

MX1C: Self-Contained Laser Displacement Sensors

- Analog output (20 to 4mA) can be selected for continuous values; digital output (on/off) can be used; or both can be used together
- Miniature sensor head is compact for high-density installations
- Visible beam is easy to align with target
- Adjustable response speed
- Shape, size, color, and material do not detract from accurate measurement (see note)
- Wide sensing range: 2.36" to 6.30" (60mm to 160mm)
- A ten-dot dynamic display shows detected positions
- Alarm output indicates when sensing conditions may result in inaccurate results



1. *Laser sensing of mirror-like surfaces is not recommended. For best results detecting reflective surfaces, tilt the sensor to reduce direct laser reflection. Sensing at a small angle (approximately $\pm 10^\circ$) does not significantly reduce sensing accuracy or linearity of resulting analog output.*
2. **WARNING:** *Class IIIa laser. Do not allow the laser to shine directly into the eyes. Always consider eye safety when installing a laser sensor. Make sure that the laser beam cannot inadvertently shine into the eyes of people passing by or working in the vicinity.*



General Specifications

Power Voltage	24V DC (ripple 10% maximum)
Current Draw	200mA (maximum)
Dielectric Strength	Between live and dead parts: 500V AC, 1 minute
Insulation Resistance	Between live and dead parts: 100M Ω (minimum), with 500V DC megger
Operating Temperature	0 to +45C (performance will be adversely affected if the sensor becomes coated with ice)
Storage Temperature	-20C to +70C
Operating Humidity	35% to 85% RH (avoid condensation)
Vibration Resistance	Damage limits: 10 to 55Hz, amplitude 1.5mm p-p, 2 hours in each of 3 axes (when de-energized)
Shock Resistance	Damage limits: 100m/sec ² (approximately 10G), 5 shocks in each of 3 axes
Extraneous Light Immunity	Incandescent light: 3,000 lux (maximum) — dened as incident or unwanted light received by a sensor, unrelated to the presence or absence of intended object
Material	Housing: diecast zinc; Filter: glass; Lens: acrylic; Rear cover: polyarylate
Degree of Protection	IP65 — IEC Pub 529; Sensors rated IP65 are dust-tight, water-resistant, and perform best when not subjected to heavy particle or water blasts
Cable	Cable type: 6-core cabtyre cable 0.3mm ² , 6' 6 3/4" (2m) long
Weight	Approximately 400g
Dimensions	1.97"D x 0.83"W x 3.07"D (50mm H x 21mm W x 78mm D)

Function Specifications

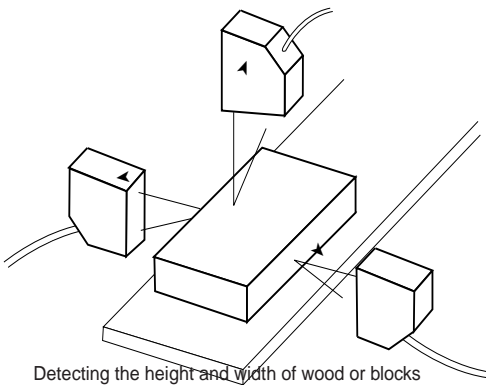
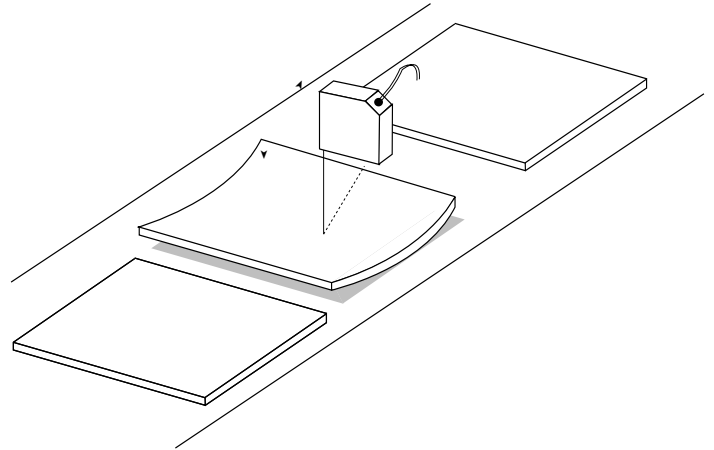
Resolution	0.002" (50 μ m) — measuring conditions: sensing a white ceramic object at the reference sensing distance (60mm) using the normal response speed (50ms) at 25C
Analog Output	20 to 4mA, 5V (maximum), xed range
Digital Output	NPN or PNP transistor open collector: 30V DC, 100mA (maximum); Residual: 1V (NPN), 2V (PNP)
Alarm Output	NPN or PNP transistor open collector: 30V DC, 100mA (maximum); Residual: 1V (NPN), 2V (PNP)
Level Meter (ten-dot LED)	Analog: Represents analog output level according to the object distance Digital: Indicates preset position for near limit
Out LED	On: When digital output on
Laser Diode LED	On: While laser is emitted (LD ON), laser emits approximately 1 second after power-up
Alarm LED	On: When reected light is insufcient
Digital Output	On: When object is within the near limit setting and beyond the close end of the sensing range (\geq 2.36" or 60mm from the sensor)
Digital Output Setting	Fine-tuning dial for near limit setting
Response Time	High-speed (F): 5ms (maximum); Normal speed (S): 50ms (maximum)
Detectable Object	Non-mirror-like surfaces
Analog Adjustment	0.20" (5mm) = 0.8mA using multi-turn dial
Linearity	$\pm 100 \mu$ m $\pm 1\%$ of displacement value, dened as how linear (i.e. accurate) the actual analog output is, with respect to distance
Hysteresis	0.039" (1mm), dened as the difference between the operating point and the release point
Temperature Drift	5 μ A per C with 1.97" (50mm) square white ceramic
Light Source Element	Visible laser diode (670nm), 5 mW laser
Receiver Element	PSD (position sensitive device)

