L-GAGE® LM Series Laser Sensor

Quick Start Guide

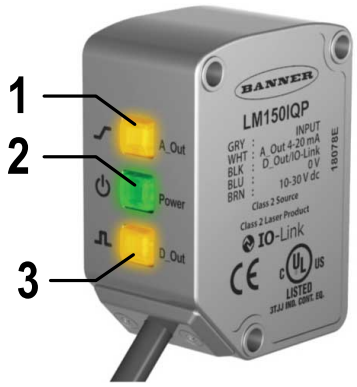
Laser displacement sensor that supports IO-Link communication with analog and discrete (switched) outputs.

This guide is designed to help you set up and install the L-GAGE LM Analog/Discrete Laser Sensor. For complete information on programming, performance, troubleshooting, dimensions, and accessories, please refer to the Instruction Manual at *www.bannerengineering.com*. Search for p/n 205812 to view the manual. Use of this document assumes familiarity with pertinent industry standards and practices.

WARNING:

- **Do not use this device for personnel protection**
- Using this device for personnel protection could result in serious injury or death.
- This device does not include the self-checking redundant circuitry necessary to allow its use in personnel safety applications. A device failure or malfunction can cause either an energized (on) or de-energized (off) output condition.

Features and Indicators



Three LED indicators provide ongoing indication of the sensing status.

1. **Analog Output LED Indicator**
   Solid Amber = Displayed distance is within the taught analog output window
   Off = Displayed distance is outside the taught analog output window
2. **Power LED Indicator**
   Solid Green = Normal operation, power On and laser On
   Flashing Green (1 Hz) = Power On and laser Off (laser enable mode)
3. **Discrete Output LED Indicator**
   Solid Amber = Discrete Output is On
   Off = Discrete Output is Off

Laser Description and Safety Information

CAUTION:

- **Return defective units to the manufacturer.**
- Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.
- Do not attempt to disassemble this sensor for repair. A defective unit must be returned to the manufacturer.

Class 2 Laser Models (LM150 Models)

CAUTION:

- **Never stare directly into the sensor lens.**
- Laser light can damage your eyes.
- Avoid placing any mirror-like object in the beam. Never use a mirror as a retroreflective target.

For Safe Laser Use - Class 2 Lasers

- Do not stare at the laser.
- Do not point the laser at a person's eye.
- Mount open laser beam paths either above or below eye level, where practical.
- Terminate the beam emitted by the laser product at the end of its useful path.

Reference IEC 60825-1:2007, Section 8.2.

Class 2 Lasers

Class 2 lasers are lasers that emit visible radiation in the wavelength range from 400 nm to 700 nm, where eye protection is normally afforded by aversion responses, including the blink reflex. This reaction may be expected to provide adequate protection under reasonably foreseeable conditions of operation, including the use of optical instruments for intrabeam viewing.

Class 2 Laser Safety Notes

Low-power lasers are, by definition, incapable of causing eye injury within the duration of a blink (aversion response) of 0.25 seconds. They also must emit only visible wavelengths (400 to 700 nm). Therefore, an ocular hazard may exist only if individuals overcome their natural aversion to bright light and stare directly into the laser beam.

Figure 1. FDA (CDRH) warning label (Class 2)

Class 1 Laser Models (LM80 Models)

Class 1 lasers are lasers that are safe under reasonably foreseeable conditions of operation, including the use of optical instruments for intrabeam viewing.

Laser wavelength: 655 nm **Output:** < 0.33 mW **Pulse Duration:** 45 µs to 1750 µs

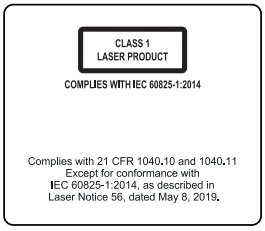


Figure 2. FDA (CDRH) warning label (Class 1)

Installation Instructions

Sensor Installation

Note: Handle the sensor with care during installation and operation. Sensor windows soiled by fingerprints, dust, water, oil, etc. may create stray light that may degrade the peak performance of the sensor. Blow the window clear using filtered, compressed air, then clean as necessary using 70% isopropyl alcohol and cotton swabs or water and a soft cloth.

Install the Safety Label

The safety label must be installed on or near the LM sensors.

Note: Position the label on the cable or near the sensor in a location that has minimal chemical exposure.

