DX80 M-GAGE Traffic Node (D Cell Battery)

M-GAGE Features (D Cell)

The Sure Cross® wireless system is a radio frequency network with integrated I/O that operates in most environments to eliminate the need for wiring runs.



- Internal three-axis magnetoresistive-based technology senses three-dimensional changes to the Earth's magnetic field caused by the presence of ferrous objects
- Designed to minimize the effects of temperature changes and destabilizing magnetic fields
- Sensor learns ambient background and stores settings in non-volatile memory
- Powered by a lithium D-cell battery integrated into the housing
- Frequency Hopping Spread Spectrum (FHSS) technology ensures reliable data delivery
- Transceivers provide bidirectional communication between the Gateway and Node, including fully acknowledged data transmission
- Lost RF links are detected and relevant outputs set to user-defined conditions
- Fully potted and sealed housing contains the power source, sensor, and antenna for a completely wireless solution

For additional information, updated documentation, and a list of accessories, refer to Banner Engineering's website, www.bannerengineering.com.

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.

M-GAGE (D Cell) Models

Models	Power	Frequency	Inputs
DX80N9X1W0P0ZTD	D-cell lithium battery integrated into the housing	900 MHz ISM Band	Internal M-GAGE™
DX80N2X1W0P0ZTD		2.4 GHz ISM Band	

M-GAGE Overview

The M-GAGE Node uses a passive sensing technology to detect large ferrous objects. The sensor measures the change in the Earth's natural (ambient) magnetic field caused by the presence of vehicles or other ferromagnetic objects.

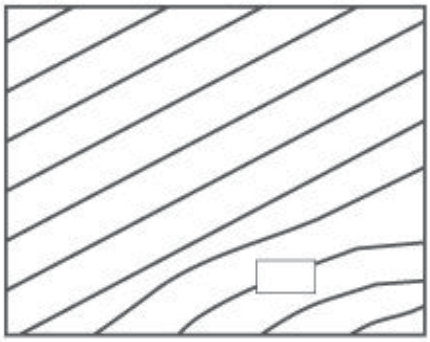
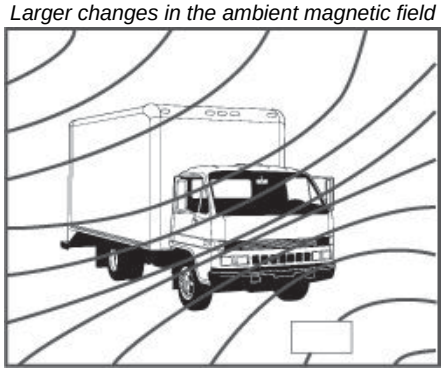
When a vehicle is detected, the M-GAGE Node output changes. After the vehicle leaves the desired position, the magnetic field returns to its natural state and the M-GAGE Node turns off its output signal to the master radio.

Original Instructions
September 13, 2023

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p/n: 180451 Rev. F

ПРОМЭЛЕКТРОНИКА/ sales@prom-elec.com

Small changes in the ambient magnetic field	*Larger changes in the ambient magnetic field*
	
Baseline magnetic field with slight disturbances caused by permanent ferrous-metal objects within or near the sensor.	After a large object is introduced, the magnetic field changes. The sensor detects the changes in the field's strength and orientation between the ambient field and the field produced by a large metal object. If the differential is greater than the sensitivity threshold, the device reports a change of state.

The sensor range depends upon three variables:

- The local magnetic environment (including nearby ferrous material)
- The magnetic properties of the object to be sensed
- Sensor settings

The M-GAGE detects changes in the ambient magnetic field in all directions. As with other sensors, the range depends upon the target. The strong disturbance of a large ferrous object decreases as distance from the sensor increases; the magnitude and shape of the disturbance depends upon the object's shape and content. The sensor can be programmed to react to magnetic field disturbances of greater or lesser intensity, using three adjustments: baseline, threshold, and hysteresis.

NOTE: The sensor continues to sense a vehicle in its sensing field even when the vehicle is stopped.

The placement of the M-GAGE Node is critical for proper operation. Because the M-GAGE sensor detects anomalies in the Earth's magnetic field in the immediate space around the sensor, it must be placed in a prescribed location to properly detect vehicle presence.

Before installing the M-GAGE Node in the pavement, bind the Node to its master radio. For this installation guide, the master radio is a DXM Controller. The master radio may also be a Performance Gateway.

After the Node is installed, the DXM Controller monitors the M-GAGE Node's output and radio connection. The output of the DXM Controller can connect to an input (PNP) on any industrial programmable logic controller, industry controllers or visual/audible indication.

