In this guide, readers will discover how Senix Ultrasonic Distance and Level sensors, Senix AirWire wireless technology and a host of additional accessories can help improve many aspects of Agriculture and Farming Applications. Ultrasonic sensors emit ultrasonic waves to measure distance and have a wide range of uses including water and liquid level monitoring to all types of distance and object detection. Ultrasonic sensor technology is extremely versatile and involves using the speed of sound to determine level measurements, assist in fertilizer application, and help monitor crops. Ultrasonic sensors can also be utilized in a variety of vehicle applications in agriculture, construction, and municipality vehicles including improving safety by alerting operators of obstacles and moving vehicles in their immediate surroundings. The ruggedness of Senix ToughSonic ultrasonic Distance and Level sensors to temperature, shock, and vibration makes them extremely well suited for outdoor applications.

- Built in 316 stainless steel housing (except PVC models)
- Offer ruggedized piezoelectric ultrasonic transducer
- Built with hardened & protected solid state electronics
- Include UV resistant, potted-in, PUR-jacketed cable
- Designed with short and overload protected outputs
- Have an IP68 ingress rating

- Easily connect with your equipment
- Optimize the sensor to the application
- Create stand-alone functions
- Duplicate applications without re-calibration
- Ready out of the box but fully adjustable with free SenixView Software with nearly 80 sensor parameters that can be optimized
- Connect To PLCs, pumps, motor drives, displays, alarms, lights & more
- Multiple simultaneous industry standard outputs that are selected using SenixVIEW software including analog outputs, sourcing, or sinking switches, and either RS-485 or RS-232 serial communications
- All configurable to the applications needs
- Choose RS-232 or RS-485 by sensor part number
- Multi-sensor Modbus-addressable RS-485 networks
- Wireless connectivity with Senix AirWire LoRa technology
- Monitor at Senix LiquidLevels.com or with other Cloud-based software

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Agriculture & Farming
30 Years
1990-2020

SENIX AGRICULTURE AND FARMING GUIDE / 3
Agriculture & Farming Measurements

With over 30 years of experience, Senix offers a full range of Ultrasonic sensors, accessories, and communications options for Agriculture and Farming Applications.

In the early 1900s, the world population was approximately 1.8 billion people. According to the United Nations data, there are approximately 7.8 billion people in the world today and we will reach between 9 and 10 billion by 2050. The world population growth and will continue to drive up global food demand. This will shape Farming and Agricultural markets in ways not previously experienced. Farmers worldwide will have to increase crop production either by expanding their agricultural land or by increasing productivity on their existing land, or more than likely both.

Enhancing and improving productivity can be accomplished through fertilizer technology, improved irrigation or adopting new methods of farming. This growth and rising demand for food is expected to drive the Farming and Agricultural market significantly into the future.

The agriculture industry influences many sectors of the economy on a worldwide basis. Changes in the Agricultural industry affect not only farmers and crop production, but also real estate markets, and food costs at supermarkets and restaurants to name a few. The use of global water resources and new technological abilities to monitor crops even further will continue to play a role in agricultural procedures both in the United States and around the world. Technology is also playing a key role in the Agricultural market as it is in other markets in rest of the world, it will continue to have an impact on the world of farming. Farmers are increasingly rising to the challenge and discovering new ways to put their use of wireless communications and sensors and software and other forms of technology can now be used to monitor crops each day.

This Agriculture and Farming Guide features Senix ultrasonic sensors and accessories. Senix Corporation is a high-tech engineering, manufacturing, and sales company nestled in the town of Hinesburg in the scenic foothills of the Green Mountains of Vermont. Since 1990, Senix has been the example of Yankee ingenuity, continually improving products and serving a gradually increasing number of customers around the world. Senix designs, manufactures, sells, and supports a wide range of perhaps the most tough and rugged ultrasonic distance and level sensors available today. The free SenixVIEW software makes Senix ToughSonic sensors the most versatile and flexible sensors available.

Non-contact ultrasonic sensors from Senix have distinct advantages in challenging environments where corrosive, scaling, coating, or dirty materials are likely to negatively impact the performance and maintenance costs of contact sensors. Non-contact ultrasonic sensors are also desirable where the material being measured cannot be corrupted by contact with a measuring device.

Ultrasonic sensors are used to measure distance to a remote object through the air without touching it. In addition to Agricultural and Farming applications, our sensors are used in a broad array of industrial and scientific applications. Distance Measurement including machine and motion controls, web controls (material loop and roll diameter), liquid level measurement, Water Measurement and control such as in Tank Level Monitoring applications — these sensors are providing fast and accurate outputs virtually any place where non-intrusive measurement and feedback are desired.

Senix non-contact ToughSonic ultrasonic sensors offer cost-effective, continuous level measurement. They are ideal for measuring water and benign liquids, and since are not immersed in the liquid or product being measured, they can measure most chemical liquids, as well as solids, some powders, and other materials. Senix SafeSonic sensors are intrinsically safe sensors for hazardous areas.

Senix sells to end-users, resellers, and OEMs (Original Equipment Manufacturers) in many industries. Standard ultrasonic sensor products provide solutions for most new or retrofit applications. Senix also creates custom sensor configurations and labeling to meet specific design or packaging requirements. The durable, flexible, and versatile ToughSonic sensors can even be built and configured into pre-packaged systems for object detection, remote monitoring, tank levels and more.

"We worked well with Senix to get this product up and running. [Ultrasonic sensor] durability has been good, and the Sonic Spray has been performing very well in the field. Gillison’s Variety Fabrication, Inc.

Matt Gillison
Ultrasound Sensors Reduce Chemical Usage, Senix Distance and Level Sensors

Senix Ultrasonic sensors with built-in switches are used in agricultural and farm equipment to Reduce Chemical Usage.
Ultrasonic sensors emit ultrasonic waves to measure distance and have a wide range of uses including water and liquid level monitoring, distance measuring, object detection and more. Ultrasonic sensor technology is extremely versatile and involves using ultrasonic detectors for stream or tank-level measurement, fertilizer application, and crop monitoring. Ultrasonic sensors can also be utilized in a variety of vehicle applications from agriculture, construction, and municipality vehicles by improving safety by alerting operators of obstacles and moving vehicles in their immediate surroundings. The ruggedness of Senix ToughSonic Ultrasonic Distance and Level sensors to temperature, shock, and vibration makes them extremely well suited for wet, dirty, outdoor agriculture applications.

