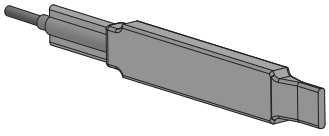
Q7LMEB M-GAGE Flat-Pak Series Sensor

Features



- Suitable for below-ground installation
- Encapsulated circuit board housing sealed with adhesive-lined heat shrink
- Capable of detecting vehicles that have stopped within the sensor's sensing field
- Three-axis magnetoresistive-based technology; senses three-dimensional changes to the Earth's magnetic field caused by the presence of ferrous objects
- Easy sensor installation
- Compact, robust one-piece, self-contained sensor package replaces inductive-loop sensing technology; no external controller is needed
- Designed to minimize the effects of temperature swings and destabilizing magnetic fields
- Sensor learns ambient background and stores settings sensor will not lose configuration or range when power is cycled

WARNING:

- **Appropriate use for vehicle detection**—The mechanical opening, braking, and reversing systems of the door will not respond in sufficient time to prevent moving trucks, cars, or material handling vehicles, even those traveling at low speeds, from coming in contact with the door. In addition, the detection zone of the device may fluctuate due to changes in the local magnetic environment.
- Failure to follow these procedures may result in serious injury or death.
- All vehicles should approach doors at speeds that allow the operator to ensure the door is operating properly and in an open position.

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.

Models

Model [1]	Cable	Cable Type	Supply Voltage	Output Type [2]	Range
Q7LMEB W/6	1.83 m (6 ft) cable	26 gauge/5-wire shielded cable with 4 mm (0.160 in) diameter polyurethane jacket	10 to 30 V DC	Bipolar NPN/PNP	Range varies depending on application and target being sensed. See "Typical Target Excess Gain" on page 7.
Q7LMEB W/15	4.57 m (15 ft) cable				
Q7LMEB W/30	9.14 m (30 ft) cable				
Q7LMEB W/50	15.2 m (50 ft) cable				
Q7LMEB W/100	30.5 m (100 ft) cable				
Q7LMEB W/200	61 m (200 ft) cable				
Q7LMEBQ5	150 mm (5.9 in) cable with a 5-pin M12 quick disconnect				

Overview

The Q7LMEB sensor implements a passive sensing technology to detect large ferrous objects. The sensor measures the change in the Earth's natural magnetic field (the ambient magnetic field) caused by the introduction of a ferromagnetic object.

The Q7LMEB sensor provides a direct replacement for inductive loop systems and needs no external frequency box. Its unique design allows quick installation within a single 3/8 in saw cut. For applications where pavement has not been poured, consider the M-GAGE S18M, which can be mounted or replaced without disrupting the pavement.

For best performance, mount the sensor below-grade, in the center of the traffic lane. The Q7LMEB may be mounted above-ground.

Theory of Operation

The sensor uses three mutually perpendicular magnetoresistive transducers. Each transducer detects magnetic field changes along one axis. By incorporating three sensing elements, maximum sensor sensitivity is achieved.

---

[1] A model with a QD connector requires a mating cable; see "Cordsets" on page 8. QD cables are not suitable for buried applications.
[2] Contact Banner Engineering for other output options.

Original Instructions
17-Jan-25

© Banner Engineering Corp. All rights reserved.

172416
p/n: 172416 Rev D

ПРОМЭЛЕКТРОНИКА/ sales@prom-elec.com

A ferrous object will alter the local (ambient) magnetic field surrounding the object. The magnitude of this magnetic field change is dependent both on the object (size, shape, orientation, and composition) and on the ambient magnetic field (strength and orientation).

During a simple programming procedure, the Q7LMEB measures the ambient magnetic field. When a large ferrous object (for example, a truck, automobile, or rail car) alters that magnetic field, the sensor detects the magnetic field changes (anomalies). When the degree of magnetic field change reaches the sensor's threshold, the sensor's discrete outputs switch.