Gateway Optimization for M-GAGE Nodes

Any Sure Cross® Gateway transmitting at 150 mW or 250 mW works with the M-GAGE Nodes. To optimize the communications between the Gateway and M-GAGE radios and maximize the M-GAGE battery life, use the DX80 Performance Configuration Software to configure the Gateway to use heartbeat mode and to define the network size.

1. In the **System Parameters › Heartbeat Config** screen, set the Node Heartbeat Interval to five minutes (300 seconds), and set the Number of Misses to 32.
2. Click **Send** to send the changes to the Gateway.
3. Use the **System Parameters › Network Size** screen in the UCT to set the network size to 47 Nodes.
4. Click **Send** to send the changes to the Gateway.

Baseline Function

The baseline function of the M-GAGE Node stores the ambient magnetic field values of the X, Y, and Z axes as a baseline reading. Once this baseline is established, any deviation in the magnetic field will be reflected in the M-GAGE register. The more disruption in the magnetic field, the larger the M-GAGE register value.

For a host-connected system using standard Gateways, set the baseline magnetic field by writing to a Modbus register. Sending the value of 4096 (0x1000) to the Node's I/O point 15 (Control Message) triggers the M-GAGE to read the existing magnetic field as the new baseline.

For non-host connected systems, use one of the two special M-GAGE Gateways to set the baseline:

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- The inputs of the DIP switch M-GAGE Gateway (model DX80G*M6*6P6ZP) are mapped to the M-GAGE Node's I/O point 14. Activating the Gateway's input for at least five seconds triggers the M-GAGE to use the existing magnetic field as the new baseline.
- The special M-GAGE Gateway (model DX80G*M6*6P6Z) uses special mapping to baseline up to six M-GAGE Nodes.

Using the LED Light

The LED flashlight is used to set device modes, such as entering binding mode.



Click and Hold. Click and hold the LED light at the receiving window to wake a wireless device from "deep sleep." If your device is not in "deep sleep," clicking and holding the LED light will put it into "deep sleep." While in "deep sleep" mode, the device does not attempt to transmit to a parent radio and remains in deep sleep until an LED light at the receiving window wakes it up.

Three clicks. Triple clicking at the receiving window puts the device into binding mode. The device binds to the Device ID the master radio is set to. Before putting the device into binding mode, verify the master radio's rotary dials are set to ensure the device will be binding to the correct device ID.

If the device is in binding mode, double-click the LED light to exit binding mode.

Model Number: BWA-MGFOB-001

Wake the M-GAGE from Deep Sleep Mode

Because the M-GAGE uses an internal battery, the device ships from the factory in a deep sleep mode. While in deep sleep mode, the M-GAGE does not attempt to transmit to a parent radio and remains in deep sleep until an LED light at the receiving window wakes it up.

Follow these instructions to wake the device from deep sleep mode.

M-GAGE receiver window



1. Point the optical commissioning device at the receiver.
   The red arrow is pointing to the receiver window.
2. Click and hold the optical commissioning device's button until the red/green LED in the center of the M-GAGE lights up, about five seconds.
   When the device wakes up, the LEDs flash according to the LED table.

To return the M-GAGE back to its deep sleep mode, click and hold the optical commissioning button until the red LED in the center of the M-GAGE stops blinking, about five seconds.

Setting Up Your Wireless Network

To set up and install your wireless network, follow these steps.

For complete instructions, including binding, configuration, installation, weatherproofing, device menu maps, troubleshooting, and a list of accessories, refer to Sure Cross® Wireless I/O Network Instruction Manual (p/n 132607)

1. Disconnect the power from your Sure Cross® devices.
2. Configure the DIP switches of all devices. DIP switch configurations are always listed in the product's datasheet.
3. If your device has I/O, connect the sensors to the Sure Cross devices. Available I/O is always listed in the product's datasheet. If your device does not have I/O, skip this step.
4. Refer to the wiring diagrams to apply power to all devices.
   - For housed models, the Gateway's LED 1 is solid green and the Node's LED 2 flashes red to indicate there is no radio link to the Gateway.
   - For board-level models, the Gateway's LED is solid green and the Node's LED flashes red to indicate there is no radio link to the Gateway.
5. Form the wireless network by binding the Nodes to the Gateway.
6. Observe the LED behavior to verify the devices are communicating with each other.

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- For housed models, the Gateway's LED 1 is solid green and the Node's LED 1 flashes green to indicate it is communicating with the Gateway.
- For board-level models, the Gateway's LED is solid green and the Node's LED flashes green to indicate it is communicating with the Gateway.

7. Configure any I/O points to use the sensors connected to the Sure Cross devices.
8. Conduct a site survey between the Gateway and Nodes.
9. Install your wireless sensor network components.

