MX1A and MX1B: Laser Displacement Detection Sensors

- Built-in math capabilities available (MX1B only)
- Digital display on amplier; easy setting and monitoring (MX1B only)
- Miniature sensor head is compact for high-density installations
- Excellent linearity: ±0.0008" (or 20 µm) ±0.5% of displacement (MX1A-B; MX1B-B)
- High resolution sensing: 0.0004" or 10 µm = 10mV (MX1A-B; MX1B-B)
- Two sensing ranges: 1.18" to 1.97" (30 to 50mm) and 1.97" to 5.12" (50 to 130mm)
- MX1B can measure thickness or differences in surface levels when used in combination with another MX1A or MX1B
- The shape, size, color, and material of the object do not detract from accurate measurement (see Note 1 below)
- Delayed laser, remote interlock, power supply key switch, and laser LED are all included on the sensor head — these features ensure safe operation
- Mount the amplier on a 1.378" (35mm) DIN rail

1. Laser sensing of mirror-like surfaces is not recommended. For best results detecting reective surfaces, tilt the sensor to reduce direct laser reection. Sensing at a small angle (approximately ±10) does not signicantly reduce the sensing accuracy or linearity of the resulting analog output.

2. See pages for more detailed information on linearity .

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

CE

General Specifications

Power Voltage	120V AC @ 50/60Hz
Allowable Range	85% to 110% of the rated voltage
Power Consumption	MX1A: 15VA, MX1B: 25VA
Dielectric Strength	Between terminal (except A.OUT, CAL OUT/IN, AG, and FG terminals) and housing: 1,500V AC, 1 minute
Insulation Resistance	Between terminal (except A.OUT, CAL OUT/IN, AG, and FG terminals) and housing: 100MΩ (minimum), with 500V DC megger
Operating Temperature	0C to +50C (performance will be adversely affected if the sensor becomes coated with ice)
Operating Humidity	45% to 85% RH (avoid condensation)
Storage Temperature	–20C to +70C
Vibration Resistance	Damage limits: 16.7Hz, 2G, 1 hour in each of 3 axes (when de-energized)
Shock Resistance	Damage limits: 100m/s^2 (approximately 10G), 3 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 and lens: acrylic; (sensor head only)
Degree of Protection	IP65 (sensor head only) — IEC Pub 529, sensors rated IP65 are dust-tight, water-resistant, and perform best when not subjected to particle or water blasts
Weight, Amplifier	MX1A: Approximately 2.0kg, MX1B: Approximately 2.5kg
Weight, Sensor Head	Short cable (P/N ends in "S"): Approximately 500g Long cable (P/N ends in "L"): Approximately 800g
Dimensions, Amplifier (HxWxD)	MX1A: 4.21" x 5.12" x 4.41" (107 x 130 x 112mm) MX1B: 4.21" x 6.69" x 4.41" (107 x 170 x 112mm)
Dimensions, Sensor Head (HxWxD)	1.73" x 0.73" x 1.79" (44 x 18.5 x 45.5mm)

Part Numbers: MX1A and MX1B Sensors

Part Number	Sensing Range	Resolution	Features	Sensor Head Cable Length
MX1A – A 12 R6S **MX1A – A 12 R6L**	1.97" to 5.12" (50 to 130mm)	0.002" (50 µm)	Display and calculation not available	16' – 4-7/8" (5m) 32' – 9-3/4" (10m)
MX1B – A 12 R6S **MX1B – A 12 R6L**			Display and calculation standard	16' – 4-7/8" (5m) 32' – 9-3/4" (10m)
MX1A – B 12 R6S **MX1A – B 12 R6L**	1.18" to 1.97" (30 to 50mm)	0.0004" (10 µm)	Display and calculation not available	16' – 4-7/8" (5m) 32' – 9-3/4" (10m)
MX1B – B 12 R6S **MX1B – B 12 R6L**			Display and calculation standard	16' – 4-7/8" (5m) 32' – 9-3/4" (10m)

IMPORTANT: The sensor head and amplier are calibrated in pairs — use units with the same serial number together to avoid damage to the laser diode. Using different serial numbers together or making alterations to the sensor amplier head or cable will void the factory warranty .

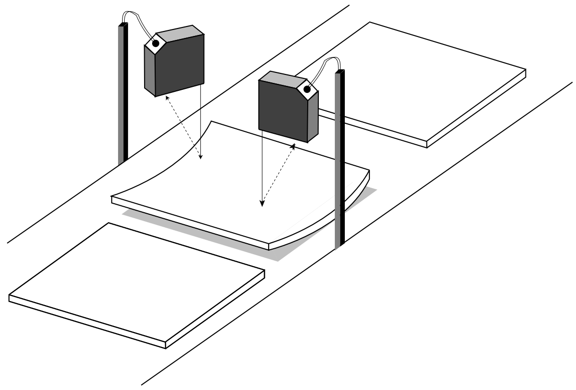
Functional Specifications

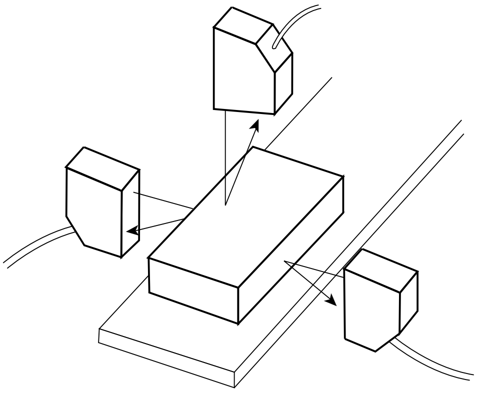
	MX1A-A, MX1B-A	MX1A-B, MX1B-B
Reference Sensing Distance	3.54" (90mm)	1.57" (40mm)
Detectable Sensing Range	±1.57" (40mm)	±0.39" (10mm)
Analog Offset	±1V (±0.16" or 4mm) zero adjustment range	±1V (±0.04" or 1mm) zero adjustment range
Analog Response Speed	Selectable: High-speed (F) = 1ms, Normal speed (S) = 20ms	
Analog Output, Measured	±10V DC, 10mA (maximum), measured analog output voltage is proportional to displacement as follows: 0.25V per mm (MX1A-A and MX1B-A), 1V per mm (MX1A-B and MX1B-B)	
Resolution*	0.002" (50 µm) = 12.5 mV	0.0004" (10 µm) = 10mV
Linearity	±0.004" (100 µm) ±0.5% of displacement	±0.0008" (20 µm) ±0.5% of displacement
Analog Input, Calculated (MX1B only)	Voltage range: ±10V DC; Impedance: 100kΩ, measured analog output from an MX1A or MX1B is used as the calculated analog input for the MX1B only; the calculated output voltage is proportional to the calculated values for the thickness or difference in levels: 0.25V per mm (MX1A-A and MX1B-A), 1V per mm (MX1A-B and MX1B-B)	
Analog Output, Calculated (MX1B only)	±10V DC, 10mA (maximum), measured analog output from an MX1A or MX1B is used as the calculated analog input for MX1B only; the calculated output voltage is proportional to the calculated values for the thickness or difference in levels: 6.35V per inch or 0.25V per mm (MX1A-A and MX1B-A), 25.32V per inch or 1V per mm (MX1A-B and MX1B-B)	
Digital Output	Transistor 30V DC, 0.1A/point (maximum), upper LED is lit when measured value > preset, lower LED is lit when < preset	
Digital Output Setting	Separate settings for upper and lower limits (innite turn)	
Digital Output Response	Rise and fall: 500 µsec (maximum)	
Out LED	On: digital output turns on	
Upper and Lower LEDs	Upper LED on: Upper limit output turns on	Lower LED on: Lower limit output turns on
Enable Input (Synchronous)	Controls inspection output with synchronous signal (one coupler)	
Enable LED	On: For synchronous signal input	
Alarm Input **Alarm Output**	Using 2 units together: Main unit (MX1B only) takes the alarm output from the sub unit (MX1A or MX1B) Transistor 30V DC, 0.1A / pt. (maximum), alarm output is lit when alarm condition exists, as displayed by the alarm LEDs	
Alarm LEDs	Dark on: Reected light is insufcient Far on: Detected distance > maximum	Bright on: Reected light is excessive Near on: Detected distance < minimum
Calculation Over LED	On: Analog output (calculated) exceeds output range, MX1B only	
Alarm Input LED	On: When alarm input turns on, MX1B only (when using two units together)	
Power LED (on both amplifier and sensor head)	Green LED when power is on Orange LED when a laser is emitted during normal operation Laser beam emitted approximately 10 seconds after power-up; laser emission can be controlled while the power is on, using remote interlock provided	
Temperature Drift	±2 mV per C (maximum)	
Frequency	11.3KHz	
Hysteresis	Selectable: Narrow (N) = 40 mV or wide (W) = 200 mV	
Light Source	Laser diode (780 nm)	
Receiving Element	PSD (position sensitive device)	

