XL-MaxSonar®- WR/WRC™ Series

High Performance, IP67 Weather Resistant, Ultrasonic Range Finder

MB7052, MB7060, MB7062, MB7066, MB7067, MB7068, MB7070, MB7072, MB7076, MB7077, MB7078, MB7092

CE ✓RoHS COMPLIANT

The XL-MaxSonar-WR and XL-MaxSonar-WRC sensor series provide users with robust range information in air. These sensors also feature high-power acoustic output along with real-time auto calibration for changing conditions (supply voltage sag, acoustic noise, or electrical noise), operation with supply voltage from 3V to 5.5V, object detection from 0-cm to 765-cm (select models) or 1068-cm (select models), and sonar range information from 20-cm out to 765-cm (select models) or 1068-cm (select models) with 1-cm resolution. Objects from 0-cm to 20-cm range as 20-cm or closer. The sensor is housed in a robust PVC housing, designed to meet the IP67 water intrusion standard, and matches standard electrical/water ¾" PCV pipe fittings. The user interface formats included are pulse-width (select models), real-time analog-voltage envelope (select models), analog voltage output, and serial output.

Features

- Real-time auto calibration and noise rejection
- High acoustic power output
- Precise narrow beam
- Object detection includes zero range objects
- 3V to 5.5V supply with very low average current draw
- Free run operation can continually measure and output range information
- 10Hz refresh rate (MB7060, MB7062, MB7066, MB7070, MB7072, MB7076, MB7092)
- 6.6Hz refresh rate (MB7052)
- Triggered operation provides the range reading as desired
- All interfaces are active simultaneously
- RS232 Serial, 0 to Vcc, 9600 Baud, 81N
- Analog, (Vcc/1024) / cm for standard models

- Analog, (Vcc/1024) / 2cm for 10-meter models (MB7066, MB7076)
- Sensor operates at 42KHz

Benefits

- Acoustic and electrical noise resistance
- Reliable and stable range data
- Robust, low cost IP67 standard sensor
- Narrow beam characteristics
- Very low power excellent for battery based systems
- Ranging can be triggered externally or internally
- Sensor reports the range reading directly, frees up user processor
- Easy hole mounting or mating with standard electrical fittings
- Filtering allows very reliable operation in most environments

Applications and Uses

- Tank level measurement
- Bin level measurement
- Proximity zone detection
- Environments with acoustic and electrical noise
- Distance measuring
- Long range object detection
- Industrial sensor
- -40°C to +65°C (limited operation to +85°C)

Close Range Operation

Applications requiring 100% reading-to-reading reliability should not use MaxSonar sensors at a distance closer than 20cm. Although most users find MaxSonar sensors to work reliably from 0 to 20cm for detecting objects in many applications, MaxBotix® Inc. does not guarantee operational reliability for objects closer than the minimum reported distance. Because of ultrasonic physics, these sensors are unable to achieve 100% reliability at close distances.

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.

XL-MaxSonar-WR/WRC Pin Out

Pin 1- Leave open (or high) for serial output on the Pin 5 output. When Pin 1 is held low the Pin 5 output sends a pulse (instead of serial data), suitable for low noise chaining.

Pin 2- This pin outputs a pulse-width representation of range. To calculate the distance, use a scale factor of 58uS per cm. (MB7052, MB7060, MB7062, MB7066, MB7067, MB7068)

This pin outputs the analog voltage envelope of the acoustic waveform. For the MB7070 series and MB7092 sensors, this is a real-time always-active output (MB7070, MB7072, MB7076, MB7077, MB7078, MB7092)

Pin 3- AN-This pin outputs analog voltage with a scaling factor of (Vcc/1024) per cm. A supply of 5V yields ~4.9mV/cm., and 3.3V yields ~3.2mV/cm. Hardware limits the maximum reported range on this output to ~700 cm at 5V and ~600 cm at 3.3V. The output is buffered and corresponds to the most recent range data.

For the 10-meter sensors (MB7066, MB7076) Pin 3 outputs an analog voltage with a scaling of (Vcc/1024) per 2cm. A supply of 5V yields ~4.9mV/2cm., and 3.3V yields ~3.2mV/2cm. This Analog Voltage output steps in 2cm increments.

Pin 4- RX- This pin is internally pulled high. If Pin-4 is left unconnected or held high, the sensor will continually measure the range. If Pin-4 is held low the sensor will stop ranging. Bring high 20uS or more to command a range reading.