Sensor Field of View and Range

The sensor range depends on three variables:

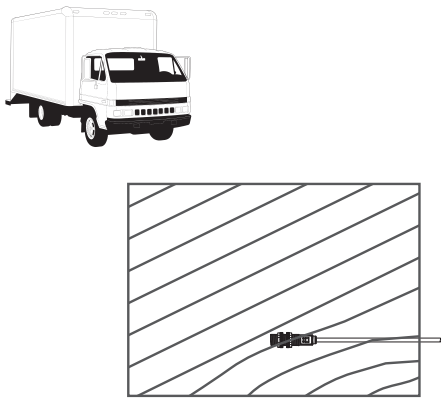
1. The local magnetic environment (including nearby ferrous material)
2. The magnetic properties of the object to be sensed
3. Sensor settings

The Q7LMEB can detect changes in the ambient magnetic field in all directions. As with other sensors, the range will depend on the target. The strong disturbance of a large ferrous object decreases as the distance from the sensor increases, and the magnitude and shape of the disturbance is dependent on the object's shape and content.

The sensor can be programmed to react to magnetic field disturbances of greater or lesser intensity using two adjustments: background condition and sensitivity level.

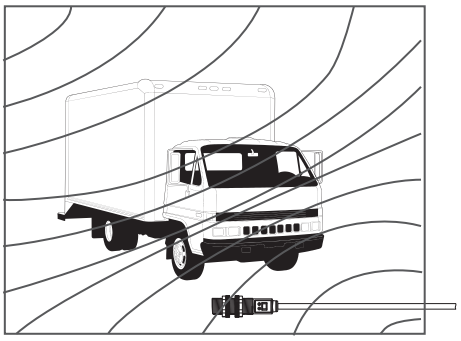
After the background condition and sensitivity level are set, the sensor is ready to detect the target object. Both settings are stored in non-volatile memory.

Baseline Magnetic Field



A. Baseline magnetic field, with slight disturbances caused by permanent ferrous-metal objects within or near the sensor.

Introduction of Large Steel Object



B. After a large steel target object is introduced, the sensor detects the differential (magnetic strength and orientation) between fields A and B. If the differential is greater than the sensitivity threshold, the sensor's outputs conduct.

> **TIP:** Sensor may be mounted inside a non-ferrous architectural detail for cosmetic or security reasons. It is important that, wherever it is mounted, the sensor is securely attached during configuration and all later use. If the sensor moves after being taught, detection errors may occur and sensor must be re-taught. If a sensor appears to lose its taught settings, it may be a result of having shifted position after setup.

Configuration Instructions

Sensor Configuration

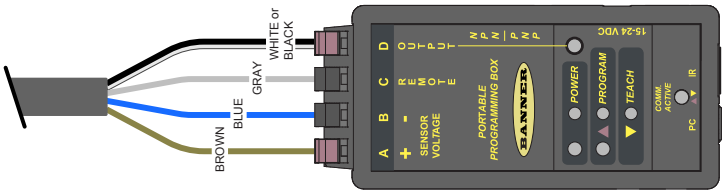
The sensor is configured via its gray Remote wire. The gray wire is always active and the sensor may be re-configured at any time. **For optimum performance, secure the sensor so that it will not move either during or following the configuration.**

Programming pulses may be executed by connecting the sensor's gray wire to the sensor's blue (common) wire with a normally open mechanical button connected between them, or as a low (< 2 V DC) signal from a programmable logic controller (PLC), or using the model DPB1 Portable Programming Box as shown. When a PLC is used for configuration, the pulses are acknowledged via the sensor output signal.

When the DPB1 is used, the pulses are accomplished by clicking the DPB1 **TEACH** push button (0.04 seconds ≤ click ≤ 0.8 seconds). The sensor's output status is reflected by the DPB1 Output indicator LED.

© Banner Engineering Corp. All rights reserved.

Connecting to the model DPB1 Portable Programming Box



Push the TEACH button to pulse the remote wire.

Q7LMEB Configuration

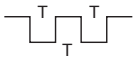
Set Background Condition (No Vehicle Present)

Wire the M-GAGE™ sensor as directed. Remove all vehicles and all other metal objects that are temporarily in the sensing area before setting the background condition.