1. These specications wer e developed from tests using a white ceramic object at the reference sensing distance, using the normal response speed at (20ms) 25ºC.
*2. * Peak to peak of analog output noise.*

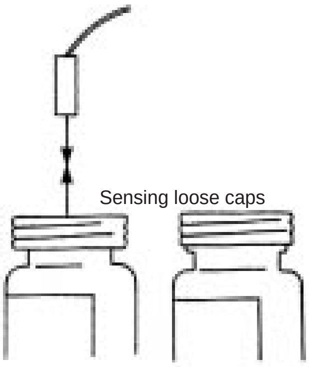
Applications

Checking for warped boards

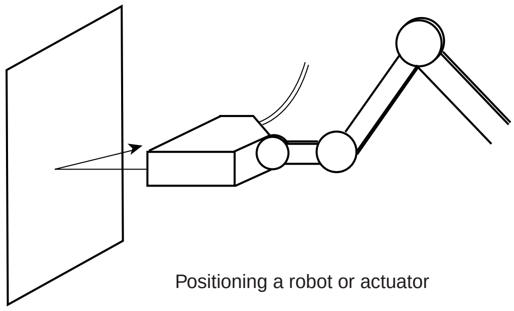




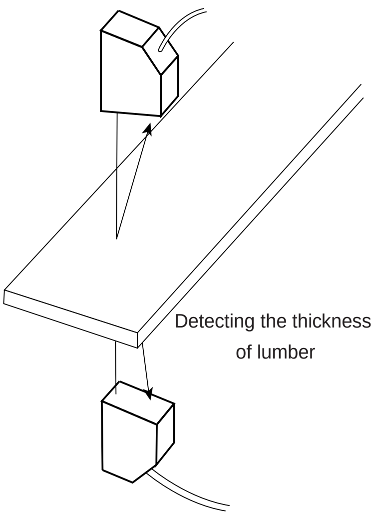
Detecting the height and width of wood or blocks



Sensing loose caps

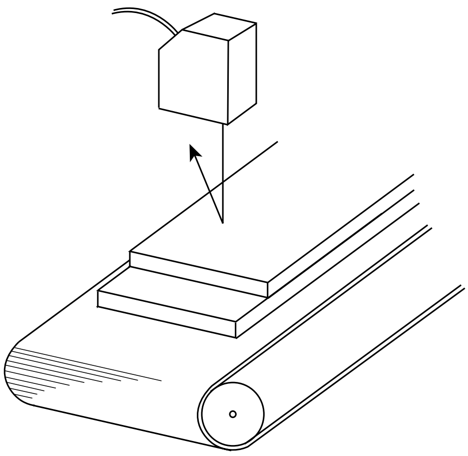


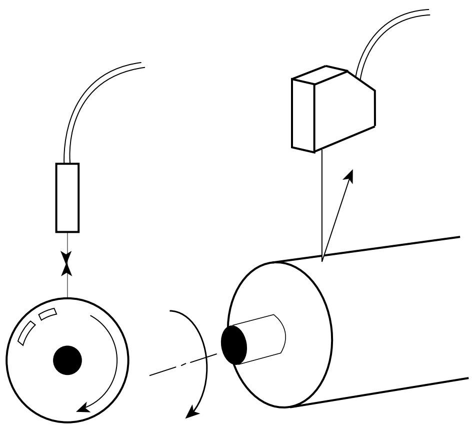
Positioning a robot or actuator



Detecting the thickness of lumber

Detecting overlapping sheets
Counting sheets of paper





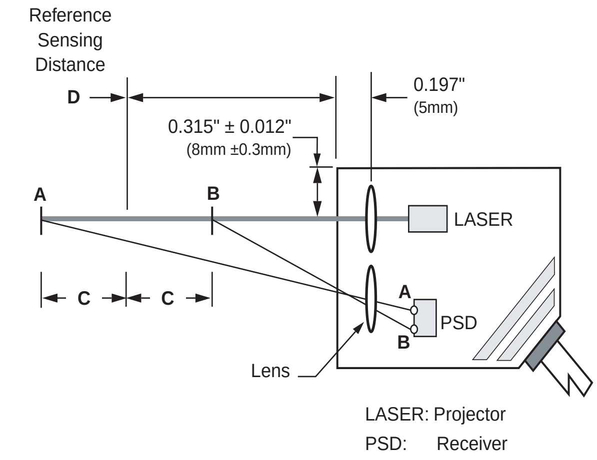
Sensing the roundness of a roller

TREICHL-ATM Electronic Auf der Bült 10 - 12 D 41189 Mönchengladbach
Tel. 02166 958545 Fax 02166 958547 eMail: atm@treichl.de internet: www.lichtschranke.de

Operation Principle

MX1A-A, MX1B-A:
C = 1.57" (40mm), D = 3.54" (90mm)

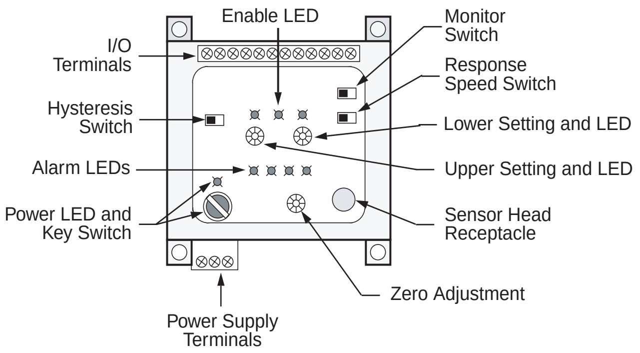
MX1A-B, MX1B-B:
C = 0.39" (10mm), D = 1.57" (40mm)



The sensor head projects a laser beam to the object. The diffuse-reected light from the object 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 for the measured distance between the sensor and the object, depending upon
the displacement.

This measured distance from one sensor can be combined with the measured distance from another, using the MX1B to calculate material thickness or differences in surface levels.

Operation: MX1A



Power key switch: Provides safety from inadvertent operation. The key is removable in the off position only.

Hysteresis switch: Select narrow (40mV) when detecting small differences in surface levels or wide (200mV) for noise immunity.

I/O terminals: Connect remote interlock, enable input, as well as analog, digital, and alarm outputs.

Monitor switch: Select between measured analog, upper or lower limit setting, as voltage output from A.OUT terminal.

Response speed switch: Specify high-speed (“F” = 1ms) or normal speed (“S” = 20ms) response. Use normal speed for the most reliable repetition. Also, it is recommended to use normal speed for the best linearity when using analog output.

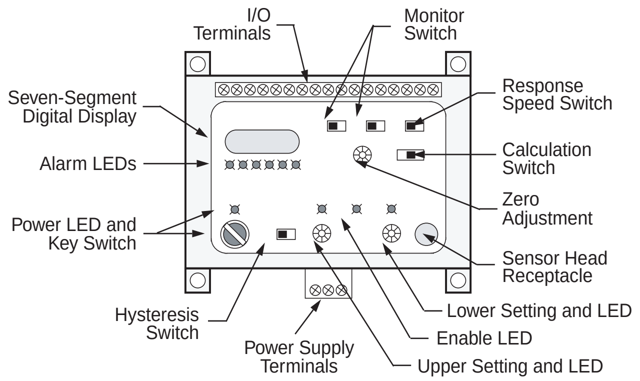
Upper/lower setting: Adjust for digital output (innite turn).

Zero adjustment: Fine tune zero point (25 turns = ±1V).

Alarm LEDs: On when conditions may result in inaccurate results, to indicate insufcient or excessive reected light, or when object is not within sensing range.

Enable LED: On when synchronous signal is being input.

Operation: MX1B



See page H-112 for general sensor instructions. Below are considerations specic to the MX1B laser displacement sensors.

Power key switch: Provides safety from inadvertent operation. The key is removable in the off position only.

Hysteresis switch: Select narrow (40mV) when detecting small differences in levels or wide (200mV) for noise immunity.

I/O terminals: Connect remote interlock, analog I/O (calculated), enable and alarm inputs, plus analog, digital, and alarm outputs.

Monitor switch: Set the switch on the left to internal (INT) or external (EXT) to select the value to be displayed):

INT: Use the right switch to select the upper (UP) or lower (LOW) limit for digital output or analog value (OUT) as specied by calculation setting.

EXT: Select the distance value (in mm) corresponding to the voltage input to the analog input (calculated) terminal.