Pin 5- TX- When Pin 1 is open or held high, the Pin 5 output delivers asynchronous serial data in an RS232 format, except the voltages are 0-Vcc. The output is an ASCII capital "R", followed by ASCII character digits representing the range in centimeters up to a maximum of 765 (select models) or 1068 (select models), followed by a carriage return (ASCII 13). The baud rate is 9600, 8 bits, no parity, with one stop bit. Although the voltages of 0V to Vcc are outside the RS232 standard, most RS232 devices have sufficient margin to read the 0V to Vcc serial data. If standard voltage level RS232 is desired, invert, and connect an RS232 converter such as a MAX232.When Pin 1 is held low, the Pin 5 output sends a single pulse, suitable for low noise chaining (no serial data).

V+ Operates on 3V - 5.5V. The average (and peak) current draw for 3.3V operation is 2.1mA (50mA peak) and 5V operation is 3.4mA (100mA peak) respectively. Peak current is used during sonar pulse transmit.

GND-Return for the DC power supply. GND (& V+) must be ripple and noise free for best operation.

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Auto Calibration

Each time before the XL-MaxSonar-WR takes a range reading it auto calibrates. 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. (The sensors do not apply compensation for the speed of sound change verses temperature to any range readings.) If the application requires temperature compensation please look at the HRXL-MaxSonar-WR sensor line.

Supply Voltage Compensation

During power up, the XL-MaxSonar-WR sensor line will calibrate itself for the supply voltage. Additionally, the sensor will compensate if the supplied voltage gradually changes.

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

For best operation, the sensor requires noise free power. If the sensor is used with noise on the supplied power or ground, the accuracy of 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.

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About Ultrasonic Sensors

Our ultrasonic sensors are desired for use in air, non-contact object detection and ranging sensors that detect objects within a defined 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.

Typical Performance to Target

All sensor models

Analog Envelope Output (Dowels, 5.0V)

ANALOG ENVELOPE (V)

Transmit Burst

Targets

Target

Temp = 20C, Vcc = 5.0V
Realtime on Pin 2 of MB727X
(or MB726X internal)
Target =
0.6cm dia at 66cm,
2.5cm dia at 111cm,
8.9cm dia at 189cm,
and a 1m by 2m flat
panel at 704cm

First target ranges at ~66cm.
Conditions = acoustic test chamber

10ms/DIV

Analog Envelope Output (Dowels, 3.3V)

ANALOG ENVELOPE (V)

Transmit Burst

Targets

Target

Temp = 20C, Vcc = 3.3V
Realtime on Pin 2 of MB727X
(or MB726X internal)
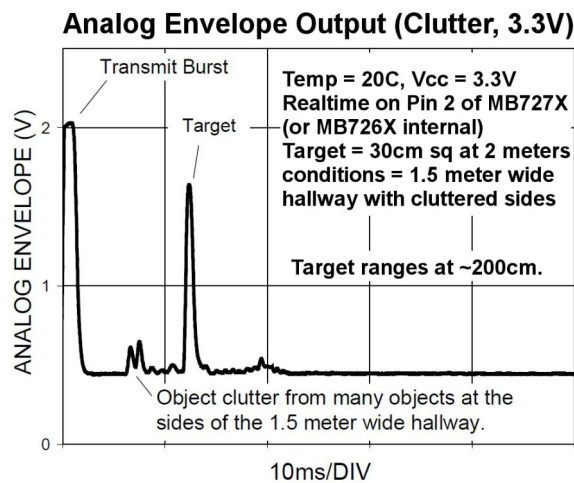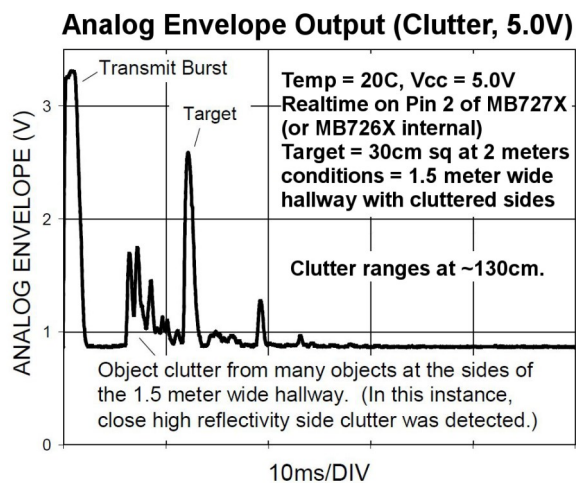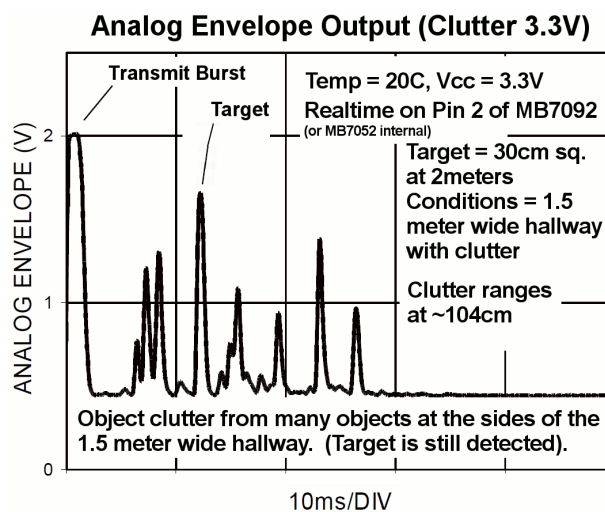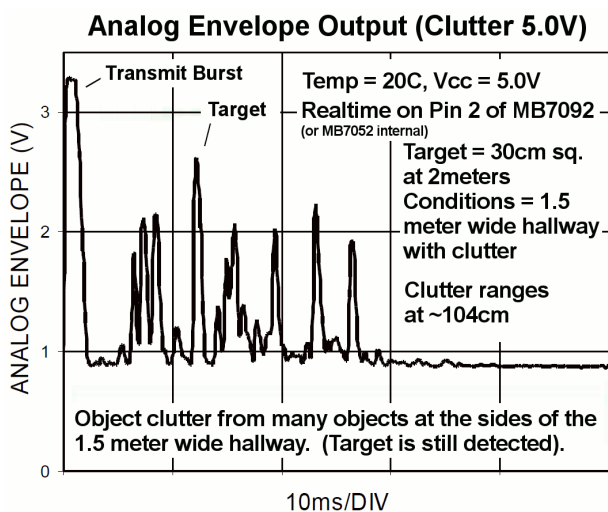Target =
0.6cm dia at 66cm,
2.5cm dia at 111cm,
8.9cm dia at 189cm,
and a 1m by 2m flat
panel at 704cm

