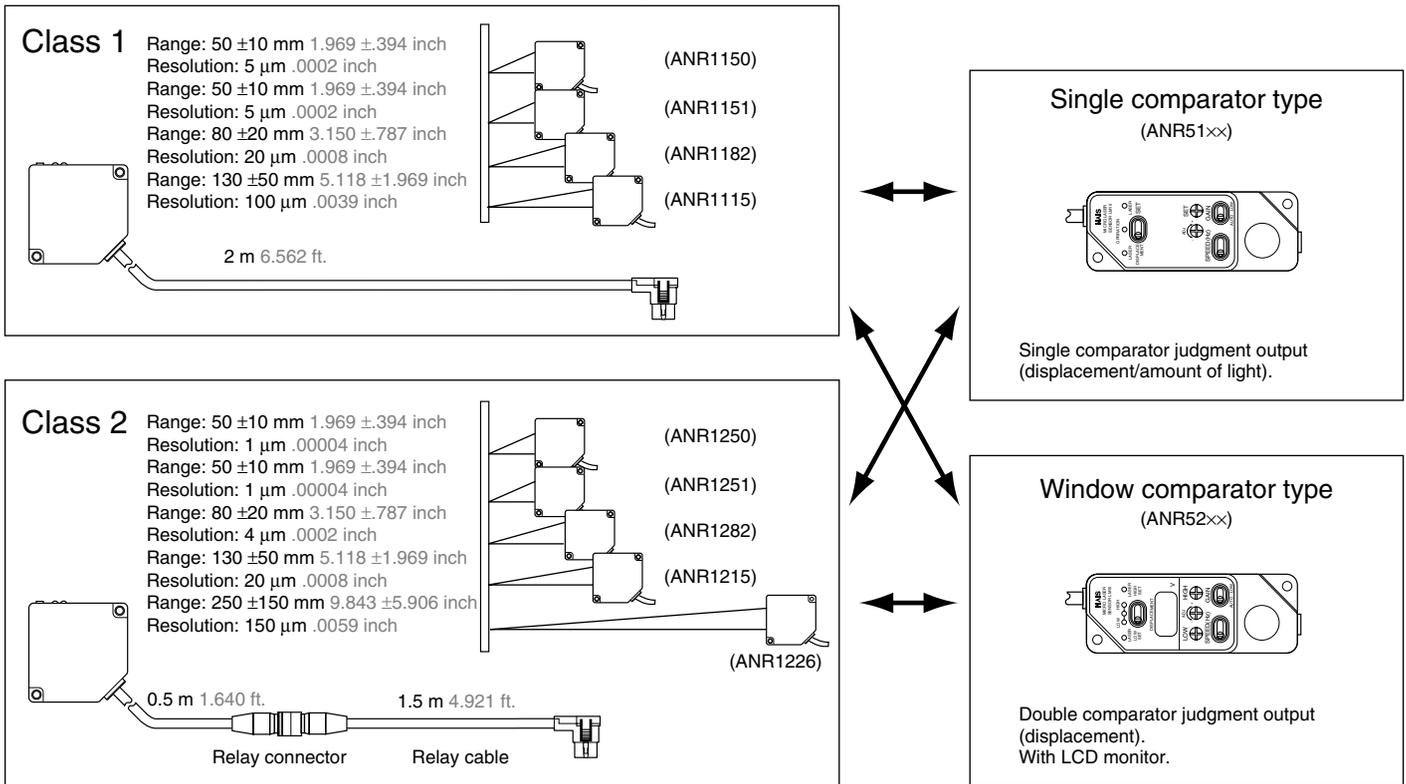
• Controller

Output	Specifications	Part No.
±5 V NPN	Built-in single comparator	ANR5131
	Built-in window comparator	ANR5231
±5 V PNP	Built-in single comparator	ANR5132
	Built-in window comparator	ANR5232
4-20 mA NPN	Built-in single comparator	ANR5141
	Built-in window comparator	ANR5241
4-20 mA PNP	Built-in single comparator	ANR5142
	Built-in window comparator	ANR5242

• Extension cable (for sensor class 2 types only) for connection to the relay cable (1.5 m 4.921 ft. relay cable is supplied with class 2 type sensor heads)

Part name	Specifications	Part No.
Extension cable	2 m 6.562 ft. cable length	ANR81020
	3 m 9.843 ft. cable length	ANR81030
	5 m 16.404 ft. cable length	ANR81050
	8 m 26.247 ft. cable length	ANR81080
	10 m 32.808 ft. cable length	ANR81100
	20 m 65.617 ft. cable length	ANR81200
	30 m 98.425 ft. cable length	ANR81300