What is often referred to as Precision Agriculture is experiencing a huge number of changes from indoor vertical farms to sensor enabled automated equipment control on traditional farms. These intelligent systems regulate crop insecticide application, monitor irrigation, control boom heights on harvesters and tillage equipment, monitor silo level and remote tank, and more. They enhance farming efficiencies to enable obtaining higher outputs and crop yield to feed an ever-growing world population.

Renowned equipment efficiency benefits have been implemented using ultrasonic level sensors to control the spray boom heights of insecticide and harvesting equipment by major farm equipment manufacturers. These types of devices use optimized Senix ultrasonic sensor transducers for monitoring spray distance from a delivery nozzle to plants to enable more accurate metering of insecticide or fertilizer application. Ultrasonic sensors are the preferred implementation due to their lower cost of ownership, potential to function in a variety of applications, and ease of setting adjustability such as sampling rate.

### Applications

- **IRRIGATION**
- **FLOOD MONITORING**
- **OPEN CHANNEL FLOW**
- **STREAMS, RIVERS, PONDS**
- **FLUMES, WEIRS AND CHANNELS**
- **FORESTRY HARVESTERS**
- **AGRICULTURAL PLANTERS, FERTILIZER, AND SPRAYERS**
- **PLANT HEIGHT**
- **TANK LEVEL MONITORING**
- **WASTEWATER**

Senix ToughSonic Ultrasonic Level Sensors are accurate and reliable enough to monitor plant crop growth—Senix in Farming and Agriculture

The Senix sensor works well for us and I found it robust and reliable for the plant height measurements in our applications.

University of Nebraska in Lincoln Assistant Professor Yufeng Ge

Professor Ge says similar research continued in 2016 and 2017 and will continue for the next few years, expanding to include corn, sorghum and camelina.

For tank, silo and storage container monitoring, spray distance measurement, boom height control, collision avoidance and inclination level applications, rugged ultrasonic sensors have proven invaluable. Senix ToughSonic sensors have multiple types of filtering, controllable sampling rates and improved echo signal processing have proven useful for a wide range of these industry applications. By configuring these sensors through SenixVIEW, users can adjust over 80 parameters to tailor every sensor to each unique application. With the advances in wireless technology, and explosion and acceptance of LoRaWAN wireless technology, agricultural operations such as irrigation systems and field storage locations also can include remote monitoring capabilities to control water distribution systems. Ultrasonic sensors like Senix ToughSonic sensors combined with AirWire LoRa technology have proven value in system deployments where solar trickle charging, or remote battery power provides the only economical means of power. The use of Senix ToughSonic ultrasonic sensors for documenting growth rates and crop health continues to be an evolving area as well. Specialty crops, like those grown in controlled environments such as greenhouses, vertical farming or nursery settings produce a great yield with less resources. These types of environments provide a controllable growth setting suitable for valuable crops that need regulation, distribution monitoring and optimization of the therapeutically active compounds. Sensors can be utilized by plant breeders to accurately monitor plant canopies, growth rates and the interactions of fertilizer and water application.
Ultrasonic Sensors

Ultrasonic level measurement with Senix ToughSonic Sensors provides continuous, non-contact and maintenance-free level measurement of fluids, pastes, sludges, and coarse bulk materials. An ultrasonic measurement is unaffected by dielectric constant, density, or humidity. Senix non-contact ToughSonic® ultrasonic sensors offer cost-effective, continuous level measurement for small and large tanks.

What do Senix® ultrasonic sensors do?

Ultrasonic sensors measure the distance to or presence of a target object or material through air without touching it. The measured distance is provided as an output in a variety of standard electrical interfaces compatible with displays, machinery, PLC’s, computers and most electronic or electrical machinery. Knowing the speed of sound, the sensor determines the distance of the target and sets its outputs accordingly. There are several advantages of ultrasonic technology, and specific advantages of Senix’s ultrasonic sensor technology.

Sensor outputs are set based on the measured distance, or under override conditions, a lack of target detection or user-selected response algorithms.

Outputs can be:
- An analog voltage or current signal proportional to the measured distance
- Switches or relay contact closures that open or close at specific distances
- Distance data transmitted as serial data communications.

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Outputs can be:
- An analog voltage or current signal proportional to the measured distance
- Switches or relay contact closures that open or close at specific distances
- Distance data transmitted as serial data communications.

Ultrasonic sensors are well-suited for most tank or container level measurements. They will detect both large and small targets, including liquids, solids, and granular materials. The size, shape, orientation, and composition of the target will affect the maximum distance at which it can be detected. The sensor is not affected by optical characteristics such as color, reflectivity, transparency, or opaqueness.

The Growing Demand

From Population Growth

Increasing demand from framers worldwide to increase crop production, changes in population, and per capita income affecting lifestyles are driving the growth of the agriculture and farming markets. In order to stay ahead of major economic and environmental factors such as population growth and climate change, the necessity to improve global agricultural productivity is expected to fuel the growth of the Agricultural and Farming Market for many years to come.

From IoT Technology

With the growing wireless technology market that allows for remote monitoring, there is an increasing interest from farmers and water or liquid level monitoring systems, as well as to monitor them remotely. Sensors and sensor systems can communicate via cellular, satellite, or the rapidly growing LoRa technology.

Remote monitoring can provide the necessary data to minimize water usage while maximizing crop production for example.
The following tables summarize Senix ToughSonic General Purpose and CHEM sensors for:

**Maximum Range:**
The longest distance each sensor can measure

**Optimum Range:**
When selecting a sensor, it is advisable not to select a sensor at the very edges of the desired measuring range. For example, when wanting to measure anything that might get close to 14 ft., it is advisable to select the next sensor range up rather than risk having a measurement need at the fringe of the range of the sensor.

**Dead Band:**
Objects that are too close to the transducer may return the echo before the transducer is ready to receive it. The minimum working distance is the dead band. The dead band is larger for longer range models, varying from 44 to 305 mm (1.75 to 14 inches). The minimum range and maximum range define the limits of the material window, which is the useful operating range of the sensor. The material window is user adjustable with SenixVIEW software to ignore unwanted targets or optimize system performance. When used outdoors we recommend limiting the range to the sensor’s “Optimum Range” specification rather than the “Maximum Range” to allow for environmental extremes.