Binding Radios to Form Networks (M-GAGE Optical Commissioning models)

Verify the Gateway is set to use Extended Addressing Mode (DIP switch 1 ON) before binding the Node to the Gateway. (Refer to the Setting DIP Switches section of the datasheet for instructions on accessing the DIP switches.) The Gateway and Node must both be powered to run binding mode.
Before using the M-GAGE devices, you must bind them to the Gateway and assign a Node address using the Gateway's rotary dials. There are no physical switches or dials on the M-GAGE Node. To bind and address an M-GAGE, follow these steps.

1. Put the Gateway into binding mode.
   - If your Gateway has buttons, triple-click button 2 to enter binding mode.
   - If your Gateway does not have buttons, remove the rotary dial access cover and set both the right and left rotary dials to 0, then set both the right and left rotary dials to F. Note that both rotary dials must be changed to F after applying power, not before applying power.

   The red LEDs flash alternately when the Gateway is in binding mode. Any Node entering binding mode will bind to this Gateway.
2. Using the Gateway's rotary dials, select the Node address to assign to the M-GAGE. Use the left rotary dial for the left digit and the right rotary dial for the right digit.

   For example, to assign your M-GAGE to Node 10, set the left dial to 1 and the right dial to 0. (Device ID 00 is reserved for the Gateway. Nodes assigned to 00 will not bind to a Gateway.)
3. On the M-GAGE Node, place the optical commissioning device in contact with the clear plastic housing and pointed directly at the configuration port indicated by the label.
4. Click the button on the optical commissioning device three times to place the Node into binding mode.

   (If the Node is in its "slow scan" mode, this will wake up the Node as well as begin binding mode.)

   If binding doesn't occur within 60 seconds, the Node exits binding mode. After entering binding mode, the M-GAGE LEDs blink slowly, alternating between red and green. After the M-GAGE receives a valid binding code from the Gateway, the red and green LEDs are both illuminated continuously, resulting in a slightly orange light.
5. Click the button on the optical commissioning device three times to accept the binding code and return to RUN mode.
   If the binding code is not accepted within 60 seconds, the Node exits binding mode. The red and green LEDs simultaneously flash four times to indicate that the M-GAGE accepts the binding code. The M-GAGE enters RUN mode. Note: If the M-GAGE is in binding mode and the user does not accept the binding code with a triple click from the optical commissioning device, the M-GAGE automatically exits binding mode after one hour and returns to the previous binding code.
6. Write the Node address on the Node's label.
7. Repeat steps 3 through 6) for as many M-GAGE Nodes are you need to bind. When using this addressing system, up to 47 Nodes may be addressed by a single Gateway.
8. Exit binding mode on the Gateway.
   - If your Gateway has buttons, single-click either button 1 or button 2 to exit binding mode and reboot.
   - If your Gateway does not have buttons, change the Gateway's rotary dials to a valid Network ID. Valid Network IDs are 01 through 32, in decimal, established using both rotary dials. The left dial may be set to 0, 1, 2, or 3. The right dial may be set from 0 to 9 when the left dial is at 0, 1, or 2; or set to 0 through 2 when the left dial is at 3. (Positions A through F are invalid network ID numbers.)

   A few seconds after exiting binding mode, the M-GAGE Node's LED blinks green, indicating it is synchronized to the Gateway. The Gateway enters standard operating mode with the LCD autoscrolling through the menu options.

If two Nodes are accidentally assigned the same Node address, rerun the binding procedure on one of the Nodes to reassign the address. The binding sequence may be run on a Node as many times as necessary.

M-GAGE LEDs

One two-color LED under the clear lid indicates the M-GAGE status.

Green blinking (1 per second). The M-GAGE is synchronized with the DX80 Gateway.

Green blinking (slow). The M-GAGE is synchronized with the DX80 Gateway in power-saving heartbeat mode. The slow blink is once every two seconds for 2.4 GHz models and once every four seconds for 900 MHz models.

Red blinking (every 3 seconds). The M-GAGE is attempting to synchronize with the DX80 Gateway.

No light. The M-GAGE is attempting to synchronize with the Gateway and it is in slow scan mode or hibernate/storage mode.

Alternating red and green blinking. The M-GAGE has entered binding mode.

Red and green on at the same time (looks orange). The M-GAGE has received the binding code.

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Red and green flash simultaneously four times (looks orange). The M-GAGE has accepted the binding code and has entered RUN mode.

Slow scan mode occurs when the M-GAGE is out of synchronization with the Gateway for more than 15 minutes. After the M-GAGE enters slow scan mode, the M-GAGE may still synchronize with a Gateway, but the scanning period is longer. After the M-GAGE is synchronizes to the Gateway, the M-GAGE returns to standard operating mode.