Configuration (0.04 ≤ T ≤ 0.8 seconds)		Result
Set Background	Single-pulse the remote wire. 	Sensor learns background. Outputs toggle approximately 12 times while the background is taught. Sensor returns to Run mode.

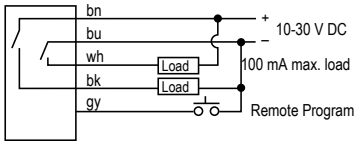
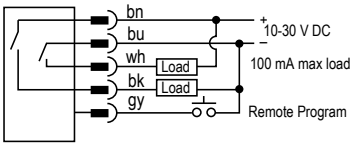
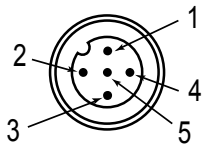
Set Sensitivity Level

Level 1 = least sensitive, Level 6 = most sensitive.

Configuration (0.04 ≤ T ≤ 0.8 seconds)		Result
Access Sensitivity Mode	Double-pulse the remote wire. 	Output toggles 1 to 6 times every 2 seconds to indicate the current sensitivity level (for example, two flashes indicates level 2). When DPB1 is used, the sensor always begins at sensitivity level 1.
Adjust Sensitivity	To increase the sensitivity incrementally, single-pulse the remote wire again; continue until the desired sensitivity level is reached. 	Output toggles from 1 to 6 times every 2 seconds to indicate the sensor's sensitivity level (for example, two flashes indicates level 2).
	Double-pulse the remote wire to save the setting. 	Sensor returns to Run mode.
Test Operation	Drive a vehicle past the sensor to trip the output. Use a small/light vehicle to ensure larger vehicles will be detected later.	Verify Output comes On as expected.
	Adjust the sensitivity as needed.	
Prepare for Operation	Disconnect DPB1 or other temporary switch used for configuration and connect the sensor to a permanent power supply/output device (user-supplied). See "Wiring" on page 4.	

© Banner Engineering Corp. All rights reserved.

Wiring

Cabled Model	Quick-Disconnect Model	Pinout
			1 = Brown 2 = White 3 = Blue 4 = Black 5 = Gray

Installation Instructions

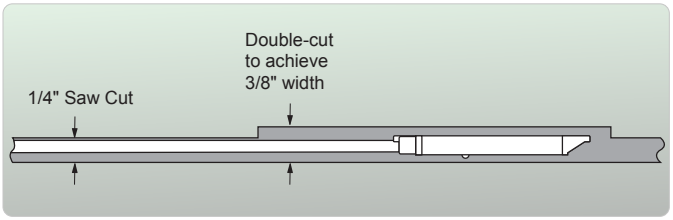
Installing the Q7LMEB Below-Grade

Optimally, the Q7LMEB should be mounted in the center of the vehicle traffic lane (see "Q7LMEB Installation Placement Considerations" on page 5). The axles of the vehicles provide the most effective and most repeatable magnetic field changes. When replacing an inductive loop, the geometric center of the failed loop is typically a good location for mounting.

For applications at the side of the traffic lane, consider the movement of metallic objects within a few feet of the sensor on the side opposite the traffic lane, even if the activity is not visible, for example behind a wall, or inside a building. Consult a Banner Applications Engineer with any questions.

The Q7LMEB sensor's narrow housing allows the sensor to be mounted in pavement, within a single 3/8-in. saw cut. Typically, saw cut depths of 2 inches to 4 inches are sufficient. Consult Banner Engineering Applications if you are planning to install the sensor more than 24 inches below the final grade. The sensor cable will fit into a slot as narrow as ¼ inches If a blade smaller than 3/8 in. is used, make a double cut to account for the sensor width. Rebar or other metal embedded in the pavement will not affect the sensor's performance.