First target ranges at ~66cm.
Conditions = acoustic test chamber

10ms/DIV

Typical Performance in Clutter

MB7060, MB7062, MB7076, MB7070, MB7072, MB7076

Analog Envelope Output (Clutter, 5.0V)

ANALOG ENVELOPE (V)

Transmit Burst

Target

Temp = 20C, Vcc = 5.0V
Realtime on Pin 2 of MB727X
(or MB726X internal)
Target = 30cm sq at 2 meters
conditions = 1.5 meter wide
hallway with cluttered sides

Clutter ranges at ~130cm.

Object clutter from many objects at the sides of
the 1.5 meter wide hallway. (In this instance,
close high reflectivity side clutter was detected.)

10ms/DIV

Analog Envelope Output (Clutter, 3.3V)

ANALOG ENVELOPE (V)

Transmit Burst

Target

Temp = 20C, Vcc = 3.3V
Realtime on Pin 2 of MB727X
(or MB726X internal)
Target = 30cm sq at 2 meters
conditions = 1.5 meter wide
hallway with cluttered sides

Target ranges at ~200cm.

Object clutter from many objects at the
sides of the 1.5 meter wide hallway.

10ms/DIV

Typical Performance in Clutter

Analog Envelope Output (Clutter 5.0V)

ANALOG ENVELOPE (V)

Transmit Burst

Target

Temp = 20C, Vcc = 5.0V
Realtime on Pin 2 of MB7092
(or MB7052 internal)
Target = 30cm sq.
at 2meters
Conditions = 1.5
meter wide hallway
with clutter

Clutter ranges
at ~104cm

Object clutter from many objects at the sides of the
1.5 meter wide hallway. (Target is still detected).

10ms/DIV

Analog Envelope Output (Clutter 3.3V)

ANALOG ENVELOPE (V)

Transmit Burst

Target

Temp = 20C, Vcc = 3.3V
Realtime on Pin 2 of MB7092
(or MB7052 internal)
Target = 30cm sq.
at 2meters
Conditions = 1.5
meter wide hallway
with clutter

Clutter ranges
at ~104cm

Object clutter from many objects at the sides of the
1.5 meter wide hallway. (Target is still detected).