Part Numbers: MX1C Sensors

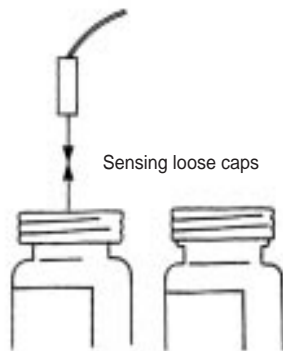
Part Number	Output	Sensing Range	Resolution
MX1C-AK1	NPN	2.36" to 6.30"	0.002" (50µm)
MX1C-AL1	PNP	(60mm to 160mm)	

Applications

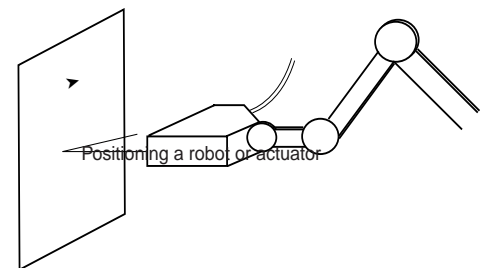
Checking for warped boards



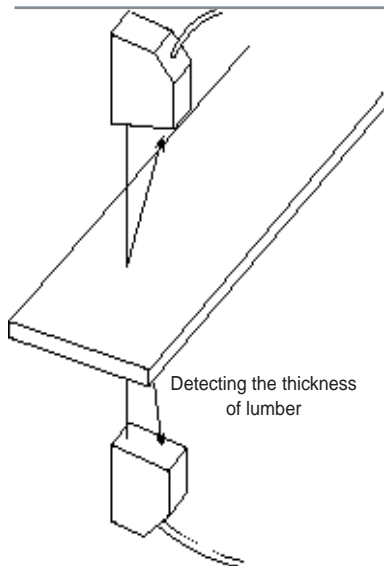
Detecting the height and width of wood or blocks



Sensing loose caps

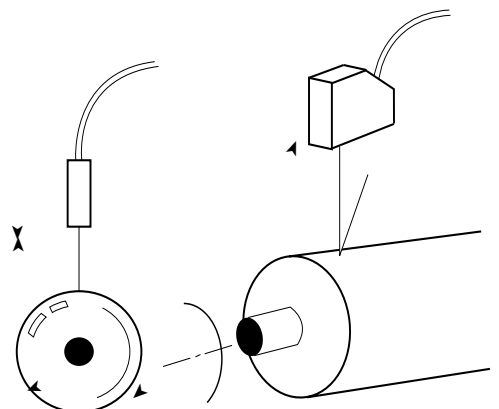
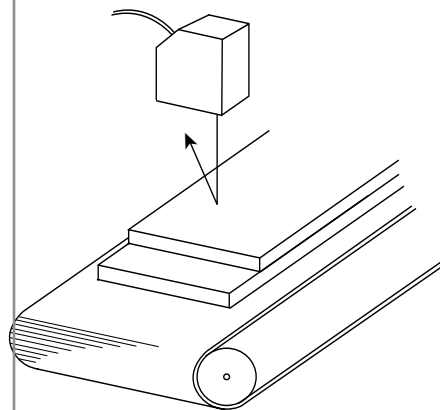