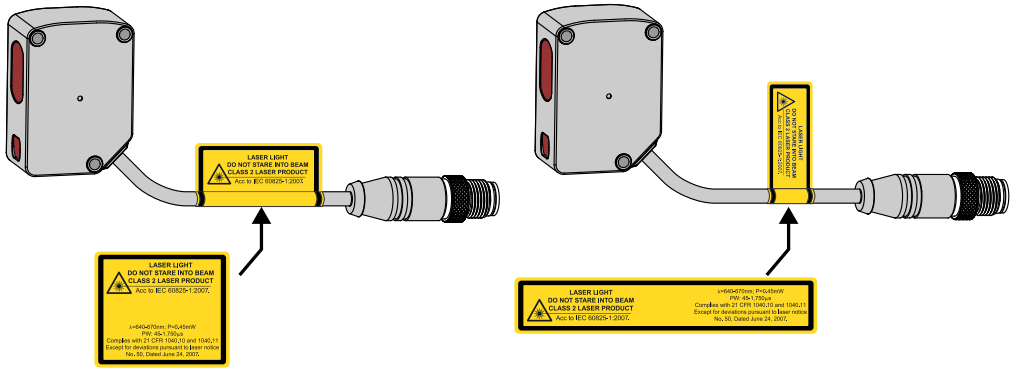


Figure 3. Typical installation; other mounting options are possible.

1. Remove the protective cover from the adhesive on the label.
2. Wrap the label around the LM cable, as shown.
3. Press the two halves of the label together.

Sensor Orientation

Correct sensor-to-object orientation is important to ensure proper sensing. See the following figures for examples of correct and incorrect sensor-to-object orientation as certain placements may pose problems for sensing distances.

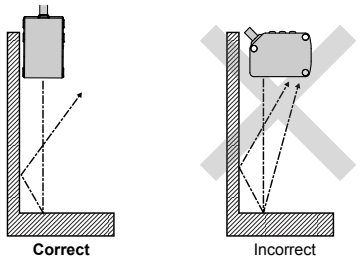


Figure 4. Orientation by a wall

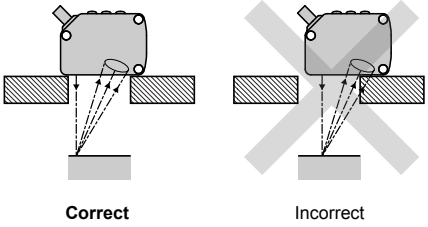


Figure 5. Orientation in an opening

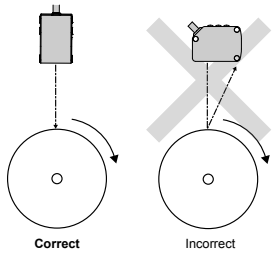


Figure 6. Orientation for a turning object

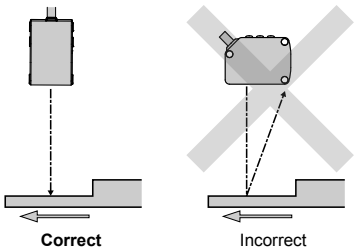


Figure 7. Orientation for a height difference

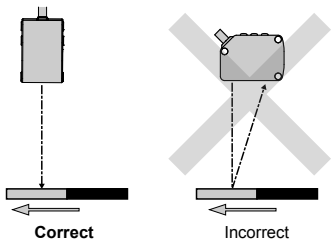


Figure 8. Orientation for a color or luster difference

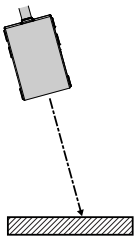


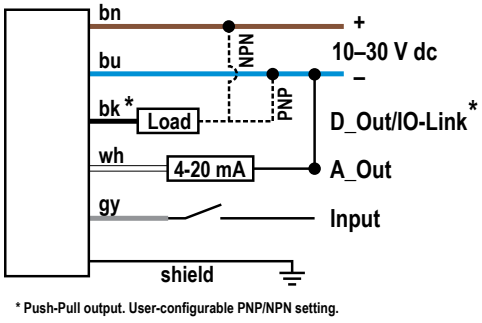
Figure 9. Orientation for a highly reflective target

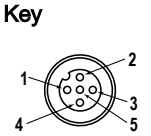
Applying tilt to sensor may improve performance on reflective targets. The direction and magnitude of the tilt depends on the application, but a 15° tilt is often sufficient.