Configuration Instructions

Modbus Register Table (M-GAGE)

I/O #	Modbus Holding Register		I/O Type
	Gateway	Any Node	
1	1	1 + (Node# × 16)	M-GAGE
		...	
7	7	7 + (Node# × 16)	Reserved
8	8	8 + (Node# × 16)	Device Message
		...	
13	13	13 + (Node# × 16)	Configuration Message
14	14	14 + (Node# × 16)	Baseline Command
15	15	15 + (Node# × 16)	Control Message
16	16	16 + (Node# × 16)	Reserved

There are sixteen Modbus holding registers for each device. Calculate the holding register number for each device using the equation: Register number = I/O# + (Node# × 16).

Because the Gateway is always device 0, the Gateway's holding registers are registers 1 through 16. Registers for Node 1 are 17 through 32. Using the equation, the register number for I/O point 15 for Node 7 is 127.

The M-GAGE value in I/O 1 is the deviation between the total measured magnetic field in the X, Y, and Z axes and the stored baseline. To send configuration messages, use the Node's I/O point 13. To create a baseline command, use a control message or use the Node's I/O point 14. For more instructions, refer to the Baseline section.

Configuring M-GAGE Parameters Using the Configuration Software

Go to the **Configuration › Device Configuration** screen of the Key definition for "{keyrefName}" not found in the DITA map. to configure the M-GAGE parameters listed below.

To configure your M-GAGE inputs, select M-GAGE Reading from the Input type drop-down list.

M-GAGE Parameters

M-GAGE Report Rate (Inputs) —The report rate defines how often the Node communicates the I/O status to the Gateway. For battery-powered applications, setting the report rate to a slower rate extends the battery life.

M-GAGE Sample High and M-GAGE Sample Low—For analog inputs, the sample high parameter defines the number of consecutive samples the input signal must be above the threshold before a signal is considered active. Sample low defines the number of consecutive samples the input signal must be below the threshold minus hysteresis before a signal is considered deactivated. The sample high and sample low parameters are used to avoid unwanted input transitions. This parameter can be applied to a discrete input or a analog input using the threshold parameter.

M-GAGE Sample Rate—The sample interval, or rate, defines how often the Sure Cross device samples the input. For battery-powered applications, setting a slower rate extends the battery life.

M-GAGE Threshold and M-GAGE Hysteresis— Threshold and hysteresis work together to establish the ON and OFF points of an analog input. The threshold defines a trigger point or reporting threshold (ON point) for a sensor input. When the input value is higher than the threshold, the input is ON. Hysteresis defines how far below the threshold the analog input is required to be before the input is considered OFF. A typical hysteresis value is 10% to 20% of the unit's range.

The M-GAGE Node's threshold and hysteresis ranges are 0 to 65,535. The factory default threshold setting is 100 and default hysteresis is 30 (the sensor detects an OFF condition at threshold minus hysteresis, or 100 - 30 = 70). With the default settings, once the magnetic field reading is above 100, an ON or "1" is stored in the lowest significant bit (LSB) in the Modbus register. When the M-GAGE reading drops below the OFF point (threshold minus hysteresis), the LSB of the Modbus register is set to "0." To determine your threshold, take M-GAGE readings of the test objects at the distance they are likely to be from the sensor. For example, if a car reads 100, a bicycle 15, and a truck

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reads 200, setting the threshold to 150 will detect only trucks of a specific size. Magnetic field fluctuations vary based on the amount of ferrous metal present and the distance from the sensor.

If the threshold parameter is 0, there is no threshold and the analog input will report based on the delta rate. Value range: 0 (disable, default) through 65535 (two-byte value).

The following filter parameters are advanced configuration parameters and are for engineering use only:

- **M-GAGE Baseline Threshold/Filter**—Under normal conditions, the ambient magnetic field fluctuates. When the magnetic field readings drift below a threshold setting, the baseline or drift filter uses an algorithm to slowly match the radio device's baseline to the ambient magnetic field. The baseline threshold/filter parameter sets a baseline threshold and filter activation time on M-GAGE devices. When M-GAGE input readings are below the selected baseline threshold setting, the filter algorithm slowly lowers the magnetic baseline reading to zero to remove small changes in the magnetic field over time.
- **M-GAGE Low Pass Filter**—The filters T0 through T6 are parameter settings that define the degree of input digital signal filtering for analog inputs. T0 is the least amount of filtering. T6 is the highest filter setting and has the least amount of fluctuation between readings.
- **Compensation Filter Adjustment**—Set the compensation filter adjustement using the **Serial address** field within the configuration software.

