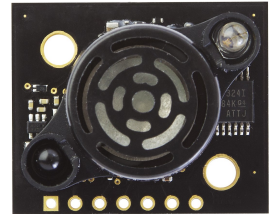


# IRXL-MaxSonar® -CS Series

## Precision, Low Voltage, IR, Ultrasonic Range Finder MB2530, MB2532<sup>3</sup>

The IRXL-MaxSonar-CS sensor line is a cost-effective solution for cargo monitoring where low-voltage operation and low-cost are needed. Optical reflectance based detection combined with sonar allows virtually 100% detection of objects. The IRXL-MaxSonar-CS sensor line provides reliable proximity detection and ultrasonic ranging in air, in a package less than one cubic inch. This sensor line features 1-cm resolution, target-size and operating-voltage compensation for improved accuracy, superior rejection of outside noise sources, and internal speed-of-sound temperature compensation. This ultrasonic sensor detects objects from the front face of the sensor to 16.5-meters and senses range to objects from 50-cm to 16.5-meters. Large objects closer than 50-cm are typically reported as 25-cm<sup>1</sup>. The interface output formats are pulse width (MB2530) / analog voltage envelope (MB2532), analog voltage, and serial digital in RS232 or TTL<sup>4</sup>. Factory calibration is standard. <sup>1</sup>See Close Range Operation



### Performance Notes

- This sensor has been characterized from 5.0V down to 2.7V is possible
- This sensor is optimized to detect large targets such as 4-ft by 4-ft cargo boxes while rejecting small targets to prevent detection of trailer walls

### General Characteristics

- Low-cost ultrasonic rangefinder
- Size less than 1-cubic inch with easy mounting
- Object proximity detection from the front face of the sensor to 16.5-meters
- Resolution of 1-cm
- Excellent Mean Time Between Failure (MTBF)
- Triggered operation yields a real-time 530mS measurement cycle
- Free run operation uses a 0.4Hz filter, with 530mS measurement and output cycle
- Actual operating temperature range from -40°C to +65°C.
- Operating voltage from 2.7V to 5.5V
- Average current draw of 1.65mA at 5V
- Fast first reading after power-up eases battery requirements

### Easy to Use Module

- Stable and reliable range readings
- Excellent noise rejection
- Easy to use interface with distance provided in a variety of outputs
- Target size compensation provides greater consistency and accuracy when switching targets
- Sensor automatically handles acoustic noise<sup>2</sup>
- Small and easy to mount

### Range Outputs

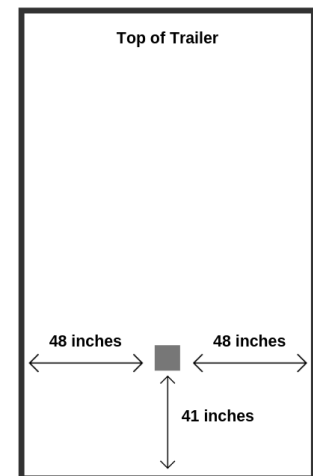
- Pulse width, 1uS/cm (MB2530)
- Analog Voltage Envelope (MB2532)
- Analog Voltage, (2-cm resolution)
- RS232 or TTL<sup>4</sup> Serial Data

### Precision Range Sensing

- Range-finding at a fraction of the cost of other precision rangefinders
- Sensors calibrated to reliably detect cargo while ignoring side walls and artifacts in most cargo containers
- Compensation for target size variation and operating voltage range
- Standard internal temperature compensation

### Mounting Notes

- Our recommended mounting position is 48-in by 48-in by 41-in for optimal performance. (see figure below)
- If you would like to mount in a different location, our engineering team is ready to work with you on the end solution.



#### Notes:

- <sup>1</sup> See Close Range Operation
- <sup>2</sup> Not designed for multiple sensor applications
- <sup>3</sup> Please reference page 9 for part number key
- <sup>4</sup> Contact us to order TTL version

## Close Range Operation

With the use of high power acoustic output and an optical back up, the IRXL-MaxSonar-CS line of sensors provides virtually 100% detection to most objects at all ranges. While nearly all targets will be detected, in very bright environments or with certain dark colors, acoustically soft targets may not be perfectly detected.

## Technical Support and Consulting — We're here to help

A successful integration of our sensor into your project is our top priority. Many successful projects have required some MaxBotix support and consulting.

Please contact us at [techsupport@maxbotix.com](mailto:techsupport@maxbotix.com) for consultation, sensor selection, questions, application review and troubleshooting. We're dedicated to designing sensors that work and building relationships that last.

## Warning: Personal Safety Applications

We do not recommend or endorse this product be used as a component in any personal safety applications. This product is not designed, intended or authorized for such use. These sensors and controls do not include the self-checking redundant circuitry needed for such use. Such unauthorized use may create a failure of the MaxBotix® Inc. product which may result in personal injury or death. MaxBotix® Inc. will not be held liable for unauthorized use of this component.