Mount the Device

1. If a bracket is needed, mount the device onto the bracket.
2. Mount the device (or the device and the bracket) to the machine or equipment at the desired location. Do not tighten the mounting screws at this time.
3. Check the device alignment.
4. Tighten the mounting screws to secure the device (or the device and the bracket) in the aligned position.

Wiring Diagrams





The bare shield wire is connected internally to the sensor housing and should be connected as follows:

- If the sensor housing is mounted so that it is in continuity with both the machine frame and earth ground, connect the bare wire (also) to earth ground.
- If the sensor housing is mounted so that it is insulated from the machine frame and you are experiencing noise, connecting the bare wire to -V dc (together with the blue wire), may help.
- If the sensor is mounted so that it is in continuity with the machine frame, but not with earth ground, do not connect the bare wire (e.g. cut off the bare wire).

Configuration Instructions

Sensor Programming

Program the sensor using the buttons on the RSD1 remote sensor display accessory, via IO-Link, or the remote input (limited programming options).

If you are using the RSD1 for programming, from Run mode, use the buttons to access the Quick Menu and the Sensor Menu. See the instruction manual (p/n 205812) for more information on the options available from each menu. For TEACH options, follow the TEACH instructions in the instruction manual.

In addition to programming the sensor, use the remote input to disable the buttons for security, preventing unauthorized or accidental programming changes. See the instruction manual for more information.

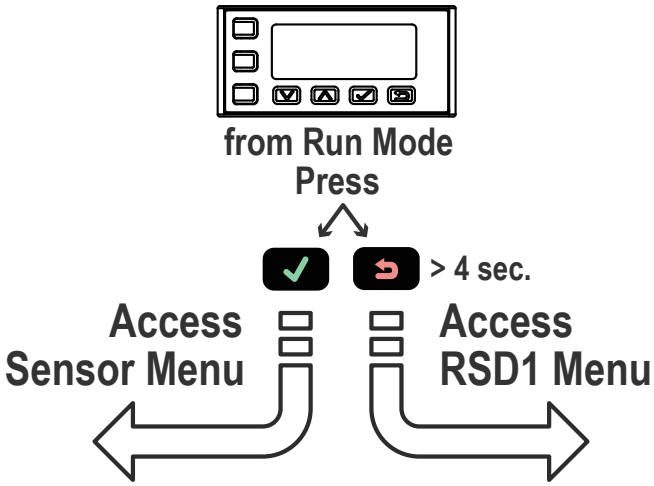


Figure 10. Accessing the Menus

Remote Display Buttons and the LM

Use the RSD1 buttons **Down**, **Up**, **Enter**, and **Escape** to view or change RSD1 settings and information and to program a connected sensor.

Down and Up Buttons

Press **Down** and **Up** to:

- Access the Quick Menu from Run mode
- Navigate the menu systems
- Change programming settings
- Change individual digit values in distance based settings

When navigating the menu systems, the menu items loop.

Press **Down** and **Up** to change setting values. Press and hold the buttons to cycle through numeric values. After changing a setting value, the value slowly flashes until the change is saved using the **Enter** button.

Enter Button

Press **Enter** to:

- Access the Sensor Menu from Run mode
- Access the submenus
- Move right one digit in distance based settings
- Save changes

In the RSD1 Menu, a check mark ⋱ in the lower right corner of the display indicates that pressing **Enter** accesses a submenu.

Press **Enter** to save changes. New values flash rapidly, and the sensor returns to the parent menu.

Escape Button

Press and hold **Escape** for 4 seconds to:

- Access the RSD1 Menu while in Run mode

Press **Escape** to:

- Leave the current menu and return to the parent menu

Important: Pressing **Escape** discards any unsaved programming changes.

In the RSD1 Menu, a return arrow in the upper left corner of the display indicates that pressing **Escape** returns to the parent menu.

Press and hold **Escape** for 2 seconds to return to Run mode from the RSD1 Menu.

Quick Menu

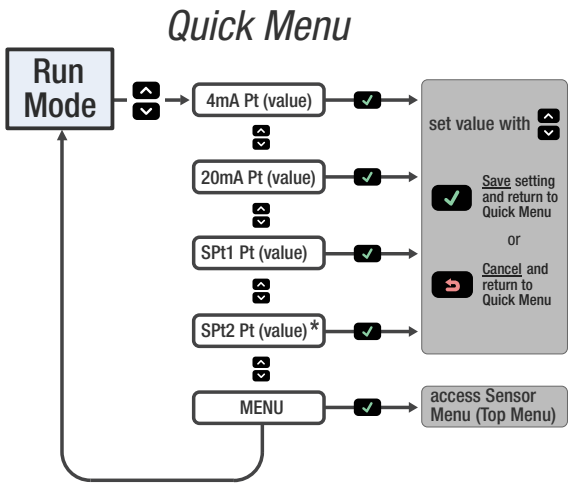
The sensor includes a Quick Menu with easy access to view and change the analog and discrete output switch points.

