BINMASTER
Level Controls and Software

ToughSonic®
TS-200

Ultrasonic Distance Sensors
PC Configurable/PVDF Chemically-Resistant Housing

INSTALLATION & OPERATING INSTRUCTIONS

CE

BinMaster Lincoln, NE
402-434-9102 | www.binmaster.com | 1 Aug 2023 by BinMaster v3.6.3 | 925-0458

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Product Declarations

Document Revisions

Initial release	31 May 2015
Updated for new models	5 Sep 2019
Updated for new models	1 Dec 2020
Upgrade sensor 12 to sensor 14	15 Apr 2022
Style and Content Rev.	1 Aug 2023

Related Products

SensorView™ for Windows

SensorView™ is a setup tool for ToughSonic® series sensors. This software is installed on a PC and is used to configure sensor options, manage configurations, calibrate outputs, view, and analyze measurements, and save the results. Configurations can be created, copied, and distributed to any number of sensors. View, chart, log, and analyze sensor operation. Sensor firmware upgrades can be done easily through SensorView™ too. Download SensorView™ at no charge from: https://senix.com/senixview-ultrasonic-sensor-software/

Setup Kits

Setup Kits are used for bench viewing or configuring sensors within SensorView™. Our Setup Kit includes a power supply, terminal board, and cables to interconnect ToughSonic® sensors and your PC.

CE Compliance

ToughSonic® family of ultrasonic sensors are compliant with the CE Electromagnetic Compatibility Directives and Standards listed below:

Directives:	Electromagnetic Compatibility (2004/108/EC) Low-Voltage (2006/95/EC)
Standards:	EMC: EN 61326-1:2006 Industrial
Safety:	EN 61010-1:2001

Warranty

BinMaster makes no warranty, representation or guarantee regarding the suitability of the products for any particular purpose. All specifications are subject to change without notice. BinMaster will repair or replace, at our option, any part found by us to be defective in material or workmanship if the product is received by BinMaster, within **one year** from the date of original shipment to buyer.

Disclaimer and Release

The warranties, obligations and liabilities of BinMaster and the remedies of buyer set forth above are exclusive and in substitution for, and buyer hereby waives, releases and renounces all other warranties, obligations and liabilities of BinMaster and all other rights, claim, and remedies of buyer against BinMaster, expressed or implied, arising by law or otherwise, including but not limited to: (A) Any implied warranty or merchantability or fitness; (B) Any implied warranty arising from course of performance, course of dealing or usage of trade; (C) Any obligation, liability, right, claim or remedy in tort, whether or not arising from the negligence of BinMaster (whether active, passive or imputed); and (D) Any obligation, liability, right, claim or remedy for loss or damage to any product.

Exclusion of Consequential and Other Damages

BinMaster shall have no obligation or liability, whether arising in contract (including warranty), tort (including active, passive, or imputed negligence) or respect to any non-conformance or defect in any product delivered under this agreement, or for any other direct, incidental, or consequential damages.

Repairs and Returns

Returns must have a RMA case number.
Contact info@binmaster.com and visit www.binmaster.com

Terminology

Terms shown in italics throughout this document. An asterisk (*) indicates a SensorView™ configurable parameter.

Analog - An electrical output type that varies in proportion to measured distance. Analog output types can be either current loop or voltage.

Analog High Value* - The maximum (highest) value of an analog output. For example, the Analog High Value for a 4-20 mA current loop analog output is 20 mA. Computer configurable models allow this value to be user-entered.

Analog Low Value* - The minimum (lowest) value of an analog output. For example, the Analog Low Limit value for a 0-10 VDC voltage output is 0 volts. Computer configurable models allow this value to be user-entered.

Analog Window* - A range of distances between two endpoints, within which the analog output will vary between the analog low value and analog high value proportional to measured distance.

Current Loop Output* - An analog output type that drives an electrical current proportional to measured distance. ToughSonic® sensors provide 4-20 mA or SensorView™ customized output ranges in sourcing or sinking current.

Deadband - The small distance near the sensor face within which distance cannot be measured. See also Range MIN.

Endpoint* - One of two end distances representing the outer limits of the analog window.

Hysteresis* - The distance between a switch's Setpoint and OFF Distance. It reverses direction about the Setpoint if the Polarity is reversed.