Configuring the M-GAGE Using Register 13

A host system can configure the M-GAGE Node by setting I/O 13 on the M-GAGE Node. Writing a defined value to the Modbus register sets the M-GAGE operation immediately. The following parameters can be configured by writing to the M-GAGE Node Modbus register 13. The host system must resend the configuration settings if power is cycled to the wireless system.

	Modbus Register 13 [15:8]							
	Low Pass Filter			**Sample High/Sample Low Counter**			**Report Rate**	
Device Settings	**15**	**14**	**13**	**12**	**11**	**10**	**9**	**8**
No Change	0	0	0					
No Low Pass Filter	0	0	1					
Low Pass Filter T0	0	1	0					
Low Pass Filter T1	0	1	1					
Low Pass Filter T2	1	0	0					
Low Pass Filter T3	1	0	1					
Low Pass Filter T4	1	1	0					
Low Pass Filter T6	1	1	1					
No Change				0	0	0		
1				0	0	1		
2				0	1	0		
3				0	1	1		
4				1	0	0		
8				1	0	1		
16				1	1	0		
32				1	1	1		
No Change							0	0
On Change of State							0	1
16 seconds							1	0
Sample Rate							1	1

	Modbus Register 13 [7:0]							
	Sample Rate			**Baseline Filter**		**Threshold and Hysteresis**		
Device Settings	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
No Change	0	0	0					
62.5 milliseconds	0	0	1					
125 milliseconds	0	1	0					

Continued on page 7

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Continued from page 6

	Modbus Register 13 [7:0]							
	Sample Rate			Baseline Filter		Threshold and Hysteresis		
Device Settings	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
250 milliseconds	0	1	1					
500 milliseconds	1	0	0					
1 second	1	0	1					
31 milliseconds	1	1	0					
20 milliseconds	1	1	1					
No Change				0	0			
Filter Off				0	1			
Filter Threshold 30, 2 hour				1	0			
Filter Threshold 30, 8 hour				1	1			
No Change						0	0	0
Threshold: 50, Hysteresis: 15						0	0	1
Threshold: 100, Hysteresis: 30						0	1	0
Threshold: 150, Hysteresis: 30						0	1	1
Threshold: 200, Hysteresis: 30						1	0	0
Threshold: 300, Hysteresis: 40						1	0	1
Threshold: 500, Hysteresis: 50						1	1	0
Threshold: 800, Hysteresis: 60						1	1	1

Sending the Configuration Message to Register 13

Modbus command 06 (write single holding register) is used in this example to set the parameter values for the M-GAGE Node. A sample configuration message for Node 1:

	Low Pass Filter			Sample High Counter			Report Rate		Sample Rate			Baseline Filter		Threshold and Hysteresis		
Bits	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Values	0	0	0	0	1	0	1	1	0	1	0	0	1	1	0	1
Hex	0			B					4			D				

Sending this configuration message to register 13 sets the low pass filter to “no change;” the sample high counter to 2; the report rate and sample rate to 125 milliseconds; the baseline filter to 0, 15; the threshold to 300; and the hysteresis to 40.

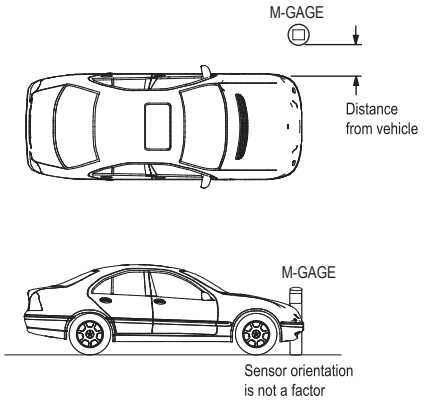
The complete Modbus command, in hexidecimal, is:

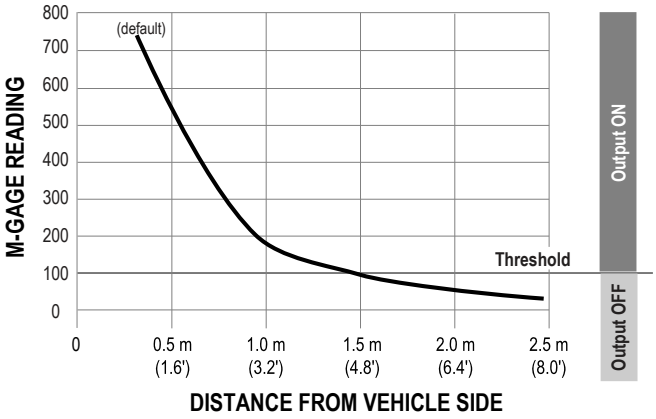
Slave ID#	Modbus Command	Register Number		Configuration Value			
01	06	00	1C	0B	4D	CRC	CRC