10ms/DIV

MB7052, MB7092

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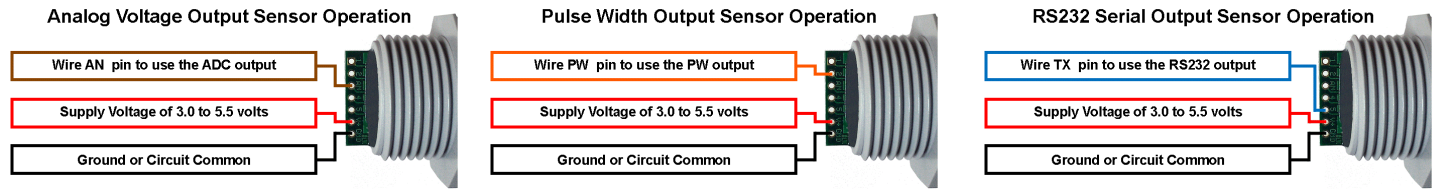Tel: + 86-755-83289036   Fax: + 86-755-83289052   E-mail: sales@isweek.com
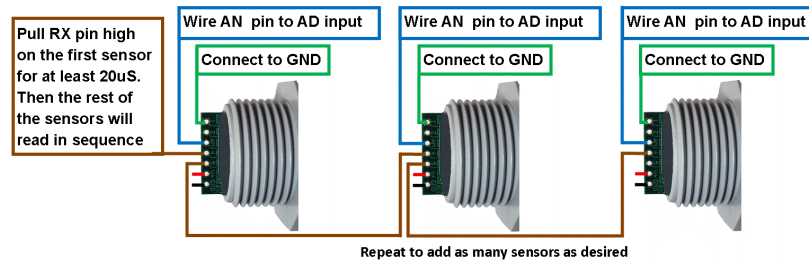
Device Comparison Chart

Notes:

[1] Alternative package types have a maximum effective detection range of 645cm, the sensor will still report 765 as a "no detection" output if a target is not found

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Analog Voltage Output Sensor Operation

| Wire AN pin to use the ADC output |
| Supply Voltage of 3.0 to 5.5 volts |
| Ground or Circuit Common |

Pulse Width Output Sensor Operation

| Wire PW pin to use the PW output |
| Supply Voltage of 3.0 to 5.5 volts |
| Ground or Circuit Common |

RS232 Serial Output Sensor Operation

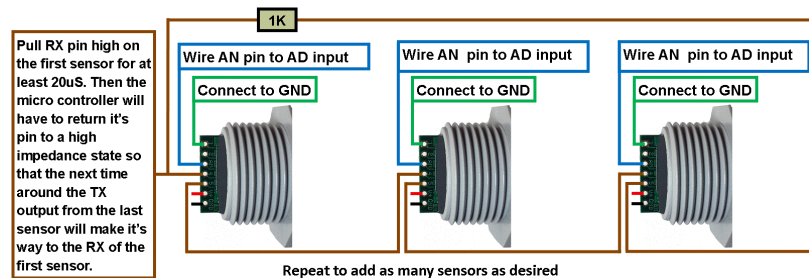| Wire TX pin to use the RS232 output |
| Supply Voltage of 3.0 to 5.5 volts |
| Ground or Circuit Common |

Real-time Auto Calibration

The XL-MaxSonar-WR automatically calibrates prior to each range reading. 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. (The sensors do not apply compensation for the speed of sound change verses temperature to any range readings.) Detection has been characterized in the published sensor beam patterns.
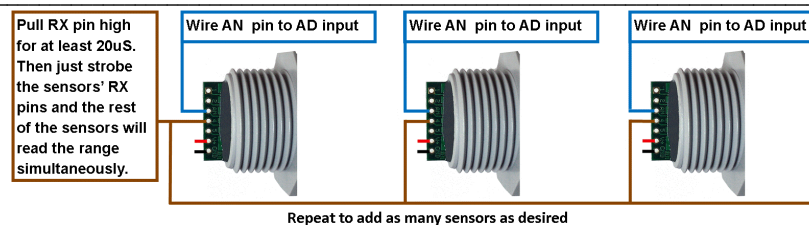
Pull RX pin high on the first sensor for at least 20uS. Then the rest of the sensors will read in sequence

Wire AN pin to AD input — Connect to GND

Wire AN pin to AD input — Connect to GND

Wire AN pin to AD input — Connect to GND

Repeat to add as many sensors as desired

Real-time Noise Rejection

While the XL-MaxSonar-WR is designed to operate in the presence of noise, best operation is obtained when noise

Pull RX pin high on the first sensor for at least 20uS. Then the micro controller will have to return it's pin to a high impedance state so that the next time around the TX output from the last sensor will make it's way to the RX of the first sensor.