## Pin Out Description

### Pin 1– Unused

**Pin 2- Pulse Width Output:** This pin outputs a pulse width representation of the distance with a scale factor of 1uS per cm. Output range is 50uS (50-cm) to 1650uS (1650-cm). Reports a 25uS pulse when the optical sensors detect a target. The MB2532 has an analog voltage envelope output instead of pulse width.

**Pin 3- Analog Voltage Output:** On power-up, the voltage on this pin is set to 0V, after which, the voltage on this pin has the voltage corresponding to the latest measured distance. This pin outputs an analog voltage scaled representation of the distance with a scale factor of (Vcc/1024) per 2-cm. (This output voltage is referenced to GND, Pin 7.)

**Pin 4- Ranging Start/Stop:** This pin is internally pulled high. If this pin is left unconnected or held high, the sensor will continually measure and output the range data. If held low, the IRXL-MaxSonar-CS will stop ranging. Bring high for 20uS or longer to command a range reading.

**Pin 5-Serial Output:** The serial output is either RS232 or TTL<sup>1</sup> format (0 to Vcc) with a 1-cm resolution. The output is an ASCII capital “R”, followed by four ASCII character digits representing the range in centimeters, followed by a carriage return (ASCII 13). The maximum distance reported is 1650. The serial output is the most accurate of the range outputs. Serial data sent is 9600 baud, with 8 data bits, no parity, and one stop bit.

**V+ Pin 6 - Positive Power, Vcc:** The sensor operates on voltages from 2.7V - 5.5V DC. The sensor has an average current draw of ~1.65mA and a peak current draw of ~3.71mA at 5V. For best operation, the sensor requires that the DC power be free from electrical noise. (For installations with known dirty electrical power, a 100uF capacitor placed at the sensor pins between V+ and GND will typically correct the electrical noise.)

**GND Pin 7 – Sensor ground pin:** DC return, and circuit common ground.

Notes: 1 Contact us to order TTL versions

## About Ultrasonic Sensors

Our ultrasonic sensors are in air, non-contact object detection and ranging sensors that detect objects within an area. These sensors are not affected by the color or other visual characteristics of the detected object. Ultrasonic sensors use high frequency sound to detect and localize objects in a variety of environments. Ultrasonic sensors measure the time of flight for sound that has been transmitted to and reflected back from nearby objects. Based upon the time of flight, the sensor then outputs a range reading.

### Auto Calibration

Each time the IRXL-MaxSonar-CS takes a range reading, it calibrates itself. The sensor then uses this data to range objects. If the temperature, humidity, or applied voltage changes during sensor operation; the sensor will continue to function normally over the rated temperature range while applying compensation for changes caused by temperature and voltage.

### Sensor Operation: Free-Run

When operating in free run mode, the IRXL-MaxSonar-CS sensors are designed to be used in a variety of indoor environments. Most range readings are accurately reported. Many acoustic noise sources will have little to no effect on the reported range of the IRXL-MaxSonar-CS sensors. However, users are encouraged to test sensor operation in the operating environment.

### Sensor Minimum Distance

The sensor minimum reported distance is 50-cm (19.7-inches). The IRXL-MaxSonar-CS will range and report targets to within 1-mm of the front sensor face. Large targets closer than 50-cm will typically range as 50-cm or 25-cm when detected by the optical sensor.

### Range “0” Location

The IRXL-MaxSonar-CS reports the range to distant targets starting from the back of the sensor PCB as shown in the

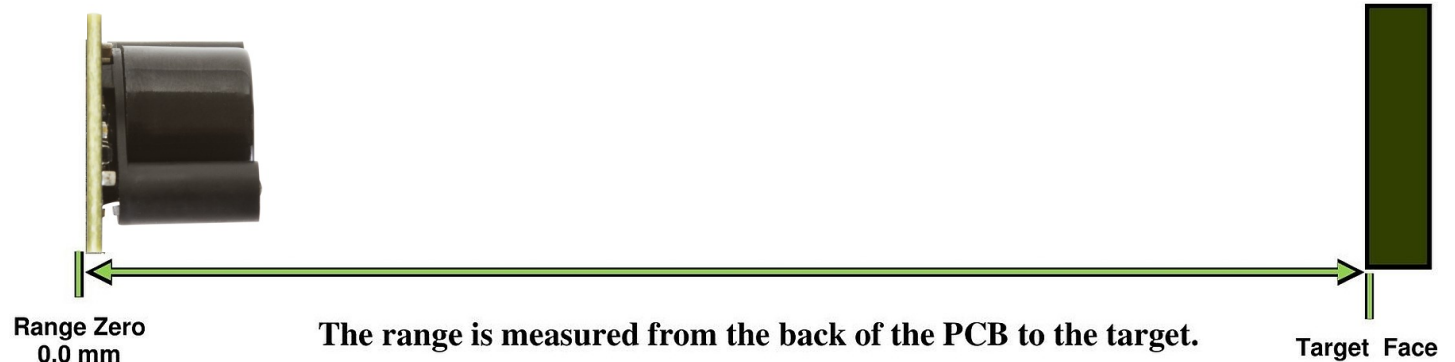
diagram below.

