SureCross DX80 M-GAGE with Button/Rotary Dials

A battery-powered Node in a compact, tubular housing for vehicle detection

The SureCross® wireless system is a radio frequency network with integrated I/O that can operate in most environments and eliminate the need for wiring runs. Wireless networks are formed around a Gateway, which acts as the wireless network master device, and one or more Nodes.

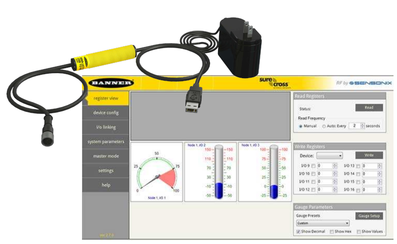
- Internal three-axis magnetoresistive-based technology senses three-dimensional changes to the Earth's magnetic field caused by the presence of ferrous objects
- Designed to minimize the effects of temperature changes and destabilizing magnetic fields
- Sensor learns ambient background and stores settings in non-volatile memory
- *Flex*Power® technology driven by one lithium primary battery integrated into the housing
- Frequency Hopping Spread Spectrum (FHSS) technology and Time Division Multiple Access (TDMA) control architecture ensure reliable data delivery within the unlicensed Industrial, Scientific, and Medical (ISM) band
- 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
- Sealed housing contains the power source, sensor, and antenna for a completely wireless solution

For additional information, updated documentation, and accessories, refer to Banner Engineering's website, *www.bannerengineering.com/surecross*.

Models	Power	Frequency	I/O
DX80N9X1W0P0ZR	3.6V dc battery integrated into the housing	900 MHz ISM Band	Internal M-GAGE™
DX80N2X1W0P0ZR		2.4 GHz ISM Band	

WARNING: Not To Be Used for Personnel Protection
Never use this device as a sensing device for personnel protection. Doing so could lead to serious injury or death. This device does not include the self-checking redundant circuitry necessary to allow its use in personnel safety applications. A sensor failure or malfunction can cause either an energized or de-energized sensor output condition.

SureCross User Configuration Tool



The User Configuration Tool (UCT) offers an easy way to link I/O points in your wireless network, view I/O register values graphically, and set system communication parameters when a host system is not part of the wireless network.
The UCT requires a special USB to RS-485 (model number BWA-UCT-900 for 1 Watt radios, BWA-HW-006 can be used for all other radios) converter cable to pass information between your computer and the Gateway. Download the most recent revisions of the UCT software from Banner Engineering's website: *http://www.bannerengineering.com/wireless*.

M-GAGE Overview

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

The M-GAGE provides a direct replacement for inductive loop systems and needs no external frequency box. Its unique design allows quick installation within a core hole. For best performance, mount the sensor below-grade, in the center of the traffic lane. The M-GAGE also may be mounted above-ground.

Because the M-GAGE uses an internal battery, the device ships from the factory in a "slow scan" mode to conserve battery life. In "slow scan" mode, the M-GAGE wakes up every 15 minutes to search for a parent radio (e.g. Gateway). If the parent radio is not detected, the M-GAGE goes back to sleep for another 15 minutes. To wake the device:

- **DX80N*X1W0P0ZR Models**: Click the button once.
- **DX80N*X1W0P0ZL Models**: Hold the supplied optical commissioning device in contact with the clear plastic cover and pointed directly at the receiving window (marked with a label). Click the optical commissioning device once.

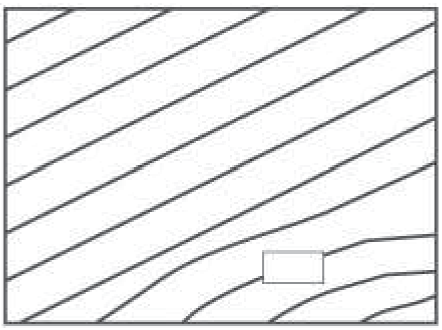
The device will also wake from its "slow scan" mode upon starting the binding procedure. After binding to its Gateway, the device will not drop into "slow scan" mode again unless it loses contact with its Gateway. When the device wakes up, the LEDs flash according to the pattern listed in *M-GAGE LEDs*.