### Maximum Range

<table>
<thead>
<tr>
<th>Sensor Model</th>
<th>Maximum Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>ToughSonic 3</td>
<td>15 m (49 ft)</td>
</tr>
<tr>
<td>ToughSonic 12</td>
<td>30 m (98 ft)</td>
</tr>
<tr>
<td>ToughSonic 14</td>
<td>30 m (98 ft)</td>
</tr>
<tr>
<td>ToughSonic 30</td>
<td>30 m (98 ft)</td>
</tr>
<tr>
<td>ToughSonic 50</td>
<td>30 m (98 ft)</td>
</tr>
</tbody>
</table>

### Optimum Range

<table>
<thead>
<tr>
<th>Sensor Model</th>
<th>Optimum Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>ToughSonic 3</td>
<td>10.5 m (34 ft)</td>
</tr>
<tr>
<td>ToughSonic 12</td>
<td>15 m (49 ft)</td>
</tr>
<tr>
<td>ToughSonic 14</td>
<td>15 m (49 ft)</td>
</tr>
<tr>
<td>ToughSonic 30</td>
<td>15 m (49 ft)</td>
</tr>
<tr>
<td>ToughSonic 50</td>
<td>15 m (49 ft)</td>
</tr>
</tbody>
</table>

### Dead Band

<table>
<thead>
<tr>
<th>Sensor Model</th>
<th>Dead Band (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ToughSonic 3</td>
<td>44</td>
</tr>
<tr>
<td>ToughSonic 12</td>
<td>56</td>
</tr>
<tr>
<td>ToughSonic 14</td>
<td>56</td>
</tr>
<tr>
<td>ToughSonic 30</td>
<td>56</td>
</tr>
<tr>
<td>ToughSonic 50</td>
<td>56</td>
</tr>
</tbody>
</table>

### Chemical Compatibility

The ToughSonic CHEM sensors avoid these problems by using a continuous injection molded housing of Polyvinylidene fluoride (PVDF), a highly non-reactive thermoplastic that resists solvents, acids, and hydrocarbons. ToughSonic CHEM sensors have both top and bottom mounting threads and include a potted-in, PUR-jacketed, UV resistant cable. Verify your chemicals and operating temperatures with this [compatibility chart](#).

Where resistance to chemical exposure is required, Senix offers its Tough Sonic CHEM 10, ToughSonic CHEM 12, ToughSonic CHEM 20 and ToughSonic CHEM 35 sensor for environments that require chemical compatibility.

Large, flat targets such as a liquid surface in a tank are detected at the maximum range. Curved objects or sound absorbing materials such as fabrics or non-wovens reflect less energy directly back to the sensor. Granular materials may absorb sound or deflect sound energy away from the sensor due to surface variation and/or angle of repose. Sensor maximum range should be de-rated for these targets.

Other factors affect how close an ultrasonic sensor can be to a target and still measure distance correctly. When too close the sensor will not detect the first echo, but may detect a second or third echo, yielding a longer than actual value. This dead band distance varies by model and is larger for longer range models.

Senix has sensors than can measure just over 15 meters (about 50 feet) and varies by model. The distance at which an object is detected depends on its size, shape, composition, and orientation. In general, the target must be larger to be detected at longer distances – the object must reflect a sufficiently strong ultrasonic echo back to the sensor to be detected.

For General Purpose sensors and applications, Senix offers its ToughSonic 3, ToughSonic 12, ToughSonic 14, ToughSonic 30 and three different models of it ToughSonic 50. The number “3” in ToughSonic 3, is the maximum distance measured in feet.

Some common chemicals can damage or corrode sensor materials, even 316 stainless steel. Transducer elements and bonding adhesives are also susceptible. ToughSonic CHEM sensors expand the range of environments in which our sensors operate.

Based upon desired measurement range, and the chemical characteristics of the target being measured, Senix has a sensor for all types of tank applications.
## Senix Product Line Summary

### General Purpose Sensors

<table>
<thead>
<tr>
<th>Model</th>
<th>Ranges</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ToughSonic 3</strong></td>
<td>3 Ft. (91 cm)</td>
<td><strong>Features</strong> – Material, Mounting &amp; Outputs:</td>
</tr>
<tr>
<td></td>
<td>14 Ft.</td>
<td>- 316 Stainless Steel</td>
</tr>
<tr>
<td></td>
<td>30 Ft.</td>
<td>- Available in either 30mm or 1” NPT threads (w/o nuts)</td>
</tr>
<tr>
<td></td>
<td>50 Ft.</td>
<td>- 316 Stainless Steel</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Available in either 30mm or 1” NPT threads (w/o nuts)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- 6 Wire Sensor</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Power or switches</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Rear Mount</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- 6 Wire Sensor</td>
</tr>
<tr>
<td><strong>ToughSonic 14</strong></td>
<td>100 mm - 3m</td>
<td>- 2 Configurable outputs</td>
</tr>
<tr>
<td><strong>ToughSonic 30</strong></td>
<td>50 ft.</td>
<td>- Teach Button</td>
</tr>
<tr>
<td><strong>ToughSonic 50</strong></td>
<td>100 mm - 3m</td>
<td>- 5 Configurable outputs</td>
</tr>
<tr>
<td><strong>ToughSonic 50</strong> (rear mount)</td>
<td>50 ft.</td>
<td>- Teach Button</td>
</tr>
<tr>
<td><strong>ToughSonic 50</strong> (clamp mount)</td>
<td>50 ft.</td>
<td>- 5 Configurable outputs</td>
</tr>
</tbody>
</table>

### ToughSonic CHEM Sensors

<table>
<thead>
<tr>
<th>Model</th>
<th>Ranges</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ToughSonic CHEM 10</strong></td>
<td>10 ft. (3 m)</td>
<td>- PVDF</td>
</tr>
<tr>
<td></td>
<td>12 Ft.</td>
<td>- 1.5” Parallel Universal threads (bottom) and 1” NPT threads (top)</td>
</tr>
<tr>
<td><strong>ToughSonic CHEM 12</strong></td>
<td>20 Ft.</td>
<td>- RS232 or RS485</td>
</tr>
<tr>
<td><strong>ToughSonic CHEM 20</strong></td>
<td>20 ft.</td>
<td>- 9 Wire Sensor</td>
</tr>
<tr>
<td><strong>ToughSonic CHEM 35</strong></td>
<td>35 ft.</td>
<td>- Power or switches</td>
</tr>
<tr>
<td><strong>ToughSonic CHEM 30</strong></td>
<td>35 ft.</td>
<td>- Serial Interface</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- 5 Configurable outputs</td>
</tr>
</tbody>
</table>

### Power Requirements

All ToughSonic sensors have an input power requirement of 10-30 VDC (typical 45 mA @24 VDC)

### Cable & Terminations

All Senix ToughSonic sensors include potted in and protected PUR jacketed cables. Standard cable length is 6.5 ft., although other lengths are available as a custom sensor. All cables are shipped with flying leads, however optional connectors such as M12 and others are available as options.