Response speed switch: Specify high-speed (“F” = 1ms) or normal speed (“S” = 20ms) response. Use normal speed for the most reliable repetition. Also, it is recommended to use normal speed for the best linearity when using analog output.

Upper/lower setting: Adjust for digital output (innite turn).

Zero adjustment: Fine tune zero point (25 turns = ±1V).

Alarm LEDs: On when conditions may result in inaccurate results, to indicate insufcient or excessive reected light or when object is not within the sensing range. Also on when the alarm input is on and when the calculated value exceeds the output range.

Enable LED: On when a synchronous signal is being input.

Seven-segment digital display: Indicates the upper or lower limits, or the measured or calculated values, depending on the monitor switch setting.

Calculation switch: Select measured or calculated values for analog output:

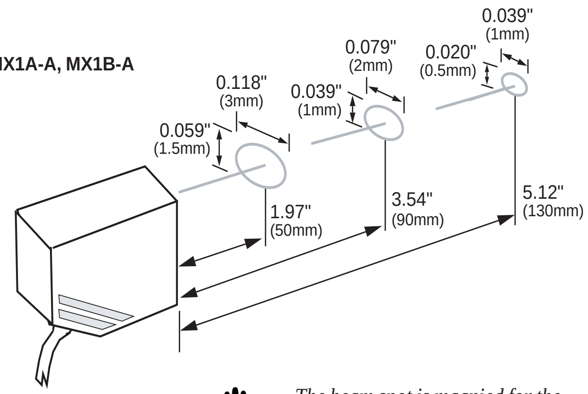
SINGLE: Select measured analog output using one sensor.

ADD: Select calculated analog output, adding measured values to determine thickness, using two sensors.

SUB: Select calculated analog output, subtracting measured values to determine difference in levels with two sensors.

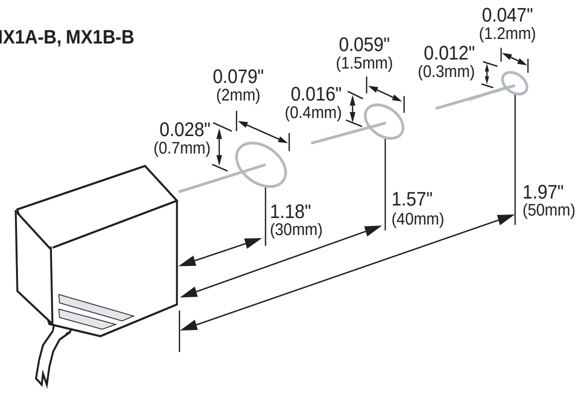
Projected Beam Characteristics

MX1A-A, MX1B-A

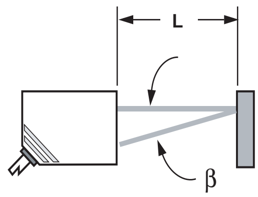


The beam spot is magnied for the purpose of these dimensions only.

MX1A-B, MX1B-B



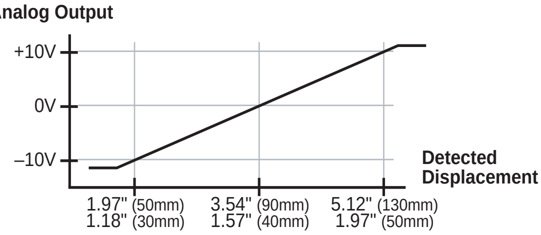
Due to the focusing characteristics of the lens, the projected beam of a laser sensor gets smaller (converges) from the near end to the far end of the sensing range. The beam gets larger (diverges) beyond the far end of the sensing range.



Angle of Reection

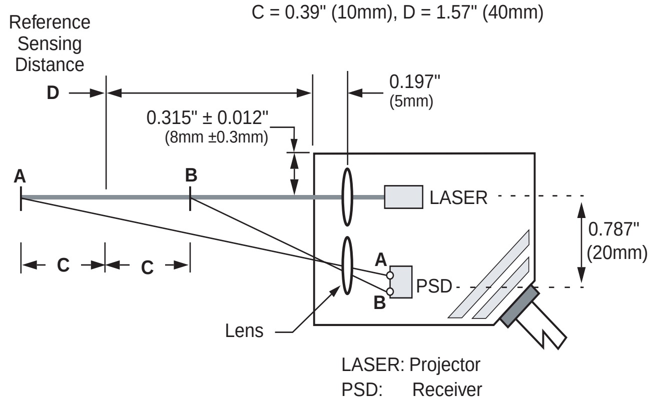
MX1A-A, MX1B-A	
L = 1.97" (50mm)	Angle β = 19.98
L = 3.54" (90mm)	Angle β = 11.89
L = 5.12" (130mm)	Angle β = 8.43
MX1A-B, MX1B-B	
L = 1.18" (30mm)	Angle β = 29.74
L = 1.57" (40mm)	Angle β = 23.96
L = 1.97" (50mm)	Angle β = 19.98

Analog Output Characteristics



MX1A-A, MX1B-A
C = 1.57" (40mm), D = 3.54" (90mm)

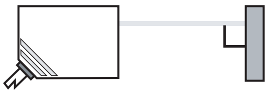
MX1A-B, MX1B-B
C = 0.39" (10mm), D = 1.57" (40mm)



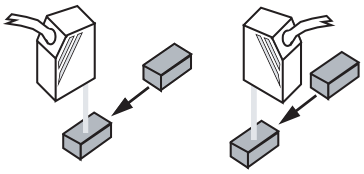
Installation

IMPORTANT! The sensor head and amplier are calibrated in pairs. Be sure to use those with the same serial number together.

Install the sensor so that the optical window on the front of the sensor and the surface of the object area are as parallel as possible.

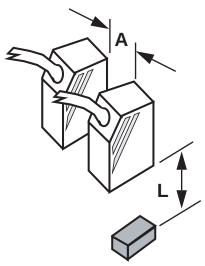


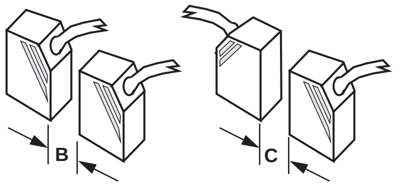
To minimize uctuations resulting from motion, make sure that the sensor is mounted with the longitudinal axis perpendicular to the path of travel, as shown in the gure on the right. Sensor output should be taken when the projection beam falls exactly on the object.



Incorrect Correct

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





"L" is the distance between the sensor head surface and the object.

Distance: MX1A-A

L	A	B	C
1.97" (50mm)	0.20" (5mm)	0.39" (10mm)	0.59" (15mm)
3.54" (90mm)	1.57" (40mm)	1.97" (50mm)	2.56" (65mm
5.12" (130mm)	2.75" (70mm)	4.72" (120mm)	4.92" (125mm)

Distance: MX1A-B

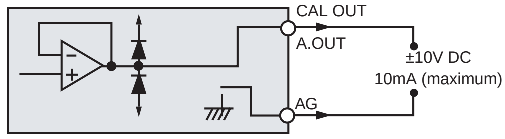
L	A	B	C
1.18" (30mm)	1.57" (40mm)	0.39" (10mm)	1.57" (40mm)
1.57" (40mm)	0.39" (10mm)	0.0" (0mm)	1.18" (30mm)
1.97" (50mm)	1.97" (50mm)	0.79" (20mm)	1.97" (50mm)

Wiring: MX1B

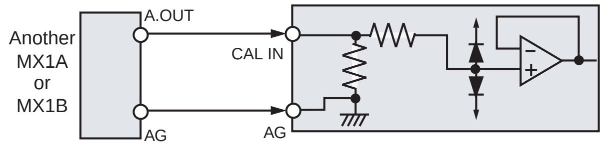
Wire No.	Name	Function
1	FG	Frame Ground
2	AG	Analog Ground (calculated)
3	CAL IN	Analog Input (calculated)
4	CAL OUT	Analog Output (calculated)
5	AG	Analog Ground (measured)
6	A.OUT	Analog Output or Upper/Lower Limit
7	LOWER	Lower Limit Output
8	U/L COM	Upper/Lower Limit Output Common
9	UPPER	Upper Limit Output
10	AL OUT	Alarm Output
11	AL COM	Alarm Output Common
12	AL IN	Alarm Input (from another MX1A or MX1B)
13	AL IN (–)	Alarm Input (–)
14	ENBL	Enable Input (synchronous signal)
15	ENBL (–)	Enable Input (–)
16	LD RMT	Laser Disable Remote Interlock
17	LD RMT (–)	Laser Disable Remote Interlock (–)