In general, the IRXL-MaxSonar-CS will report the range to the leading edge of the closest detectable object.

Target detection has been characterized in the sensor beam patterns.

## Supply Voltage Droop and Charge Compensation

During power up, the IRXL-MaxSonar-CS sensor line will calibrate itself for changes in supply voltage. Additionally, the



sensor will compensate if the supplied voltage gradually changes.

If the voltage applied to the sensor changes faster than 0.5V per second, it is best to remove and reapply power to the sensor.

The sensor requires noise free power for best operation. If the sensor is used with noise on the supplied power, the readings may be affected. Typically adding a 100uF capacitor at the sensor between the V+ and GND pins will correct most power related electrical noise issues.

---

## Temperature Compensation

### On Board - Internal Temperature Compensation

The speed of sound in air increases about 0.6 meters per second, per degree centigrade. Because of this, each IRXL-MaxSonar-CS is equipped with an internal temperature sensor which allows the sensor to apply a compensation for speed of sound changes.

The self heating (15mW at 5V, or 8mW at 3.3V) will change the temperature of the sensor by about 1 degree C. The amount of self heating is dependent upon user mounting.

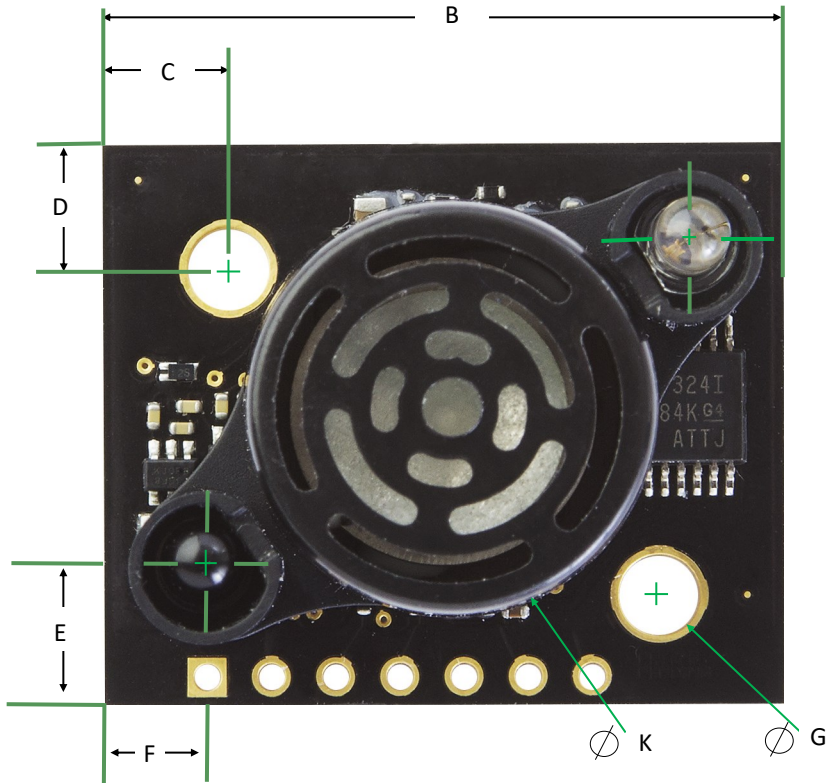
While the actual air temperature of the path between the sensor and the target may not match the temperature measured at the sensor electronics, the internal temperature sensor will compensate for the speed of sound changes related to the temperature at the sensor which will provide reliable compensated ranges to the user.

---

## Performance Note

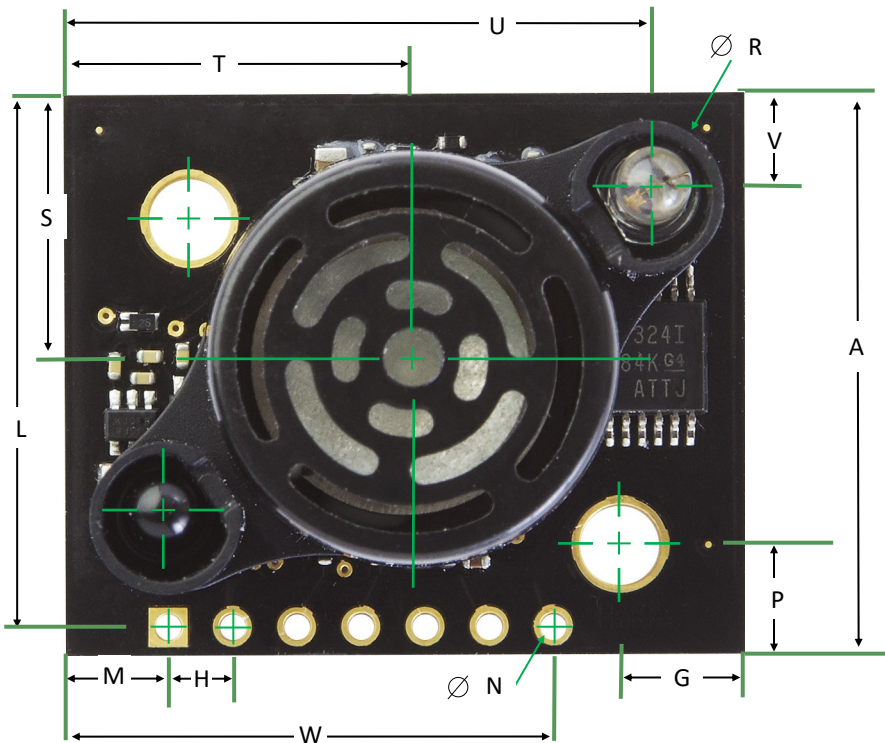
The IRXL-MaxSonar-CS line of sensors has been tested and shown to operate in environmental conditions ranging from –40 degrees C to +65 degrees C. For humidity levels less than 10% at temperatures above 45C diminished ability to detect long range targets will be seen due to absorption effects of the air at these temperature and humidity combinations. While these conditions can be recreated in laboratory settings, they are highly unlikely to occur in real world environments. Additionally, in very bright lighting the performance of the optical sensors may be limited.