Sensor placed in saw cut in pavement



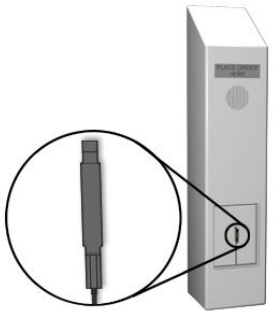
CAUTION: Check for any utility pipes or wires, including heated floors, when cutting into pavement or floors.

Use an air hose to remove loose particles and moisture from the saw cut. Lay the sensor and cable into the saw cut, with the cable extending back to the control cabinet. Fill the saw cut with the loop or pavement sealer. **Do not fill the saw cut with heated asphalt.** Work the sealant around the sensor and cable with a thin object to eliminate any trapped air gaps.

Installing the Q7LMEB Above-Grade

The Q7LMEB is non-directional, and can be mounted in any position. The sensor may be mounted on a non-ferrous architectural detail for cosmetic or security reasons.

Above-Grade Installation



Select a location as close as possible to the vehicle(s) to be detected.

In applications where the sensor is mounted to the side of the vehicle traffic lane (for example, in a kiosk, menu board, or gate control box), consideration must be made for the movement of metallic objects within a few feet of the sensor on the opposite side of the traffic lane, even if the activity is not visible (for example, behind a wall or inside a building). Consult Banner Applications Engineer for further information.

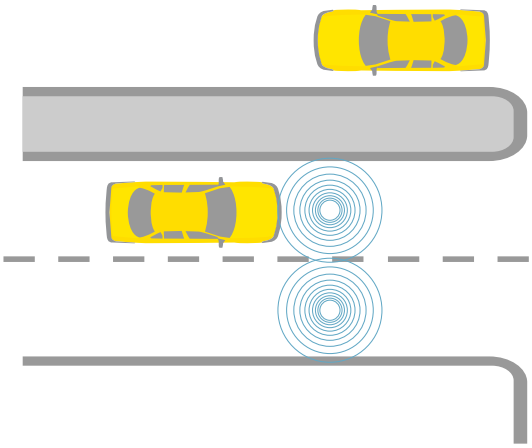
When mounting a QD-cable model, route the cable through conduit for protection from environmental conditions.

Verify the sensor is securely attached during configuration and operation. If the sensor moves after being taught, detection errors may occur and the sensor must be re-taught. If a sensor appears to lose its taught settings, the sensor may have shifted position after configuration.

© Banner Engineering Corp. All rights reserved.

Q7LMEB Installation Placement Considerations

Example good sensor placement

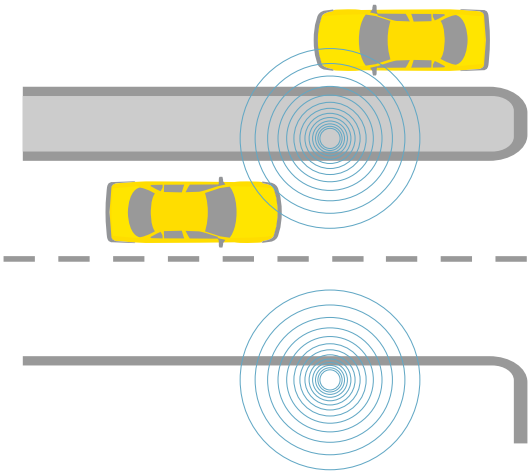


Good Placement

This example shows the optimum placement of M-GAGE sensors for vehicle detection. When the sensor is positioned in the middle of the traffic lane, it can be configured to a lower sensitivity level and still detect vehicles in the lane of interest only. This is known as lane separation, or not detecting a vehicle in an adjacent lane.

A lower sensitivity level also aids the sensor in vehicle separation – detecting a break between the back bumper of a leading vehicle and the front bumper of the next vehicle. With proper placement and configuration, the M-GAGE can achieve vehicle separation with distances of 635 mm (24 in) or less between vehicles.

Example bad sensor placement



Bad Placement

This example depicts a potential problem installation. While mounting the sensor at the side of a lane may be successful, this mounting location increases the potential for detection problems. To reliably detect a vehicle from the side, the sensor sensitivity must be increased to see objects further away in the lane of interest. Unfortunately, this also enables the sensor to detect another object operating behind the sensor or vehicles in adjacent lanes, which will cause false counts.