Schematics

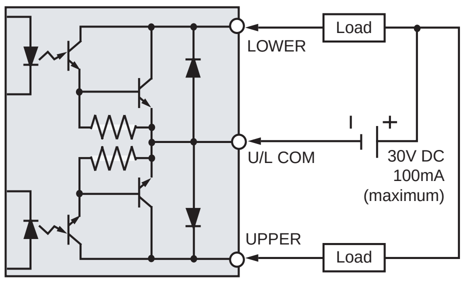
Analog Output (measured or calculated)



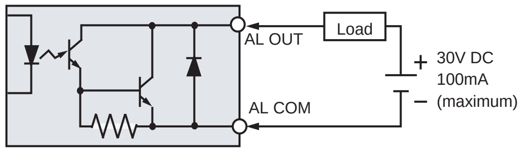
Analog Input (measured to calculated)



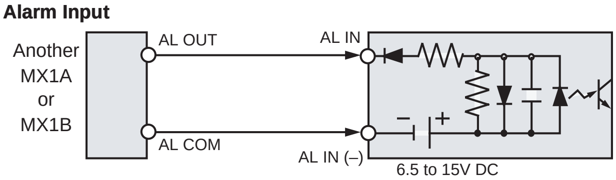
Upper/Lower Limit Output



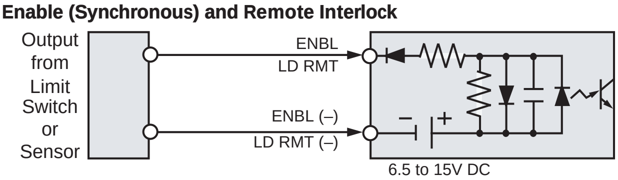
Alarm Output



Alarm Input



Enable (Synchronous) and Remote Interlock



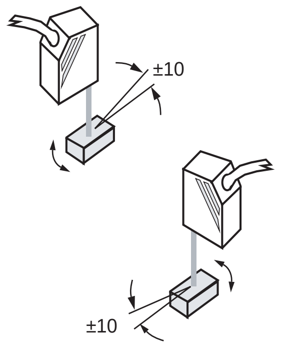
Wiring: MX1A

Wire No.	Name	Function
1	FG	Frame Ground
2	AG	Analog Ground (measured)
3	A.OUT	Analog Output or Upper/Lower Limit
4	LOWER	Lower Limit Output
5	U/L COM	Upper/Lower Limit Output Common
6	UPPER	Upper Limit Output
7	AL OUT	Alarm Output
8	AL COM	Alarm Output Common
9	ENBL	Enable Input (synchronous signal)
10	ENBL (–)	Enable Input (–)
11	LD RMT	Laser Disable Remote Interlock
12	LD RMT (–)	Laser Disable Remote Interlock (–)

Installation, continued

Laser sensing of mirror-like surfaces is not recommended, as the sensor receiver is designed for detecting diffuse-reected light. Direct laser reection may result in an alarm output.

For best results detecting reective surfaces, tilt the sensor to reduce direct laser reection. Sensing at a slight angle (approximately ±10) does not signicantly reduce sensing accuracy or linearity of resulting analog output.



WARNING: Class IIIb laser. Do not allow the laser to shine directly into 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

Using One Sensor

Both the MX1A and MX1B can be used individually. When using the MX1B alone, set the calculation switch to SINGLE.

When the MX1B series is used individually, measured analog values always output to the A.OUT (analog output) terminal, regardless of monitor and calculation settings. However, the lefthand monitor switch should *not* be set to EXT (external) and the calculation switch should *not* be set to ADD or SUB (for calculated values).

Switch Settings

Amplifier	Switch	Setting
MX1A	MON (monitor)	OUT
MX1B	MON.L (monitor left) MON.R (monitor right)	INT OUT
	CAL (calculation)	SINGLE

2. Set response to normal speed (20ms) for normal applications or t high-speed (1ms) to detect rapidly moving objects.

Monitoring (Single Unit Application)

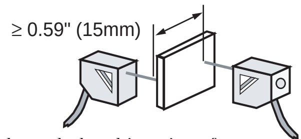
MX1A	Switch	A.OUT Terminal
—	UP	Output voltage as set for the upper limit
	OUT	Output measured analog output voltage
	LOW	Output voltage as set for the lower limit

MX1B	Switch	Display
INT	UP	Display upper limit preset value
	OUT	Display measured value
	LOW	Display lower limit preset value

3. For a single unit application of the MX1B, set the calculation switch to SINGLE. When setting the upper and lower limits, the monitoring function provides a fairly good approximation. Calibration using the detected object is recommended to ensure accuracy.

Using Two Sensors in Combination

The MX1B has built-in math capabilities which can be used to determine material thickness or differences in levels when used together with another MX1A or MX1B.



4. If some infrared light passes through the object, interference may cause the measurements of thickness to be unreliable. It may be necessary to observe the clearance shown above.

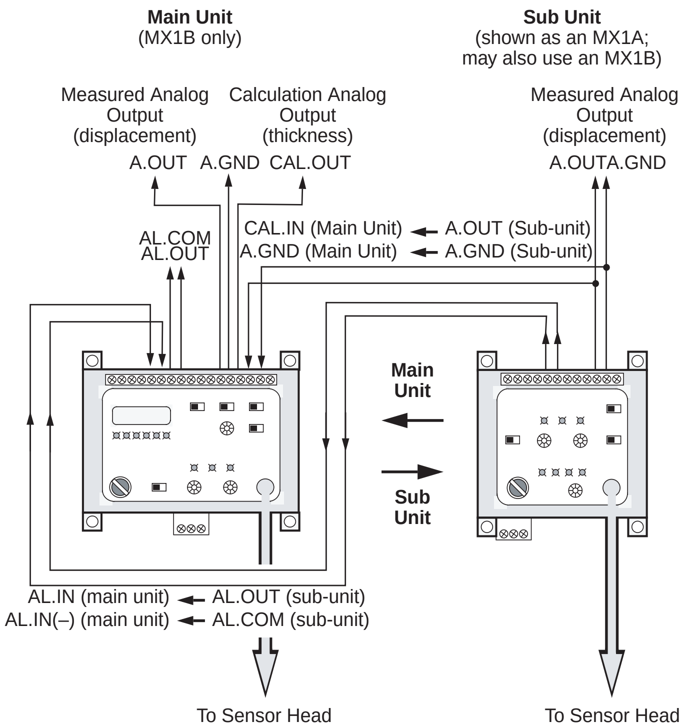
The settings are the same when using two sensors together as shown on the left (using one sensor), with one exception. When using the MX1B for calculation: set the calculation switch to ADD (calculating material thickness) or SUB (determining differences in levels).

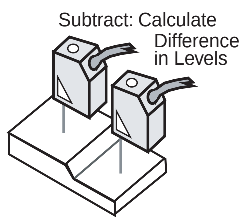
The measured analog output of the MX1A or MX1B is input to the calculated analog input (CAL IN) terminal of the MX1B, which provides calculated analog output values. In addition, the alarm output from the MX1A or MX1B is input to the AL IN (alarm input) terminal of the same MX1B doing the calculations.

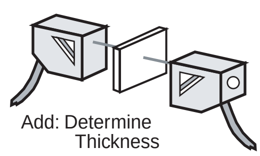
When an alarm condition occurs, the output voltage existing at the time of alarm is maintained, with attenuation factor ≤ 20mV per second. When using two sensors in combination, double the values specied for temperature drift, resolution, and linearity for measured analog output. For the linearity for the calculated analog output, add the following values to the linearity for the measured analog output:

MX1A-A and MX1B-A:
±0.0023" (60 µm) ±0.1% of displacement

MX1A-B and MX1B-B:
±0.0008" (20 µm) ±0.1% of displacement

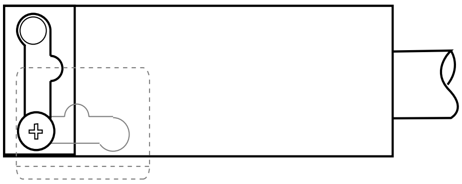


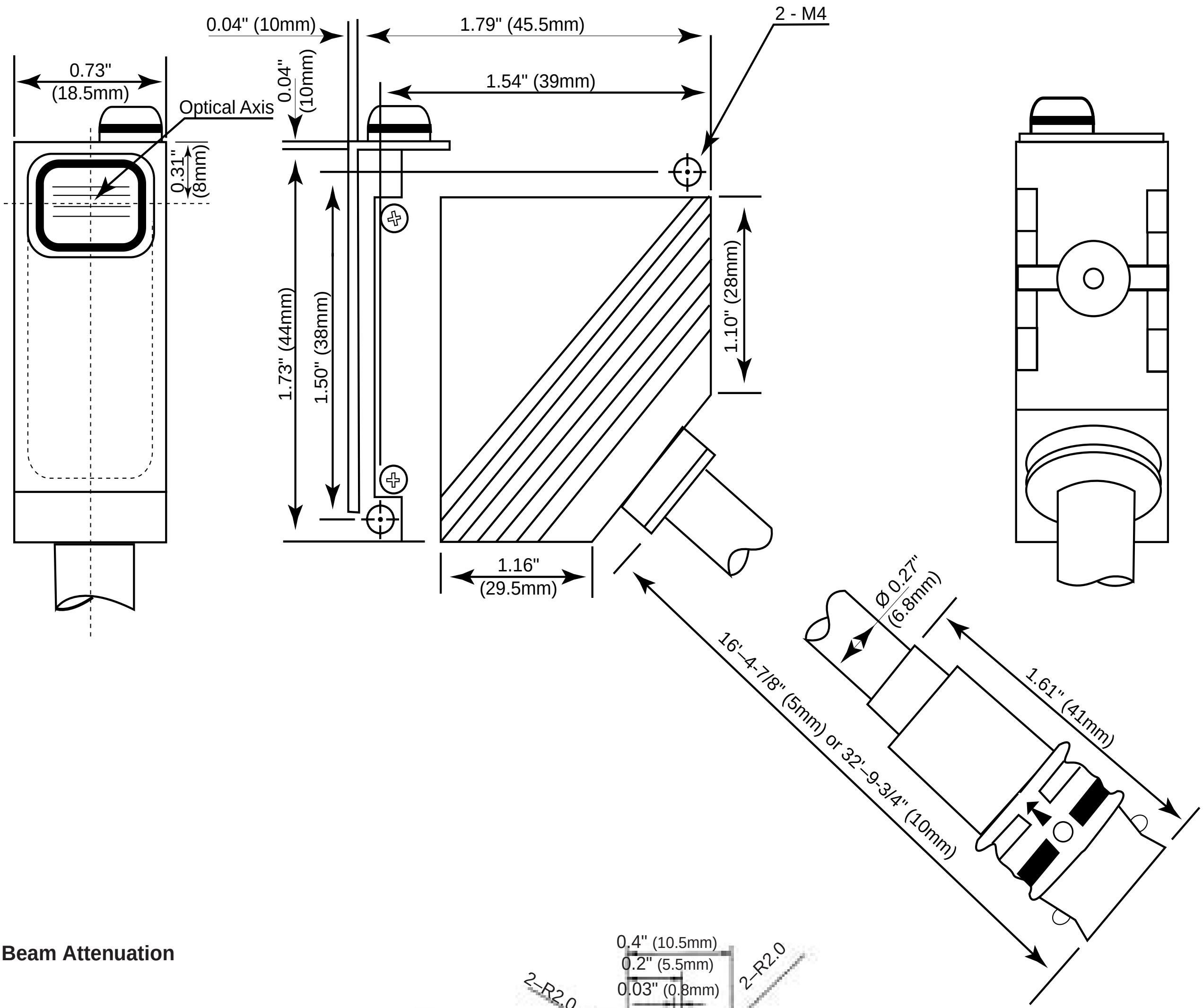




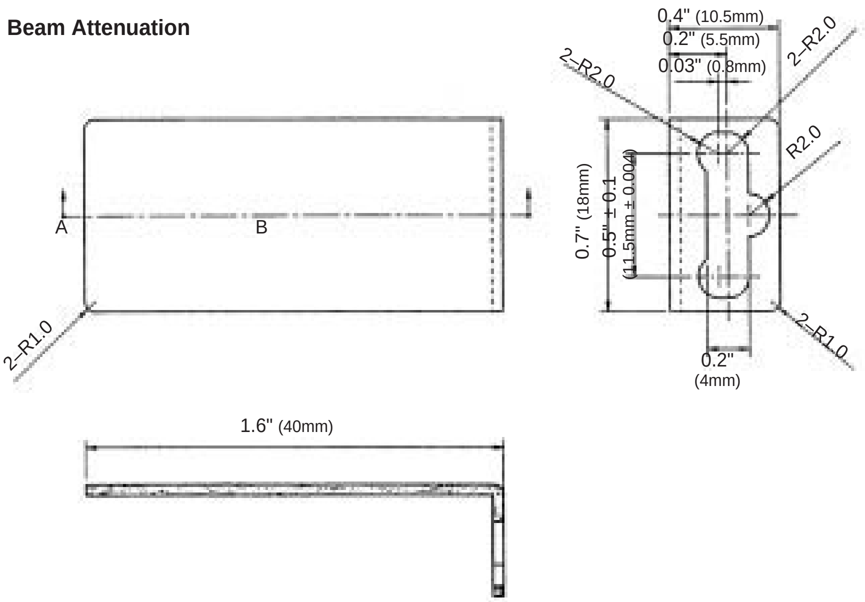
Dimensions

Sensor Head

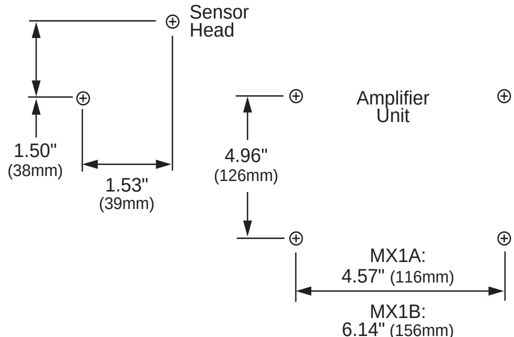




Beam Attenuation



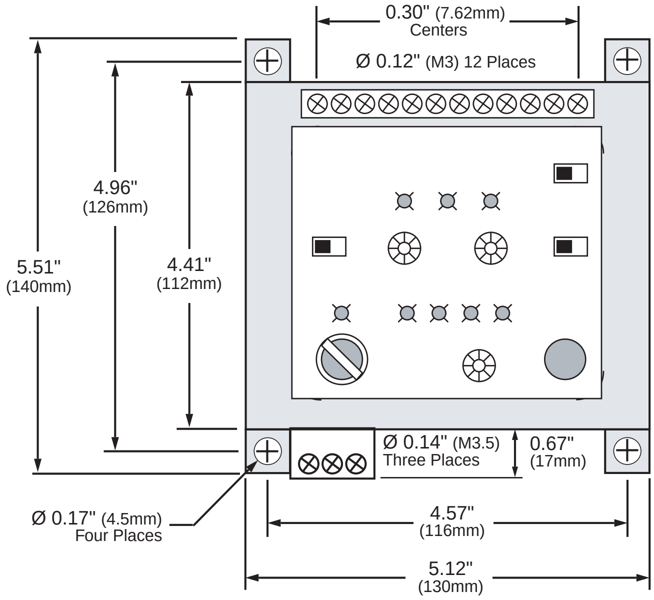
Panel Cut-Out



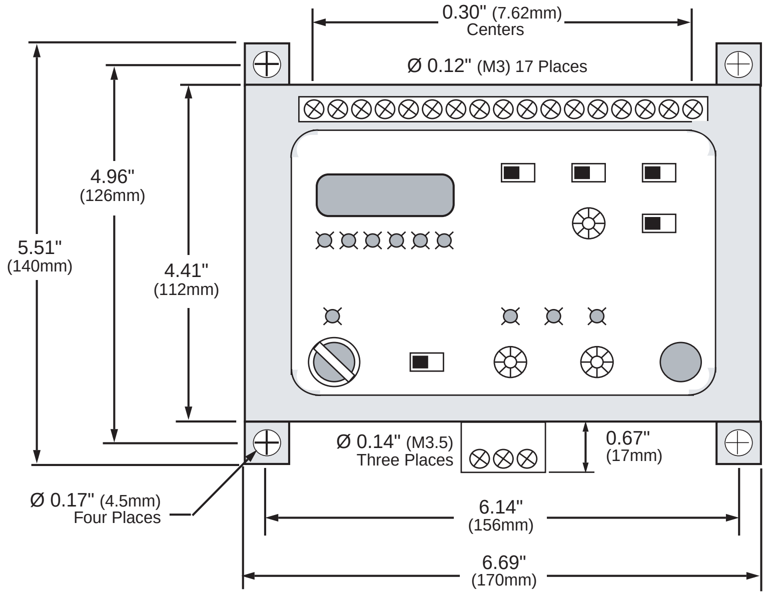
Note: The amplifier can also be mounted on a 1.375" (35mm) DIN rail.