Theory of Operation

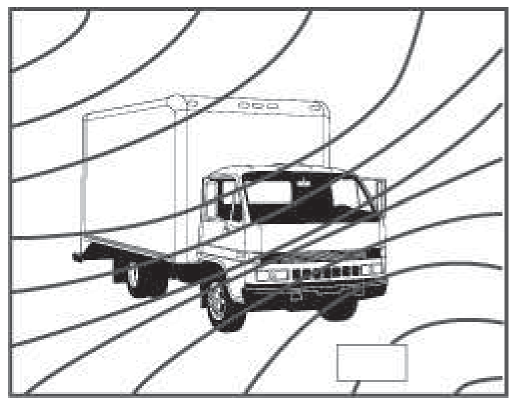
The sensor uses three mutually perpendicular magneto-resistive transducers, with each transducer detecting magnetic field changes along one axis. Incorporating three sensing elements produces maximum sensor sensitivity.

A ferrous object alters the local (ambient) magnetic field surrounding the object, as shown. The magnitude of this magnetic field change depends both on the object (size, shape, orientation, and composition) and on the ambient magnetic field strength and orientation.

During a simple programming procedure, the M-GAGE sensor measures the ambient magnetic field. When a large ferrous object 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 device reports a change of state.



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



Field B: 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 Field B. If the differential is greater than the sensitivity threshold, the device reports a change of state.

Sensor Field of View and Range

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 sensor 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.

DX80 Gateway Optimization for M-GAGE Nodes

Any DX80 Gateway transmitting at 150mW or 250mW 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 User Configuration Tool (UCT) to configure the Gateway to use heartbeat mode and 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 on the Send button to send the changes to the Gateway.
3. Use the System Parameters > Network Size tab in the UCT to set the network size to 48 nodes.
4. Click on the Send button to send the changes to the Gateway.

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.

Using the M-GAGE Node

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:

- 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.

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.

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.

Binding Radios to Form Networks

Binding Nodes to a Gateway ensures the Nodes only exchange data with the Gateway they are bound to.

Apply power to the Gateway and the Node you are binding.

Binding Nodes to a Gateway ensures the Nodes only exchange data with the Gateway they are bound to. After a Gateway enters binding mode, the Gateway automatically generates and transmits a unique extended addressing (XADR), or binding, code to all Nodes within range that are also in binding mode. The extended addressing (binding) code defines the network, and all radios within a network must use the same code. After binding your Nodes to the Gateway, make note of the binding code displayed under the *DVCFG menu, XADR submenu on the LCD. Knowing the binding code prevents having to re-bind all Nodes if your Gateway is ever replaced.

1. Enter binding mode on the Gateway.

Model	To enter binding mode:
Two-button Gateways	Triple-click button 2
One-button Gateways	Triple-click the button
Gateways without 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. Enter binding mode on the Node.

Model	To enter binding mode:
Two-button Nodes	Triple-click button 2
One-button Nodes	Triple-click the button
Nodes without buttons	Remove the top cover and set both the left and right rotary dials to F to enter binding mode.*

   The Node enters binding mode and locates the Gateway in binding mode. With two LED models, the red LEDs flash alternately. With one LED models, the red and green LED flashes alternately while the Node searches for the Gateway; after binding is complete, the LED is red and green for four seconds (looks orange), then the red and green flash simultaneously (looks orange) four times. The Node automatically exits binding mode. After the Node is bound, the LEDs are both solid red for a few seconds. The Node cycles its power, then enters RUN mode.
3. Use both of the Node's rotary dials to assign a valid decimal Node Address (between 01 and 47). The left rotary dial represents the tens digit (0 through 4) and the right dial represents the ones digit (0 through 9) of the Node Address.
4. Repeat steps 2 and 3 for all Nodes that need to communicate to this Gateway.
5. Exit binding mode on the Gateway.