Place the M-GAGE sensor at the edge of a traffic lane only if there is no possibility of other objects being detected by the sensor. A good practice is to ensure that no vehicles will be within 3.05 m (10 ft) of the sensor on the non-traffic side.

Other Considerations for the Q7LMEB

For sub-surface installations that do not use non-ferrous, environmentally secure enclosures, using loop sealant to provide environmental isolation to the sensor is required. Ensure you fully encapsulate the sensor in environmentally stable sealant as part of the installation process. Please contact Banner Engineering for more information.

Specifications

Supply Voltage

10 V DC to 30 V DC (10% maximum ripple) at 43 mA, exclusive of load

Above +50° C (+122° F), supply voltage is 10 V DC to 24 V DC (10% maximum ripple)

Axis Sensitivity

1.5 counts/milligauss (typical)

Sensing Technology

Passive three-axis magnetoresistive transducer

Supply Protection Circuitry

Protected against reverse polarity and transient voltages

Output Configuration

Two SPST solid-state outputs conduct when object is sensed; Bipolar NPN/PNP

Output Protection

Protected against short-circuit conditions

Remote TEACH Input

Impedance 12K ohms (low ≤ 2 V DC)

© Banner Engineering Corp. All rights reserved.

Adjustments

Configuration of Background Condition and Sensitivity Level may be set by pulsing the gray wire remotely via the portable programming box

Construction

Housing: E-coated aluminum

End Caps: Thermoplastic polyester

Circuit board encapsulated with 2-part polyurethane. Housing sealed with adhesive-lined polyolefin heat shrink.

Output Ratings

100 mA maximum (each output)

NPN saturation: 0.4 V at 10 mA and <2.0 V at 100 mA

NPN OFF-state leakage current: < 200 microamps

PNP saturation: < 1.4 V at 10 mA and < 2.5 V at 100 mA

PNP OFF-state leakage current: < 5 microamps

Output Response Time

20 milliseconds

Delay at Power-Up

0.5 seconds

Drift Filter

Enabled

Time: 4 hours

Connections

Shielded 5-conductor (with drain) polyeuthylene jacketed attached cable or 5-pin Euro-style QD PVC pigtail (see "Cordsets" on page 8)

Sensor Function Control:

Expanded control of XYZ axis

Patent

U.S. Patent 6,546,344 B1

Operating Conditions

–40 °C to +70 °C (–40 °F to +158 °F)

100% maximum relative humidity

Vibration and Mechanical Shock

All models meet Mil. Std. 202F requirements method 201A (vibration: 10 to 60 Hz maximum, double amplitude 0.06 inch, maximum acceleration 10G). Also meets IEC 947-5-2: 30G 11 ms duration, half sine wave.

Environmental Rating

Leak proof design is rated IEC IP69K; NEMA 6P

Certifications

Banner Engineering BV
Park Lane, Culliganlaan 2F bus 3
1831 Diegem, BELGIUM

Turck Banner LTD Blenheim House
Blenheim Court
Wickford, Essex SS11 8YT
GREAT BRITAIN

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

FCC Part 15 Class A for Unintentional Radiators

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

(Part 15.21) Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

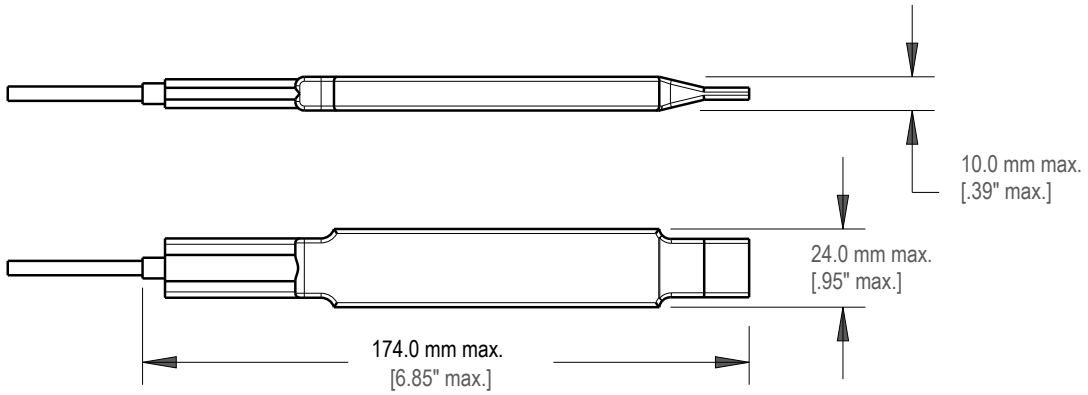
Industry Canada ICES-003(A)