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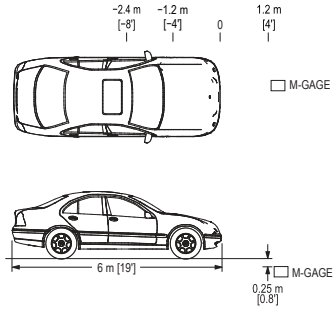
M-GAGE Installation

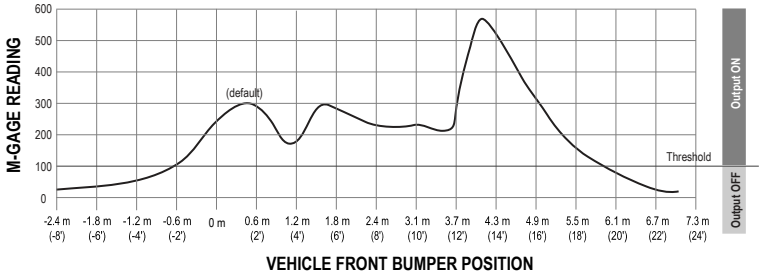
M-GAGE Reading when installed 1 meter above the ground.





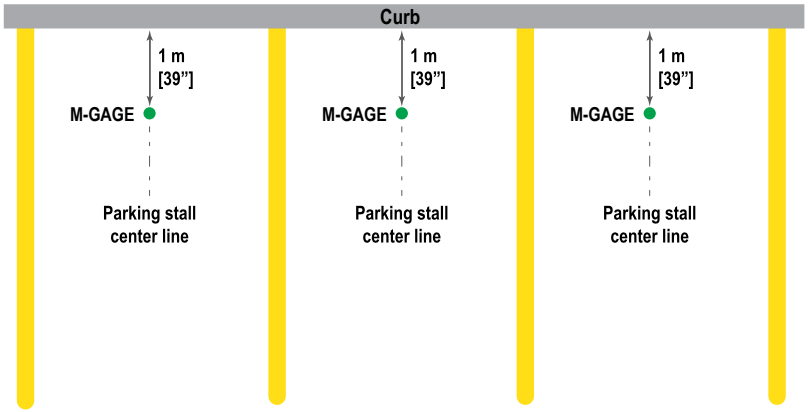
M-GAGE Reading when installed underground.





