I2CXL-MaxSonar® - EZ™ Series

High Performance Sonar Range Finder

MB1202, MB1212, MB1222, MB1232, MB1242

The I2CXL-MaxSonar-EZ series is the first MaxSonar ultrasonic sensor to feature the I2C interface. The sensors have high acoustic power output along with real-time auto calibration for changing conditions (voltage and acoustic or electrical noise) that ensure users receive the most reliable (in air) ranging data for every reading taken. The I2CXL-MaxSonar-EZ low power 3V – 5.5V operation provides very short to long-range detection and ranging, in a tiny and compact form factor. The I2CXL-MaxSonar-EZ detect objects from 0-cm to 765-cm (25.1 feet) and provide sonar range information from 20-cm out to 765-cm with 1-cm resolution. Objects from 0-cm* to 20-cm typically range as 20-cm. (*Objects from 0-mm to 1-mm may not be detected).*

Features

- I2C bus communication allows rapid control of multiple sensors with only two wires
- High acoustic power output
- Real-time auto calibration and noise rejection for every ranging cycle
- Calibrated beam patterns
- Continuously variable gain
- Object detection as close as 1-mm from the sensor
- 3V to 5.5V supply with very low average current draw
- Readings can occur up to every 25mS (40Hz rate)[3] for up-close objects. 15Hz rate for full range.
- Triggered operation provides a new range reading as desired
- Ultrasonic signal frequency of 42KHz
- Status pin available to determine sensor state
- Power-up address reset pin available
- Physical dimensions match other XL-MaxSonar-EZ products
- -40°C to +65°C operation (+85°C limited operation)

Low Power Requirement

- Wide, low supply voltage requirements eases battery powered design
- Low current draw reduces current drain for battery operation
- Fast first reading after power-up eases battery requirements

Benefits

- Acoustic and electrical noise resistance
- Reliable and stable range data
- Sensor dead zone virtually gone
- Low cost
- Quality controlled beam characteristics
- Very low power ranger, excellent for multiple sensor or battery based systems
- Ranging is triggered externally
- Fast measurement cycle
- No power up calibration required
- Perfect for when objects may be directly in front of the sensor during power up
- Easy mounting

Applications and Uses

- Multi-sensor arrays
- Proximity zone detection
- People detection
- Robot ranging sensor
- Autonomous navigation
- Educational and hobby robotics
- Environments with acoustic and electrical noise
- Distance measuring
- Long range object detection
- Security systems
- Motion detection
- Landing flying objects
- Collision avoidance
- Bin level measurement
- This product is not recommended as a device for personal safety

Notes:

[1] Users are encouraged to evaluate the sensors performance in their application

[2] By design

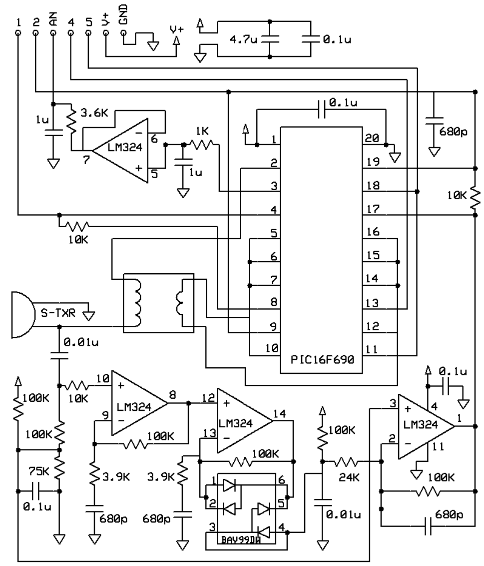
[3] Recommended time between readings of 100ms (10Hz Rate)

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 determines the range to a target.

I2CXL-MaxSonar®-EZ™ Circuit

The sensor functions using a variety active components which create an excellent ultrasonic sensor solution. The schematic is shown to provide the user with detailed connection information.



I2CXL-MaxSonar®-EZ™ Pin Out

Pin 1- Add-Reset: This pin is internally pulled high by the sensor. On power up, the state of this pin is checked; if left high or disconnected, the sensor will use the address stored in EEPROM for I2C communications. If pulled low (to ground), the sensor will use its default shipped address for I2C communications for the current power cycle only (to permanently change the address, one must use the I2C Change Address command).

Pin 2- Status- This pin provides a status indicator for the current state of the sensor.

On power up, it will provide a pulse width representation of the address that will be loaded from EEPROM and used, with a length of 100 microseconds × the 8-bit read/write version of address (~22.4 milliseconds for the default address).

During real-time operation, the line will be driven low while I2C bus communications are active and the sensor is listening for a command. Pin 2 will transition within 50 microseconds of receiving a ranging command to high, and will remain high until after the sensor is ready to communicate via I2C again after a range cycle. This is provided so users may poll the line to determine if the sensor has finished its ranging cycle, or set up an interrupt to be generated when the sensor is ready to report the latest range reading.

Pin 3-Not Used- This pin is not used for the I2CXL-MaxSonar-EZ series.

Pin 4-SDA (I2C Data)– This is the data line for I2C communications. The I2CXL-MaxSonar-EZ series operate as I2C slave devices, supporting 7-bit addressing, with a default shipped address of hexadecimal 70 (decimal 112). This corresponds to an equivalent 8-bit address of E0 (decimal 224).

Pin 5-SCL (I2C Clock)- This is the clock line for I2C communications. The I2CXL-MaxSonar-EZ series supports I2C clock frequencies up to 100kHz. Clock stretching must be supported by the master device for read requests with a clock speed above 25kHz.

V+- Vcc – Operates on 3V - 5.5V. The average current draw for 3.3V operation is 2.7mA (50mA peak) and for 5V operation is 4.4mA (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.

Selecting a I2CXL-MaxSonar®-EZ™

Different applications require different sensors. The I2CXL-MaxSonar-EZ product line offers varied sensitivity to allow users to select the best sensor to meet their needs.

The I2CXL-MaxSonar®-EZ™ Sensors At a Glance

People Detection Wide Beam High Sensitivity	Best Balance	Large Targets Narrow Beam Noise Tolerance	Very Large Targets Narrow Beam Extreme Noise Tolerance
MB1202	MB1212	MB1222 MB1232	MB1242

The diagram above shows how each product balances sensitivity and noise tolerance. This does not affect the pin outputs or other operations of the sensor. To view how each sensor will function to different sized targets, reference the I2CXL-MaxSonar-EZ Beam Patterns.

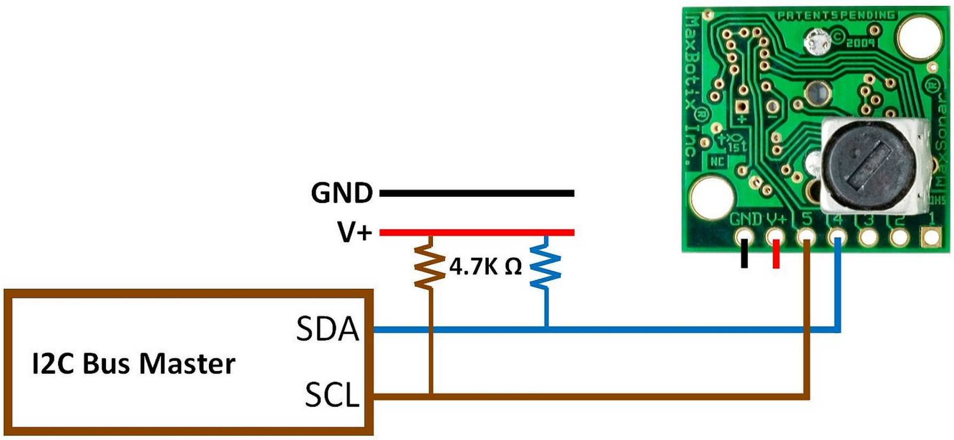
Single Sensor Reference Wiring Diagram

The I2C bus is a bi-directional, two wire interface that consists of a clock line and a data line.