Ingress Rating - An enclosure rating that identifies how susceptible a product is to the entry (ingress) of external objects or liquids.

Measurement Rate* - The repetitive rate that the sensor measures distance (see response time).

Measurement Interval* - The time between measurements [1 / Measurement Rate].

Measurement Process* - The measurement, filtering and time delays that affect sensor outputs.

Maximum Range - The maximum target detection distance of a sensor model may be overridden by Range MAX.

Near MIN - A distance extending 0.25 in. farther than Range MIN within which the Target Indicator will flash as a warning.

Operating Range* - The range of distances between the range MIN and range MAX values.

Optimum Range - The range of target distances recommended for optimum performance in varying environmental conditions.

Output Status Indicator - An indicator at the rear of ToughSonic® 3,12, and 14 that shows the status of an analog, switch, or serial data output. There is a separate output status indicator for output #1 (black wire) and output #2 (white wire).

Polarity* - The behavior of a switch output at its setpoint, defined as "on-closer" or "on farther". A switch turns OFF in the reverse direction after the Hysteresis distance.

Range MAX* - The farthest distance of the Operating Range; user adjustable in SensorView™.

Range MIN* - The nearest distance of the Operating Range; a target is not detected closer than the greater of Range MIN or the Deadband.

RS-232* - An electrical interface standard used to transfer information using serial data communications. This is a single ended interface with a specified maximum range of 50 feet (15 meters) that typically supports one device.

Terminology

RS-485* - An electrical interface standard used to transfer information using serial data communications. This is a long-distance differential interface capable of supporting multiple addressable devices.

Response Time* - The time required for sensor outputs to respond to measurements; affected by measurement rate and filter selections.

Serial Data - Distance data output over the serial interface as opposed to the analog or switch lines.

Setpoint* - The distance a switch output turns ON. (See also OFF distance, polarity, and Hysteresis)

Sinking Switch* - A switch where current flows into the sensor to ground from an externally sourced load when turned ON (output voltage low when ON).

SensorView™ - PC–based software that is used to configure and install ToughSonic® sensors.

Sourcing Switch* - A switch where current flows from the sensor (sensor power input is the source) to the load when turned ON (output voltage high when ON).

Switch* - An electrical output type that is either ON or OFF. ToughSonic® switches are solid state and can be either sinking or sourcing type.

SYNC* - A wired configuration that synchronizes the timing of two or more sensors to prevent crosstalk or ensure simultaneous measurements.

SYNC Interval The time interval of measurement of all SYNC sensors. It equals the number of SYNC phases x measurement interval.

Target - Any object or material that reflects ultrasonic energy back to the sensor thus allowing the sensor to measure its distance.

Target Indicator - A rear indicator that shows the status of a detected target and more.

Teach* - A product feature that uses a pushbutton to store a current target distance measurement into memory and automatically calibrate the output(s).

Time Delay* A period triggered by a set of conditions and, after those conditions persist for the entire period, cause a secondary event to occur. There are several user-selected time delays features available.

Ultrasonic - A sound wave of a frequency greater than 20,000 Hz, typically above the range of human hearing.

Voltage Output* - An analog output type that drives an electrical voltage proportional to measured distance. ToughSonic® sensors provide industry standard or SensorView™ customized output ranges.

Ultrasonics Overview

BinMaster ToughSonic® sensors measure the distance or presence of a target by employing the consistency of the speed of sound. The sensor measures distance to an object by sending an ultrasonic pulse while measuring the time elapsed before the echo returns. With the known speed of sound, the sensor can determine the distance of the object from the transducer element.

Advantages

> Non-contact
Measures through the air without touching the target object, at relatively large distances.

> Object Ranging
Object distance is measured rather than just the presence or proximity.

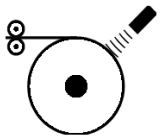
> Distance Proportional Output
The sensor's outputs are proportional or affected by the measured target distance.

> High Resolution
Precise discrimination of target position.

> Unaffected by Target's Optical Characteristics
The sensor's operation is not sensitive to ambient light levels, the color of the target, or target is optically transparency/reflectivity.