### Measurement in Hazardous Areas

If your Agricultural or Farming application might require an intrinsically safe sensor, our SafeSonic 25-L is a two-wire, 4-20 mA, loop powered, intrinsically safe sensor CS4 approved for use in hazardous areas only in the United States and Canada.
Compared to wired communications, a wireless IoT solution for Agricultural and Farming applications has many advantages. Wireless connectivity is flexible, cost-effective, and much easier to deploy. With a long-range and power-efficient solution like low power wide area networks (LPWANs), one can easily connect hard-to-reach assets using sensors operating on batteries instead of requiring a wired power source.

LPWANS can be implemented at a lower cost than other wireless alternatives due to lower device, network, and maintenance requirements. By unlocking 24/7 asset visibility and feeding this data into enterprise management systems, a wireless IoT architecture enables enhanced production planning, asset management and protection, and operational safety.

IoT solutions are focused on helping farmers close the supply demand gap, by ensuring high yields, productivity, and protection of the environment. The IoT technology being used to ensure optimum application of resources to achieve high crop yields and reduce operational costs is called precision agriculture. IoT in agriculture technologies comprise specialize equipment and sensors, wireless connectivity, software and IoT services.

Step 2

Accessories and Components

Senix offers a variety of displays, alarms, lights, and other accessories. The displays include panel mounted, enclosure mounted and stand-alone models. Senix can build custom enclosures and do all enclosure wiring and display configurations for turn-key systems ready to install and power on.

Displays & Controllers

Digital controller accessories display level measurements and/or provide outputs to control other equipment. Tank levels can be displayed as level or volume in any units. Relay output options control pumps, valves, or level alarms. Measurements can also be re-transmitted to additional displays or equipment at other locations.

Mounting

Flanges, Adapters & Brackets

Senix sensors have threaded housing and can be screwed directly to a tank or vessel. A wide variety of flanges, adapters, brackets, and clamp mounts are available.

Other features include:
- Sunlight readable outdoor displays with large digits
- Pump control sequencing for multi-pump systems
- Volume calculations for horizontal cylindrical tanks or other shapes

Displays, controllers, and IoT ready multi-variable controllers are sold individually, with or without housings, or Senix can custom build a packaged system according to customer requirements.

Low Profile Mounting or Reducing Dead Band Limitations

Senix offers a 90-degree adapter for its 1” NPT models (ToughSonic 3 and 14). The sensor screws into the adapter and then the adapter screws in or mounts to a 1” NPT thread. The dead band for these two sensors is essentially inside the adapter….so measurements can be taken to the top of a container or closer to the transducer. Other adapters can be made for other sensors as well. Senix also offers straight adapters if a lower profile is not needed, all intended both as size adapters and to be able to essentially eliminate the limitations of the dead band.

External Temperature Compensation

The ToughSonic Reference Target, Temperature Compensation accessory uses an external reference target at the front of the sensor located in the measurement path. Combined with the latest SenixVIEW software, each measurement the sensor makes two readings; one to locate the reference target, and one to the distant object. Any change in the speed of sound affects both measurements. The reference target location is locked during calibration, and any change in its apparent position is applied proportionally to correct the distant object’s apparent location. The result is a more accurate measurement, unaffected by ambient air temperature, diurnal temperature swings, sensor self-heating, sunshine warming the sensor, cold ambient temperatures, or vibration.

This Reference Target can be ideal for sensors out in the hot sun or where the temperature changes greatly during the day and night.
Senix AirWire Wireless LoRa System provides a complete solution for remote monitoring of liquid and many solid levels. The system is available with a variety of Senix high-quality ultrasonic sensors. It can be used for measuring liquid levels in tanks or storage vessels, or a wide range of other applications. At each site, a Level Transmitter provides battery power to an ultrasonic sensor, and wireless communication. Data from the site is transmitted periodically through a local wireless link to a Gateway. This eliminates the need for costly installation of electrical conduit or cellular infrastructure and recurring costs.

With AirWire LoRa Technology:
- Transmit tank levels inside or outdoors without installing conduit or wiring
- Collect nearby tank levels from up to several miles away
- No recurring cellular charges
- No wiring is needed at the tank site
- Uses standard Senix ToughSonic sensors
- Ideal for measurement rates as fast as a few times per hour
- Connects with any Senix ToughSonic sensor with an RS-485 interface.

Functionality
- Collect level data from monitor sites and put it to use
- Display and alert level or volume conditions
- Use in buildings or outdoors
- Real-time measurements
- 50,000-100,000 measurements on D-cell batteries

Cost Savings
- Less expensive than running conduit inside buildings
- No wiring or power needed at monitored sites
- No cellular connect charges within the LoRa network
- Reduce labor and increase safety with fewer site visits
- Upgrade to AirWire and use your existing tank sensors

Why Use LoRa?
- Relatively long range handles many nearby applications
- Very low power consumption
- Ideal for measurement rates of a few times per hour
- High Security for privacy, measurement integrity and authenticity
- Data can be restricted to company LAN or connected to cloud services
- Conforms to latest IoT standards and can integrate with existing applications

AirWire Level Transmitter
The battery-powered Level Transmitter connects with and controls a Senix RS-485 interfaced ultrasonic level sensor, then sends each level measurement to the Gateway. It maximizes battery life by operating for a very short period to power the sensor andsend the data, then goes back to “sleep” until the next measurement.