# Mechanical Dimensions



Values are Nominal

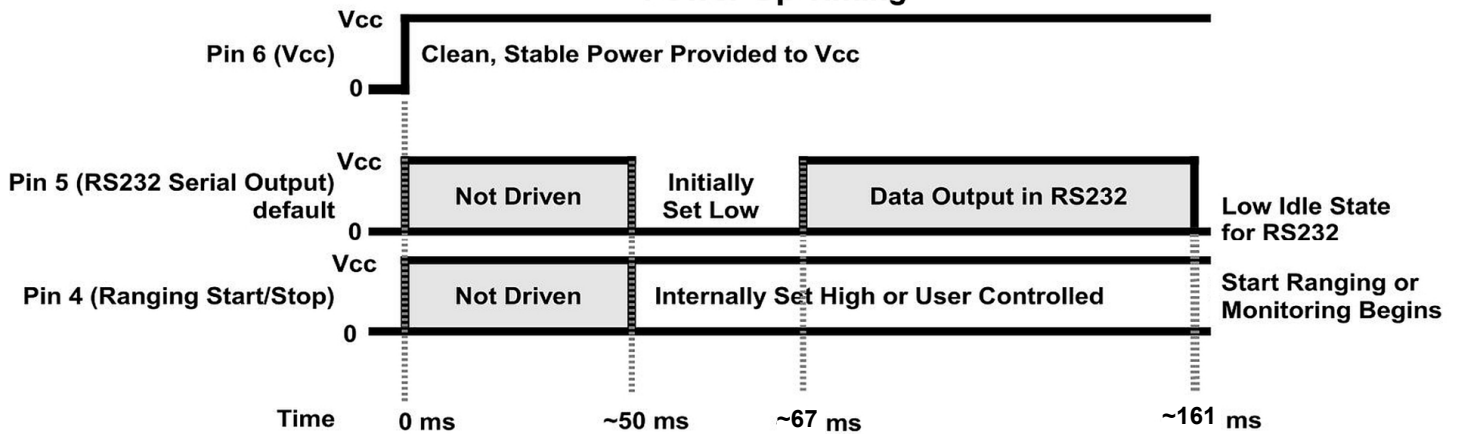
A	0.885"	22.5 mm
B	1.070"	27.2 mm
C	0.200"	5.08 mm
D	0.200"	5.08 mm
E	0.213"	5.41 mm
F	0.175"	4.45 mm
G	0.124" dia.	3.1 mm dia.
H	0.100" x 6	2.54 mm
J	0.628"	16.0 mm
K	0.645"	16.4 mm
L	0.835"	21.2 mm
M	0.165"	4.2 mm
N	0.038" dia.	1.0 mm dia.
P	0.175"	4.5 mm
Q	0.200"	5.08 mm
R	0.232" dia. x 2	5.9 mm dia.
S	0.420"	10.67 mm
T	0.535"	13.59 mm
U	0.895"	22.73 mm
V	0.168"	4.27 mm
w	0.775"	19.69mm
Mass 5.6 grams		