Access the Quick Menu by pressing **Down** or **Up** from Run mode. When in the Quick Menu, the current distance measurement displays on the first line and the menu name and the analog value alternate on the second line of the display.

Press **Enter** to access the switch points.

Press **Down** or **Up** to change the switch point to the desired value.

Press **Enter** to save the new value and return to the Quick Menu.



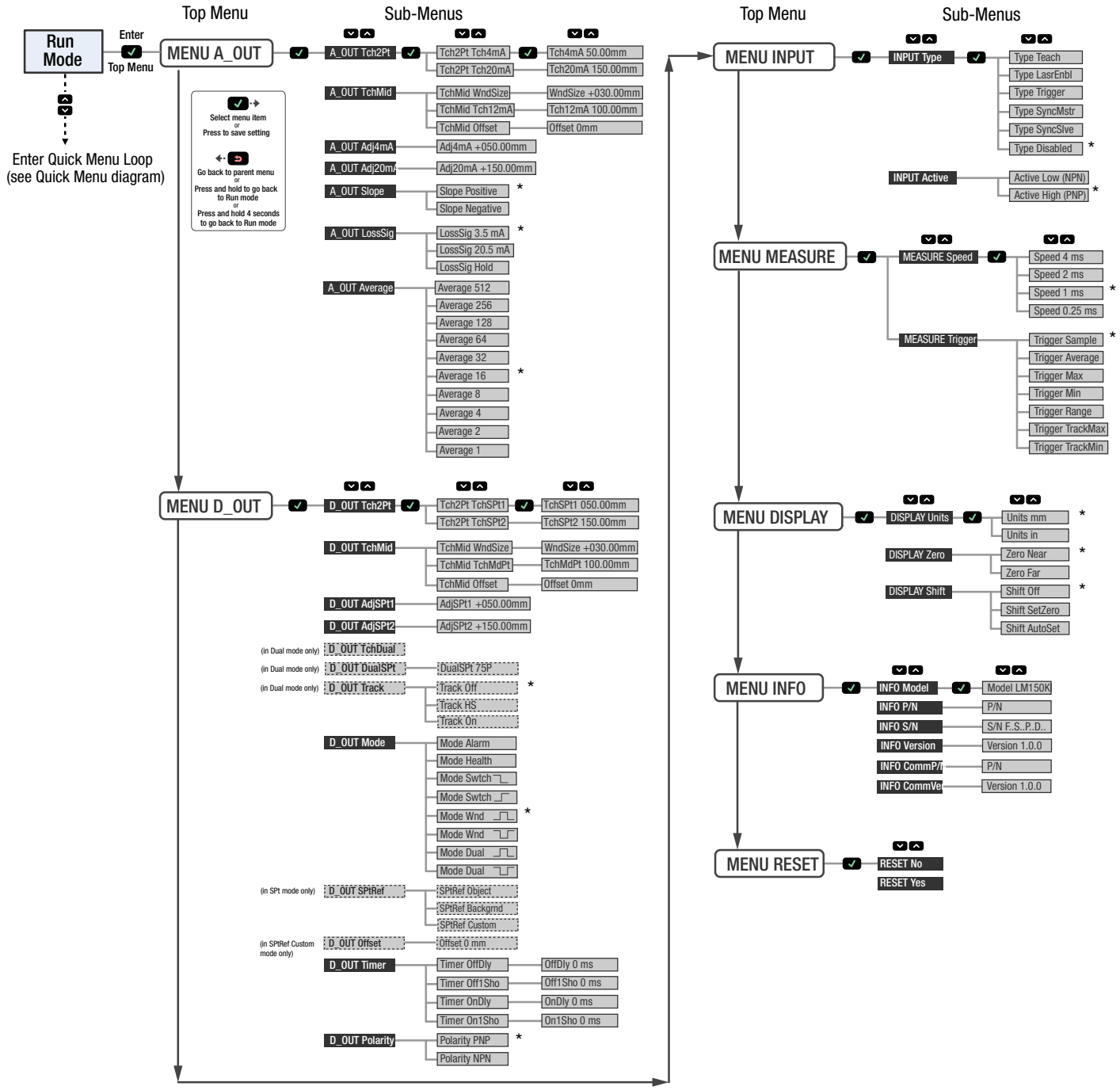
* In Setpoint mode, SPt1 Pt is replaced by SPt and SPt2 Pt is not available.
In Dual mode, SPt1 is replaced by DualSPt and SPt2 Pt is not available.