How Does AirWire Work?
At each monitored site, a Level Transmitter and attached Senix ToughSonic sensor measure the distance down to the monitored liquid or material. That distance is scaled and periodically transferred wirelessly to a Gateway that can serve many purposes, such as presenting the level(s) in a web page on a Local Area Network (LAN), sending email alerts for either high or low-level conditions, and/or transferring the data to an external application either locally or on the cloud. Level can be displayed simply as height or converted to volume (gallons, liters, etc.). Measured data is presented as level, volume, or percent of capacity.
AirWire LoRa Gateways

A Gateway accepts level measurements from one or more level transmitters and can:
- Act as a web server to show levels to users on a LAN
- Send email alerts at high and/or low-level conditions
- Inform each transmitter how long to sleep before the next measurement
- Log time-stamped levels for import to Excel or other applications
- Transfer level information to other applications either on the LAN or in the cloud

The Basic Gateway is plastic housed with an internal antenna and is surface, wall or ceiling mounted. It can act as a server and/or Ethernet gateway.

The Flex Gateway is metal housed with a rear-attached bendable antenna and is surface mounted. It can act as a server and/or Ethernet gateway, and datalog up to 22.8 million measurements (over 10 years at 15 minutes per measurement) to the cloud.

The Outdoor Gateway is sealed in an IP67 aluminum housing with attached antenna designed for elevated mounting outdoors to increase system range performance. It can act as a server and/or Ethernet gateway, and datalog up to 115,000 measurements (about 20 days at 15 minutes per measurement). Cellular gateway options are also available. If the level transmitters are within range of Public LoRa services a cloud-based application can be used in lieu of the Gateway. Similar or expanded features can be provided in a cloud-based architecture. Cloud-based services can also be provided simultaneously by transferring the level data stream through the Gateway to the cloud.

Public LoRa networks are available in a growing number of areas. If transmitters are in Public LoRa networks, no system Gateway is needed. Customers simply subscribe to the Public LoRa network. If the level transmitters are within range of Public LoRa services a cloud-based application can be used in lieu of the Gateway. Similar or expanded features can be provided in a cloud-based architecture. Cloud-based services can also be provided simultaneously by transferring the level data stream through the Gateway to the cloud. The Gateways are configured to customer-specific needs.

Cloud-Based Monitoring

AirWire done with local viewing only

All Gateways are web servers and will display an HTML webpage on the local network or on a single dedicated PC. The display shows the latest data received from every sensor and transmitter in the system. The information includes the current tank level or volume, system status, any alarms, battery, and RF signal level, and the date and time of the last transmission. Other screens include specific measurement intervals, times, alarm levels, sensor information and much more. The display will show an alert if data is overdue. The Gateway can also send an email alert of any alarm or system errors.

Monitor with LiquidLevels.com from Senix

The Gateway can also post system information in the cloud. Senix offers secure Cloud-based software to monitor your tanks, vessels, and containers remotely. LiquidLevels.com has a variety of features and there are no monthly fees. LiquidLevels.com is a secure site to view all installed tank monitoring sensors where the status is viewed, plus users can make parameter changes to individual tank monitors. Users with administrative access changes can be entered remotely. Tank data can be displayed in chart form in wide or narrow time frames. Log data is available at the LiquidLevels site for download without visiting either the tank sites or receiver gateway site. The Senix Gateways can also post data to any private address specified by the user.
Step 3

Optimizing the Sensor for your Agriculture or Farming Application

Senix ToughSonic sensors are ready to go at shipment but offer ease of customization. A quick and simple set-up can be accomplished through Senis’s Push Button TEACH technology, if the tank level application requires other optimization, SenisVIEW software is used to set outputs, set span and slope, set dead band to suit application, set filters to overcome motions or interferences, set event responses using delays, build a sensor network, and more.

The computer configurable sensor models, however, offer greater ease of use, feature flexibility and application visibility that many users find essential. The features provided by our SenisVIEW™ software would not be possible without a computer. Once an installation setup is determined, it can be stored and duplicated easily and quickly using the computer, or Senix can provide sensors pre-configured to your exact needs. Once a sensor has been selected, as well as any needed accessories, the next step is setting up your sensor an optimize them to your application.

SenisVIEW provides an intuitive, MS Windows interface for ease of understanding. Target symbols, distance data, meter and switch symbols all show proportional, real-time measurements. Help tips are available by placing your mouse over any screen element or parameter. It is easy, it’s free and it’s all at your fingertips. For step-by-step instructions on using SenisVIEW, please our Video Tutorials in the Support Center. Information is also contained in the sensor manuals.

Do I need a computer to use these sensors? Absolutely not! The pushbutton TEACH features provide all the functionality many users require. Many Senix sensors include Push Button TEACH capability. This allows calibration using actual targets for quick and easy setup. There are no touchy potentiometers to adjust, and pushbutton security features are provided to prevent accidental misadjustment. The TEACH features also provide many pushbutton-selected features that give our sensors increased flexibility.

Sensor Setup (Configuration)

SenisVIEW allows you to access nearly 80 functionally organized parameters that affect operating range, sensitivity, measurement rates, outputs, output filters, condition responses and more. Sensor changes are stored in the sensor’s non-volatile memory when power is off. As many setups as you want can also be stored for later recall to create an exact copy in a new sensor for maintenance or OEM product duplication.

Sensor Analysis

SenisVIEW allows you to view real-time output using a variety of statistical and display tools. Fine tune sensor performance in real time. Create timestamped data logs and export them to Excel to view application data over time. You can even use your ToughSonic sensor to system test the rest of your connected equipment virtually.

Analog Output

Analog outputs are voltage or current signals that vary proportionally with the measured distance. Some sensor models provide two or three simultaneous analog outputs. The analog distance endpoints are easily set anywhere within the sensor’s measurement range. Either endpoint can be the analog high limit or analog low limit, allowing either a positive or negative slope. Standard analog output value selections include 0-10 VDC, 0-5 VDC and 4-20 mA. current loop. Computer configurable models permit user-entered analog high limit and analog low limit values. The figure below shows typical analog 4-20 mA. current loop output scaling. A target is shown detected at about the midpoint of the current loop analog range, which yields a sensor output value of 12 ma.

Using Analog Outputs to Determine Loss of Echo or Signal

If a sensor were to lose the echo off the liquid surface for any reason, it reacts according to its configuration. By default, the analog outputs hold the last value until the echo is restored. Switch outputs also hold the status at loss of echo. But both these are adjustable in configuration by the user with SenisVIEW. Analog can go to the high or low output end of their output range, or switches can be sent to an active or deactivated state. Additionally, a switch can monitor for an echo loss and react, while the analog output holds the last value, useful when the analog output is part of a speed control circuit. Senix ToughSonic sensors allow many types of custom configuration to do what you need. All outputs are always available.