The clock line and the data line both require a pull-up resistor attached to positive supply voltage. The recommended resistance is 4.7 kΩ; however, the value used is dependent upon the user configuration, with more sensors possibly requiring a lower resistance and users that use only one to two sensors per bus could use a larger resistance for the pull-ups. The I2CXL-MaxSonar-EZ series is capable of sinking more current through the pull-up resistors than the I2C specification allows (15mA versus 3mA), so that users may use a much lower resistance if it is required for their application.

Only one pull-up resistor is required each for the SCL and SDA lines per bus– not per sensor.

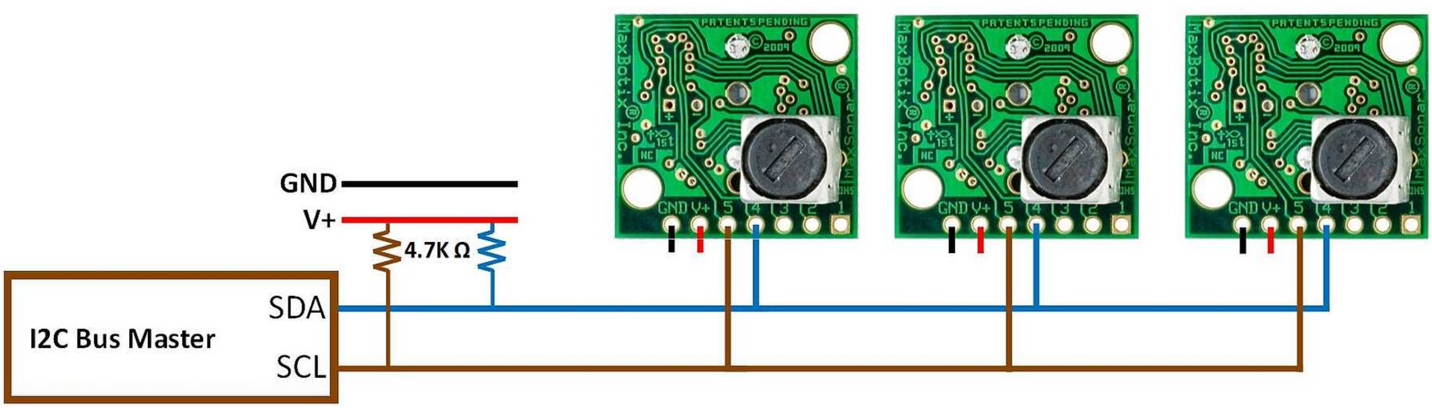
The pull-up voltage applied to the I2C clock line and data line should not be more than approximately 0.7 volts above what is applied to V+.



The four minimum required connections to the sensor to obtain basic functionality are: ground and power to GND and V+ respectively, SCL to Pin 5, and SDA to Pin 4.

Multiple Sensor Reference Wiring Diagram

Adding additional sensors to the I2C bus is extremely simple, as long as each sensor is programmed first to a different address (see I2C Address Change for more details), and the bus capacitance is low enough for the pull-up resistors to work properly. GND, V+, SCL and SDA simply need to be connected to the existing wires that the bus operates on. Each sensor can then be addressed individually to perform a range finding cycle or return the range data.



Sensor Minimum Distance - No Sensor Dead Zone

The sensor minimum reported distance is 20-cm . However, the I2CXL-MaxSonar-EZ will range and report targets to the front sensor face. Large targets closer than 20-cm will typically range as 20-cm.

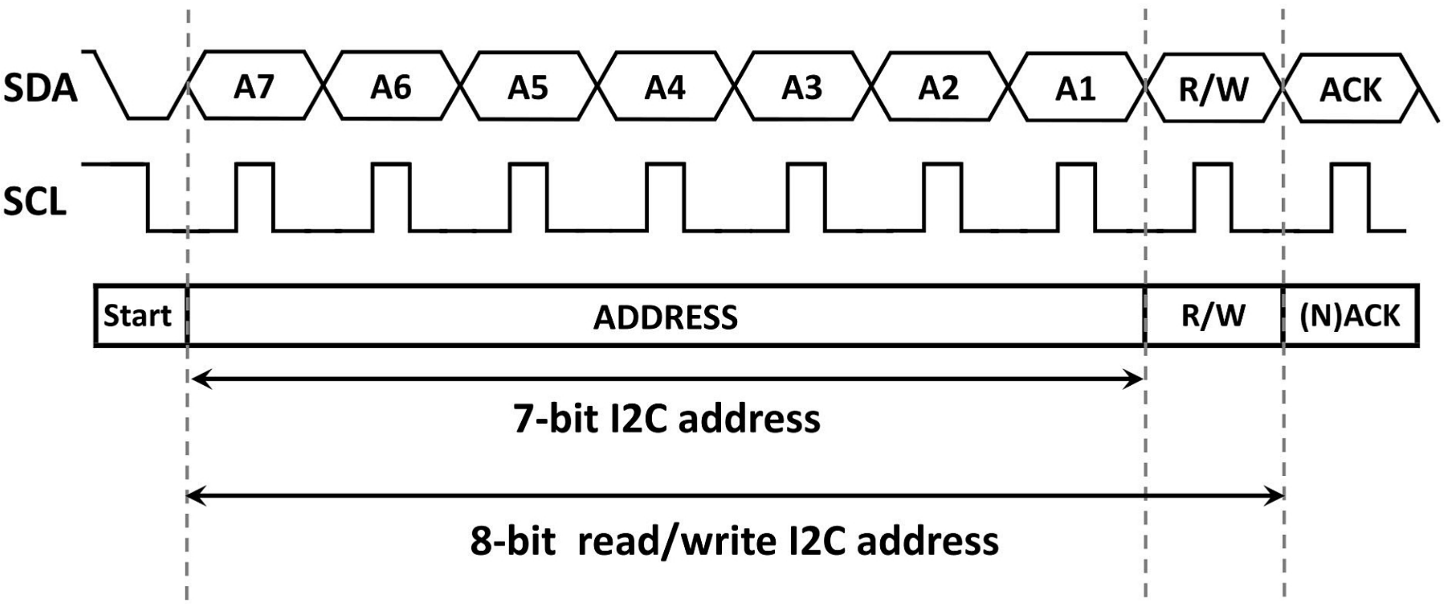
I2CXL-MaxSonar®-EZ™ General Operation

After going through the power-up cycle, the I2CXL-MaxSonar-EZ sensor(s) will remain in an idle state, listening to I2C bus communications. The sensor will always operate as an I2C slave; it is never a bus master. The sensor will wait for a read or write message from a bus master which contains an address that matches the sensors current address (determined during power-up).

By default, the sensor has a shipped 7-bit address of 0x70 (decimal 112). This translates to an equivalent 8-bit write address of hexadecimal E0 (decimal 224), and 8-bit read address of hexadecimal E1 (decimal 225). An explanation is given in the figure below. The address may be changed to any other 7-bit value, except 0x00 (decimal 0). Therefore, a single I2C bus could support up to 127 simultaneous I2CXL-MaxSonar-EZ sensors operating on it, as long as the user configuration allows I2C communications work properly.

The sensor may only be reliably addressed at clock speeds up to 100kHz. However, the bus itself may run faster than this as long as the I2CXL-MaxSonar-EZ sensor is not being addressed (tested up to 400kHz).