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Wire AN pin to AD input — Connect to GND

Wire AN pin to AD input — Connect to GND

Wire AN pin to AD input — Connect to GND
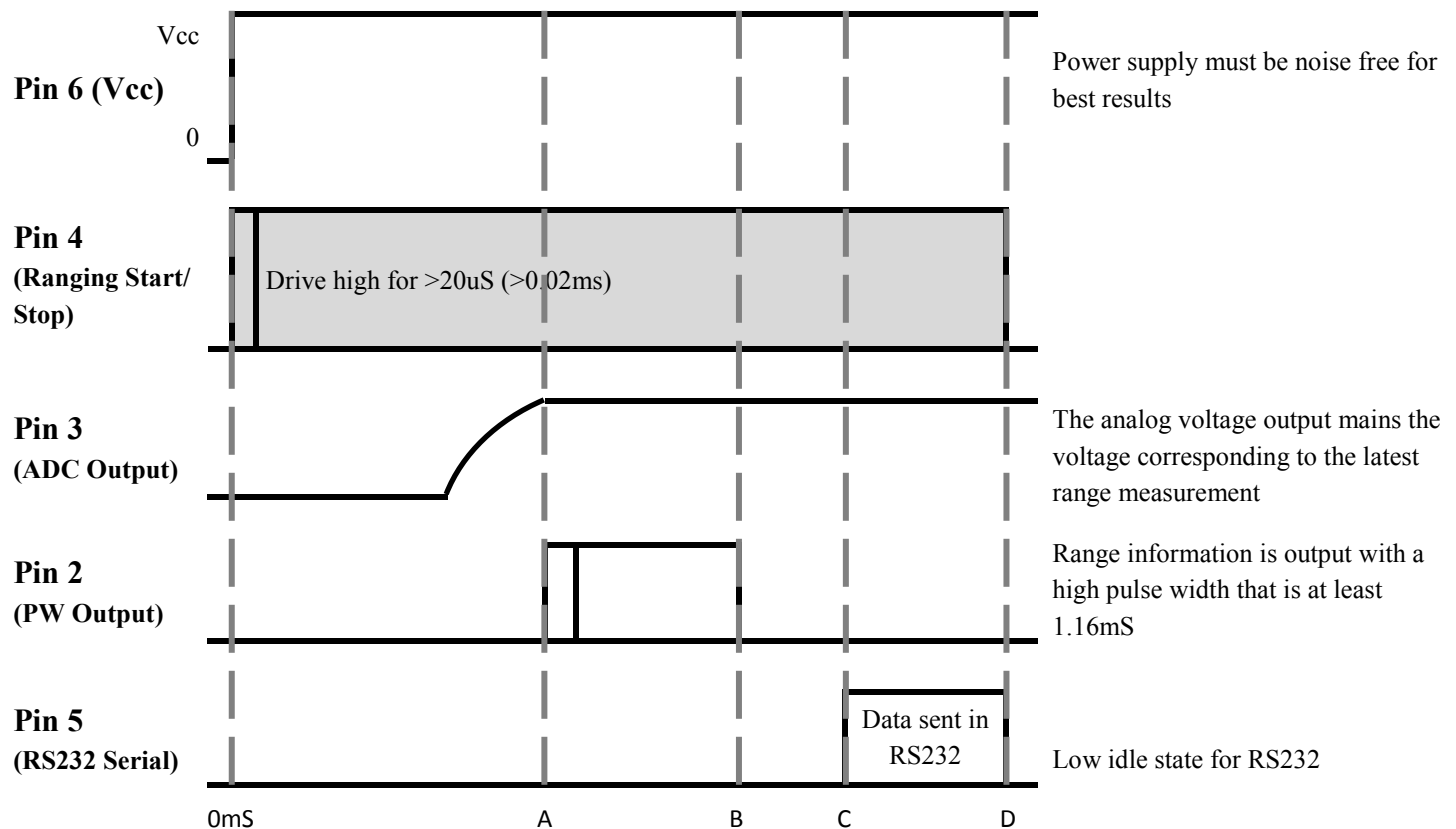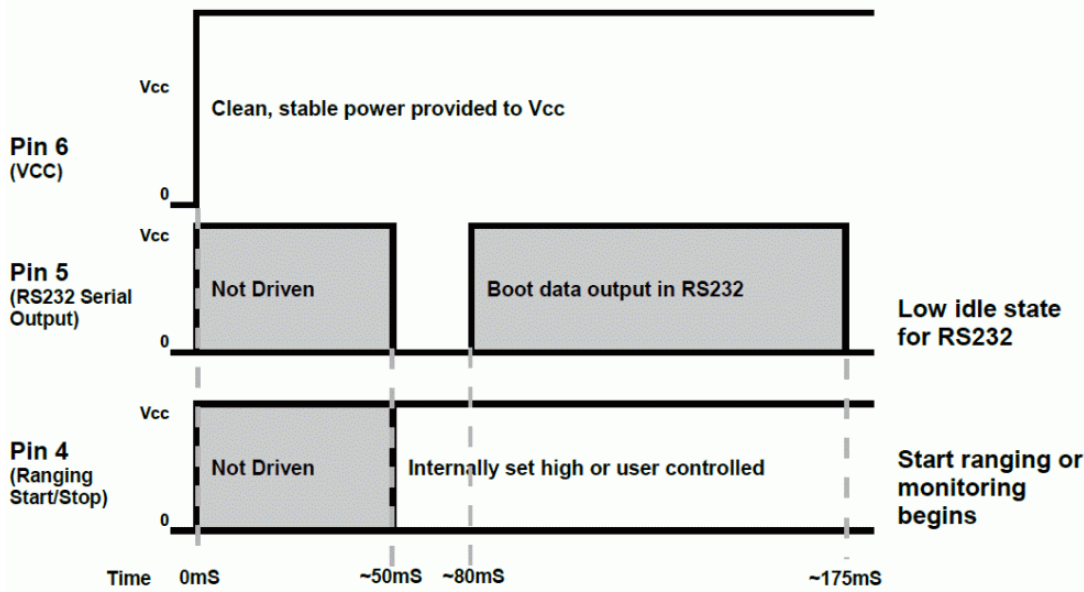
Repeat to add as many sensors as desired