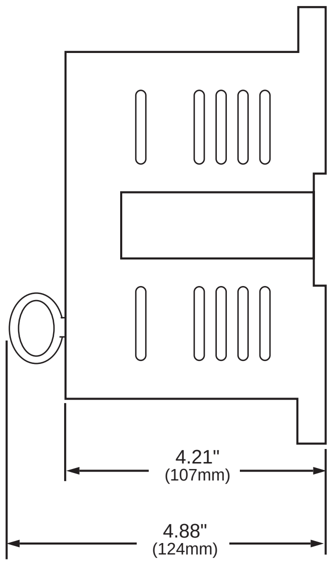
Dimensions, continued

MX1A Amplifier Unit



MX1B Amplifier Unit





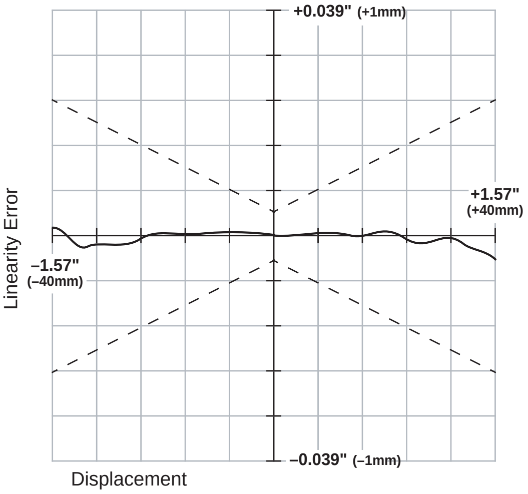
Side View

Typical for

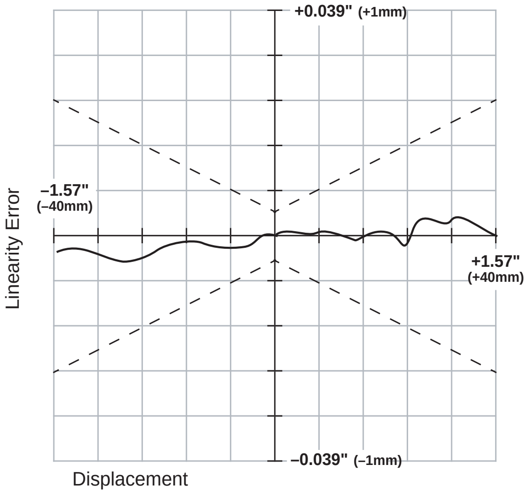
MX1A and

MX1B

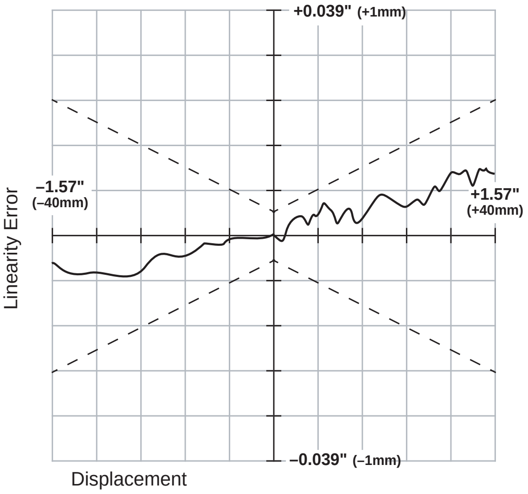
Graph 1: White Ceramic Board



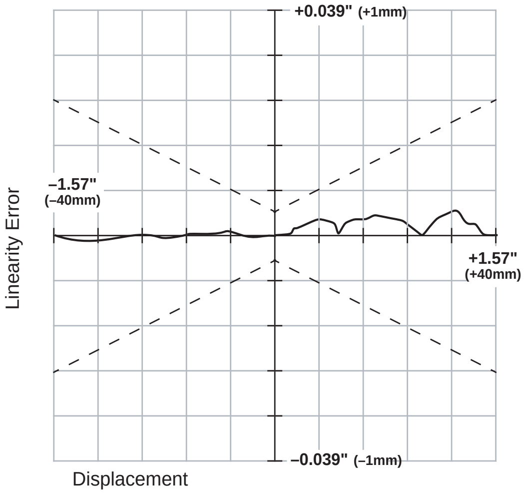
Graph 2: White Paper (4.5)



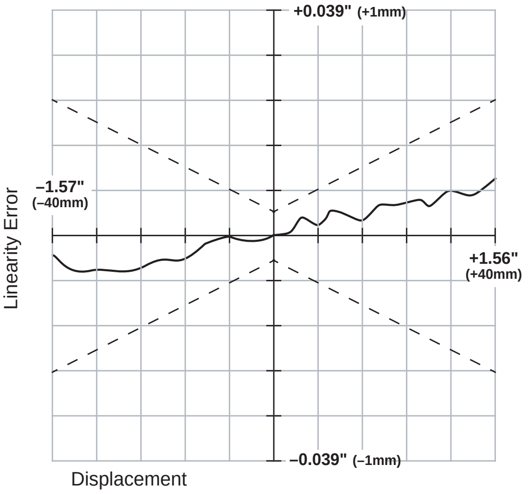
Graph 3: Less White Paper (2.5)



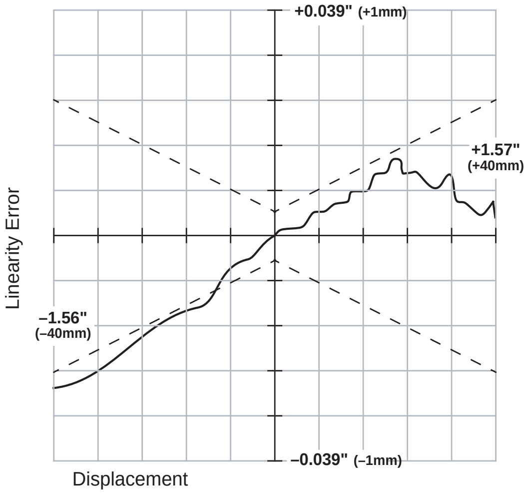
Graph 4: Cardboard Box



Graph 5: Gray Plastic Resin



Graph 6: White Aluminum (reflective, not mirror-like)



Linearity

Linearity is a measurement of how nearly linear (accurate) the relationship is between an analog output and the detected distance.

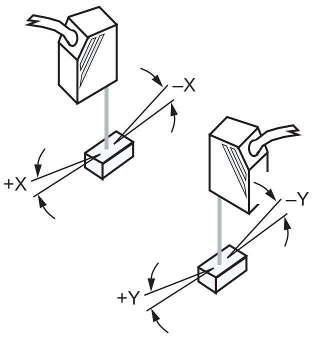
Sensing a white ceramic board, as shown in graph 1, linearity behaves according to the following equation: ± 100 µm ± 0.5% x displacement (as represented by the dashed diagonal lines radiating from the centerpoint of each graph).

In graphs 2 and 3, objects with different degrees of lightness represent a reduced amount of reected light received by the sensor. As shown, this has a minor effect on linearity. In graphs 4 and 5, typical objects, darker than "ideal" white, emphasize these results.

In graphs 6 and 7, objects with reective surfaces demonstrate that linearity is more signicantly reduced as a result of direct light reection.

1. Displacement is plotted along the x-axis where one division = 0.315" (8mm). Linearity error is plotted along the y-axis where one division = 0.008" (0.2mm).

2. For best results detecting reective surfaces, tilt the sensor to reduce direct laser reection. Sensing at a small angle (approximately ±10) does not signicantly r educe sensing accuracy or linearity of the resulting analog output.



Linearity

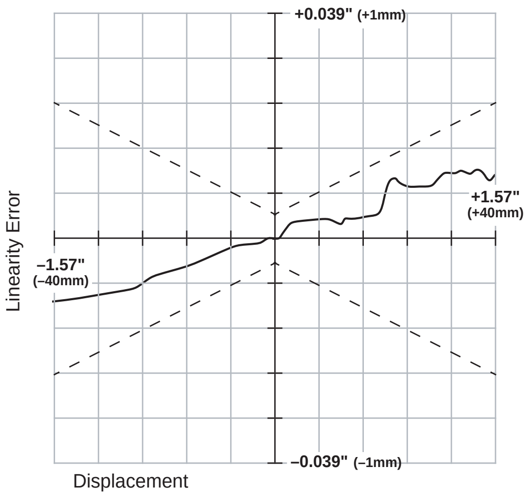
In graph 8, metal with a mirror-like surface has been used to emphasize results with reective objects. However, linearity is improved for mirror-like surfaces when the object angle is increased ±5 to ±10.

In graph 9, a translucent object shows a similar reduction in linearity.