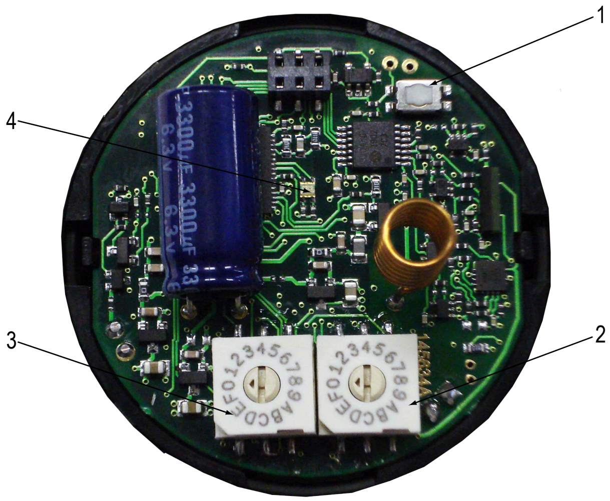
Model	To exit binding mode:
Two-button Gateways	Single-click either button 1 or button 2
One-button Gateways	Single-click the button
Gateways with no buttons	Change the Gateway's rotary dials to a valid Network ID.

   Notes on Network IDs: 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.)

When installing special kits with pre-mapped I/O, indicated by device model numbers beginning in DX80K, return the rotary dials to their original positions after binding. If the rotary dials are not returned to their original positions, the I/O mapping will not work.

* Some older M-GAGE Nodes (models DX80N*X1W0P0ZR) may require F-F binding despite having a single button.

M-GAGE Node Board

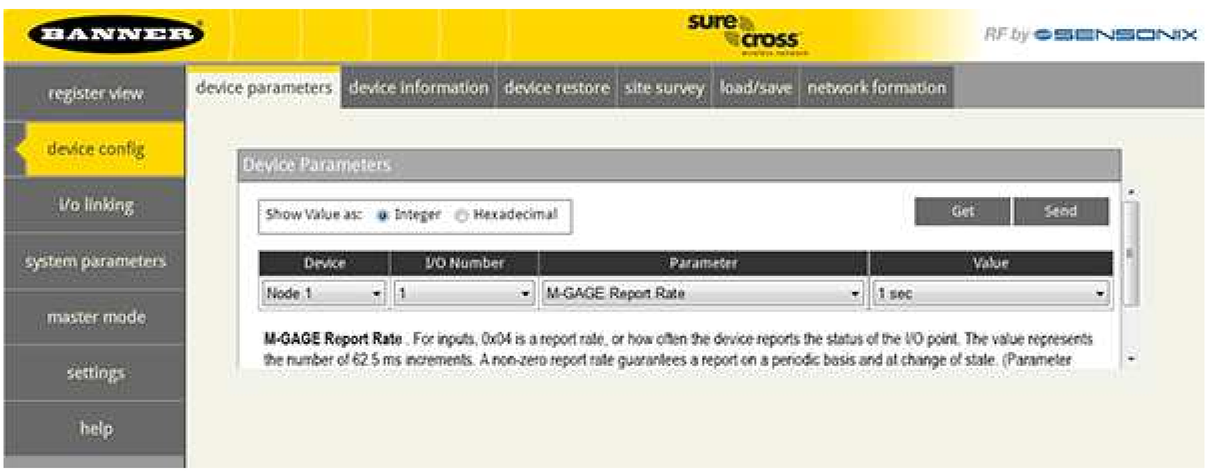


1. Button
2. Rotary dial, 1s place (right digit)
3. Rotary dial, 10s place (left digit)
4. Two-color LED

Remove the cover to access the M-GAGE Node circuit board.

Configuring M-GAGE Parameters Using the UCT

The Device Parameters screen of the User Configuration Tool (UCT) is used to configure the M-GAGE parameters listed below.



M-GAGE Parameters

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. Setting options include the following values: (Parameter number 0x13).

Filter Threshold 30, 2 hour	Two hours after the M-GAGE reading of the ambient magnetic field (baseline) has dropped below 30, the algorithm begins to slowly lower the magnetic baseline reading to zero.
Filter Threshold 30, 8 hour	Eight hours after the M-GAGE reading of the ambient magnetic field (baseline) has dropped below 30, the algorithm begins to slowly lower the magnetic baseline reading to zero.

M-GAGE Baseline Filter (unrestricted). An M-GAGE only parameter, the baseline filter parameter sets the coefficient value of the baseline filter algorithm. (Parameter number 0x15).

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. (Parameter number 0x12).