strength is low and desired signal strength is high. Hence, the user is encouraged to mount the sensor in such a way that minimizes outside acoustic noise pickup. In addition, keep the DC power to the sensor free of noise. This will let the sensor deal with noise issues outside of the users direct control (Even so, in general, the sensor will still function well even if these things are ignored). Users are encouraged to test the sensor in their application to verify usability.

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Pull RX pin high for at least 20uS. Then just strobe the sensors' RX pins and the rest of the sensors will read the range simultaneously.

Wire AN pin to AD input

Wire AN pin to AD input

Wire AN pin to AD input

Repeat to add as many sensors as desired

Sensor Minimum Distance

The XL-MaxSonar-WR sensors have a minimum reported distance of 20-cm (7.87 inches). However, the

Power Up Timing
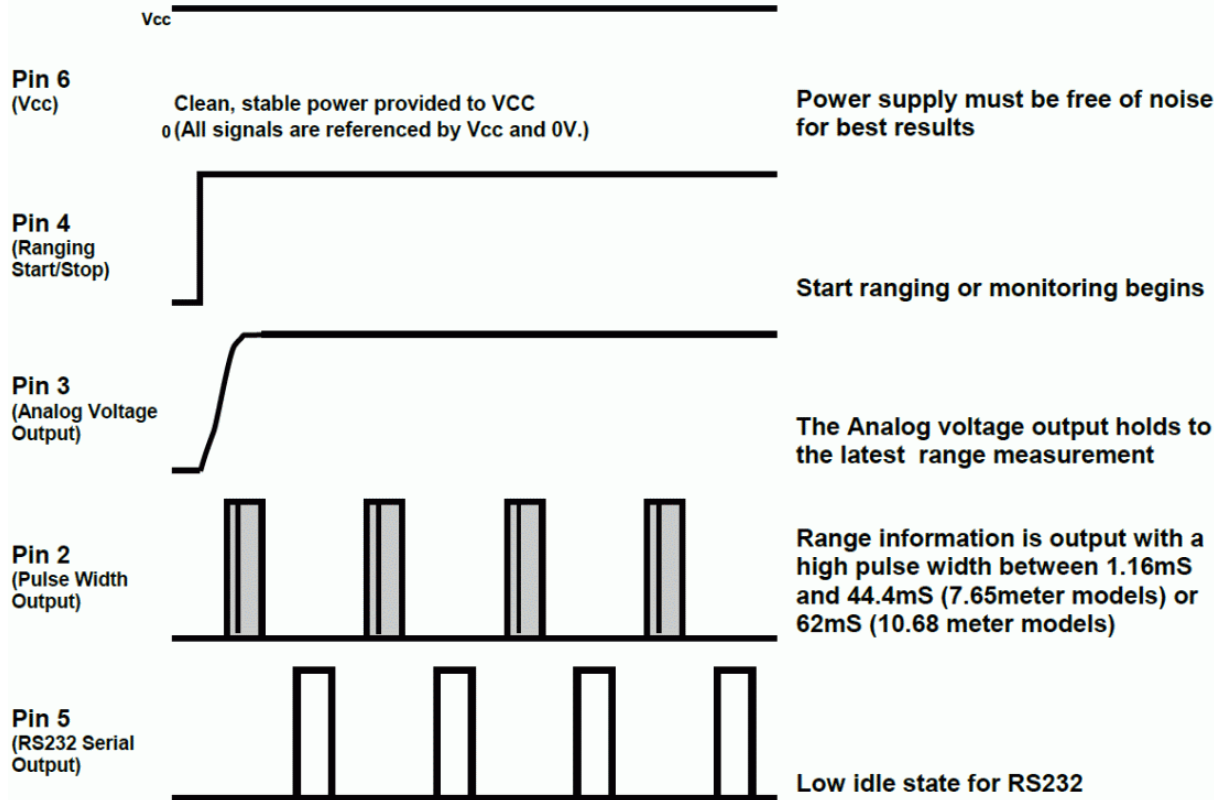
Pin 6 (VCC) — Vcc — Clean, stable power provided to Vcc — 0