Sensor head and controller assembly



Specifications

1) Sensor head

• Class 1 type

Part Number	ANR1150	ANR1151	ANR1182	ANR1115
Center Point Distance	50 mm 1.969 inch	50 mm 1.969 inch	80 mm 3.150 inch	130 mm 5.118 inch
Measurable Range	±10 mm ±.394 inch	±10 mm ±.394 inch	±20 mm ±.787 inch	±50 mm ±1.969 inch
Light Source	Visible laser diode (685 nm)			
Pulse Width/Max. Output/Laser Class	15 μs (Duty 50 %)/0.4 mW (Peak value)/Class 1 (IEC825)			
Beam Spot Diameter	0.6 × 1.1 mm .024 × .043 inch	0.09 × 0.05 mm .004 × .002 inch	0.7 × 1.2 mm .028 × .047 inch	0.7 × 1.4 mm .028 × .055 inch
Resolution (2σ)	10 Hz 100 Hz 1 kHz 5 μm .0002 inch 16 μm .0006 inch 50 μm .0020 inch	5 μm .0002 inch 16 μm .0006 inch 50 μm .0020 inch	20 μm .0008 inch 65 μm .0026 inch 200 μm .0079 inch	100 μm .0039 inch 330 μm .0130 inch 1 mm .039 inch
Linearity Error (%FS)*	±0.2 % of F.S.			
Protective Construction (except for connector)	IP67			
Ambient Light Level (fluorescent lamp)	Max. 2,500 lx			
Weight (with cable)	300 g 10.58 oz			

*White ceramics is the target of this value

• Class 2 type

Part Number	ANR1250	ANR1251	ANR1282	ANR1215	ANR1226
Center Point Distance	50 mm 1.969 inch	50 mm 1.969 inch	80 mm 3.150 inch	130 mm 5.118 inch	250 mm 9.843 inch
Measurable Range	±10 mm ±.394 inch	±10 mm ±.394 inch	±20 mm ±.787 inch	±50 mm ±1.969 inch	±150 mm ±5.906 inch
Light Source	Visible laser diode (685 nm)				
Pulse Width/Max. Output/Laser Class	15 μs (Duty 50 %)/1.6 mW (Peak value)/Class 2 (IEC825)				
Beam Spot Diameter	0.6 × 1.1 mm .024 × .043 inch	0.09 × 0.05 mm .004 × .002 inch	0.7 × 1.2 mm .028 × .047 inch	0.7 × 1.4 mm .028 × .055 inch	0.8 × 1.5 mm .031 × .059 inch
Resolution (2σ)	10 Hz 100 Hz 1 kHz 1 μm .00004 inch 3.5 μm .0001 inch 10 μm .0004 inch	1 μm .00004 inch 3.5 μm .0001 inch 10 μm .0004 inch	4 μm .0002 inch 13 μm .0005 inch 40 μm .0016 inch	20 μm .0008 inch 65 μm .0026 inch 200 μm .0079 inch	150 μm .0059 inch 500 μm .0197 inch 1.5 mm .059 inch
Linearity Error (%FS)*	±0.2 % of F.S.				±0.4 % of F.S.
Protective Construction (except for connector)	IP67				
Ambient Light Level (fluorescent lamp)	Max. 3,000 lx				Max. 2,500 lx
Weight	Sensor (with cable): 240 g 8.47 oz, Relay Cable: 130 g 4.59 oz				

*White ceramics is the target of this value

2) Controller

Part Number	ANR5131/ANR5132	ANR5141/ANR5142	ANR5231/ANR5232	ANR5241/ANR5242
Analog Output	±5 V/F.S. (Max. 2 mA)	4 to 20 mA/F.S. (Max. 250 Ω)	±5 V/F.S. (Max. 2 mA)	4 to 20 mA/F.S. (Max. 250 Ω)
Output Impedance	50 Ω	—	50 Ω	—
Temperature Drift (sensor and controller range set)	Max. ±(0.03 % of F.S.)/°C	Max. ±(0.04 % of F.S.)/°C	Max. ±(0.03 % of F.S.)/°C	Max. ±(0.04 % of F.S.)/°C
Zero-Point Adjustment	±10 % of F.S.			
Response Frequency (−3 dB)	1 kHz/100 Hz/10 Hz			
Response Time (10 – 90 %)	0.4 ms/4 ms/40 ms			
Comparison Output	NPN/PNP open collector 2 points (100 mA, Max. 30 V DC, residual output voltage Max. 1.5 V) FAR/LIGHT ON, NEAR/DARK ON		NPN/PNP open collector 3 points (100 mA, Max. 30 V DC, residual output voltage Max. 1.5 V) HIGH, IN-RANGE, LOW	
Hysteresis	Max. 0.15 % of F.S.			
Alarm Output	NPN/PNP open collector 1 point (100 mA, 30 V DC, residual output voltage Max. 1.5 V)			
Intensity Output	±5 V			
Timing Input	No voltage input (when earthing, no comparison judgement output allowed)			
Indication	Sensor: LED (RANGE)		Sensor: LED (RANGE) Controller: LCD 3 digits display (indication renewal cycle)	
Gain Selection	AUTO, LOW (switchable)			
Cross Talk Prevention**	Yes (between 2 sets)			
Operating Voltage Range	12 to 24 V DC (−15 %, +10 %) Ripple 0.5 V (P-P)			
Rated Current Consumption (sensor and controller set)	Max. 250 mA at 12 V DC			
Weight (with cable)	180 g 6.35 oz			