M-GAGE Report Rate (Inputs) . The report rate defines how often the Node communicates the I/O status to the Gateway. Change of state reporting sets the system to report only when the value crosses the threshold setting. For FlexPower™ applications, setting the report rate to a slower rate extends the battery life. (Parameter number 0x04).

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. (Sample high parameter number 0x06, Sample low parameter number: 0x07).

M-GAGE Sample Rate. The sample interval, or rate, defines how often the SureCross device samples the input. For battery-powered applications, setting a slower rate extends the battery life. (Parameter number 0x03).

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. Setting a threshold establishes an ON point. 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 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). (Threshold parameter number 0x08; Hysteresis parameter number 0x09).

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		

	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**
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					
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

	Modbus Register 13 [7:0]							
	Sample Rate			Baseline Filter		Threshold and Hysteresis		
Device Settings	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
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 Values	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

Baseline Threshold/Filter (M-GAGE)

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.

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.

Sample High and 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.

Sample and Report Rates

The sample interval, or rate, defines how often the SureCross device samples the input. For battery-powered applications, setting a slower rate extends the battery life.

The report rate defines how often the Node communicates the I/O status to the Gateway. Change of state reporting sets the system to report only when the value crosses the threshold setting. For FlexPower™ applications, setting the report rate to a slower rate extends the battery life.

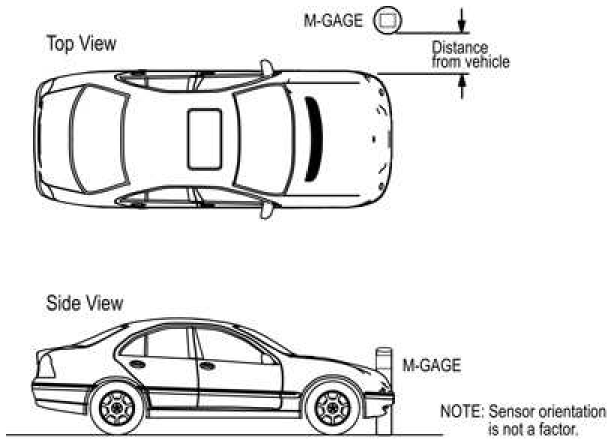
Threshold and Hysteresis (M-GAGE)

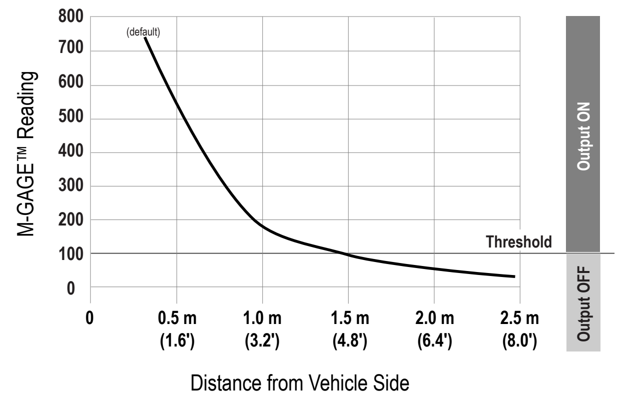
Threshold and hysteresis work together to establish the ON and OFF points of an analog input. The threshold defines a trigger point or reporting threshold (ON point) for a sensor input. Setting a threshold establishes an ON point. Hysteresis defines how far below the threshold the analog input is required 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 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.