Pin 5 (RS232 Serial Output) — Vcc — Not Driven — Boot data output in RS232 — 0 — Low idle state for RS232

Pin 4 (Ranging Start/Stop) — Vcc — Not Driven — Internally set high or user controlled — 0 — Start ranging or monitoring begins

Time   0mS   ~50mS   ~80mS   ~175mS

Pin 6 (Vcc) — Vcc — 0 — Power supply must be noise free for best results

Pin 4 (Ranging Start/Stop) — Drive high for >20uS (>0.02ms)

Pin 3 (ADC Output) — The analog voltage output mains the voltage corresponding to the latest range measurement

Pin 2 (PW Output) — Range information is output with a high pulse width that is at least 1.16mS

Pin 5 (RS232 Serial) — Data sent in RS232 — Low idle state for RS232

0mS   A   B   C   D

Product	Maximum Refresh Rate	Pulse Width Reported	Max Pulse Width End	Serial Data Reported	End of Range Cycle
MB7052	6.6 Hz	~82.3mS	~126.7mS	~144.3mS	~149mS
MB7060, MB7062,	10 Hz	~32.3mS	~76.7mS	~94.3mS	~99mS
MB7066	10 Hz	~32.3mS	~94.2mS	~94.3mS	~99mS
MB7070, MB7072, MB7076, MB7092	10Hz	NA	NA	~94.3mS	~99mS

XL-MaxSonar-WR will range and report targets to the front sensor face. Large targets closer than 20-cm will typically range as 20-cm. For the alternative housings, objects between 4-cm and 20-cm will typically range as 20-cm.

Free-Run Operation

Pin 6
(Vcc)

Clean, stable power provided to VCC
0 (All signals are referenced by Vcc and 0V.)

Power supply must be free of noise for best results

Pin 4
(Ranging
Start/Stop)

Start ranging or monitoring begins

Pin 3
(Analog Voltage
Output)

The Analog voltage output holds to the latest range measurement

Pin 2
(Pulse Width
Output)

Range information is output with a high pulse width between 1.16mS and 44.4mS (7.65meter models) or 62mS (10.68 meter models)

Pin 5
(RS232 Serial
Output)

Low idle state for RS232

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XL-MaxSonar-WR Sensor Operating Modes

Independent Sensor Operation

The XL-MaxSonar-WR sensors are designed to operate in a single sensor environment. Free-run is the default mode of operation for all of the MaxBotix Inc., sensors. The XL-MaxSonar-WR sensors have three separate outputs that update the range data simultaneously: Analog Voltage, Pulse Width[1], and RS232 Serial. Below are diagrams on how to connect the sensor for each of the three outputs.

Note 1 - select models output an Analog Envelope for end user processing (MB707X sensors and MB7092)

Using Multiple Sensors in a Single System

When using multiple ultrasonic sensors in a single system, there can be interference (cross-talk) from the other sensors. MaxBotix Inc., has engineered a solution to this problem for the XL-MaxSonar-WR sensors. The solution is referred to as chaining. We have 3 methods of chaining that work well to avoid the issue of cross-talk.

The first method is AN Output Commanded Loop. The first sensor will range, then trigger the next sensor to range and so on for all the sensors in the array. Once the last sensor has ranged, the array stops until the first sensor is triggered to range again. Below is a diagram on how to set this up.

The next method is AN Output Constantly Looping. The first sensor will range, then trigger the next sensor to range and so on for all the sensor in the array. Once the last sensor has ranged, it will trigger the first sensor in the array to range again and will continue this loop indefinitely. Below is a diagram on how to set this up.