**The value of the linearity characteristics, resolution and response time might get worse.

3) Common

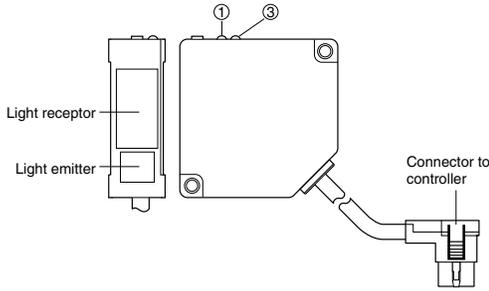
Insulated Resistance (initial)	Between external DC input and Sensor metal parts (except for connector metal parts) 20 MΩ or more (at 500 V DC)
Breakdown Voltage (initial)	Between external DC input and Sensor metal parts (except for connector metal parts) 50 V AC 1 min
Vibration Resistance (screw installation)	10 to 55 Hz (1 cycle/min) Double amplitude of 1.5 mm .059 inch (Sensor) 2 hours on 3 axes Double amplitude of 0.75 mm .030 inch (Controller)
Shock Resistance (screw installation)	Shock of 98 m/s ² or more, 3 times on 3 axes
Operating Ambient Temperature	0 to 50° C +32 to +122° F
Storage Ambient Temperature	−20 to 70° C −4 to +158° F
Operating Ambient Humidity	35 % to 85 % RH (without dew condensation)

• If there is no description for measurement conditions, the test is performed under operating voltage 24 V DC, ambient temperature 20° C 68° F, Gain AUTO, response 10 Hz, Cross-talk prevention OFF and white ceramics as a target at a center point distance.

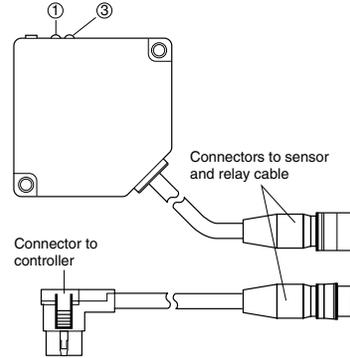
LM10

Part names and functions

• Class 1 type sensor

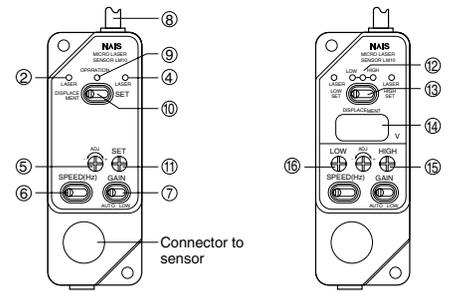


• Class 2 type sensor and relay cable



• Controller

Single-comparator type Window-comparator type



Common for both types

- ①, ② **Laser emission indicator LED**
This LED lights during laser emission or just before and after its emission. To indicate an alarm condition, the LED on the sensor head flashes.
- ③ **Range indicator LED**
Flashes when the target is within the measurable range. Stays lit when the target is around the center point distance.
- ④ **Alarm indicator LED**
Lights when measurement is not possible (not enough light [DARK] or too much light [BRIGHT]).
- ⑤ **Zero-point adjustment potentiometer**
Adjusts the zero point position to within a $\pm 10\%$ F.S. Use to make minute adjustments after installing the sensor.
- ⑥ **SPEED selection switch**
The response speed can be set to one of three settings to allow adjustment for the target speed. When high response speed is unnecessary, set to the 10 Hz mode.
- ⑦ **GAIN selector switch**
Under normal conditions, set to AUTO. During edge detection and other applications where you want to cut out the low light level areas, set to LOW.
- ⑧ **I/O cable**