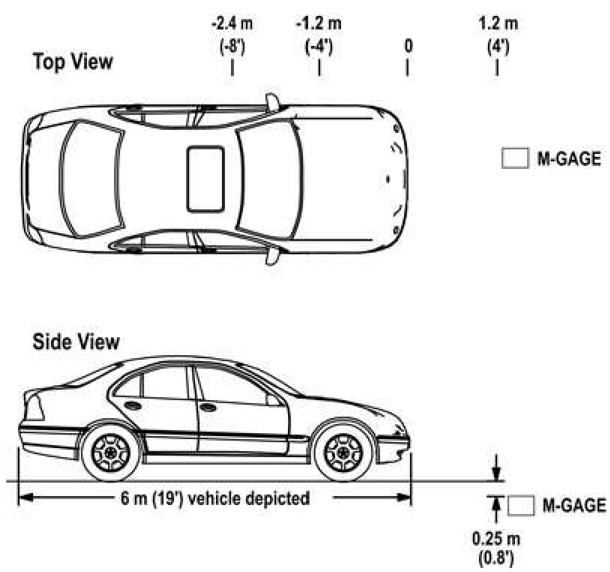
M-GAGE Installation

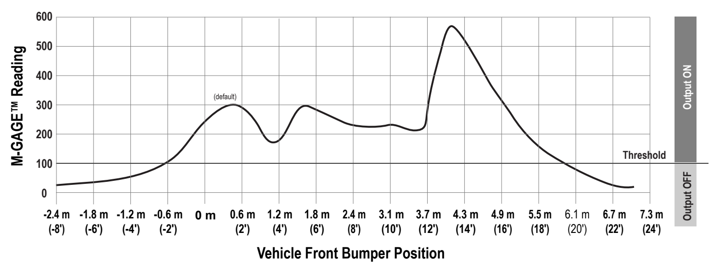
The included charts indicate the excess gain for a typical car. Excess gain is the measure of "extra" signal detected by the sensor in excess of the level needed to detect change in the magnetic fields. The graphs represent the default sensitivity threshold levels (solid line) and half the default sensitivity (dotted line). As shown in the table, the excess gain of the default sensitivity is twice that of the other sensitivity.





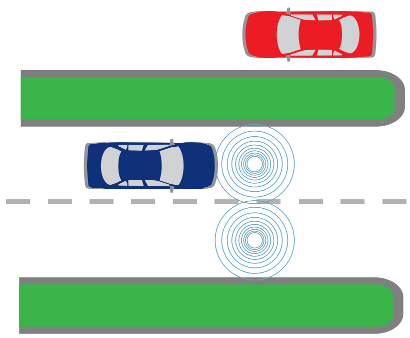
This next figure illustrates a typical vehicle passing over a sensor mounted underground. Note that the excess gain is greatest when the front bumper is positioned such that the rear axle is directly over the M-GAGE™.





Placing the M-GAGE for Best Results

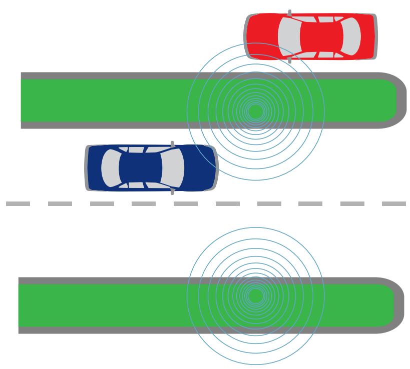
Good Placement



The first image 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 threshold level to detect vehicles only in the lane of interest. This is known as lane separation, or not detecting a vehicle in an adjacent lane.

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 between vehicles.

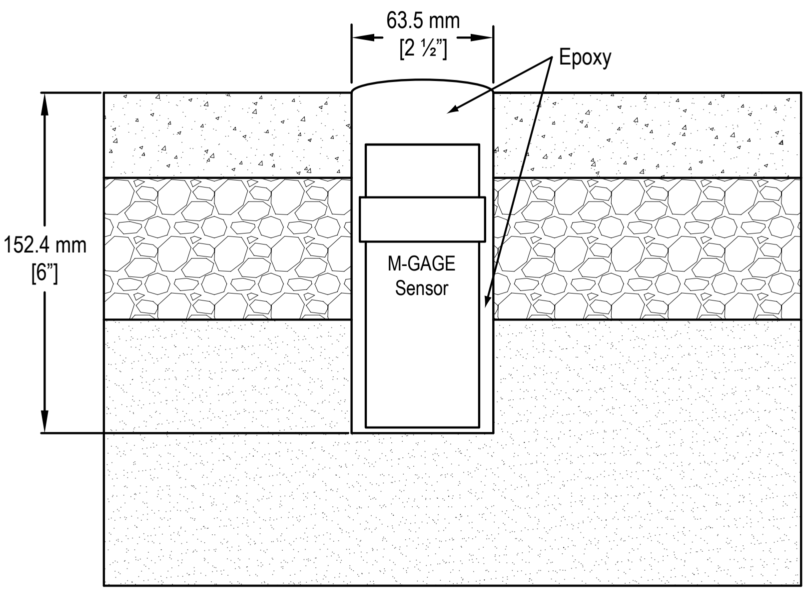
Poor Placement



While 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.