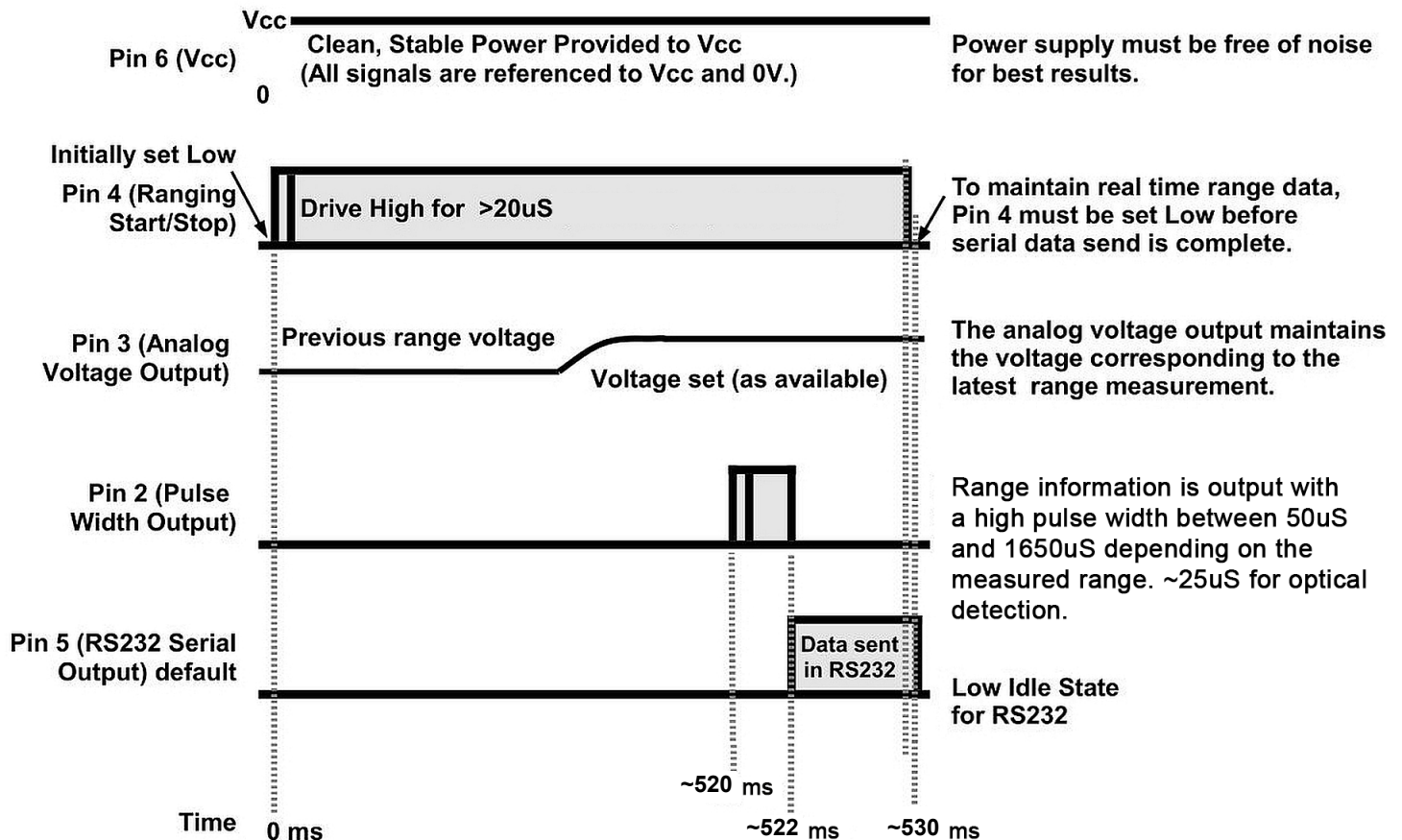
## Operations and Timing

### Power Up Timing



## Real-Time Operation - Triggered

### Realtime Triggered Operation



Real-time or triggered operation allows users to take advantage of a few functions unavailable during free run mode. By operating in triggered mode, a maximum refresh rate of 1.8Hz can be achieved.

Users can enter and remain in the Real-time or Triggered Operation by making sure that after each range cycle, the voltage level on Pin 4 is set low. After the sensor has completed the last reading, then the voltage on Pin 4 is brought high. This starts a brand new range cycle and the IRXL-MaxSonar-CS will output the most recent range data without filtering. Please reference the Real-time Triggered Operation timing diagram for full implementation details.

Readings during triggered operation can be less accurate as the noise tolerance can be greatly reduced. Take care to make sure that only one sensor is sampling range at a time.

## Operations and Timing Continued

### Sensor Operation - Free-Run

When operating in free run mode, the IRXL-MaxSonar-CS sensors are designed to be used in a variety of indoor environments. Many acoustic noise sources will have little to no effect on the reported range of the IRXL-MaxSonar-CS sensors.

### Filtered Operation - Free-Run

The IRXL-MaxSonar-CS uses an internal 0.4Hz bandwidth filter to process range data; which reports the latest range every 530mS (1.8Hz). This improves the sensor's performance for accuracy, noise rejection, and reading to reading stability. The filtering in the free-run operation also permits additional acoustic and electrical noise tolerance.

## IRXL-MaxSonar®-CS Beam Patterns

### Background Information Regarding our Beam Patterns

Each IRXL-MaxSonar-CS sensor has a calibrated beam pattern. Each sensor is matched to provide the approximate detection pattern shown in this datasheet. This allows end users to select the part number that matches their given sensing application. Each part number has a consistent field of detection so additional units of the same part number will have similar beam patterns. The beam plots are provided to help identify an estimated detection zone for an application based on the acoustic properties of a target versus the plotted beam patterns.