Single comparator type

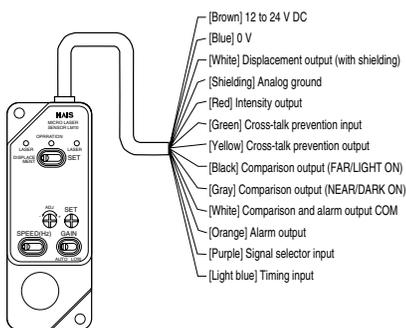
- ⑨ **Operation indicator LED**
lights when the NEAR/DARK ON output is on.
- ⑩ **OUTPUT selector switch**
Switches between the displacement data/intensity data output and the comparison value setting output.
- ⑪ **Comparison value setting potentiometer**
Sets the comparison value. By setting the OUTPUT selector switch to the right, the set value can be monitored by the analog displacement output.

Window comparator type

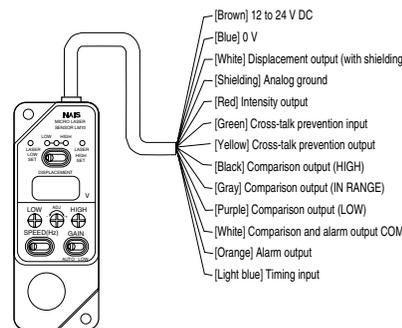
- ⑫ **Operation indicator LED**
The LED lights that corresponds to the comparison output currently being output.
- ⑬ **Display/output selector switch**
Switches between the displacement data output and the comparison value setting output.
- ⑭ **Display**
3-digit display of the displacement data or the upper and lower limit values.
- ⑮ **HIGH limit setting potentiometer**
- ⑯ **LOW limit setting potentiometer**
Sets the comparison value's upper limit (HIGH) and lower limit (LOW). Set it so that the HIGH value is greater than the LOW value. By setting the display and analog displacement output switch to either LOW or HIGH, you can monitor the set value by display and analog displacement output. When not set, return the switch to the center position.

Connections and functions

Single comparator type

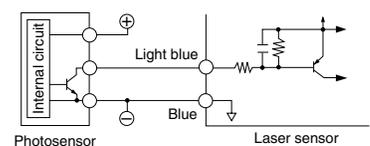


Window comparator type



transistor to establish the timing, use a transistor with a residual output voltage of 1.5 V or less during output.

Timing input connection example



1. **Power input**
[brown (+), blue (-)]
Input 12 to 24 V DC.

2. **Timing input [light blue]**
While shorted to the 0 V (blue), comparison output is prevented. When using a

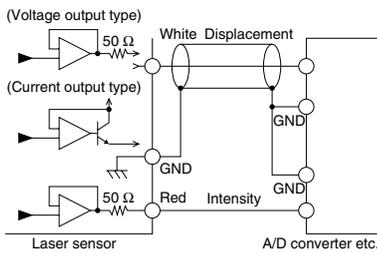
3. **Cross-talk prevention I/O [green (input), yellow (output)]**
When using two sensors, you can set the cross-talk prevention mode by connecting the input wire of each to the output wire of the other. Be aware that this mode may adversely affect the linear characteristics, resolution, and response.

4. Analog displacement output [white, shielding (GND)]

An analog voltage is output that corresponds to the displacement of the target within the measurement range. When the output switch is at the SET position, each comparison value setting is output.

5. Intensity output [red, shielding (GND)]

Analog voltage (-5 V to +5 V) is output corresponding to the amount of light reflected from the target. If the amount of light increases, the voltage value becomes larger and if it decreases, the voltage value becomes smaller.



6. Alarm output [orange, white (COM)]

Outputs during insufficient light (DARK) or too much light (BRIGHT).

7. Comparison output • Single comparator type [black, white (COM)]

Signal selector input [purple]	Comparing operations
When not connected	When displacement data is greater than set value (far side): FAR/LIGHT ON output is on. When displacement data is less than set value (near side): NEAR/DARK ON output is on.
When connected to 0 V [blue]	When intensity data is greater than set value (near side): FAR/LIGHT ON output is on. When intensity data is less than set value (far side): NEAR/DARK ON output is on.

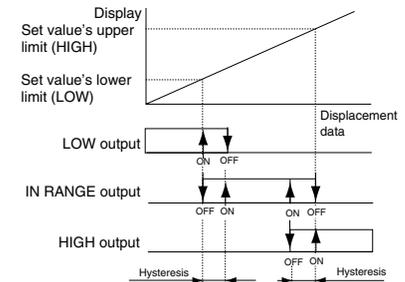
Note: With the single comparator type, connecting the purple wire and blue wire changes from the analog displacement output to the light amount monitoring value output.