Sampling faster than 10Hz in certain environments that reflect acoustic noise well could cause the sensor to pick up signals from previous range readings and report false data. However, in certain environments it is possible to take range readings at a significantly faster rate (up to 40Hz depending on the application, see the “Take Range Reading” command page for more details).



The diagram above is an I2C addressing explanation: Each address sent over the I2C bus consists of 7 bits. Because each message over the bus is 8 bits long, the final bit when addressing indicates whether the master wishes to write to or read from the addressed slave. As such, the 7-bit version of the address is effectively the 8-bit version divided by 2 and includes only the first seven bits, whereas the 8-bit read and 8-bit write addresses include the final read/write bit in the address. A final ninth bit is sent back from the slave device to either acknowledge or not acknowledge the request—this bit can be used to determine whether a sensor is responding to the written address.

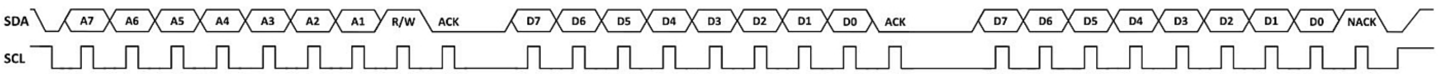
Reading from the sensor

After an address match with a read request, the sensor will return the high byte, followed by the low byte (to be interpreted as a 16-bit word), of the latest range reading in centimeters, followed by hexadecimal FF (decimal 255) for each subsequent byte requested. If the sensor receives a range request after power up without taking a range reading (i.e. receiving the "Take Range Reading" command), the sensor will respond with two bytes containing information used for in-factory manufacturing purposes. Therefore, a bus master simply needs to request two bytes back from the sensor after a range cycle to determine the range to a target. The diagram below is an I2C command diagram for reading back two bytes from the sensor after taking a range reading. The stop is optional and signifies only that the bus master does not wish to communicate further.

Start	ADDRESS	R	ACK	High byte	ACK	Low byte	NACK	Stop

Bus Master	Sensor	Bus Master	Sensor	Bus Master

The diagram below shows the SCL and SDA signals for the I2C read request operation. Notice that the sensor will clock stretch after every ACK, while preparing to respond with the latest byte of data. The sensor will release the clock line as soon as the sensor is ready to respond with the latest byte. This clock stretching must be supported if operating over approximately 25kHz clock rate (the clock stretching becomes trivial compared to the time between rising edges).



Start	ADDRESS	R	ACK	High byte	ACK	Low byte	NACK	Stop

Bus Master	Sensor	Bus Master	Sensor	Bus Master

Writing to the sensor

Command	Hexadecimal Value	Decimal Value	Explanation
Take Range Reading	**51**	**81**	Sensor takes a new range reading
I2C Change Address 1	**AA**	**170**	1st command of 2-command sequence to change the I2C address.
I2C Change Address 2	**A5**	**165**	2nd command of 2-command sequence to change the I2C address.

After an address match with a write request, all data written to the sensor over the bus is compared to the command set that the I2CXL-MaxSonar-EZ series supports; a summary is included above. A match of the received data by the sensor with a command will cause the specific action to be performed. If a value sent to the sensor does not correspond to one of the available commands, no action is taken by the sensor.

I2C Command Description

Take Range Reading

After receiving a byte from a bus master with a value of the ranging command and responding with the ACK, the sensor will stop responding to I2C communications sent to it. Within 50 microseconds of the ACK bit being generated, the sensor will drive pin 2 high. The sensor will transmit the ultrasonic pulse that will be used to measure distance, and proceed to measure the time of flight to a detectable target. . After detecting a target and determining the range (from approximately 15 milliseconds up to approximately 60 milliseconds after raising pin 2 high), the sensor will resume I2C communications and return to an idle state while listening for incoming messages. Pin 2 will then be brought low to indicate the sensor is ready to communicate via I2C again.

If the sensor is addressed while in the middle of a range reading, all requests for communication will be responded with a NACK. If the sensor receives a read request while ranging, it will respond with NACK for the initial request, and all data bytes returned will be equal to hexadecimal FF.

The figure below shows the I2C command diagram of how to command the sensor to take a range reading. After addressing the sensor with a write request, the "Take Range Reading" command value (0x51, decimal 81) must be written to the sensor. After acknowledging receipt of the command, the sensor will take a range reading.

Start	Address	W	ACK	Range Command (0x51)	ACK	Stop
Bus Master			Sensor	Bus Master	Sensor	Bus Master

I2C Address Change

Through power cycles, the I2CXL-MaxSonar-EZ sensor stores a permanent address in internal EEPROM, which will be used on power up for I2C communications if Pin 1 (Address Reset) is left disconnected or held high. Users may change the power-up address to suit their application by performing the address change sequence. It is recommended to avoid changing the address often, as it could cause premature EEPROM failure due to repeated erase/write cycles. The sensor includes a safeguard of requiring two separate values to be sent in sequence before changing the stored address.

In order to change the address, the two address change commands, 0xAA (decimal 170) and 0xA5 (decimal 165) must be sent to the sensor sequentially in a single message, with no other bytes in between the commands. The next byte received in the same message will become the new address. If there are no bytes sent within the same message on the bus to the sensor after receiving the two sequential change address commands, the commands will need to be resent on another message if the sensor needs to have the address changed. The sensor will not accept a new address of 0x00 (decimal 0); if the new address of 00 is sent after receiving the two commands to change the address, the sensor will ignore the new address and continue waiting for a valid new address to be received, unless the bus master stops the transaction with a stop or restart condition. The address must be written in an 8-bit read/write format to the sensor (i.e. one would write 0xE0 to the sensor to set the EEPROM address back to the shipped default).

After receiving a valid byte to change the I2C address to, the sensor will write the new address to internal EEPROM, taking approximately 50 milliseconds. The senssor will then reset itself to go through the power-up cycle again. It is very important that power to the sensor is not disrupted while it is writing to EEPROM, or EEPROM corruption could occur. In the event of severe EEPROM corruption, the sensor will default on power up to using the default shipped address.

Start	Address	W	ACK	I2C Change Address 1 (0xAA)	ACK	I2C Change Address 2 (0xA5)	ACK	New 8-bit I2C Address	ACK	Stop
Bus Master			Sensor	Bus Master	Sensor	Bus Master	Sensor	Bus Master	Sensor	Bus Master

Above is the I2C command diagram for changing the sensor address. The two I2C "Change Address" commands must be sent sequentially in the same message, with the new valid (non-zero) address following the commands for a change to occur. After receiving the 8-bit address and responding with ACK, the sensor will update internal EEPROM and then reset itself.

Real-time Noise Rejection

While the I2CXL-MaxSonar®-EZ is designed to operate in the presence of noise, best operation is obtained when noise strength is low and desired signal strength is high. 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 (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.

For every ranging cycle, individual filtering for that specific cycle is applied. In general, noise from regularly occurring periodic noise sources such as motors, fans, vibration, etc., will not falsely be detected as an object. This holds true even if the periodic noise increases or decreases (such as might occur in engine throttling or an increase/decrease of wind movement over the sensor). Even so, it is possible for sharp non-periodic noise sources to cause false target detection. In addition, *(because of dynamic range and signal to noise physics,) as the noise level increases, at first only small targets might be missed, but if noise increases to very high levels, it is likely that even large targets will be missed.

The I2CXL-MaxSonar-EZ series has additional resistance against periodic noise and small target rejection capabilities over the standard XL-MaxSonar-EZ/AE series.