Each beam pattern is a 2D representation of the detection area of the sensor. The beam pattern is actually shaped like a 3D cone (having the same detection pattern both vertically and horizontally). Detection patterns for dowels are used to show the beam pattern of each sensor. Dowels are long cylindered targets of a given diameter. The dowels provide consistent target detection characteristics for a given size target which allows easy comparison of one MaxSonar sensor to another MaxSonar sensor.

For each part number, the four patterns (A, B, C, and D) represent the detection zone for a given target size. Each beam pattern shown is determined by the sensor's part number and target size.

The actual beam angle changes over the full range. Use the beam pattern for a specific target at any given distance to calculate the beam angle for that target at the specific distance. Generally, smaller targets are detected over a narrower beam angle and a shorter distance. Larger targets are detected over a wider beam angle and a longer range.

#### People Sensing:

For users that desire to detect people, the detection area to the 1-inch diameter dowel, in general, represents the area that the sensor will reliably detect people.

### Beam Pattern Target Shapes

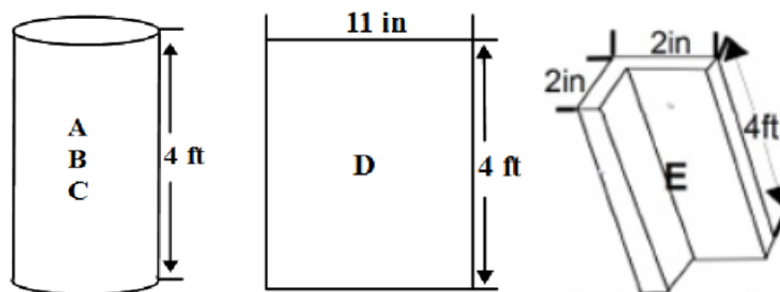
**A** 6.1-mm (0.25-inch) diameter dowel 4ft length

**B** 2.54-cm (1-inch) diameter dowel 4ft length

**C** 8.89-cm (3.5-inch) diameter dowel 4ft length

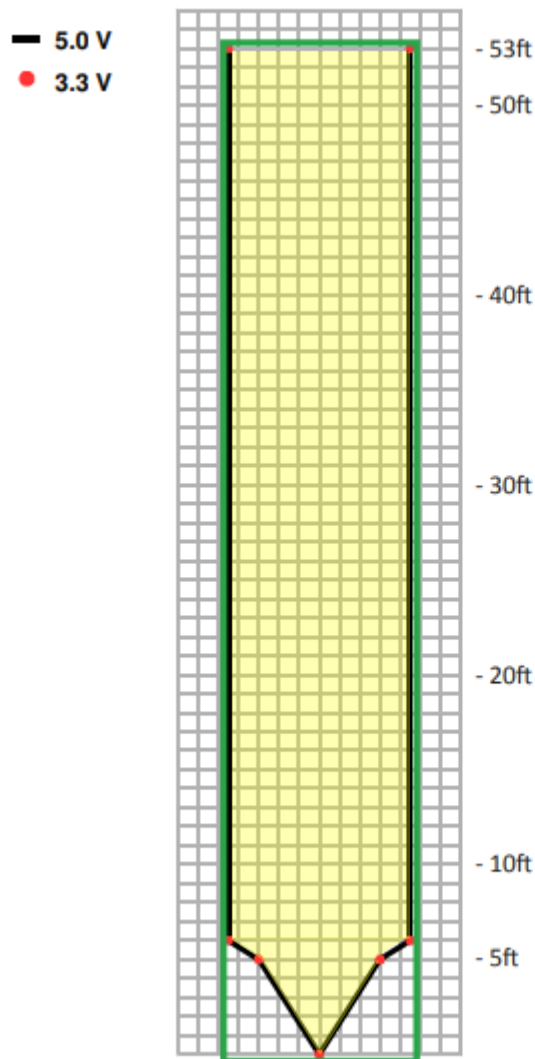
**D** 11-inch wide board 4ft in length moved left to right with the board parallel to the front sensor face. This shows the sensor's range capability.

**E** 5.08-cm (2-inch) cube corner



## MB2530 IRXL-MaxSonar-CS Beam Pattern

The IRXLV-MaxSonar-EZ sensors offer high sensitivity as well as very short to very long range detection. This makes this sensor ideal for applications needing to monitor a large space with the least number of sensors possible. This sensor is excellent for cargo monitoring and other large target applications.



The area highlighted in yellow indicates where a cargo sized box was regularly detected. Targets that are outside of this range, may not be consistently detected.

The green border outlines the shape of the semi trailer.

Sensitivity of the part is controlled as to reject small features along the trailer side walls.

### MB2530

#### Features and Benefits

- Factory calibrated beam width
- Low operating voltages from 2.7V to 5.5V
- High acoustic sensitivity

### MB2530

#### Performance

This sensor is optimized for large target detection while rejecting small targets to prevent detection of trailer walls

Our recommended mounting location is 48-in from each side wall and 41-in from the base of the trailer.<sup>1</sup>

#### Notes:

<sup>1</sup> See Page 1 for mounting suggestion diagram.