Switch/Relay Output

Switch outputs turn ON or OFF at a distance setpoint and are used to start and stop external actions or indicators at those distances. Senix sensors have one or two simultaneous switches depending on the model. Each is independently adjustable. Computer configurable models allow the switches to turn ON and OFF at different distances (hysteresis) or to be ON or OFF only when a target is within a specified switch window. The hysteresis feature allows a single sensor to perform a complete control function, such as turning a pump on at a low level and off at a high level to maintain a liquid level within limits.

The switch window feature allows proximity sensing only within specific distance ranges. A single switch output can perform a control function such as managing the liquid level in a tank by turning a pump or valve on or off at specific levels.

Using SenisVIEW software, switch functions and responses can be optimized using adjustable ON and OFF time delays, initial power-up states, hysteresis and window modes, and loss of target states with an associated time delay. Each switch output can be set to “PNP” type (sourcing) or “NPN” type (sourcing) for universal compatibility. Some switch features are also adjustable using the “teach” push-button.

Manage Sensor Configurations

Use SenisVIEW to manage sensors by saving configuration files along with notes about the setup. Commission new sensors by cloning configuration files in a few seconds without the need for recalibration. Easily distribute configuration files among facilities and colleagues.
FAQs

Ultrasonic Sensor

adjustment, range adjustment, by adjusting beam width, sensitivity sensors, the detection of undesired sensor from the surface. With Senix® no sound energy is reflected to the measurement will not be affected if the other objects if those objects do not matter if the target there is a problem. This is if the ultrasonic beam is larger than of the sensor. Computer configurable world response to an off-angle target varies slightly by specific sensor and The ultrasonic beam angle in Senix® transmitted to the air between the sensor and influence the measurements. Senix sensor should be kept from direct deep inside the sensor itself. The compensation is usually based Senix ToughSonic sensors have built-in transmission of sound energy will be reduced or blocked. Temperature Senix ToughSonic sensors have built-in temperature compensation for the change in the speed of sound in air. This compensation is usually based on an internal temperature sensor deep inside the sensor itself. The sensor should be kept from direct sunlight or heat sources if temperature compensation is being used, because artificial heating of the sensor can influence the measurements. Senix offers an external temperature compensation option that is not affected by sensor heating, rapid temperature changes day to night, or internal self-heating. The temperature of the air between the sensor and the target can affect measurement accuracy since the speed of sound varies with temperature. If this is an issue, temperature compensation is available in all computer configurable models. The speed of sound changes approximately 0.179%/°C, or 1% for every 5.7 °C. As the temperature increases the target will measure closer, and vice versa.

Humidity

Humidity change is generally not a significant factor (0.036% / 10% RH change).

Pressure/Vacuum

Normal atmospheric pressure changes or small pressure changes in vessels will not affect ultrasonic sensor operation. Ultrasonic sensors are not designed for high pressure applications, although Senix sensors have proven to work fine at pressures <100 psi. With respect to a vacuum, sound does not travel in a vacuum and therefore the sensors will not work in a vacuum environment.

Ultrasonic Noise

Locally generated ultrasonic noise at the sensor operating frequency can interfere with measurements. Some potential sources are high pressure air releases near the sensor caused by air nozzles, pneumatic valves or solenoids, and ultrasonic welders. In computer programmable sensors, processing options can be selected to ignore the effects of noise bursts. Higher frequency sensors are less susceptible due to sound absorption in the air. Air paths are usually rearranged, blocked, or eliminated to prevent this. Senix sensors are designed to allow several ultrasonic sensors in the same vicinity without mutual interference.

Audible Noise

Loud audible noises produced by machinery do not affect the sensor.

How do I know what the measured distance is?

Senix sensors provide the measured distance in several analog and serial data formats. Sensors can have one or more simultaneous outputs in various combinations for connection to displays, Programmable Logic Controllers (PLC’s), computers, motor drives – almost any type of electronic equipment.

Serial Data

All Senix sensors have either an RS-232 or RS-485 serial data interface that uses either the industry standard Modbus protocol or a simpler ASCII streaming output. Modbus allows two-way communication of control instruction and data transfer. SenixVIEW configuration software uses Modbus for sensor configuration, monitoring sensor performance, and testing. Serial RS-232 is an electrical interface for single sensor communication with computers, displays or other user equipment over relatively short distances. Serial RS-485 interface allows multiple ultrasonic sensors and other RS-485 devices, such as numeric displays, PCs, or loggers, to be connected to a Modbus addressable, multi-drop wired network. It is more robust than RS-232 and allows for longer communication distances.

Senix ToughSonic sensors can also send unidirectional ASCII characters (“ASCII streaming”) after each measurement, useful in some applications. Communications baud rate is adjustable from 9,600 to 115,200 baud and proprietary features are available for high-speed data collection in multi-sensor applications.

Mounting ultrasonic sensors

The following general sensor mounting guidelines should be adhered to. For more complex mounting guidance, please contact Senix Customer Service.

• Ultrasonic sensors should be mounted in plastic threaded adapters to avoid acoustic energy absorption through the sensor body.
• Sensors should be hand tightened only. Never apply a wrench to the sensor body.
• When tank mounting to a domed or round tank, adjust the sensor mount until the transducer face is square with the target surface.
• Mount the sensor directly to the tank ceiling at a flange opening. If a riser is added, it must be of sufficient diameter to cause no inner wall reflections. Round off the lower edge of the riser.
• Provide a sunshade for outside installations to prevent the sensor body from overheating and causing erroneous measurements. The sensor body should stay equal to the ambient air temperature so the sensor's built-in temperature compensation can work correctly.

How do I maintain my Senix® ultrasonic sensors? Senix sensors are housed in rugged materials and fully potted in epoxy resin. It is important to keep the ultrasonic transducer face clear of ice, snow, dirt, and other physical barriers to prevent disruption of the ultrasonic signals. Ideally, sensors will be mounted with transducer faces pointed downward to minimize material collection on the face. If transducer faces do require cleaning, pressurized air can be used. In liquid level applications, occasional submersion or spraying of the material being measured is often sufficient to maintain a clean transducer face. Sensors with exposed transducer faces can also be cleaned with alcohol or window cleaner, if necessary. DO NOT use solvents such as MEK or acetone on ToughSonic sensors with exposed transducers.