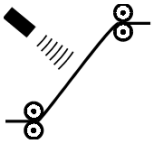
> Sensitive
Detects large and small objects (smaller objects must be closer)

Typical Applications



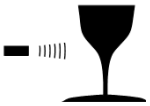
Roll Diameter
Measure the size of a roll to control tension or speed or determine when full or empty.

Loop Control
Precisely control the position of material loops, including wires, tubes, and webs.

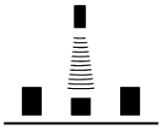


Web Break
Rapidly detect a broken web in a printing press or paper machine.

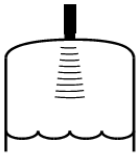
Dimensioning
Determine the size of an object for information or to determine its volume or width.



Proximity
Determine the presence of objects to count or control their movement.



Sort/Select
Sort or select objects based on differences in their physical dimensions.



Level Measurement
Measure or control the level of liquid or solid materials in tanks or bins for inventory or batching...and many more

Sensor Overview

ToughSonic® Product Features

ToughSonic® sensors measure distance without contact and are designed for tough industrial environments.

Rapid PC Setup & Control

PC setup gives you control over all sensor outputs and features. View, analyze and save sensor setups for rapid implementation or cloning.

Chemically Resistant Packaging

Rugged Kynar® PVDF housings are completely sealed and impervious to most chemicals and operate over a wide temperature range. A PUR jacketed interface cable is potted into each housing.

KYNAR® is a registered trademark of Arkema Inc. For chemical resistance information refer to https://senix.com/technical-support/documentation/

Industry Standard Interfaces

Multiple simultaneous outputs, each with many Sensor-View™ adjustable features.

- 0-5 / 0-10VDC or Custom VDC Range
- Positive or Negative Analog Slope
- Adjustable Response / Delays

- 4-20mA or Custom mA Range
- Current Sourcing Loop
- Current Sinking Loop available in ToughSonic 15S, 21S, and 25P models.
- Positive or Negative Analog Slope
- Adjustable Response / Delays

- Sinking (NPN) or Sourcing (PNP)
- Up to two overload protected switches.
- Reversable Polarity (NO/NC)
- Adjustable Response / Delays

- RS-232 and RS-485 models available
- MODBUS or ASCII streaming
- Adjustable baud rate & address
- Multi-drop addressable (RS-485)

Identification

The ToughSonic® model number and serial number are printed on the label on the side of the housing.

Specifications

	ToughSonic® TS-200.14G.XXXX	ToughSonic® TS-200.20.H.XXXX	ToughSonic® TS-200.20.J.XXXX
PHOTO			
MAXIMUM RANGE DEADBAND (MINIMUM)	14 ft (4.3m) <3.5 in (10 cm)	20 ft. (6.1 m) 8 in. (20.3 cm)	35 ft. (10.7 m) 12 in. (31 cm)
OPTIMUM RANGE (SMALL TARGETS, DRY MATERIALS, HOT)	10 ft. (3 m)	13 ft. (4.1 m)	25 ft. (7.6 m)
RESOLUTION (SERIAL DATA)	0.003384 in. (0.086 mm)	0.006768 in. (0.1719 mm)	0.013536 in. (0.3438 mm)
DEFAULT: RANGEMIN RANGEMAX SWITCH #1 SETPOINT SWITCH #2 SETPOINT ANALOG LOW ENDPOINT ANALOG HIGH ENDPOINT	4.0 in. (10 cm) 14ft. (4.3 m) 100 in. (254 cm) 8 in. (20.3 cm) 100 in. (254 cm) 4.0 in. (10.2 cm)	8 in. (20.3 cm) 20 ft. (6.1 m) 160 in. (406 cm) 18 in. (45.7 cm) 160 in. (406 cm) 8 in. (20.3 cm)	12 in. (31.5 cm) 35 ft. (10.7 m) 280 in. (711 cm) 18 in. (45.7 cm) 280 in. (711 cm) 12 in. (30.5 cm)
PERFORMANCE	Repeatability: Greater of +/-0.03 in. (0.76 mm) or 0.2% of target distance in stable environment Accuracy: Better than 0.5% of target distance in stable, homogeneous environment; affected by temperature gradients, target echo strength, speed of sound in vapors.		
RESOLUTION (ANALOG)	4100 steps 0-10 VDC and 3279 steps 4-20 mA (scaled between user-set distance endpoints)		
MEASUREMENT INTERVAL	Default 50 msec (20 Hz)	Default 100 msec (10 Hz)	Default 200 msec (5 Hz)
	Adjustable from 5 mS to 2.8 hours; affected by filter selections; faster rates limit max target distance		Adjustable from 100 mS to 2.8 hours
	Two switches: 150 mA, SensorView™ configured as PNP (@ input voltage) or default NPN (external 40 VDC max.), setpoint mode or window mode		