Positioning a robot or actuator



Detecting the thickness of lumber

Detecting overlapping sheets
Counting sheets of paper

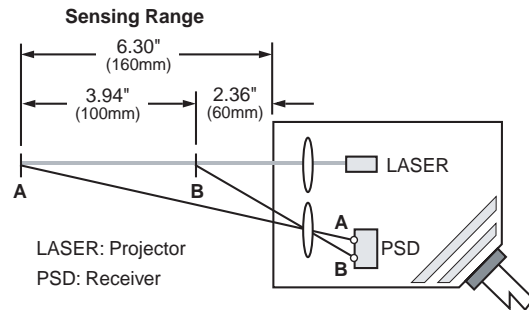
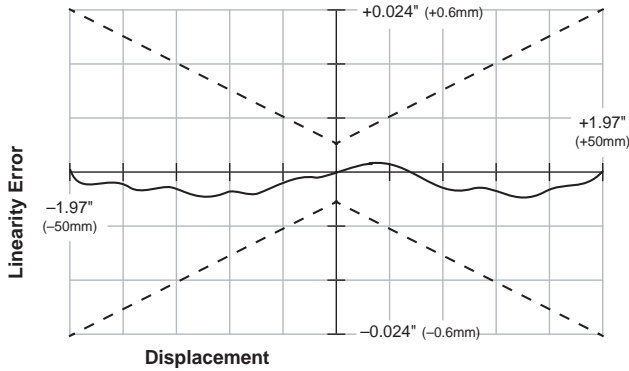


Sensing the roundness of a roller

Operation Principle

The sensor projects a laser beam to the object. The diffuse-rected light from the object's surface is received as a spot image. This spot image moves from position A to B on the position sensitive device (PSD). The optical triangle is used to determine the distance between the sensor and the object, depending upon the displacement.

Linearity



Measuring conditions: Sensing a white ceramic object at 25C, from a stand-off of 4.33" (110mm), with a sensing range of $\pm 1.97"$ (± 50 mm), and a sensing interval of 0.039" (1mm).



Displacement is plotted along the x-axis; one division = 0.394" (10mm). Linearity error is plotted along the y-axis; one division = 0.008" (0.2mm).

Operation

Monitor mode selector dial: Sets the near limit (SET) to be used with digital output, or selects ANALOG to monitor the object distance corresponding to analog value, on the dynamic ten-dot display while operating the sensor.

Analog offset dial: Adjusts the low end of the analog range (5mm/0.8mA).

Level meter: Shows the near limit for digital output or provides a dynamic display of analog output level corresponding to the object distance.

Response selector dial: Species high-speed ("F" = 5ms) or normal speed ("S" = 50ms) response. Use normal speed for the most reliable repetition. Also, it is recommended to use normal speed for the best linearity when using an analog output.

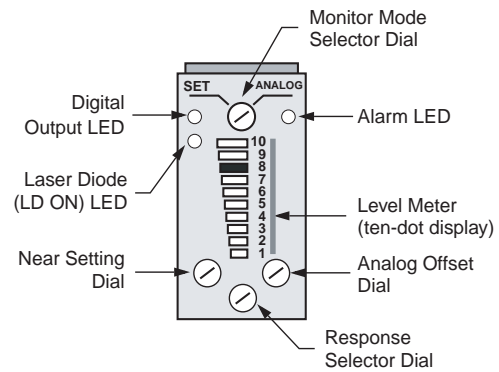
Laser diode (LD ON) LED: Turns on and stays on for the duration while a laser beam is emitted.

Remote interlock terminal: Safety feature turns the laser beam on and off with an external switch from a remote location. When the switch is on, the laser is off and locked out.

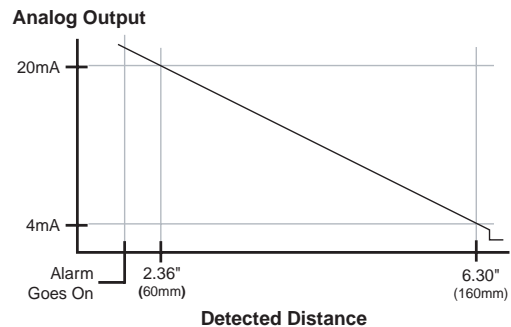
Alarm output: Turns on, along with alarm LED, when conditions may result in inaccurate results; indicates insufficient reected light.

Digital output: Turns on, along with out LED, when the detected object is within the near limit setting, but beyond the close end of the sensing range $\geq 2.36"$ or 60mm from the sensor).

Analog output: Provides the current output ranging from 20 to 4mA in response to object distance, as monitored on the dynamic ten-dot display.