Sensor Menu (MENU)

Access the Sensor Menu by pressing **Enter** from Run mode. The Sensor Menu is also accessible from the Quick Menu: navigate to **MENU** and press **Enter**. The Sensor Menu includes several submenus that provide access to view and change sensor settings and to view sensor information.

Sensor Menu Full Map

From Run mode, press **Enter** to enter the top-level menu system (A_OUT, D_OUT, INPUT, MEASURE, etc).



* Factory default setting

Specifications

Supply Voltage (Vcc)
10 V dc to 30 V dc
Use only with a suitable Class 2 power supply (North America)

Power and Current Consumption, exclusive of load
Normal Run Mode: 1.5 W, Current consumption < 62 mA at 24 V dc

Supply Protection Circuitry
Protected against reverse polarity and transient overvoltages

Ambient Light Immunity
10,000 lux

Construction
Housing: stainless steel
Window: acrylic

Output Ratings
Discrete Output: 50 mA maximum (protected against continuous overload and short circuit)
Output saturation voltage (PNP): < 3 V at 50 mA
Output saturation voltage (NPN): < 2.5 V at 50 mA
Analog current output (LM...I Models): 500 Ω maximum

Maximum Torque
1.5 N·m

Remote Input
Allowable Input Voltage Range: 0 to Vcc
Active Low (internal weak pullup—sinking current):
High State: > 3.6 V
Low State: < 2.4 V
Active High (internal weak pulldown—sourcing current):
High State: > Vcc - 2.9 V
Low State: < Vcc - 4.6 V

Minimum Window Size, Analog and Discrete
LM80:
Analog: 1 mm
Discrete: 0.024 mm
LM150:
Analog: 1 mm
Discrete: 0.1 mm

Minimum Object Separation
LM80:
Uniform targets (6% to 90% reflectivity) 40–70 mm: 0.04 mm
Uniform targets (6% to 90% reflectivity) 70–80 mm: 0.06 mm
Non-uniform targets (6% to 90% reflectivity): 0.4 mm
LM150:
Uniform targets (6% to 90% reflectivity) 50–120 mm: 0.120 mm
Uniform targets (6% to 90% reflectivity) 120–150 mm: 0.140 mm
Non-uniform targets (6% to 90% reflectivity): 0.8 mm

Environmental Rating
IEC IP67

Operating Conditions
–10 °C to +55 °C (+14 °F to +131 °F)
90% at +55 °C maximum relative humidity (non-condensing)

Storage Temperature
–35 °C to 60 °C (–31°F to 140 °F)

Sensing Beam
Visible red, 655 nm

Sensing Range
LM80: 40 to 80 mm
LM150: 50 mm to 150 mm

Delay at Power Up
2.1 s

Measurement/Output Rate
0.25 ms to 4 ms; user selectable from the Speed menu

Output Configuration
Analog output: 4 to 20 mA
Discrete output: Push/Pull, IO-Link

Analog Resolution
LM80: 0.002 mm
LM150: 0.004 mm

Repeatability
LM80: ± 0.001 mm[1]
LM150: ± 0.002 mm [2]

Analog and IO-Link Linearity
LM80:
40–70 mm: ± 0.02 mm
70–80 mm: ± 0.03 mm
LM150:
50–120 mm: ± 0.06 mm
120–150 mm: ± 0.07 mm

IO-Link Accuracy[3]
LM80: ± 0.175 mm
LM150: ± 0.2 mm

Temperature Effect, Typical
LM80: ± 0.006 mm/°C
LM150: ± 0.008 mm/°C

Response Time
Total response speed varies from 0.5 ms to 2048 ms, depending on base measurement rate and averaging settings.
See Instruction Manual for more information.