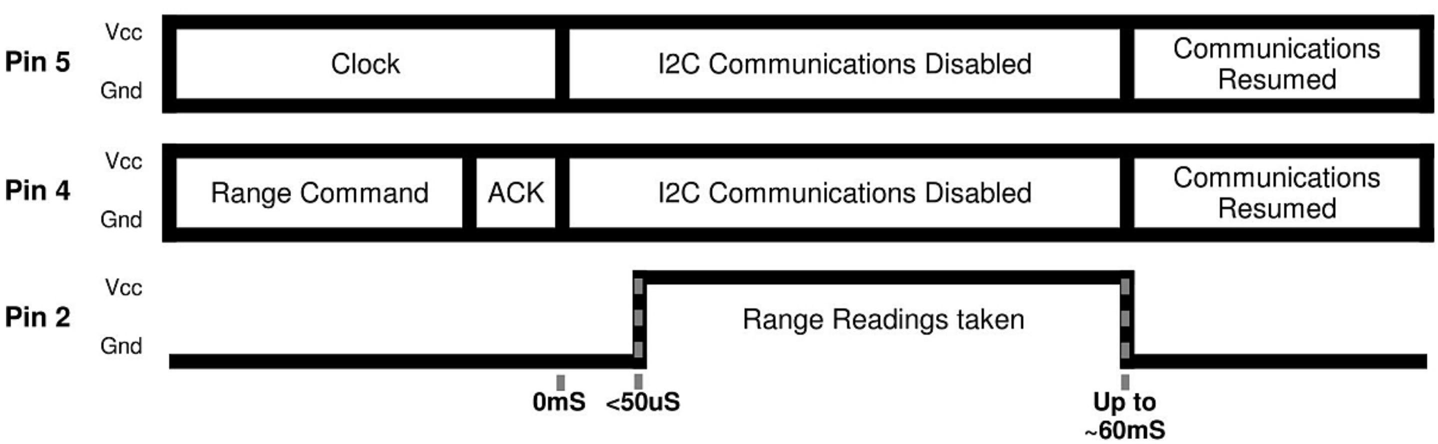
*In high noise environments, if needed, use 5V power to keep acoustic signal power high. In addition, a high acoustic noise environment may use some of the dynamic range of the sensor, so consider a part with less gain such as the MB1222, MB1232, or MB1242. For applications with large targets, consider a part with clutter rejection like the MB7360.

Real Time Ranging Operation

The diagram depicts the real time operation of the sensor for the SDA and SCL lines, and the status line. Pin 2 is raised from low to high almost immediately after receiving the range command, and will be brought back low as soon as the sensor detects a target, and begins listening to the I2C bus again. The sensor will then be ready to take a new range reading or report the results from the last range reading. The sampling period may take between approximately 15 to 60 milliseconds to detect a target, so it is only possible to achieve higher sampling rates from the sensor if targets are detected up close.

The sensor will always report a range between 20-cm and 765-cm. If a target is detected closer than 20-cm, the sensor will typically report the distance as 20-cm, and if no target is detected by the time a target at 765-cm would have been found, the sensor will limit the maximum reported distance to 765-cm.

Real Time Ranging Operation



I2CXL-MaxSonar®-EZ™ Power-up Timing Description

After applying stable, clean power, the sensor will drive Pin 2 (Status) low, and then undergo initialization and setup for approximately 50 milliseconds. During this time, the sensor will be unresponsive to all I2C communications. After the setup has finished, Pin 1 (Add-Reset) will be internally pulled high through a weak pull-up. The state of Add-Reset is checked for approximately 20 milliseconds. If Pin 1 is left high, the sensor will use the address stored in internal EEPROM for I2C communications . If Pin 1 is low, the sensor will use the default shipped address of 0xE0 (decimal 224). In the event that the sensor determines extreme EEPROM corruption has occurred, the sensor will use the default shipped address.

Then, approximately 70 milliseconds after power is applied, Pin 2 will be driven from low to high for a period of 100 microseconds times the value of the address being used (depending on the state of Add-Reset), for up to approximately 25 milliseconds. After approximately 50 more milliseconds, the sensor will be ready to receive I2C commands over the bus.

The formula used for calculating the pulse width length of the I2C address is as follows:

Pulse width length (microseconds) = 100 × value of 8-bit write address, or

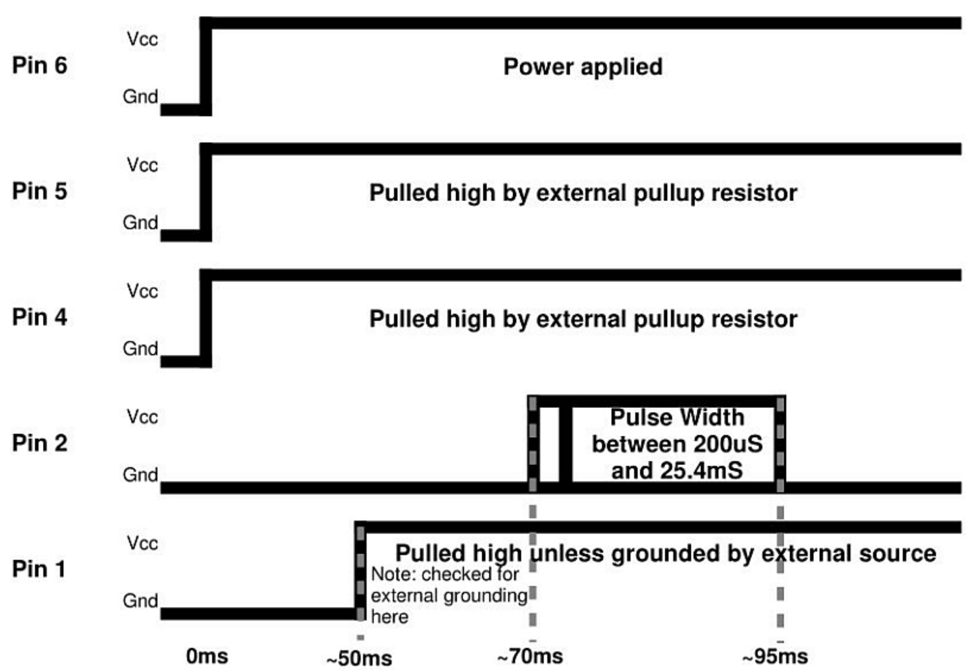
Pulse width length (microseconds) = 200 × value of 7-bit address

Therefore, to determine the address the sensor is using after measuring the pulse width length -

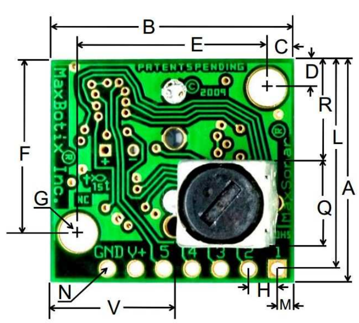
Value of 7-bit address = Pulse width length (microseconds) ÷ 200, or

Value of 8-bit write address = Pulse width length (microseconds) ÷ 100

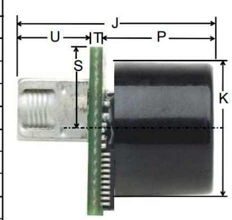
Power-up Timing Diagram



Mechanical Dimensions



A	0.785”	19.9mm	L	0.735”	18.7mm
B	0.870”	22.1mm	M	0.065”	1.7mm
C	0.100”	2.54mm	N	0.038” dia.	1.0mm dia.
D	0.100”	2.54mm	P	0.537”	13.64mm
E	0.670”	17.0mm	Q	0.304”	7.72mm
F	0.610	15.5mm	R	0.351”	8.92mm
G	0.124” dia.	3.1mm dia.	S	0.413”	10.5mm
H	0.100”	2.54mm	T	0.063”	1.6mm
J	0.989”	25.11mm	U	0.368”	9.36mm
K	0.645”	16.4 mm	V	0.492”	12.5mm
values are nominal			Weight, 5.9 grams		



Target Size Compensation

The I2CXL-MaxSonar-EZ sensors do not apply target size compensation to detected objects. This means that larger size targets may report as a closer distance than the actual distance or smaller size targets may report as a further distance then the actual distance.