• Window comparator type [black, gray, purple, white (COM)] Judgment result of displacement data is output.

LOW [purple]	Outputs when below the set value's lower limit.
IN RANGE [gray]	Outputs when between the set value's lower and upper limits.
HIGH [black]	Outputs when above the set value's upper limit.

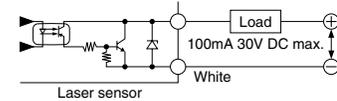
Description of comparison output operations

Window comparator type

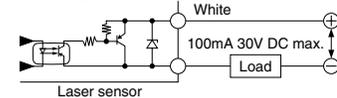


Alarm and comparison output connection example

• NPN type (ANR5XX1)



• PNP type (ANR5XX2)



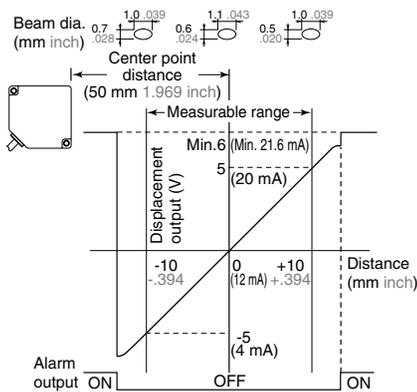
Data

1. Distance – output range

An analog voltage is output that corresponds to the displacement of the target within the measurable range.

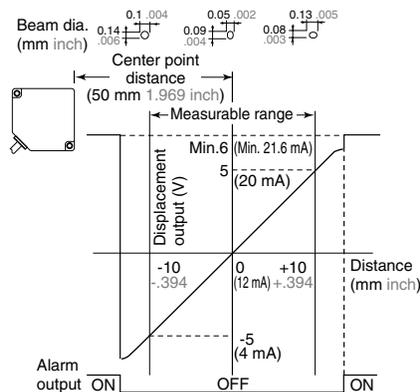
LM10-50

(ANR1150, ANR1250)



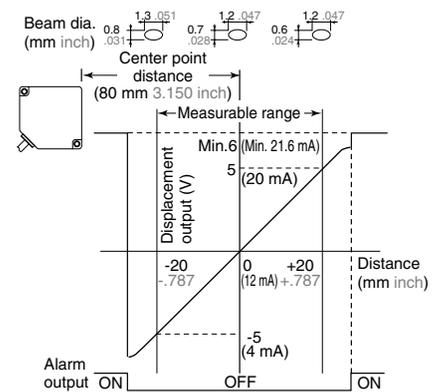
LM10-50S

(ANR1151, ANR1251)



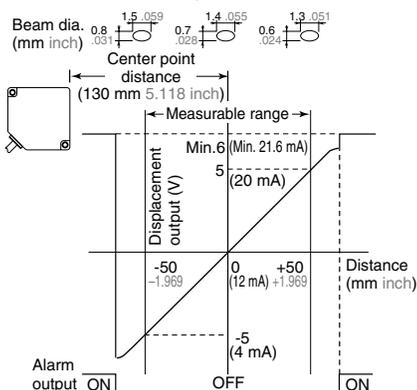
LM10-80

(ANR1182, ANR1282)



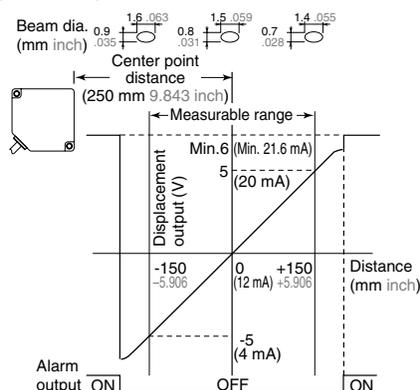
LM10-130

(ANR1115, ANR1215)



LM10-250

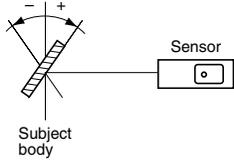
(ANR1226)



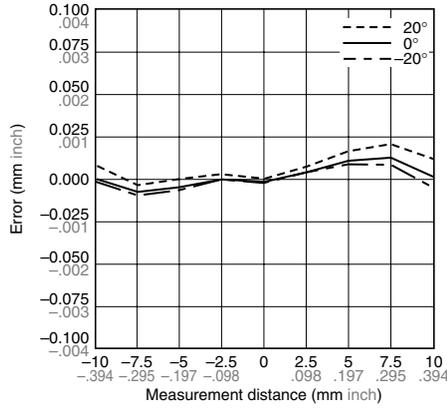
LM10

2. Distance characteristics (class 2 type sensor head)

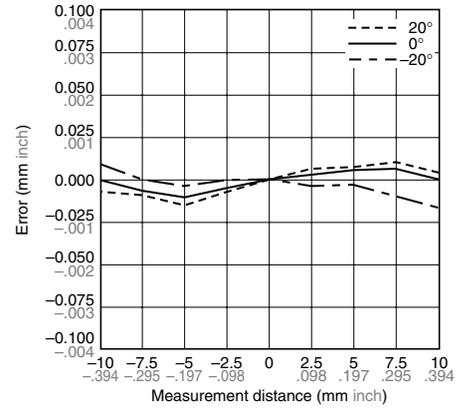
- White ceramic ($0^\circ, \pm 20^\circ$) vertical orientation