This device complies with CAN ICES-3 (A)/NMB-3(A). 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.

Cet appareil est conforme à la norme NMB-3(A). Le fonctionnement est soumis aux deux conditions suivantes : (1) ce dispositif ne peut pas occasionner d'interférences, et (2) il doit tolérer toute interférence, y compris celles susceptibles de provoquer un fonctionnement non souhaité du dispositif.

© Banner Engineering Corp. All rights reserved.

Dimensions



Typical Target Excess Gain

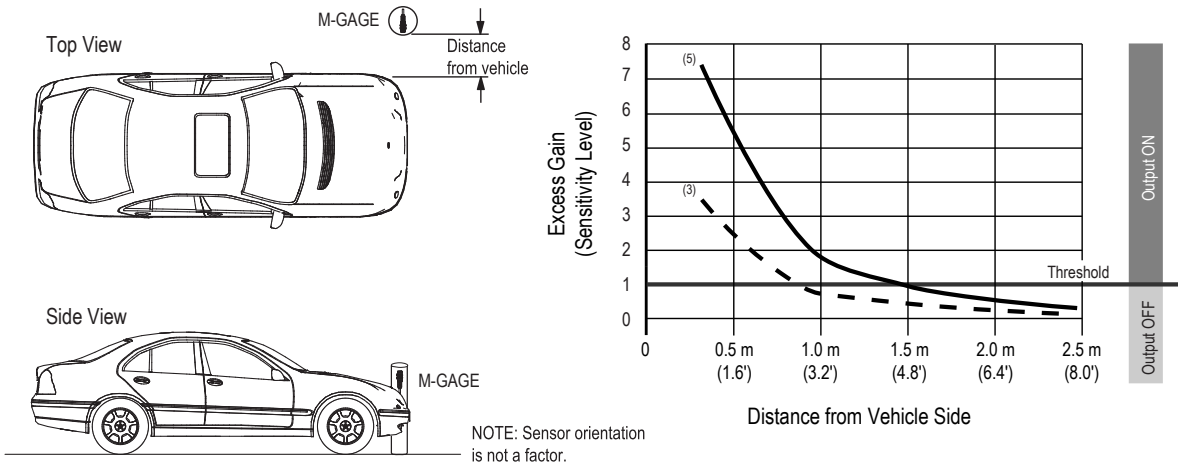
If the sensitivity is at Level 6, then the excess gain at a given distance would be 1.3 times larger than for a Level 5 sensitivity. Conversely, if the sensitivity threshold is Level 1, then the excess gain would be one third as big as for Level 5.

Excess gain vs sensitivity level (assumes level 5) compares the change in excess gain if the sensitivity level changes

Level	Excess Gain Multiplier
1	0.33
2	0.4
3	0.5
4	0.66
5	1.0 (default)
6	1.3

After the sensor has been securely mounted and configured, it is ready to operate. The following example application shows typical responses for the M-GAGE™ sensor. This example describes mounting the M-GAGE™ 1 meter (3.3 ft) above the ground to sense an automobile. The graph shows the excess gain for a typical car. Excess gain is a measure of the amount of extra signal detected by the sensor over and above the Level needed to detect the target. This example assumes a Level 5 sensitivity threshold.