How accurate are Senix® ultrasonic sensors? ToughSonic 3, 12, 14 and the ToughSonic CHEM 10 and CHEM 12 models have a measurement resolution of 0.086 mm (0.003384 inches). The ToughSonic CHEM 20 has a measurement resolution of 0.172 mm (0.0068 inches) and the ToughSonic CHEM 35 has a measurement resolution of 0.3438mm (0.0135 in.)

Other measurement, environmental and target factors affect the overall result. Typical repeatability is better than 0.5%, and accuracy is <2% of the measured target distance.

Ingress Ratings:

Our Senix ToughSonic line is IP68 / NEMA-4X / NEMA-GP rated and will operate after complete submersion.

Outdoor Environments

The ToughSonic models are designed to withstand the harshest outdoor environment with full epoxy potting, UV shielded cables and stainless steel or polymer housings. The sensor face must be protected from buildup of ice, snow, mud and other debris or the transmission of sound energy will be reduced or blocked.

Senix ToughSonic Ultrasonic Sensor FAQs

How wide is the ultrasonic beam?
The ultrasonic beam angle in Senix® sensors is typically 10-15 degrees and conically shaped. The ultrasonic beam varies slightly by specific sensor and detailed on our data sheets. The real-world response to an off-angle target has a lot to do with the target size and orientation, and the sensitivity setting of the sensor. Computer configurable sensors can be adjusted to optimize detection of the desired target and ignore undesired targets.

What happens if the ultrasonic beam hits other objects?
A common misunderstanding is that if the ultrasonic beam is larger than the target there is a problem. This is not true in general. It does not matter if the beam hits another object or the other objects if those objects do not reflect sound back to the sensor or are farther away than the target of interest. For example, this means that a sensor can be mounted next to a wall or can measure inside a tube and the measurement will not be affected if the wall or tube surface is smooth because no sound energy is reflected to the sensor from the surface. With Senix sensors, the detection of undesired or off-axis objects can be measured by adjusting beam width, sensitivity adjustment, range adjustment, processing filters and object masking.
Filtering & Stillings Tubes

If a pond, river, or other outdoor surface being measured is subject to waves, foaming, or turbulence for example, there are multiple ways to compensate for these factors. With SenixVIEW, all Senix ToughSonic sensors can utilize one of several filters to mitigate the jittery readings they produce. Available filters include stability test, averaging type, and delayed reaction types. Often a simple running average of the previous 25 measurements or so gives proper smoothing of otherwise jittery data, and the data comes from the sensor at its configured running rate.

Input Rejection Filtering precedes any averaging filtering. Input rejection filters ignore some measurements. The input to these filters is the raw sensor distance measurement. The output (“Good” data) is then input to an averaging filter (if used). For example, the sensor can be configured to reject all except the closest measurement, or all but the farthest measurement. Examples include maintaining a measurement value of a poor target (weak or intermittent echo). This filter is useful to ignore an unintended or unwanted target that occasionally passes between the sensor and the intended target. Examples include ignoring traversing objects or rejecting sporadic interference (electric, physical, or acoustic). Averaging Filters receive unwanted target that occasionally passes between the sensor and the intended target. Examples include ignoring traversing objects or rejecting sporadic interference (electric, physical, or acoustic). Averaging Filters receive unwanted target that occasionally passes between the sensor and the intended target. Examples include ignoring traversing objects or rejecting sporadic interference (electric, physical, or acoustic).

Foam, Turbulence, and Condensates

Foam or Condensation created by certain liquids can partly absorb an ultrasonic signal. Turbulence can deflect an ultrasonic signal. There are several possible techniques for addressing these issues when using an ultrasonic level sensor for tank level measurements.

1. Install a Still or Stilling Tube

Also referred to as a Standpipe, a Stilling Tube is often used to separate surface foam, dampen turbulence, or maximize the acoustic signal strength of the level sensor. Although frequent cleaning may help, it is not generally recommended to use a standpipe in applications with dirty, coating or scaling liquids that will leave material build-up on the inner pipe wall. The standpipe must be one continuous section of smooth pipe without any breaks or transitions. The inner diameter of the pipe must be greater than the sensor surface 0.0, and preferably the level sensors beam width. The latter may not be practical depending on the size of the tank and distance measured, so it is important to have a standpipe that will reflect ultrasonic signals and have a smooth surface. It is also recommended to have at least one vent hole and preferably within the sensors dead band. The pipe should extend to the bottom of the tank, or at least below the level sensor’s measurement span, and have a 45° angle on the bottom of the pipe, and the level should always be maintained above the cut.

2. Maximize Range and Power

As with foam and some condensates, powder products are absorbers of acoustic energy. In addition, dry materials in silos present smaller target surfaces that are often not level or simply absorb most of the sound energy. We recommend using a longer-range sensor product for the additional power they provide in those cases. Also, it may be necessary to point the sensor out of the vertical depending on the angle of repose of materials in a silo as it is both filled or drawn down. A better target strength may be possible with careful sensor positioning.

Small or Closed Spaces

Sensors in a closed space like a storage container or silo for example, are usually run at a slower rate (i.e., longer interval between measurements). This allows sufficient time for acoustic energy to dissipate in the closed space. An interval of no less than one second is often recommended to avoid this interference. Sensors installed in a standpipe or stilling tubes likewise have a slow dissipation so they should be slowed. Senix products include a special sensitivity setting for stilling tubes that more closely matches the dissipation rate occurring in that environment.

Sensor Mounting

Level sensors should be mounted in the vertical to receive ultrasonic echoes from the liquid surface. A sensor mounted on a sloped roof or surface must still be mounted vertical. For measuring distance, the sensor does not have to be mounted vertical, but still must be mounted 90 degrees from the target surface. The greater the measurement range the more critical this alignment is. All Senix ToughSonic sensors are threaded for easy mounting and Senix also offers a variety of flanges, mounting options and adapters for a range of threaded hole diameters and configurations.

Multi-Sensor Wired Connections: Networks and Synchronization

Senix ultrasonic sensors can be connected in multi-sensor data networks to retrieve measurements and/or adjust sensors using SenixVIEW software. An entire collection of data-networked sensors can be managed, stored, and retrieved using a SenixVIEW feature called Group Control that permits the entire collection to be backed-up, restored or duplicated quickly. Multiple sensors can also be connected for synchronization (SYNC) to prevent crosstalk or assure simultaneous measurements. The data networking and SYNC functions are mutually exclusive, but generally serve different purposes.