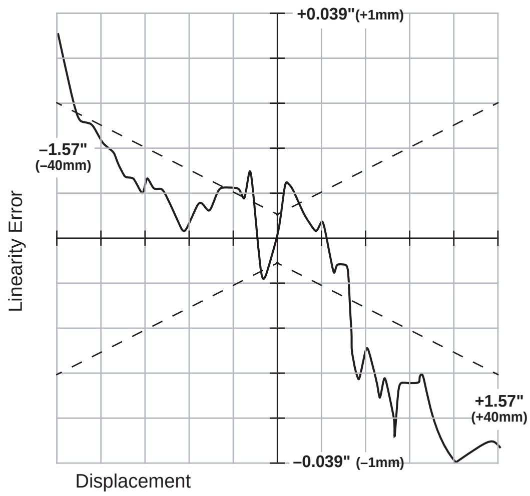
In practice, an alarm output can be avoided by tilting the sensor slightly (approximately 10).

In graphs 10, 11, and 12, the same objects with the best linearity results have been used again, except no angle of tilt was used in graphs 1, 4, and 5. Objects used in graphs 10, 11, and 12 have been tilted at an angle of ±10, showing no signicant reduction in linearity .

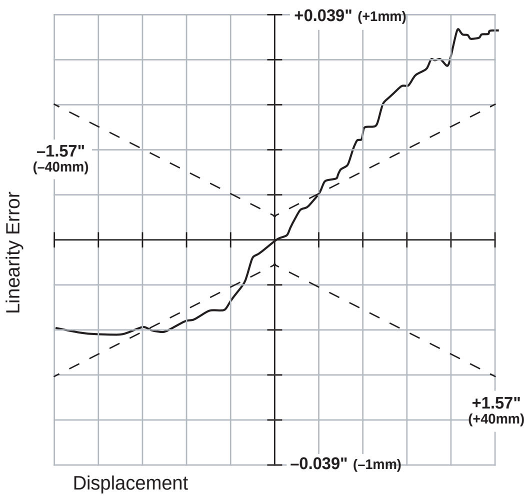
Graph 7: Black Aluminum (reflective, not mirror-like)



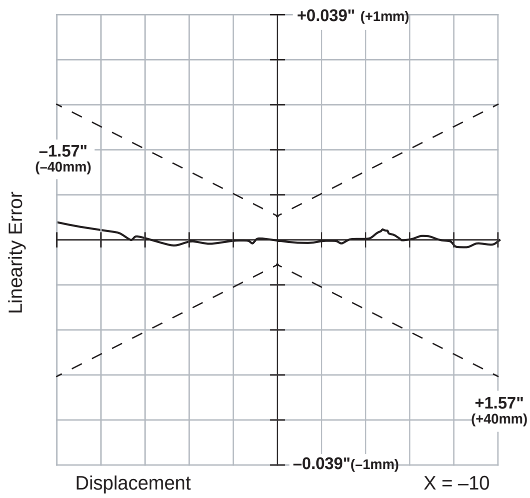
Graph 8: Metal with Mirror-Like Surface



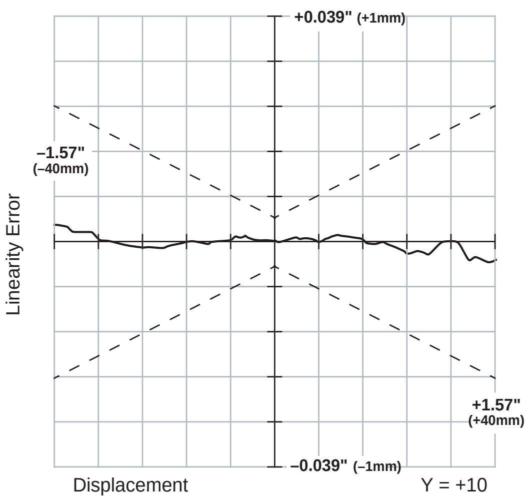
Graph 9: Resin (semi-transparent)



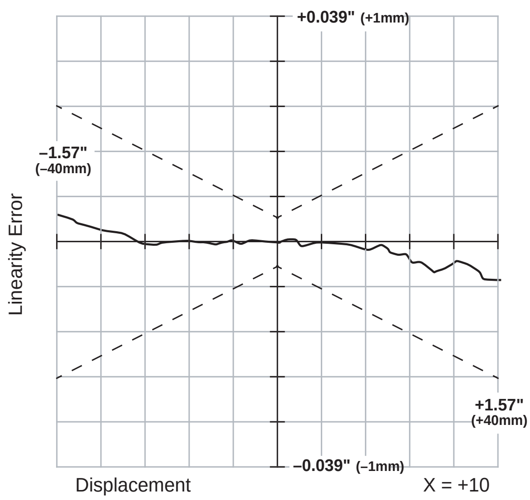
Graph 10: White Ceramic Board



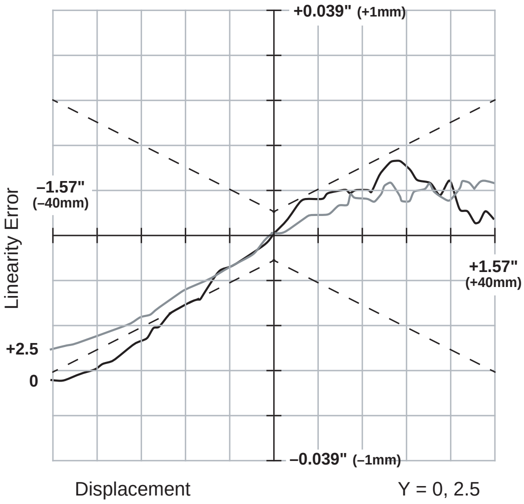
Graph 11: Cardboard Box



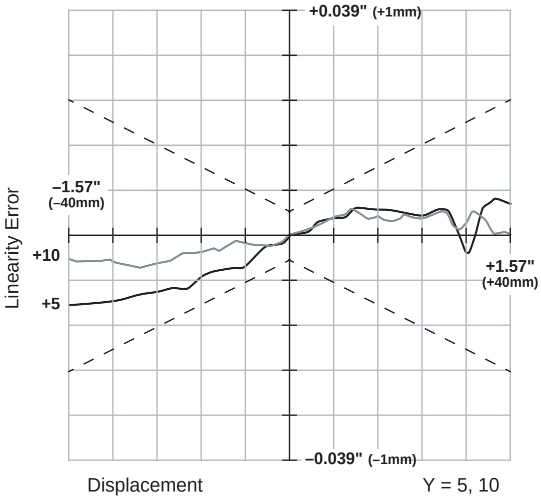
Graph 12: Gray Plastic Resin



Graph 13a: White Aluminum (reflective, not mirror-like)



Graph 13b: White Aluminum (reflective, not mirror-like)

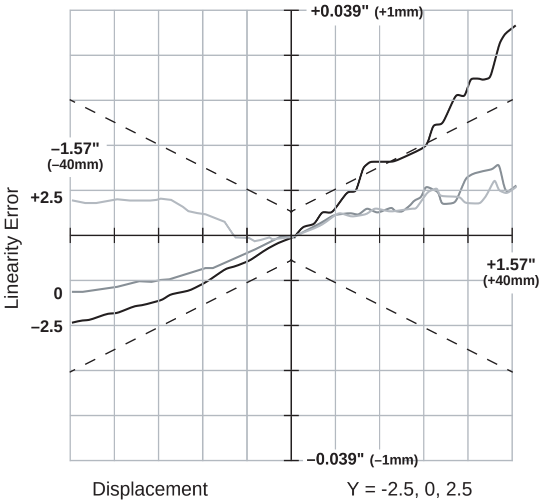


Linearity

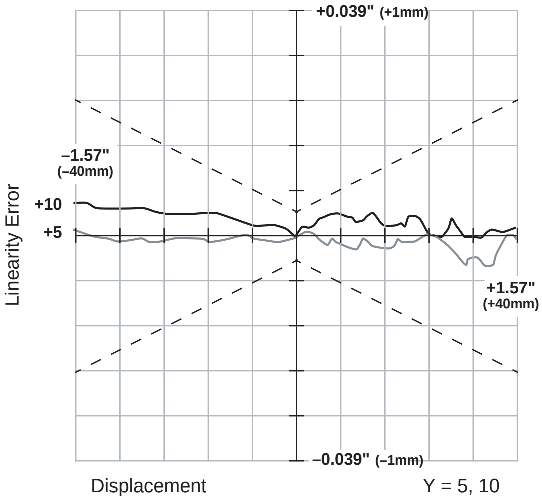
In graphs 13, 13a, 14, 14a, 15, and 15a, the same objects with reective surfaces have been used again, except no angle of tilt was used for objects in graphs 6, 7, and 8. Objects used in graphs 13, 13a, 14, 14a, 15, and 15a have been tilted to show that linearity is improved for mirror-like surfaces when the object angle is increased from ±5 to ±10.