Instructions for a Buried Installation



Safety

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

Equipment Required

- 2.5" Coring equipment. Many varieties exist; choose whichever best suits the conditions of the particular installation site.
- Epoxy. We recommend using a flexible, weather-proof liquid asphalt/concrete repair compound, such as the joint sealers by Fabick Protective Coatings.

Installation

1. Drill a 2.5" diameter hole to a depth of between 5 and 6 inches. Thoroughly compact any loose material remaining in the bottom of the hole.
2. Verify all surfaces inside and near the hole are clean (free of debris), warm (consult Epoxy manufacturer data for temperature threshold data) and thoroughly dry.
3. All devices should be properly bound and configured (see datasheet pages 5–8 for details) before continuing.
4. Place device in hole, press down lightly (by hand only) and measure the device's depth below the surface plane. The top surface of the device should be a minimum of ½-inch below the surface, but NO MORE THAN 1½ inches.
5. Repeat steps 1 through 4 for all locations. Once all devices are properly placed in their holes, continue to step 6.
6. Fill the spaces surrounding each device with epoxy. Completely fill the hole with epoxy to avoid leaving a recess that will collect water and dirt.

Specifications

Range
300 meters (1000 feet)

Transmit Power
900 MHz: 21 dBm (150 mW) conducted
2.4 GHz: 18 dBm (65 mW) conducted, less than or equal to 20 dBm (100 mW) EIRP

900 MHz Compliance (150 mW Radios)
FCC ID TGUDX80 - This device complies with FCC Part 15, Subpart C, 15.247
IC: 7044A-DX8009

2.4 GHz Compliance
FCC ID UE300DX80-2400 - This device complies with FCC Part 15, Subpart C, 15.247
ETSI/EN: In accordance with EN 300 328: V1.7.1 (2006-05)
IC: 7044A-DX8024

Spread Spectrum Technology
FHSS (Frequency Hopping Spread Spectrum)

Link Timeout
Gateway: Configurable via User Configuration Tool (UCT) software
Node: Defined by Gateway

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

CE

Power
Requirements: 3.6V dc low power option from an internal battery

Housing
Polycarbonate housing and rotary dial cover; polyester labels; EDPM rubber cover gasket; nitrile rubber, non-sulphur cured button covers
Weight: 0.28 kg (0.60 lbs)

Interface
Indicators: One bi-color LED

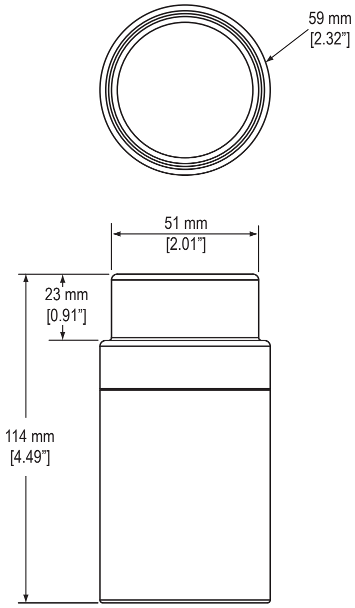
M-GAGE Inputs
Input: Internal Magnetometer
Sample Rate: 250 milliseconds
Report Rate: On Change of State
Ambient Temperature Effect: Less than 0.5 milligauss/°C
Sensing Range: See figures on previous pages

Rating
IEC IP67; NEMA 6; (See UL section below for any applicable UL specifications)

Operating Conditions
Temperature: −40 to +85 °C
Humidity: 95% max. relative (non-condensing)
Radiated Immunity: 10 V/m, 80-2700 MHz (EN61000-6-2)

Shock and Vibration
IEC 68-2-6 and IEC 68-2-7
Shock: 30g, 11 millisecond half sine wave, 18 shocks
Vibration: 0.5 mm p-p, 10 to 60 Hz

M-GAGE Dimensions



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Exporting SureCross Radios

Exporting SureCross 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.** A list of approved countries appears in the *Radio Certifications* section of the product manual. The SureCross 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. Consult with Banner Engineering Corp. if the destination country is not on this list.

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