# MB2530 and MB2532

## IRXL-MaxCargo-CS Beam Pattern

Sample results for measured beam pattern are shown on a 30-cm grid. The detection pattern is shown for dowels of varying diameters that are placed in front of the sensor.

**A** 6.1-mm (0.25-inch) diameter dowel

**B** 2.54-cm (1-inch) diameter dowel

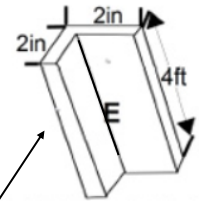
**C** 8.89-cm (3.5-inch) diameter dowel

**D** 30.48-cm (12 inch) diameter pourform

**E** 5.08-cm (2-inch) cube corner

**F** 11-inch wide board moved left to right with the board parallel to the front sensor face.

This shows the sensor's range capability.



Cube Corner Example

— 5.0 V- Outside Trailer

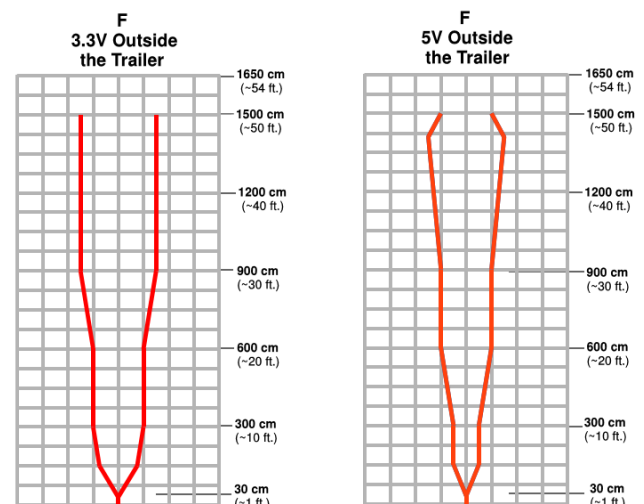
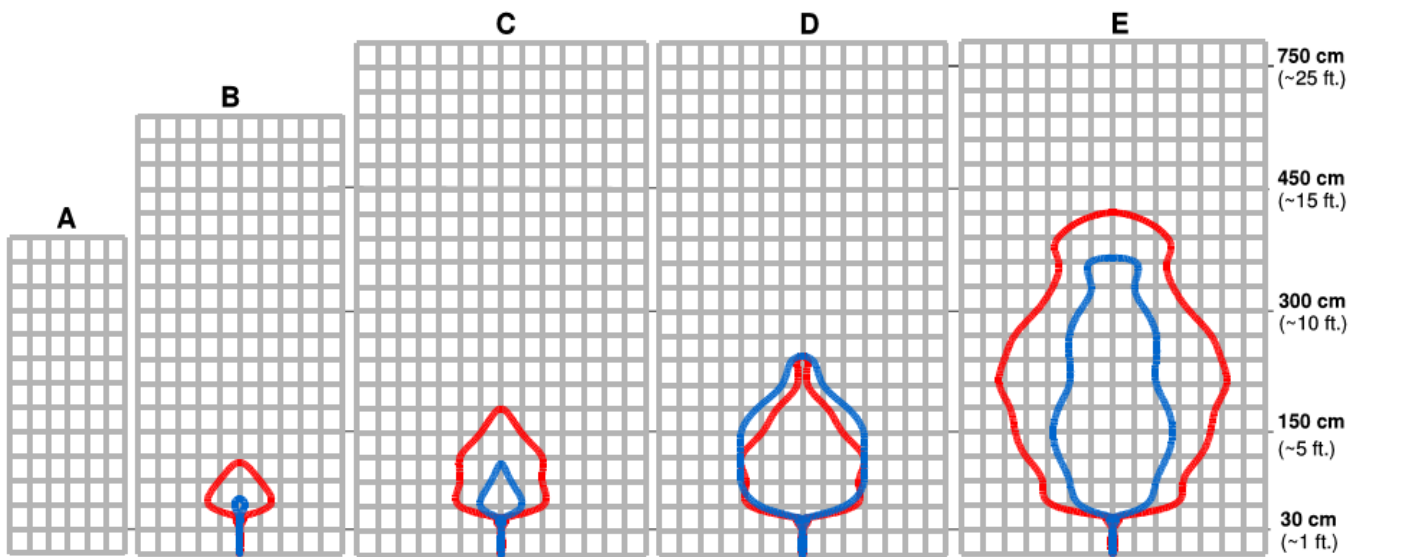
— 3.3 V- Outside Trailer