Real-Time Auto Calibration

Each time before the I2CXL-MaxSonar-EZ sensor takes a range reading it calibrates itself. The sensor then uses this data to range objects. If the humidity or applied voltage changes during sensor operation, the sensor will continue to function normally. The sensor does not apply compensation for the speed of sound change versus temperature to any range readings.

Range “0” Location

The I2CXL-MaxSonar-EZ reports the range to distant targets starting from the front of the sensor as shown in the diagram below.

The I2CXL-MaxSonar-EZ will report the range to the closest detectable object. Target detection has been characterized in the sensor beam patterns.

I2CXL-MaxSonar®-EZ™ Beam Characteristics

Background Information Regarding our Beam Patterns

Each I2CXL-MaxSonar-EZ 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.

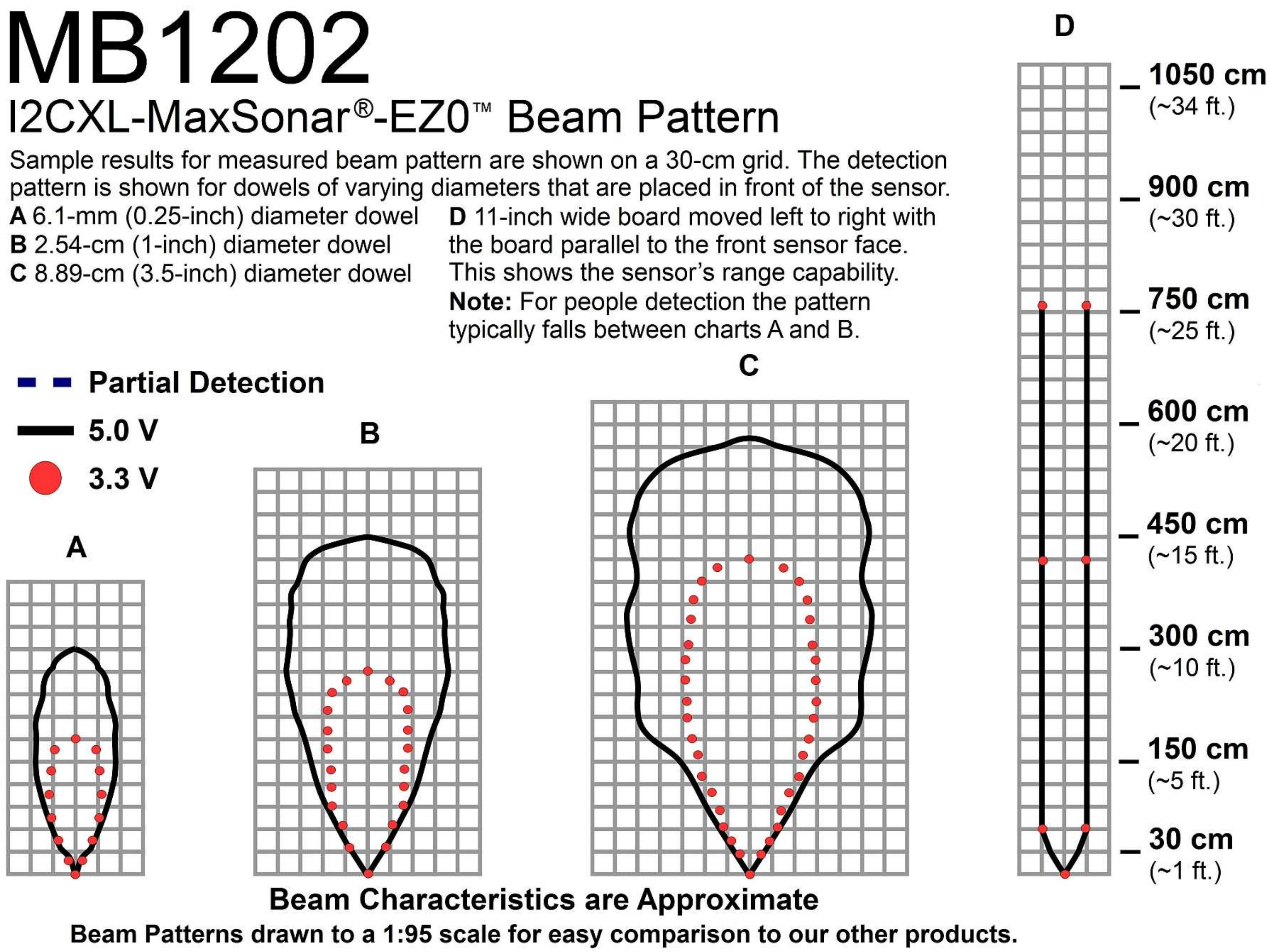
People Sensing:
For users that desire to detect people, the detection area to the 1-inch diameter dowel, in general, represents the area that the sensor will reliably detect people.

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.

Compared to the XL-MaxSonar-EZ line, the I2CXL-MaxSonar-EZ lines offers slightly tighter beam patterns compared to the same model number (i.e. I2CXL-MaxSonar-EZ1 versus XL-MaxSonar-EZ1).

MB1202: I2CXL-MaxSonar®-EZ0™

The I2CXL-MaxSonar-EZ0 is the highest sensitivity and widest beam sensor of the I2CXL-MaxSonar-EZ sensor series. The wide beam makes this sensor ideal for a variety of applications including people detection, autonomous navigation, and wide beam applications.