Sensor Synchronization (SYNC)

Sensors in close proximity in an open setting may interfere with nearby sensors. Senix sensors offer SYNC, a full featured method of controlling sensors measurement sequence or groupings.

Sensor Data Networks

- Data networks are created by wiring two or more ToughSonic sensors in a multi-drop configuration
- Sensors can be any RS-485 model type, but all must have independent addresses and use the same baud rate
- Sensors in continuous mode will update analog and switch outputs independent of the network requests
- Sensors in polled mode will only measure and update outputs upon receiving a network request
- A 4-wire data cable can supply both data and power to the sensors, or sensors can instead be locally powered

SYNC networks are created by wiring the yellow and gray communications wires of all sensors together (see diagram). Operating SYNC groups cannot simultaneously act as a data network. SYNC consumes the serial data port and assumes the sensor’s analog and/or switch outputs are used.

- One sensor is selected as the group Master and the remaining sensors as Slaves (up to 31)
- Selection is made using wither the Teach pushbutton or SenixVIEW software
- The Master can have between 1 and 5 “phases”, and its Measurement Interval determines the phase timing
- Sensors measure simultaneously, sequentially, or in groups depending on their phase configuration
- Slave sensors that lose their SYNC input have configurable analog and switch “Loss of SYNC” responses

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Accuracy & Temperature Compensation

Accuracy specifications are generally determined indoors, in a controlled lab environment, and under constant temperature and fixed conditions with no interference from factors such as wind or air movement, etc. Generally, specifications such as Accuracy are used to compare one sensor to another. Accuracy, or absolute accuracy is the difference between the output value that is measured by the Ultrasonic sensor, and the actual target distance. For example, an ultrasonic water level sensor reading a full-scale range of 12 feet or 144 inches will have an accuracy of ±0.144 inches (at ambient temperature and controlled conditions). The same sensor reading a distance of 75 inches will have an accuracy of ±0.075 inches. This 0.1% detected accuracy is applicable whether the sensor is reading in distance level/volume (gallons). As mentioned earlier, the performance of an ultrasonic sensor depends on several physical parameters. For temperature, there are several options available to improve accuracy.

External Reference Targets

For even more severe changes in air temperature that require an even faster response, Senix has developed the ToughSonic RTTC system that overcomes the time lag inherent with a built-in sensor and offers customers with an improved compensation option.

### ToughSonic Reference Target

Temperature Compensation accessory uses an external reference target at the front of the sensor located in the measurement path. Combined with the latest SenisVIEW software, for each measurement the sensor takes two readings; one to locate the reference target, and one to the distant object. Any change in the speed of sound affects both measurements. The reference target location is locked during calibration, and any change in its apparent position is applied proportionally to correct the distant object’s apparent location. The result is a more accurate measurement, unaffected by ambient air temperature, diurnal temperature swings, sensor self-heating, sunshine warming the sensor, cold ambient temperatures, or vibration. Field calibrations can be done at any time or temperature.

The two illustrations below show side by side sensors operating over a canal, one with conventional temperature compensation and one with RTTC compensation. In the conventional, notice the apparent canal depth varies with the extremes of temperature, while in the RTTC plot notice the apparent distance is unaffected by temperature diurnal swings. The temperature effects have been largely eliminated. Diurnal temperature swings can be ignored, and external heating or cooling of the sensor will not result in incorrect distance or level measurements. The sensor could be exchanged on site and a new calibration could be done on site at any temperature. The RTTC accessory will improve the sensor’s performance in conditions with significant changes in temperature due to diurnal affects. The intensity of the diurnal changes and how the sensor software is set up will affect the sensor’s ultimate performance.

The following shows a Senix ToughSonic CHEM sensor measuring outdoors with fluctuating temperature. The Orange is the temperature of the sensor that is changing by as much as 5-6 degrees Fahrenheit. The Red shows the distance measurement fluctuating with temperature by at least 3-4 inches. The Green line is the distance measurement with temperature compensation turned on in the sensor and measurements much more stable and consistent.

### Internal Temperature Compensation

Air temperature has the greatest impact on the measuring accuracy of an ultrasonic sensor. Temperature fluctuation affects the speed of an ultrasonic sensors pulse or sound waves. As temperature increases, sound waves travel faster to and from the target. Even though the target has not likely moved or shifted, it will appear that the target is closer.

A more detailed explanation is that after the transit time of the reflected ultrasonic pulse has been measured, the sensor calculates the distance to the object using the speed of the sound. When sound is propagated in air, the speed of sound is about 344 m/s at room temperature. However, the speed of sound is temperature-dependent and changes by approximately 0.17% with each degree Celsius. These changes affect the transit time and can distort the calculated distance. Without temperature compensation and at a measuring distance of 100 cm, a 20°C change in temperature would cause a measurement error of -8.5 cm at 70°C and +1.65 cm at -25°C.

Most ultrasonic sensors by Senix have a working range of -40°C to +70°C, and all ToughSonic ultrasonic sensors have an internal or embedded temperature sensor to compensate for this effect. This internal sensor measures the sensor body temperature, and the sensor corrects the temperature-related distortion of the measured values (see temperature compensation). Internal temperature compensation sensors do have limits, however. An internal temperature compensation may also be affected by external heating or cooling sources as they cannot adjust to extremely rapid changes well, plus they may not be close to the temperature in the actual measurement path such as inside an enclosed silo, tank or container. The following shows a Senix ToughSonic CHEM sensor measuring outdoors with fluctuating temperature. The Orange is the temperature of the sensor that is changing by as much as 5-6 degrees Fahrenheit. The Red shows the distance measurement fluctuating with temperature by at least 3-4 inches. The Green line is the distance measurement with temperature compensation turned on in the sensor and measurements much more stable and consistent.

Sensor with Reference Target Temperature Compensation (RTTC).
Senix designs and manufactures advanced ultrasonic sensors for level measurement, distance ranging and object detection. Senix ToughSonic® sensors are used in a wide range of automation and research applications worldwide. Our sensors are used in a broad array of industrial and scientific applications, including machine and motion controls, web controls (material loop and roll diameter), liquid level measurement, water measurement and control such as in farming and agriculture applications, person/object proximity sensing – virtually any place where non-intrusive measurement and feedback are desired. The company transformed non-contact distance measurement in 1990 with the world’s first user-configurable ultrasonic sensor and has been pushing the boundaries of sensor intelligence and ruggedness ever since. Senix Corporation is a privately held company located in Hinesburg, VT, USA.