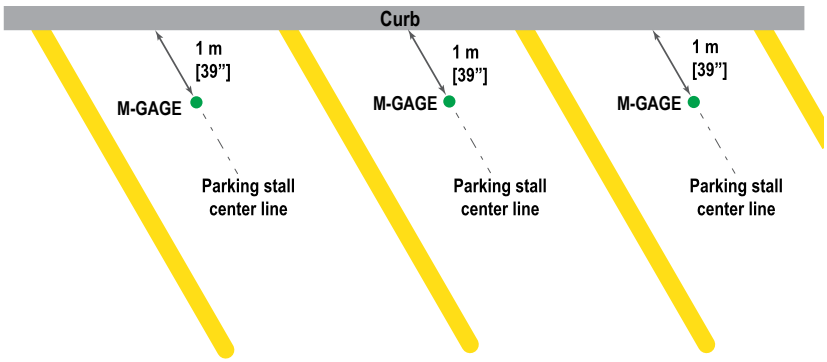
Placing the M-GAGE

Optimum M-GAGE placement perpendicular parking stalls

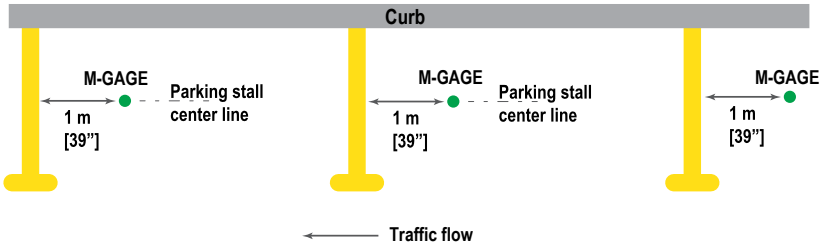


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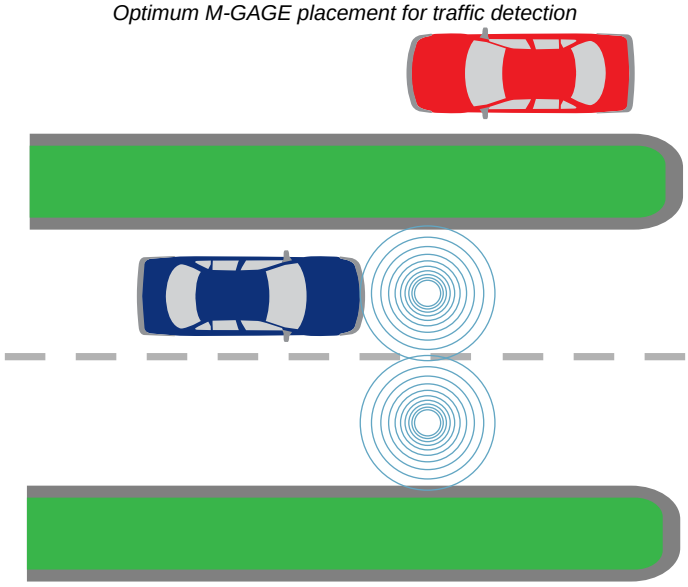
Optimum M-GAGE placement for angled parking stalls



Optimum M-GAGE placement for parallel parking stalls



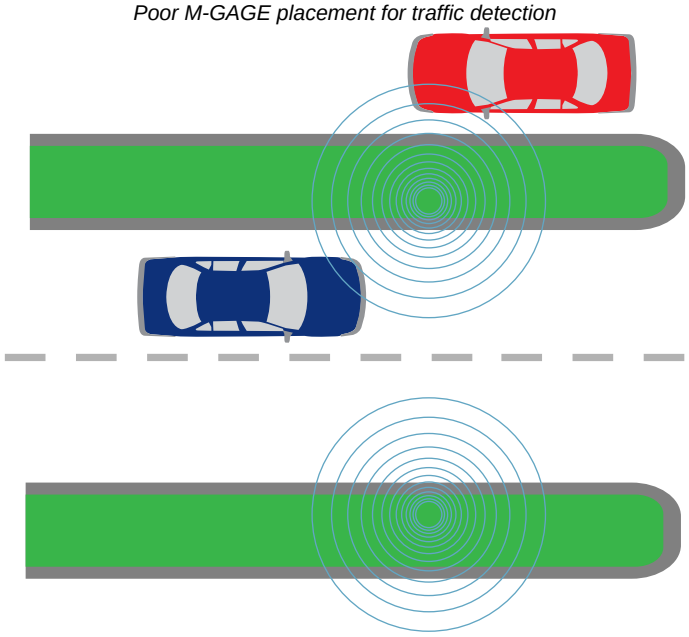
Optimum M-GAGE placement for traffic detection



When the sensor is positioned in the middle of the traffic lane, it can be configured to a threshold level to detect vehicles only in the lane of interest. This is known as lane separation. A threshold 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 24 inches or less.

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Poor M-GAGE placement for traffic detection



Although mounting the sensor at the side of a lane may be successful, this mounting location increases the potential for problems. To reliably detect a vehicle from the side, the sensor threshold must be increased to see objects farther away in the lane of interest. Unfortunately, this enables the sensor to also detect lawn mowers in the median or vehicles in adjacent lanes, causing false counts. Place the M-GAGE sensor at the edge of a traffic lane only if there is no possibility of the sensor detecting other objects. To avoid detecting other objects, ensure no vehicles will be within 10 feet of the sensor on the non-traffic side.

Buried Installation

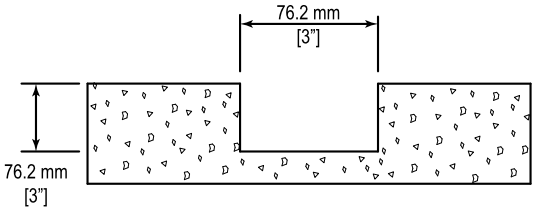
- Always wear proper eye protection when grinding or drilling.
- Gloves, hearing protection, and sturdy boots are highly recommended.
- Always read and follow all specific instructions and safety precautions provided by the manufacturer of all equipment.

Required equipment includes:

- 3” Coring equipment. Many options exist; choose what works best for the conditions of your installation site.
- Sealer. We recommend using a flexible, weather-proof liquid asphalt/concrete repair compound suitable for your needs. Banner Engineering used Fabick Protective Coatings joint sealers for test installations. Banner recommends Fabrick Pour-Pac™ MP-55. See www.fabick.com/sealants.html for more information.

The installation objective is to fully encapsulate the M-GAGE sensor in sealant.

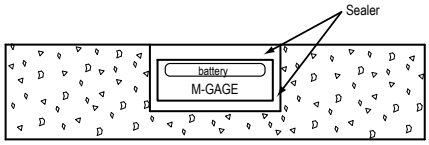
1. Bind and configure all devices before continuing.
2. Drill a 3 inch diameter hole to a depth of about 3 inches. Use a chisel to break off the plug of material and remove any loose material remaining in the bottom of the hole.