MB1202 Features and Benefits

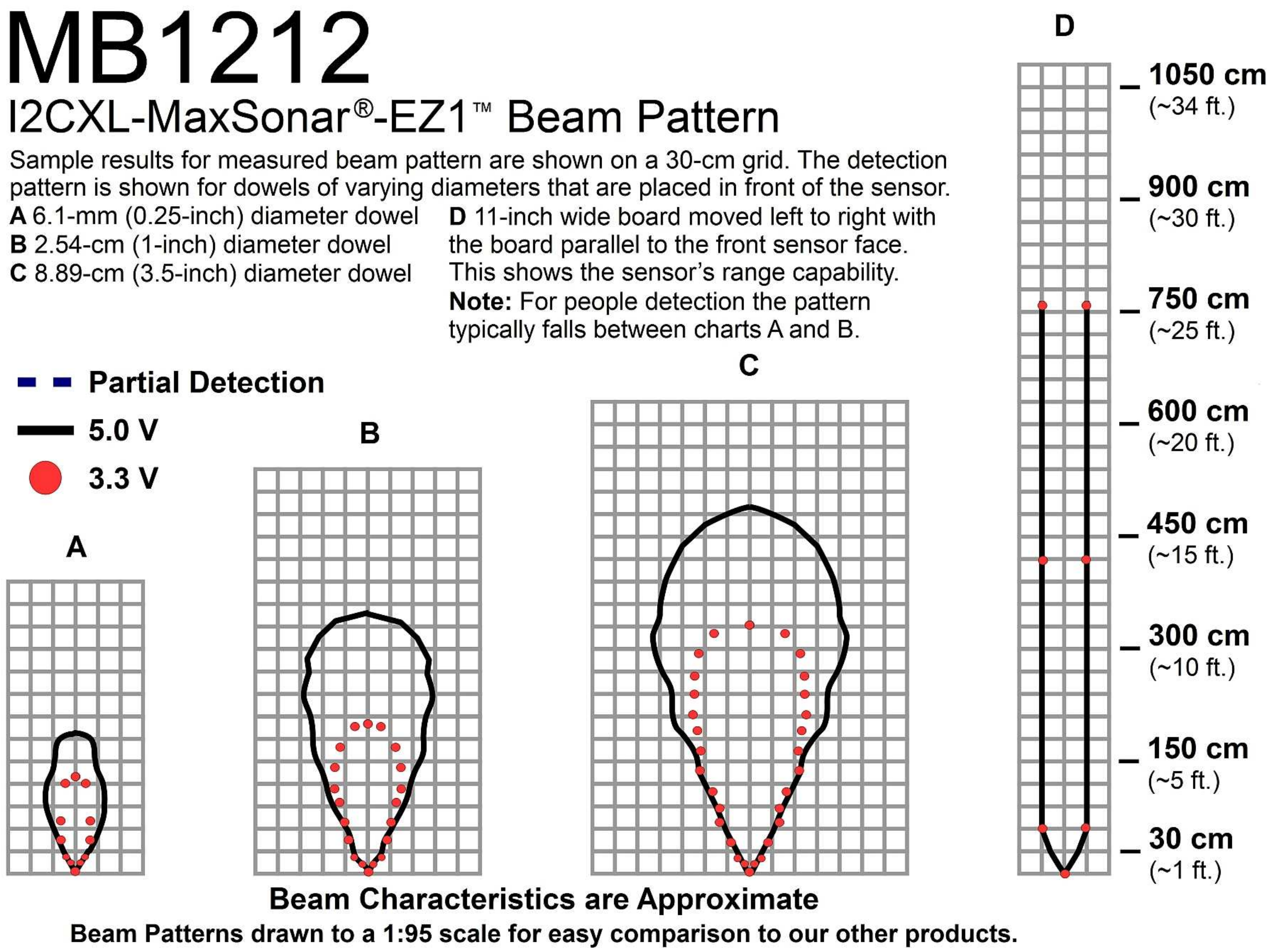
- Widest and most sensitive beam pattern in I2CXL-MaxSonar-EZ line
- Low power consumption
- Easy to use interface
- Will pick up the most noise clutter of any of the sensors in I2CXL-MaxSonar-EZ line
- Detects smaller objects
- Best sensor to detect soft object in I2CXL-MaxSonar-EZ line
- Can be powered by many different types of power sources
- Can detect people up to approximately 14 feet

MB1202 Applications and Uses

- Great for people detection
- Security
- Motion detection
- Landing flying objects
- Useable with battery power
- Autonomous navigation
- Educational and hobby robotics
- Collision avoidance

MB1212: I2CXL-MaxSonar®-EZ1™

The I2CXL-MaxSonar-EZ1 is our most recommended indoor sensor, and offers a lower hardware gain and a slightly smaller, narrower beam pattern than the MB1202. This makes the I2CXL-MaxSonar-EZ1 a great choice for people detection applications.



MB1212 Features and Benefits

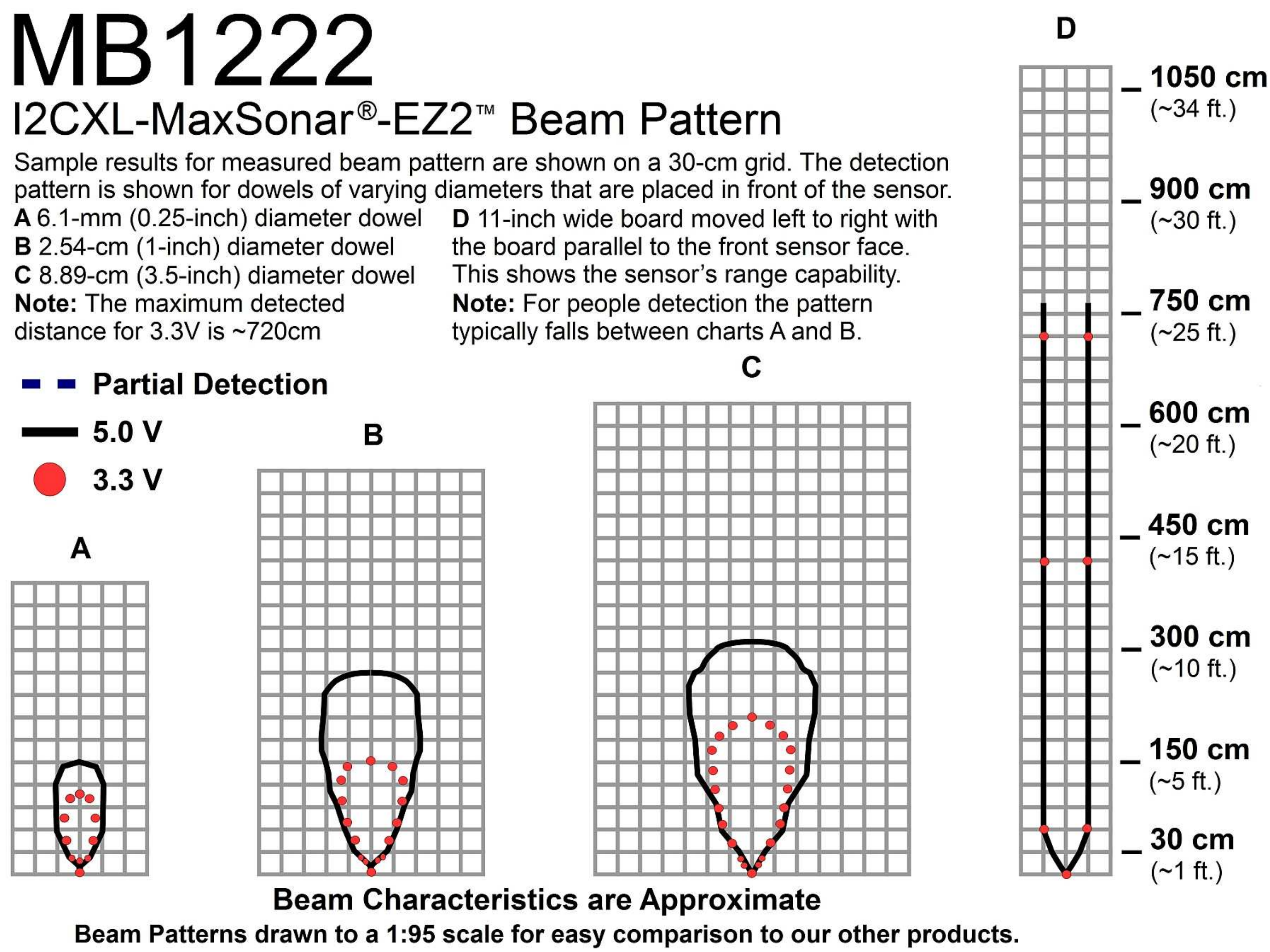
- Wide and sensitive beam pattern in the I2CXL-MaxSonar-EZ line
- Low power consumption
- Easy to use interface
- Detects smaller objects
- Can be powered by many different types of power sources
- Great sensor to detect soft object in I2CXL-MaxSonar-EZ line
- Can detect people up to approximately 10 feet

MB1212 Applications and Uses

- Great for people detection
- Security
- Motion detection
- Landing flying objects
- Useable with battery power
- Autonomous navigation
- Educational and hobby robotics
- Collision avoidance

MB1222: I2CXL-MaxSonar®-EZ2™

The I2CXL-MaxSonar-EZ2 offers a good balance between wide and narrow beam sensors, and large and narrow object detection. The I2CXL-MaxSonar-EZ2 works for nearly all indoor applications where the wider or narrower beam of other models could be a problem, including people detection, large-target detection, long range detection, and applications requiring high noise tolerance.