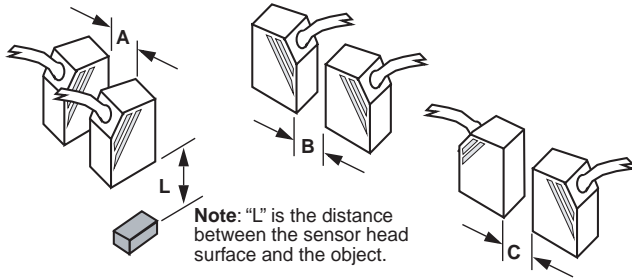


Analog Output Characteristics



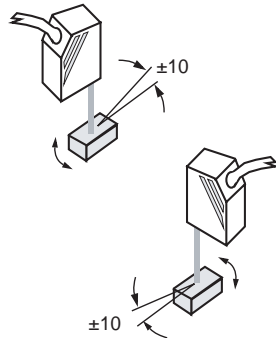
Installation

When installing multiple sensors, provide the recommended clearance as shown below, to prevent the interference of signals.



L	A	B	C
2.36" (60mm)	0	0	0
4.33" (110mm)	0	0.79" (20mm)	1.97" (50mm)
6.30" (160mm)	0.79" (20mm)	2.36" (60mm)	3.94" (100mm)

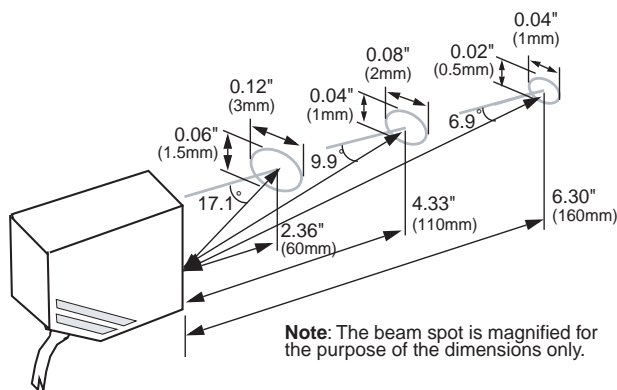
Laser sensing of mirror-like surfaces is not recommended, as the sensor receiver is designed for detecting diffuse-reflect light. Direct laser reflection may result in unreliable results.



For best results detecting reflective surfaces, tilt the sensor to reduce direct laser reflection. Sensing at a small angle (approximately $\pm 10^\circ$) does not significantly reduce the sensing accuracy or linearity of the resulting analog output.

WARNING: Class IIIa laser. Do not allow the laser to shine directly into the eyes. Always consider eye safety when installing a laser sensor. Make sure laser beam cannot inadvertently shine into the eyes of people passing by or working in the vicinity.

Projected Beam Characteristics



Note: The beam spot is magnified for the purpose of the dimensions only.

Due to the focusing characteristics of the lens, the projected beam of a laser sensor gets smaller (converges) from the near end to the far end of the sensing range. The beam gets larger (diverges) beyond the far end of the sensing range.

Wiring

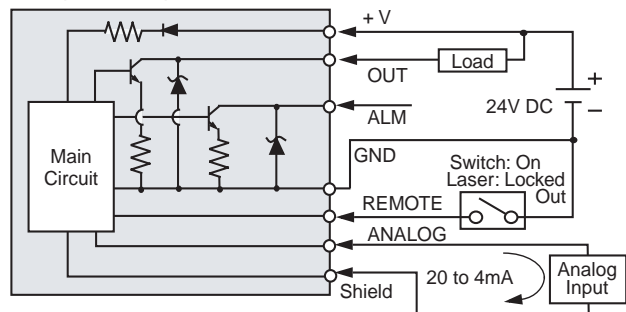
Wire Color	Name	Function
Brown	+V	24V DC, 200mA (maximum)
Black	OUT	Digital Output, 30V DC, 100mA
Orange	ALM	Alarm Output, 30V DC, 100mA
Blue	GND	Power Ground (0 V)
White	ANALOG	Analog Output, 20 to 4mA
Peach	LD RMT	Remote Interlock On/Off Switch
Shield	A. GND	Analog Ground



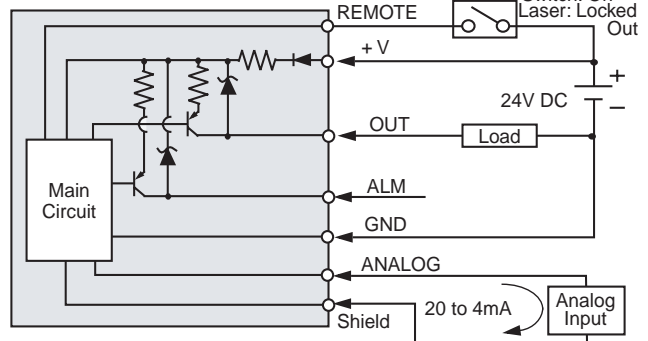
The analog output line may be extended up to 33' (10m), as long as the cable used is equal to or superior to the cable provided. Other lines may be extended up to 164' (50m), using #22 AWG (0.3mm²) wire.

Schematics

NPN (MX1C-AK1)



PNP (MX1C-AL1)



Dimensions