Boresighting
± 0.70 mm at 40 mm
± 0.87 mm at 50 mm
± 1.40 mm at 80 mm
± 2.62 mm at 150 mm

Vibration/Mechanical Shock
Meets IEC 60947-5-2 (10 to 60 Hz max., double amplitude 0.06 in, max acceleration 10G. 30G 11 ms duration, half sine wave)

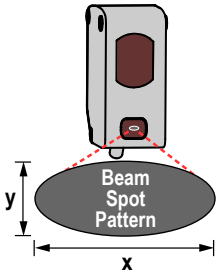
Application Note
For optimum performance, allow 10 minutes for the sensor to warm up

Certifications

UL Type 1

1 Performance with 6% to 90% reflectivity with 128× averaging. With 1× averaging, repeatability of ± 0.004 mm from 40 to 80 mm.
2 Performance with 6% to 90% reflectivity with 128× averaging. With 1× averaging, repeatability of ± 0.005 mm from 50 to 120 mm and ± 0.010 mm from 120 to 150 mm.
3 The accuracy specification refers to the possible absolute offset when installing a sensor without taking any reference measurement. Linearity is the more relevant specification for most applications.

Typical Beam Spot Size[4]



	LM80 Distance (mm)		
	40	60	80
x	0.90	0.63	0.37
y	0.42	0.31	0.21

	LM150 Distance (mm)		
	50	100	150
x	2.12	1.44	0.77
y	0.68	0.49	0.31

Required Overcurrent Protection

WARNING: Electrical connections must be made by qualified personnel in accordance with local and national electrical codes and regulations.

Overcurrent protection is required to be provided by end product application per the supplied table.
Overcurrent protection may be provided with external fusing or via Current Limiting, Class 2 Power Supply.
Supply wiring leads < 24 AWG shall not be spliced.
For additional product support, go to *www.bannerengineering.com*.

Supply Wiring (AWG)	Required Overcurrent Protection (Amps)
20	5.0
22	3.0
24	2.0
26	1.0
28	0.8
30	0.5

FCC Part 15 and CAN ICES-3 (B)/NMB-3(B)

This device complies with part 15 of the FCC Rules and CAN ICES-3 (B)/NMB-3(B). Operation is subject to the following two conditions:

1. This device may not cause harmful interference, and
2. This device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules and CAN ICES-3 (B)/NMB-3(B). These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the manufacturer.

Banner Engineering Corp. Limited Warranty

Banner Engineering Corp. warrants its products to be free from defects in material and workmanship for one year following the date of shipment. Banner Engineering Corp. will repair or replace, free of charge, any product of its manufacture which, at the time it is returned to the factory, is found to have been defective during the warranty period. This warranty does not cover damage or liability for misuse, abuse, or the improper application or installation of the Banner product.

THIS LIMITED WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES WHETHER EXPRESS OR IMPLIED (INCLUDING, WITHOUT LIMITATION, ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE), AND WHETHER ARISING UNDER COURSE OF PERFORMANCE, COURSE OF DEALING OR TRADE USAGE.

This Warranty is exclusive and limited to repair or, at the discretion of Banner Engineering Corp., replacement. **IN NO EVENT SHALL BANNER ENGINEERING CORP. BE LIABLE TO BUYER OR ANY OTHER PERSON OR ENTITY FOR ANY EXTRA COSTS, EXPENSES, LOSSES, LOSS OF PROFITS, OR ANY INCIDENTAL, CONSEQUENTIAL OR SPECIAL DAMAGES RESULTING FROM ANY PRODUCT DEFECT OR FROM THE USE OR INABILITY TO USE THE PRODUCT, WHETHER ARISING IN CONTRACT OR WARRANTY, STATUTE, TORT, STRICT LIABILITY, NEGLIGENCE, OR OTHERWISE.**

Banner Engineering Corp. reserves the right to change, modify or improve the design of the product without assuming any obligations or liabilities relating to any product previously manufactured by Banner Engineering Corp. Any misuse, abuse, or improper application or installation of this product or use of the product for personal protection applications when the product is identified as not intended for such purposes will void the product warranty. Any modifications to this product without prior express approval by Banner Engineering Corp will void the product warranties. All specifications published in this document are subject to change; Banner reserves the right to modify product specifications or update documentation at any time. Specifications and product information in English supersede that which is provided in any other language. For the most recent version of any documentation, refer to: *www.bannerengineering.com*.

For patent information, see *www.bannerengineering.com/patents*.

[4] Beam spot size is the D4σ measured value