MB1222 Features and Benefits

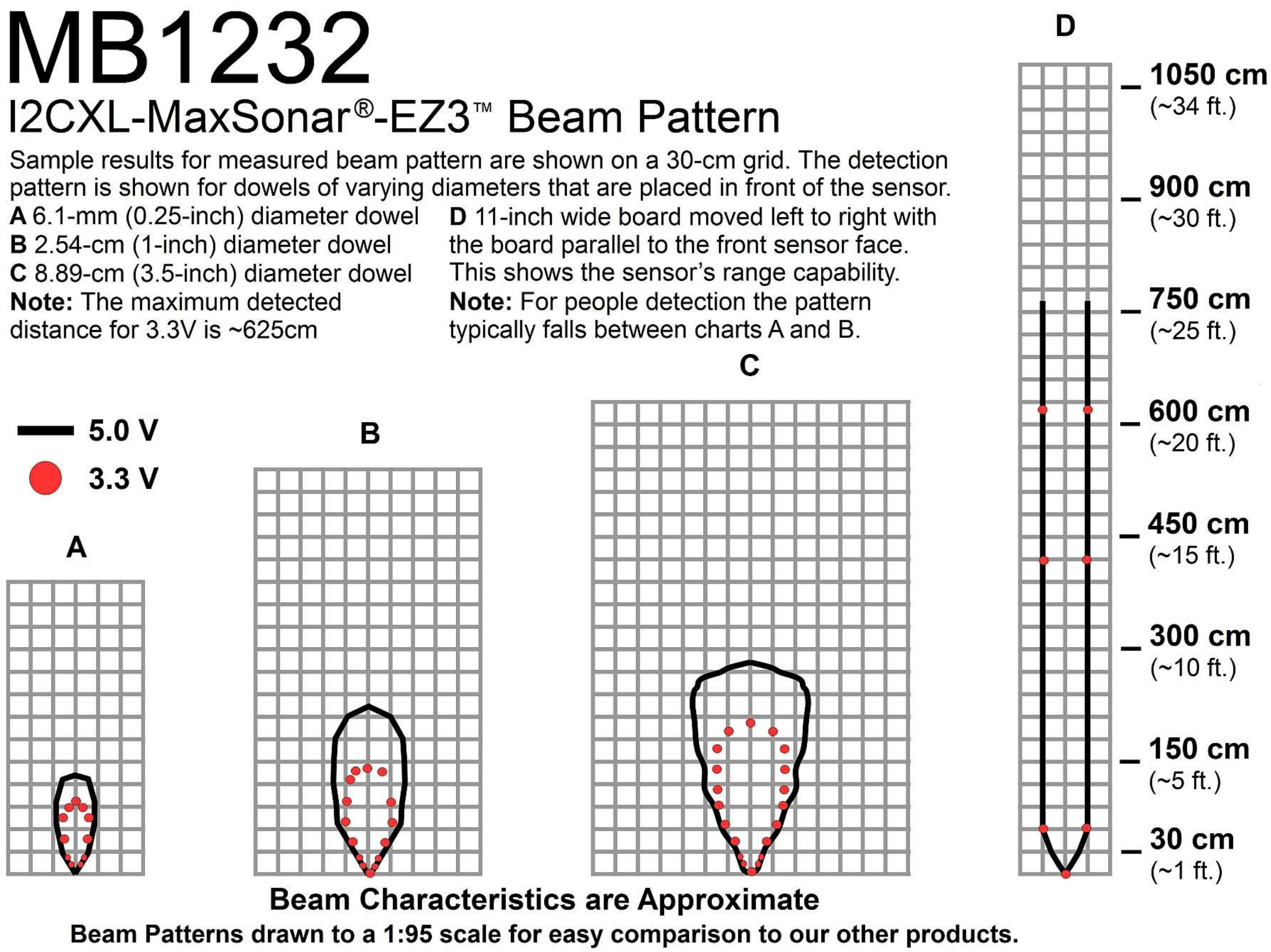
- Balanced beam pattern in I2CXL-MaxSonar-EZ line
- Low power consumption
- Easy to use interface
- Detects smaller objects
- Can be powered by many different types of power sources
- Good sensor to detect soft object in I2CXL-MaxSonar-EZ line
- Can detect people up to approximately 8 feet

MB1222 Applications and Uses

- Great for people detection
- Security
- Motion detection
- Landing flying objects
- Useable with battery power
- Autonomous navigation
- Educational and hobby robotics
- Collision avoidance

MB1232: I2CXL-MaxSonar®-EZ3™

The I2CXL-MaxSonar-EZ3 has high noise tolerance and a narrow beam with more sensitivity compared to the MB1242. The lower sensitivity of the I2CXL-MaxSonar-EZ3 makes it great for detecting only large targets at greater distances and filtering out smaller targets.



MB1232 Features and Benefits

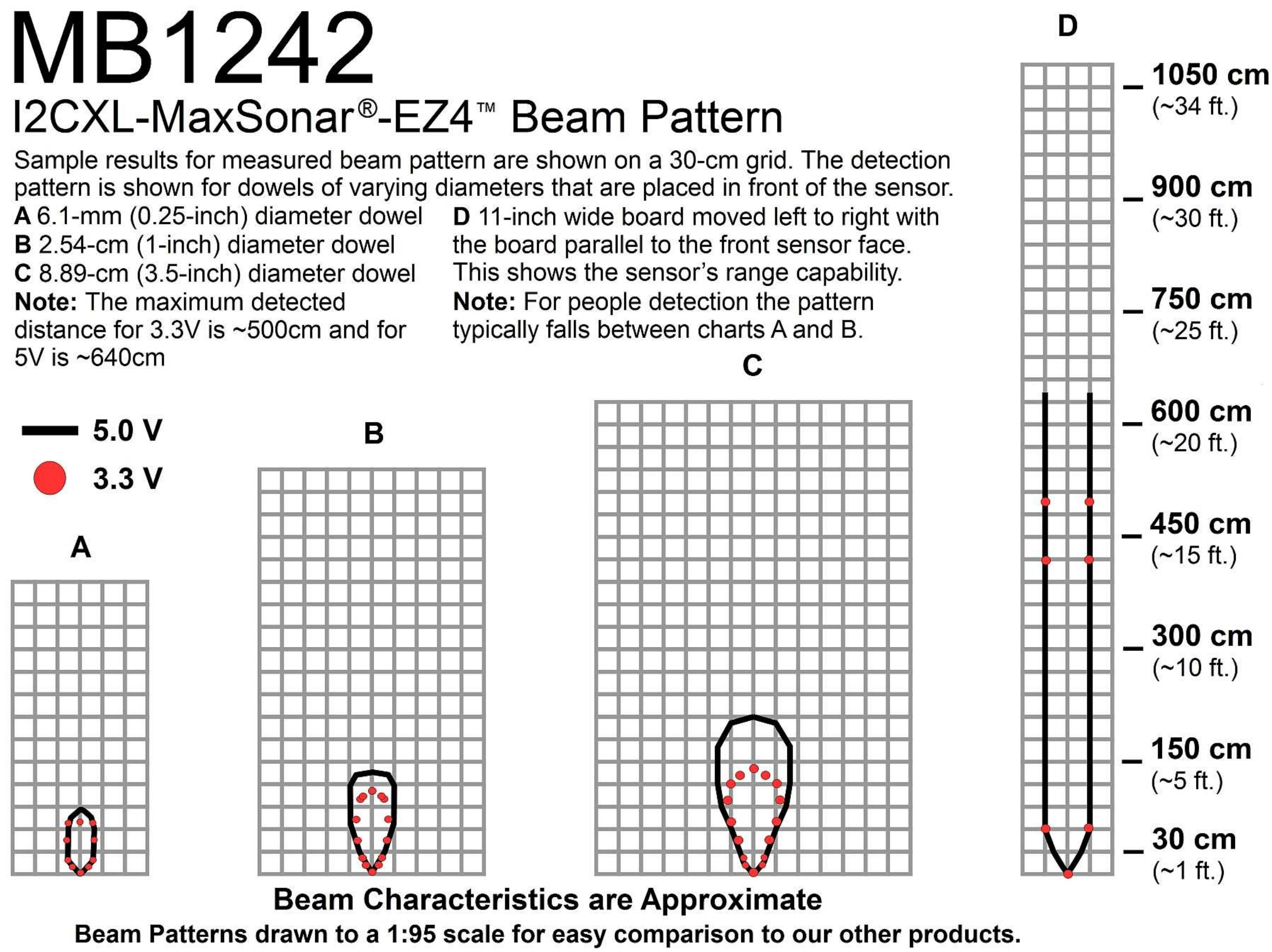
- Narrow beam pattern in the I2CXL-MaxSonar-EZ line
- Low power consumption
- Easy to use interface
- Rejects small clutter
- Can be powered by many different types of power sources