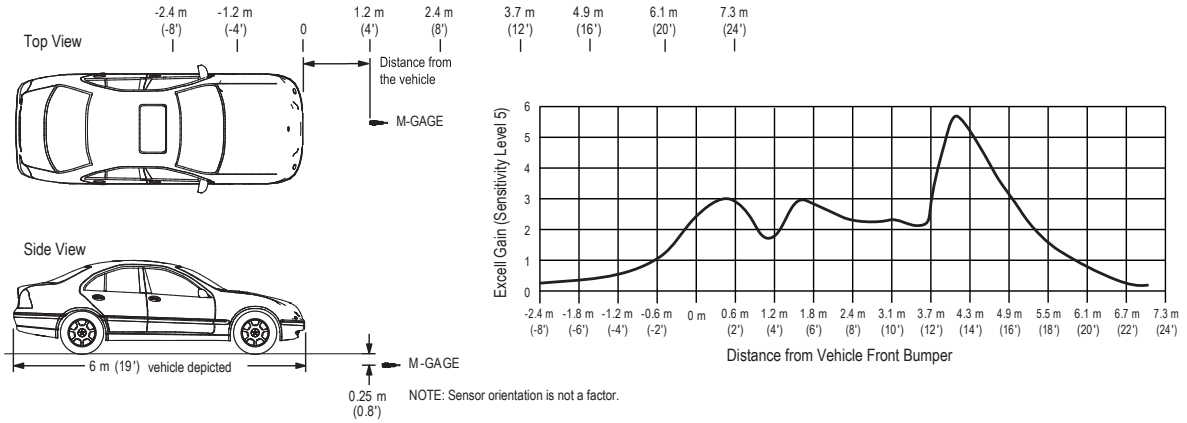
Application example: sensor mounted 1 meter (3.3 ft) above ground



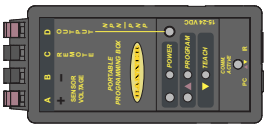
This example example illustrates a typical vehicle passing over a sensor mounted underground. Note that excess gain is greatest when the bulk of the vehicle (the rear axle) is positioned directly over the sensor.

© Banner Engineering Corp. All rights reserved.

Application example 2: sensor mounted 0.25 meters (0.8 ft) below ground

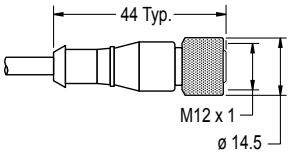
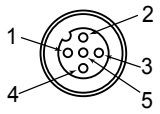
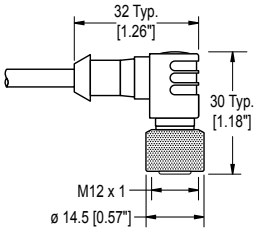


Accessories

Model	Description	
DPB1	Handheld Portable Programming Box, used for configuring sensor when the push button is not accessible	
SP-DPB1	Optional 115 V AC power supply for DPB1 Handheld Portable Programming Box	

Cordsets

Quick-disconnect cordsets are not suitable for buried applications.

5-Pin Single-Ended M12 Female Shielded Cordsets				
Model	**Length**	**Style**	**Dimensions**	**Pinout (Female)**
MQDEC2-506	2 m (6.56 ft)	Straight		
MQDEC2-515	5 m (16.4 ft)			
MQDEC2-530	9 m (29.5 ft)			
MQDEC2-550	15 m (49.2 ft)			
MQDEC2-575	23 m (75.44 ft)			
MQDEC2-5100	30.5 m (100 ft)			
MQDEC2-506RA	2 m (6.56 ft)	Right-Angle		1 = Brown 2 = White 3 = Blue 4 = Black 5 = Gray
MQDEC2-515RA	5 m (16.4 ft)			
MQDEC2-530RA	9 m (29.5 ft)			
MQDEC2-550RA	15 m (49.2 ft)			
MQDEC2-575RA	23 m (75.44 ft)			
MQDEC2-5100RA	31 m (101.68 ft)			

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.

© Banner Engineering Corp. All rights reserved.

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.

© Banner Engineering Corp. All rights reserved.