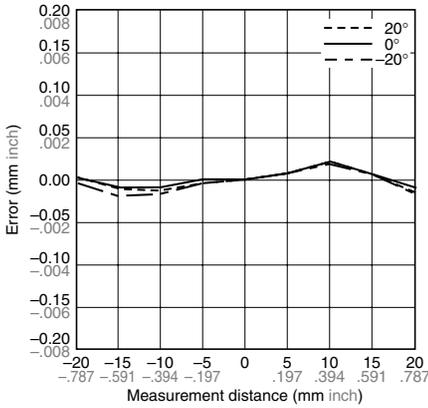
ANR1250



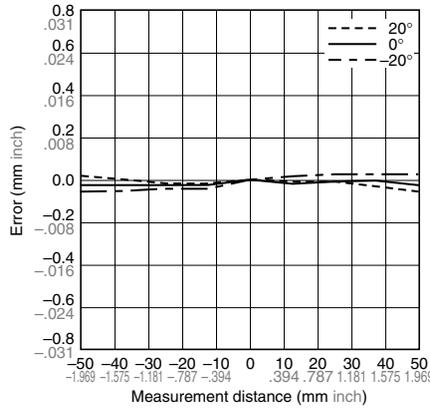
ANR1251



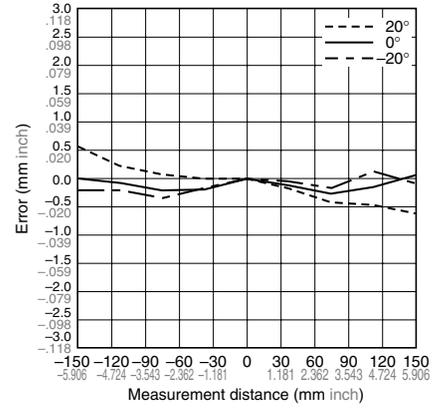
ANR1282



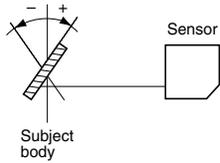
ANR1215



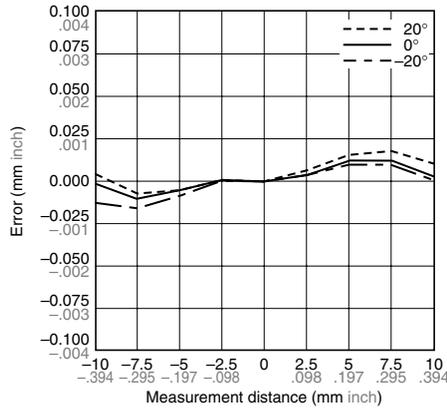
ANR1226



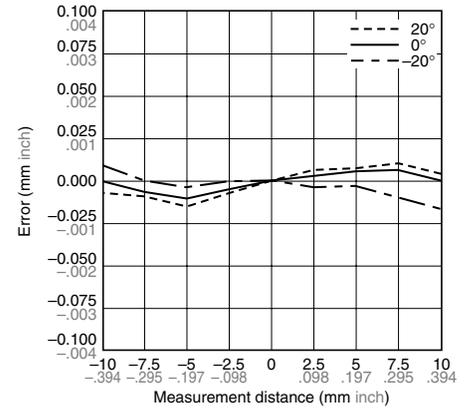
- White ceramic ($0^\circ, \pm 20^\circ$) horizontal orientation