MB1232 Applications and Uses

- Security
- Motion detection
- Landing flying objects
- Useable with battery power
- Autonomous navigation
- Educational and hobby robotics
- Collision avoidance

MB1242: I2CXL-MaxSonar®-EZ4™

The I2CXL-MaxSonar-EZ4 has the highest noise tolerance and the narrowest beam of any of our indoor sensors. The sensor is calibrated and tested to provide stable range readings to large targets even in electrically and acoustically noisy environments.



MB1242 Features and Benefits

- Narrowest beam sensor in I2CXL-MaxSonar-EZ line
- Low power consumption
- Easy to use interface
- Rejects small clutter
- Can be powered by many different types of power sources

MB1242 Applications and Uses

- Security
- Motion detection
- Landing flying objects
- Useable with battery power
- Autonomous navigation
- Educational and hobby robotics
- Collision avoidance

I2C Code Examples

Arduino Uno (as of Arduino 1.0.1)

```
/* Code for Arduino Uno R3
Assumes the sensor is using the default address
Sensor Connections:
Pin 7 to GND
Pin 6 to 5V
Pin 5 to SCL
Pin 4 to SDA
Requires pull-ups for SCL and SDA connected to 5V to work reliably
*/
#include "Wire.h"
//The Arduino Wire library uses the 7-bit version of the address, so the code example uses 0x70 instead of the 8-bit 0xE0
#define SensorAddress byte(0x70)
//The sensors ranging command has a value of 0x51
#define RangeCommand byte(0x51)
//These are the two commands that need to be sent in sequence to change the sensor address
#define ChangeAddressCommand1 byte(0xAA)
#define ChangeAddressCommand2 byte(0xA5)

void setup() {
        Serial.begin(9600); //Open serial connection at 9600 baud
        Wire.begin(); //Initiate Wire library for I2C communications with the I2CXL-MaxSonar-EZ
}

void loop(){
        takeRangeReading();                              //Tell the sensor to perform a ranging cycle
        delay(100);                                      //Wait for sensor to finish
        word range = requestRange();                     //Get the range from the sensor
        Serial.print("Range: "); Serial.println(range);  //Print to the user
}
//Commands the sensor to take a range reading
void takeRangeReading(){
        Wire.beginTransmission(SensorAddress);           //Start addressing
        Wire.write(RangeCommand);                        //send range command
        Wire.endTransmission();                          //Stop and do something else now
}
//Returns the last range that the sensor determined in its last ranging cycle in centimeters. Returns 0 if there is no communication.
word requestRange(){
    Wire.requestFrom(SensorAddress, byte(2));
        if(Wire.available() >= 2){                       //Sensor responded with the two bytes
                byte    HighByte = Wire.read();          //Read the high byte back
                byte    LowByte = Wire.read();           //Read the low byte back
                word    range = word(HighByte, LowByte); //Make a 16-bit word out of the two bytes for the range
                return range;
        }
        else {
        return word(0);                                  //Else nothing was received, return 0
    }
}
```

I2C Code Examples

Arduino Uno cont. (as of Arduino 1.0.1)

```
/* Commands a sensor at oldAddress to change its address to newAddress
oldAddress must be the 7-bit form of the address that is used by Wire
7BitHuh determines whether newAddress is given as the new 7 bit version or the 8 bit version of the address
If true, if is the 7 bit version, if false, it is the 8 bit version
*/
void changeAddress(byte oldAddress, byte newAddress, boolean SevenBitHuh){
	Wire.beginTransmission(oldAddress);			//Begin addressing
	Wire.write(ChangeAddressCommand1);			//Send first change address command
	Wire.write(ChangeAddressCommand2);			//Send second change address command

	byte temp;
	if(SevenBitHuh){ temp = newAddress << 1; }		//The new address must be written to the sensor
	else		{ temp = newAddress;	}		//in the 8bit form, so this handles automatic shifting

	Wire.write(temp);					//Send the new address to change to

	Wire.endTransmission();
}
```

Have the right MaxSonar® for your application?

Check out our MaxSonar® Product Lines

Indoor Use (or protected environments)

- Power-up calibration
- Very low cost
- Very small size

1 in Resolution
LV-MaxSonar-EZ

1 mm Resolution
HRLV-MaxSonar-EZ

- Real-time auto calibration
- Very low cost

1 cm Resolution
XL-MaxSonar-EZ
XL-MaxSonar-AE
XL-MaxSonar-EZL
XL-MaxSonar-AEL
I2CXL-MaxSonar-EZ

Outdoor Use (or rugged environments) IP67

- Real-time auto or power-up calibration
- Very low cost

1 cm Resolution
XL-MaxSonar-WR
XL-MaxSonar-WRA
XL-MaxSonar-WRL
XL-MaxSonar-WRAL
I2CXL-MaxSonar-WR
1 mm Resolution
HRXL-MaxSonar-WR
HRXL-MaxSonar-WRT

F-Option Available for all WR models For additional protection when necessary in hazardous chemical environments.

Chemical Shield

- Real-time auto or power-up calibration
- Very low cost

1 cm Resolution
XL-MaxSonar-WRC
XL-MaxSonar-WRCA
I2CXL-MaxSonar-WRC
1 mm Resolution
HRXL-MaxSonar-WRC
HRXL-MaxSonar-WRCT

Accessories

MB7954 - Shielded Cable

The MaxSonar Connection Wire is used to reduce interference caused by electrical noise on the lines. This cable is a great solution to use when running the sensors at a long distance or in an area with a lot of EMI and electrical noise. MaxBotix Inc., has successfully tested our sensors at a distance of 1,000 ft using this wire and it was as stable as if it were next to the power supply.

MB7950 -XL-MaxSonar-WR Mounting Hardware

The MB7950 Mounting Hardware is selected for use with our outdoor ultrasonic sensors. The MB7950 Mounting Hardware gives customers easy access to the hardware needed for through hole mounting. The mounting hardware includes a steel lock nut and two O-ring (Buna-N and Neoprene) each optimal for different applications.

MB7955 / MB7956 / MB7957 / MB7958 / MB7959- MaxTemp

The HR-MaxTemp is an optional accessory for the HR-MaxSonar. The HR-MaxTemp is a temperature sensor that connects to pin 1 and 7 of the HR-MaxSonar for automatic temperature compensation without self heating or temperature gradient effects.