### Notes:

1/4" Dowel at 5V - No Detection

1/4" Dowel at 3.3V - No Detection

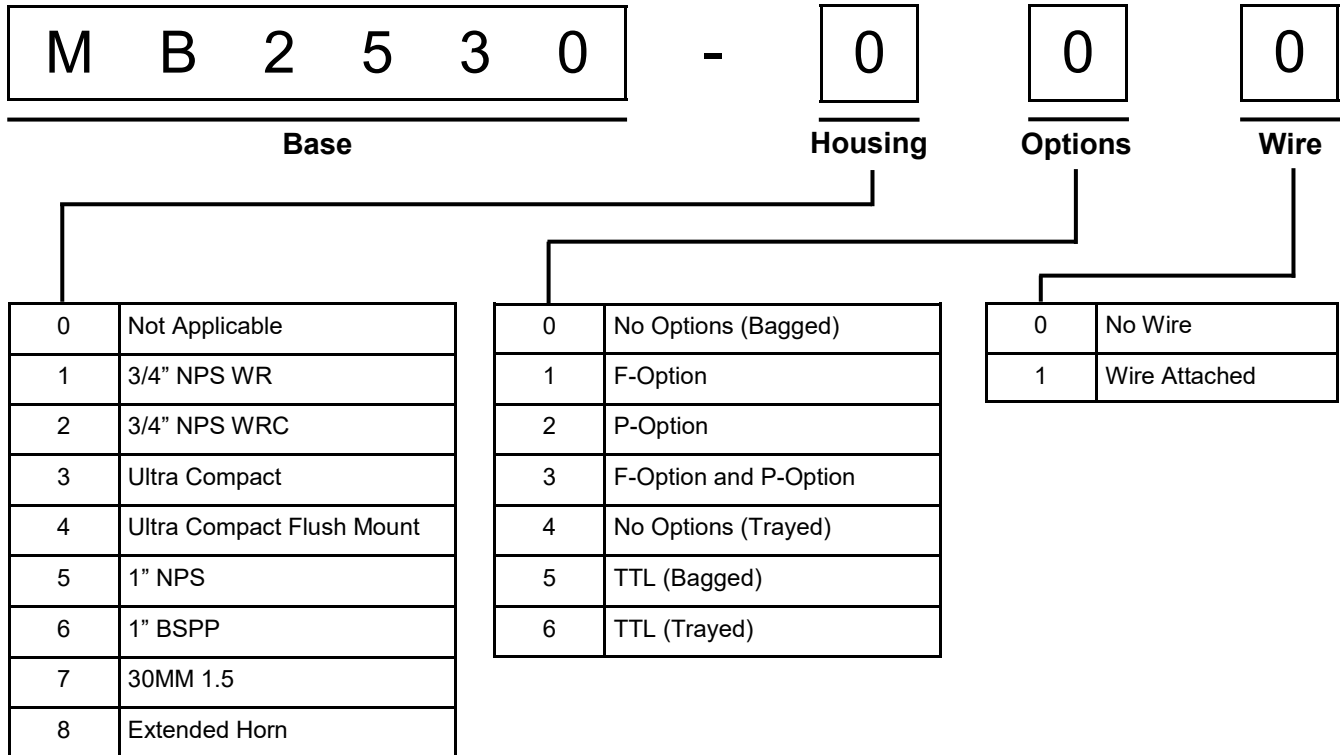
Temperature was 75.5F with 19% Humidity





## Part Numbers

All part numbers are a combination of a six-character base followed by a dash and a three-digit product code. Please review the following table for more information on the three-digit product code.



The following table displays all of the active and valid part numbers for this product.

Active Part Numbers for MB2530				
MB2530-000	MB2530-050			

Active Part Numbers for MB2532				
MB2532-000	MB2532-050			

---

## After reviewing this datasheet, do you have any more questions?

We offer Technical Support on all of our products even if you purchased them through one of our many vendors worldwide.

You can **fill out a Technical Support form** for assistance on a sensor here --> [Technical Support](#)

## Not sure which sensor you need for your application?

We offer Sensor Selection Assistance, click the link here to fill out a form for support --> [Sensor Selection Help](#)

## Looking for tutorials to help you get started?

### [Frequently Asked Questions about Our Sensors](#)

We receive many questions about our products and services. This resource offers answers to common inquiries we receive about our product lines and their application.

### [Fully Calibrated Beam Patterns](#)

All of our sensors are factory calibrated to provide consistent beam patterns, detection zones, to fit into a wide variety of applications. In our product lines, each model number comes with a different beam pattern that reflects the sensitivity and the detection zone of how it sees a target. Additionally, we strive to maintain consistency between our finished products, and you will see little to no deviation between sensors of the same model. This allows you to have confidence in your final application when using multiple sensors.

### [Understanding Range Readings](#)

The success of an application may hinge upon knowing the exact location of a target. However, a sensor may report one meter even if the target is not exactly one meter away from the sensor. Sensor specifications, such as resolution, precision, and accuracy, help you to understand sensor performance.

### [How to Use Multiple Ultrasonic Sensors](#)

This guide covers three ways to run your sensors in a Multiple Sensor environment and issues you may face.

Contact us now with any questions at [sales@maxbotix.com](mailto:sales@maxbotix.com) or call +1-218-454-0766.

Please call during our preferred business hours of 8:00 am – 4:30 pm EST on Monday through Thursday and 8:00 am – 2:00 pm EST on Friday, or you may leave us a voicemail anytime.