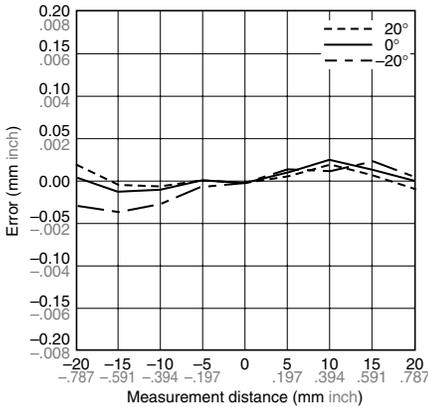
ANR1250



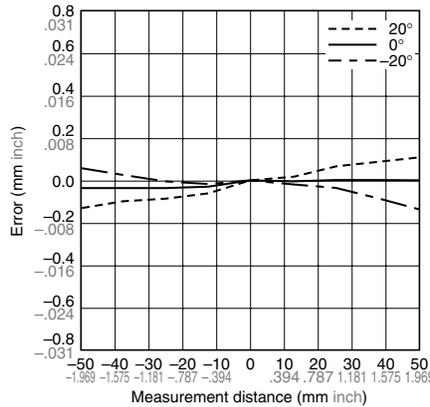
ANR1251



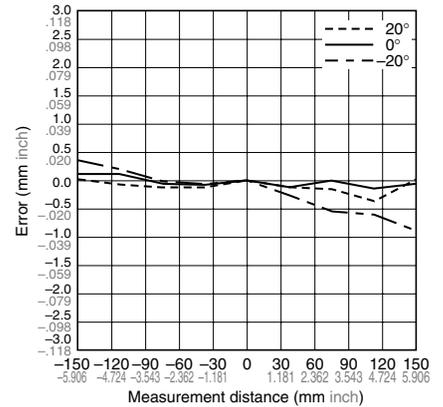
ANR1282



ANR1215



ANR1226

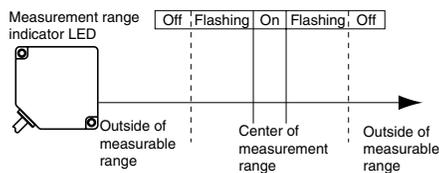


Precautions during installation



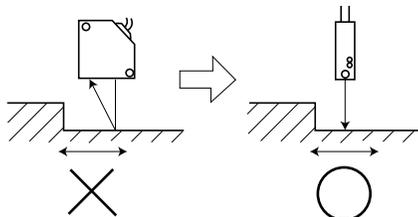
1. Procedure for setting the sensor

1) While watching the range indicator LED, set the sensor so that the distance to the subject body is within the measurable range.

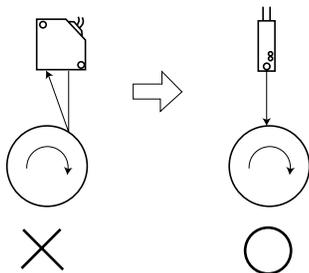


2) Be careful of the sensor's orientation during installation. When the subject body moves as shown below, errors will develop depending on the orientation of the sensor. In order to minimize these errors, be sure to install the sensor in the correct orientation.

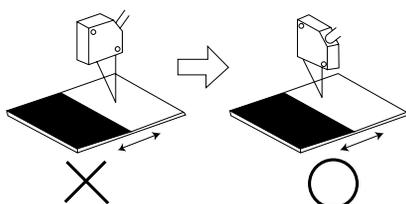
• Step detection



• Concentricity measurement



• Extremely different adjacent colors or materials



2. Installing the sensor

1) Using the two installation holes, firmly install the sensor so that the sensor's front surface is parallel to the target. Do not tighten the installation screws to a torque over 2 N·m.

2) Glass is used at the sensor's light emission and light reception surfaces and, therefore, never subject it to impacts of any kind. Also, be very careful not to allow oils, fingerprints, or other substances that may refract the light, to get on the glass during installation.

3) If light reflected off the target is then reflected off nearby objects or walls and then received by the sensor, the sensor reading will be adversely affected. To prevent this, either further separate the sensor or apply a black delustering paint to prevent the unwanted reflection of light.

3. Installing the controller

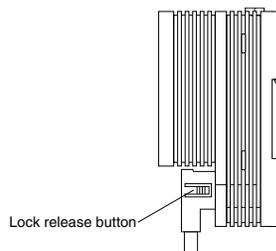
1) When installing more than one controller in a row, maintain at least 10 mm between each unit. Also, when installing the controller inside control panels or other areas where the air is not properly ventilated, the controller will cause the ambient temperature to rise. In these cases, ensure the proper cooling facilities.

4. Wiring

1) Perform all wiring by faithfully following the input and output circuit explanations and documents that came with the instrument.

2) When installing or removing a connector, always first turn off the controller and then begin operations.

3) All connectors are of the lock-on type. When connecting a connector, be sure to securely insert it until it locks into place. When removing a connector, first press in the lock release button on the connector side and then remove the connector.



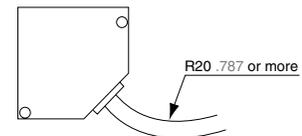
4) After removing a connector, do not touch the terminals located inside.