This is because linearity is more signicantly reduced as a result of direct light reection. Adding an angle of tilt allows the sensor to respond primarily to diffuse-reected light instead.

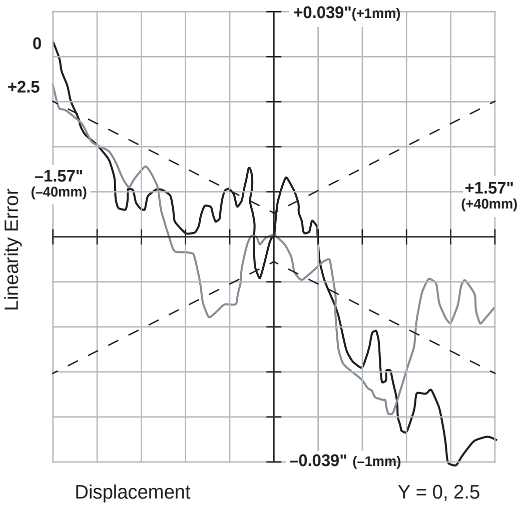
Graph 14a: Black Aluminum (reflective, not mirror-like)



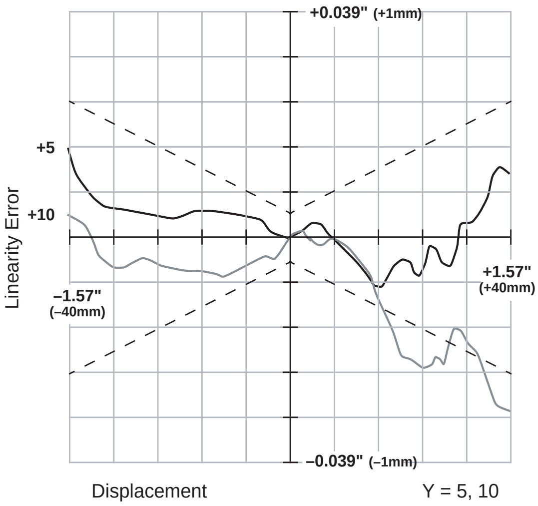
Graph 14b: Black Aluminum (reflective, not mirror-like)



Graph 15a: Metal with Mirror-Like Surface



Graph 15b: Metal with Mirror-Like Surface



Send Us Your Application, We'll Send You a Solution

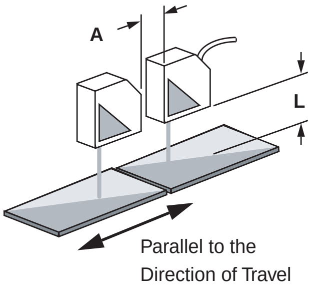
Often the right solution involves a minor adjustment to overcome operating constraints. Our experts conrm the use of a sensor under conditions which may be slightly different from those recommended in this catalog. As an example, the MX1A and MX1B laser sensors have been combined creatively and applied to a common processing concept described below.

Application

A steel manufacturer conveys a variety of metal strips, one item deep, end-to-end. The customer wants to make sure that the sheets of metal are not overlapping, so we recommend using the MX1A and MX1B laser sensors to detect leading and trailing edges. Sheet metal thickness varies from 0.0176" (0.45mm) to 0.0385" (0.98mm). This requires a sensor that will not trigger falsely with a change in metal thickness.

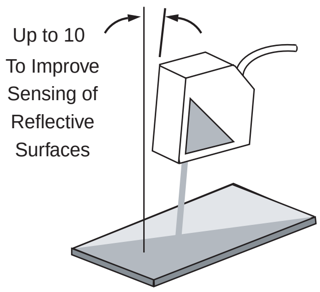
Installation

The MX1A-A and MX1B-A laser sensors, used together, can add or subtract simultaneous measurements. This feature can be used to calculate the difference in surface levels. The two sensors were mounted with recommended clearances as shown below. The highly-reective surface of metal can sometimes result in an alarm output, so the sensors were tilted at an angle of up to 10 .

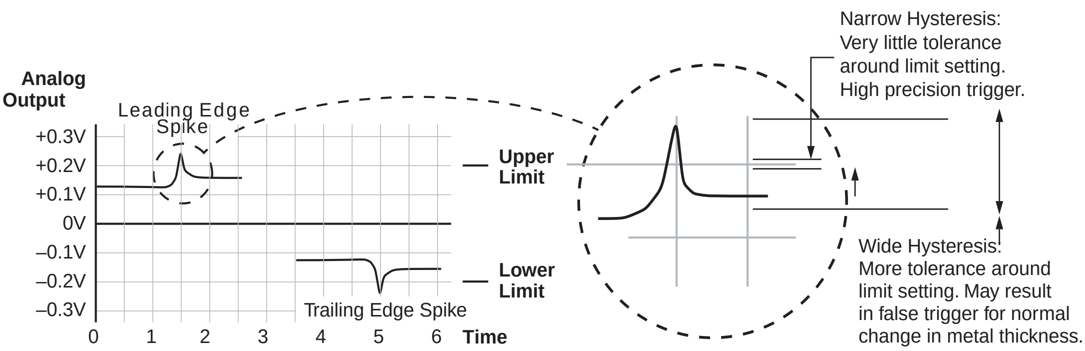


Clearances

L	A
1.97" (50mm)	0.39" (10mm)
3.54" (90mm)	1.97" (50mm)
5.12" (130mm)	4.72" (120mm)



Ordinarily, it is recommended to install the sensor head with the axis perpendicular to the direction of object travel. This minimizes any uctuations resulting from motion. However, in this application, uctuation is desirable. When the sensors are mounted parallel to the direction of t ravel, the leading and trailing edges are emphasized with a spike in the analog output.



Operation

Analog output is used only for the purpose of establishing the voltage spikes shown above. The calculation switch is set to SUB to calculate the difference between the distance that each sensor detects. Upper and lower limits are set to trigger the leading and trailing edge spikes, respectively.
Hysteresis is set as narrow as possible to avoid a false trigger when there is a normal change in metal thickness. Internally, a comparator circuit with hysteresis produces a digital output when the analog voltage spike matches the upper or lower limit. The digital output is then used to signal to a PLC when the undesired overlap occurs.

Laser Safety Information

Installation: If a sensor is installed so that the laser beam may shine or reect into the eyes of a person passing by or working in the vicinity, place an opaque sheet of material in front of the beam to prevent potential eye injury. For people working near a laser sensor, protective glasses which screen out a signicant amount of the harmful radiation are recommended at all times.

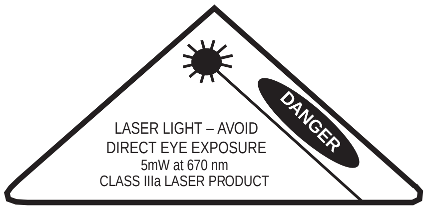
All laser sensors also include a remote interlock terminal which can be used to turn the laser on or off with an external switch, as required, to operate the sensor safely from a remote location. As required by law for all class IIIb lasers, the MX1A and MX1B sensors feature a safety key switch. For the MX1A and MX1B, an LED indicator is lit (green) upon laser transmission; 10 seconds later the LED changes color (amber) when the laser beam turns on.

To avoid exposure to harmful radiation, never disassemble a laser sensor.

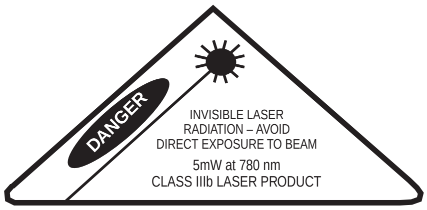
WARNING: Do not allow class IIIa and IIIb laser beams to shine directly into the eyes. Do not allow lasers to reect from a glossy , shiny, or reective surface into the eyes.

Labelling: The laser sensors include **CDRH-approved** safety warnings shown on the right and below, in compliance with federal regulations of the **Center for Devices and Radiological Health**.

MX1C Miniature Laser Sensor:
Class IIIa Laser (670nm) Visible Beam



MX1A and MX1B Laser Sensors:
Class IIIb Laser (780nm) Invisible Beam



All Laser Sensors:
Identication and Certication

mfd.: **FEBRUARY 1997**
Product conforms to
21 CFR1040

MX1A/B Invisible Laser:
Aperture Warning

AVOID EXPOSURE –
Invisible laser radiation is emitted from this aperture.

MX1C Visible Laser:
Aperture Warning

AVOID EXPOSURE –
Laser light is emitted from this aperture.