3. Verify all surfaces inside and near the hole are free of debris, warm (consult sealer manufacturer data for temperature threshold data), and thoroughly dry.
4. Repeat steps 1 through 3 for all locations.
5. One hole at a time, pour 0.25 inches of sealer into the hole.
6. Battery side up, place the M-GAGE into the hole and rotate until the internal antenna (black wire inside the housing) is facing the master radio location. Do NOT position so that the battery is between the antenna wire and the master radio.
   The top of the M-GAGE should be about 1.5 inches below the surface.
7. Verify the M-GAGE is communicating with its master radio.

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8. Immediately fill the spaces surrounding the device with sealer. Completely fill the hole with sealer to avoid leaving a recess that collects water and dirt.



9. Repeat steps 5-8 for all M-GAGE Nodes.
10. Allow the sealant to set and harden. The M-GAGE Node is now properly installed.

M-GAGE (D Cell) Specifications

Radio Range[1]

900 MHz: 300 m (1000 ft)

2.4 GHz: 150 m (500 ft)

Radio Transmit Power

900 MHz: 20 dBm (100 mW) conducted

2.4 GHz: Conducted: < 18 dBm (65 mW); EIRP with the supplied 2 dB antenna: < 20 dBm (100 mW)

900 MHz Compliance (150 mW)

Contains FCC ID: TGUDX80: FCC Part 15, Subpart C, 15.247

Contains IC: 7044A-DX8009

2.4 GHz Compliance (DX80-2400 Radio Module)

Radio module is indicated by the product label marking

Contains FCC ID: UE300DX80-2400: FCC Part 15, Subpart C, 15.247

Radio Equipment Directive (RED) 2014/53/EU

Contains IC: 7044A-DX8024

ANATEL: 15966-21-04042

ANATEL
Agência Nacional de Telecomunicações

Spread Spectrum Technology

FHSS (Frequency Hopping Spread Spectrum)

Link Timeout (Performance)

Gateway: Configurable via User Configuration Software

Node: Defined by Gateway

[1] Radio range depends on the environment and line of sight and is lower when buried.

Housing

ABS

Weight: 0.14 kg (0.3 lbs)

Power Requirements

Lithium battery pack (D cell) integrated into the housing

Battery Life: Up to 10 years

Battery life is dependent upon installation, radio frequency (RF) signal quality, the number of RF transmissions, and environmental conditions.

Interface

One bi-color LED indicator

M-GAGE Inputs

Input: Internal Magnetometer

Sample Rate: 250 milliseconds

Report Rate: On Change of State

Ambient Temperature Effect: Less than 0.5 milligauss/°C

Sensing Range: See figures on previous pages

Environmental Rating

IEC IP67; NEMA 6

Operating Conditions

–40 °C to +85 °C (–40 °F to +185 °F)

95% maximum relative humidity (non-condensing)

Radiated Immunity HF

10 V/m (EN 61000-4-3)

Shock and Vibration

All models meet IEC 60068-2-6 and IEC 60068-2-27 testing criteria

Shock: 30G 11 ms duration, half sine wave per IEC 60068-2-27

Vibration: 10 Hz to 55 Hz, 0.5 mm peak-to-peak amplitude per IEC 60068-2-6

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.

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

Exporting Sure Cross® Radios

Exporting Sure Cross® Radios. It is our intent to fully comply with all national and regional regulations regarding radio frequency emissions. **Customers who want to re-export this product to a country other than that to which it was sold must ensure the device is approved in the destination country.** The Sure Cross wireless products were certified for use in these countries using the antenna that ships with the product. When using other antennas, verify you are not exceeding the transmit power levels allowed by local governing agencies. This device has been designed to operate with the antennas listed on Banner Engineering's website and having a maximum gain of 9 dBm. Antennas not included in this list or having a gain greater than 9 dBm are strictly prohibited for use with this device. The required antenna impedance is 50 ohms. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen such that the equivalent isotropically radiated power (EIRP) is not more than that permitted for successful communication. Consult with Banner Engineering Corp. if the destination country is not on this list.

FCC Part 15 Class A for Intentional 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.

Industry Canada Statement for Intentional Radiators

This device contains licence-exempt transmitters(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS(s). Operation is subject to the following two conditions:

1. This device may not cause interference.
2. This device must accept any interference, including interference that may cause undesired operation of the device.

Cet appareil contient des émetteurs/récepteurs exemptés de licence conformes à la norme Innovation, Sciences, et Développement économique Canada. L'exploitation est autorisée aux deux conditions suivantes:

1. L'appareil ne doit pas produire de brouillage.
2. L'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Document title: Sure Cross M-GAGE Puck with D Cell Batteries
Part number: 180451
Revision: F
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