5) The connector's metal portion is internally connected to the analog output GND. In order to prevent affects from noise or damage to the internal circuits, be sure to insulate the metal portion with electrical tape or other means.

5. Cable

1) When the sensor and controller are fixed and cables connected, do not subject the cables to a pull of more than 3 kg. Have no bends in the cables with a radius of less than 20 mm. Also, do not bend a sensor's cable near where the cable is attached to the sensor.

2) When the sensor is to be moved while in use, do not have it so that the sensor's cable becomes bent. If the location is such that it cannot be helped, we recommend purchasing the appropriate length extension cable so that bending is unnecessary.



LM10

Precautions during operation

1. Operating environment

- 1) Use in an ambient temperature between 0 °C 32 °F and 50 °C 122 °F. Store in a location where the temperature stays between -20 °C -4 °F and 70 °C 158 °F.
- 2) Use in an ambient humidity between 35 % and 85 % RH. Avoid use in locations with drastic humidity changes which cause condensation.
- 3) Use in a location where the illuminance from incandescent lamps received at the light receptors surface is below 2,500 lx (ANR11 series and ANR1226), or below 3,000 lx (ANR1250, ANR1251, ANR1282, and ANR1215). Also, locate the unit so that sunlight, light of the same wavelength, or other disturbing light, does not directly hit the light receptor. When exceptional accuracy is required, install a shielding plate or other type of shading mechanism.
- 4) The power supply voltage should be between 85 % and 110 % of the rated voltage.
- 5) Since the internal circuits may become damaged if an external surge voltage exceeds 500 V [$\pm(1.2 \times 50) \mu\text{s}$ unipolar full-wave voltage], always use a surge absorber or surge absorbing element.

- 6) Keep the sensor light emitter and light receptor surface clean and free of moisture, oil, finger prints, and other light refracting substances, and free of dust, dirt, and other light blocking substances. When cleaning the glass surfaces, wipe with a soft cloth or lens cleaning paper.
- 7) Although the sensor is of waterproof construction, it does not mean that measurements can be taken underwater or in the rain. Moreover, the connectors are not watertight.
- 8) Do not use the unit in locations with flammable or corrosive gases, locations with excessive dust, locations splashed by water, or locations subjected to vibrations or excessive shocks.
- 9) Since the controller contains molded resins, do not use in environments that contain, or where contact with, benzene, thinners, alcohols and other organic solvents; and ammonia, caustic sodas, and other alkaline substances is possible.

2. Noise precautions

- 1) Install the unit as far away as possible from high voltage wires, power wires, or devices that generate large switching surges.
- 2) Separate the sensor cable wiring, high voltage circuit, and power circuit.
- 3) If there is much noise on the power supply, it will affect the analog output. In such cases, use a noise filter or noise-cut transformer.

3. Insulation resistance and withstand voltage

- 1) Do not perform insulation resistance or withstand voltage tests between the connector's metal portions and input/outputs.

4. Power supply

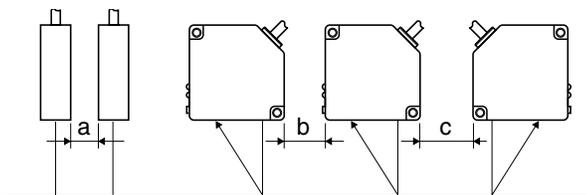
- 1) Select a power supply with a ripple voltage below 0.5 V (P-P) and a current capacity above 0.3 A.
- 2) In order to avoid high-frequency noises when using an off-the-market switching regulator, be sure to ground the frame ground (FG) terminal.
- 3) When using a power supply that uses a transformer, be sure to use an insulated transformer. When using an auto-transformer (single-wound transformer), it is possible to damage this unit or the power supply.

5. Warm-up time

- 1) Allow at least 30 minutes, after turning on the unit, for the unit to properly warm up.

Area of interference

When using more than one sensor together, be careful of the area of interference.



Sensor model	a	b	c
ANR1150	40 1.575	10 .394	70 2.756
ANR1151			
ANR1182	50 1.969		110 4.331
ANR1115	80 3.150		150 5.906
ANR1250	50 1.969	20 .787	90 3.543
ANR1251			
ANR1282	80 3.150		130 5.118
ANR1215	120 4.724		190 7.480
ANR1226	210 8.268		400 15.748

Units (mm inch)

CE marking

Conforms to the EMC and low voltage directives listed below.

- EMC directive (89/336/EEC)

EN50081-2: 1993

EN50082-2: 1995

- Low voltage directive (73/23/EEC)

EN60825-1: 1994

CE marking obtained by the standard product specifications.