The final method is AN Output Simultaneous Operation. This method does not work in all applications and is sensitive to how the other sensors in the array are physically positioned in comparison to each other. Testing is recommend to verify this method will work for your application. All the sensors RX pins are connected together and triggered at the same time causing all the sensor to take a range reading at the same time. Once the range reading is complete, the sensors stop ranging until triggered next time. Below is a diagram on how to set this up.

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.

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MB7052-MB7092 XL-MaxSonar®-WRM1/WRMA1™ Beam Pattern and Uses

The XL-MaxSonar-WRM1/WRMA1 ignores smaller targets and only reports the range to the largest acoustic return. The filtering in the MB7052 and MB7092 also rejects moving target clutter such as rain or snow, electrical noise, and outside acoustic noise.

MB7052-MB7092
XL-MaxSonar®-WRM/WRM1™ 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

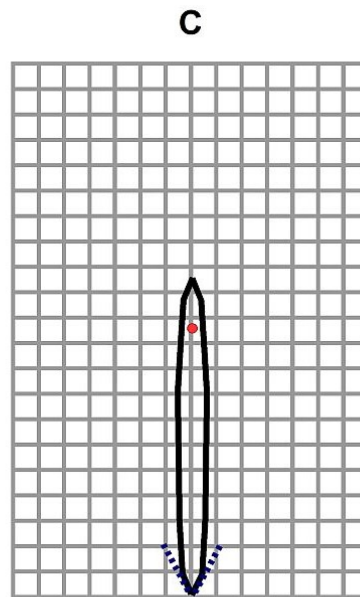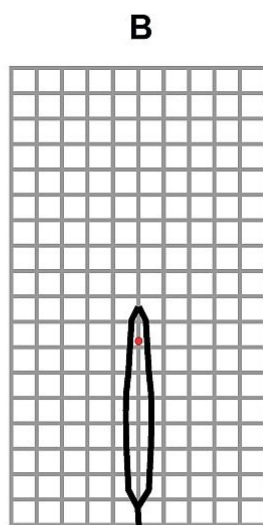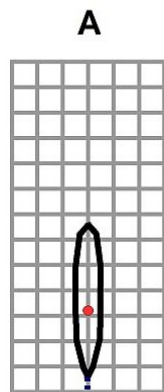D 11-inch wide board moved left to right with the board parallel to the front sensor face. This shows the sensor's range capability.
Note: For people detection the pattern typically falls between charts A and B.

- - **Partial Detection**
— **5.0 V**
● **3.3 V**

D

— 1050 cm (~34 ft.)
— 900 cm (~30 ft.)
— 750 cm (~25 ft.)
— 600 cm (~20 ft.)
— 450 cm (~15 ft.)
— 300 cm (~10 ft.)
— 150 cm (~5 ft.)
— 30 cm (~1 ft.)

A B C
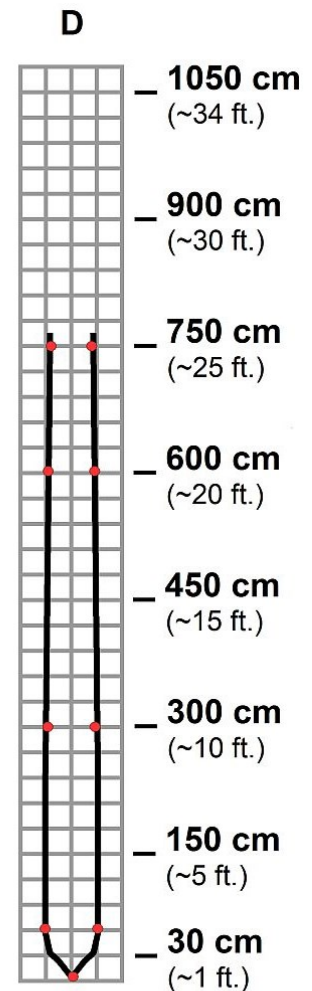
Beam Characteristics are Approximate
Beam Pattern drawn to a 1:95 scale for easy comparison to our other products.

MB7052-MB7092
Features and Benefits

- Clutter rejection provides range to the largest amplitude reflection within the field of view
- Real-time calibration, noise rejection and additional filtering provides stable range information
- Excellent for ranging to large objects in the presence of cluttered or noisy environments
- Excellent for applications that require consistently accurate outputs

- Impressive acoustic and electrical noise resistance
- 10Hz refresh rate for the MB7092
- 6.6Hz refresh rate on the MB7052

MB7052-MB7092
Applications and Uses

- Autonomous Navigation
- Environments with acoustic and electrical noise
- Bin Level Measurement
- Tank Level Measurement