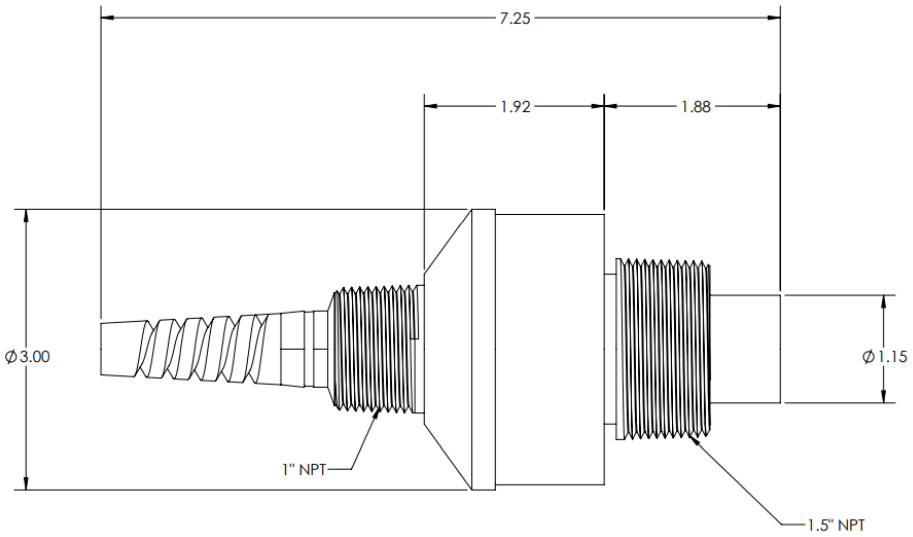
OUTPUTS, FULL-FEATURED MODELS	One voltage: 0-10 vdc or SenixVIEW configured, 10 mA max (min 15 VDC input for full 10 VDC output)			
	Two current loops: one sourcing and one sinking loop, 4-20 mA or SenixVIEW configured, 450Ω max @ >15VDC, 250Ω max @ 10 VDC			
SERIAL OUTPUT ONLY / ALL MODELS	RS-232 or RS-485, Modbus RTU or ASCII stream. Designated by letter "A" at end of part number			
SERIAL INTERFACE, INTERFACE PROTOCOL	Modbus slave, ASCII, or SYNCH. RS-232 or RS-485 interface, specify model. RS-485 models are 2-wire multi-drop addressable (addresses 1-247). RS232 is point to point, 50ft max cable. Baud rate 9600 - 115200, no parity, 8 bits, one stop bit. SenixVIEW configured.			
INDICATORS	None			
CONSTRUCTION	Chemically resistant Kynar PVDF housing, threaded both ends, potted-in 4-conductor (serial only) or 9-conductor shielded PUR cable with tinned ends, 6.5 ft. (2 m). Other length, connectors available.			
TRANSDUCER BEAM	Rugged piezoelectric, nominal beam width 12-14 degrees @ -3 dB boundary, conical			
TRANSDUCER FREQUENCY	125 kHz	125 kHz	75 kHz	50 kHz
CABLE, FULL OUTPUTS	6.5-ft (2m) 9-wire with shield, tinned ends, PUR			
CABLE, SERIAL-ONLY	6.5-ft (2m) 4-wire with shield, tinned ends, PUR			
MAX. CABLE LENGTH ADVISED	RS-232: 50ft (15 m), RS-485: 3937ft (1200m)			
CABLE, M12 OPTION	12" cable with 5-pin M12 male connector, 6ft mating cable available. M12 option limited to one output. Pin assignment by user. This is a custom accessory			
POWER INPUT	10-30 VDC @ 55 mA max			
DC CURRENT @ TYPICAL 24VDC INPUT + I/O, AT DEFAULT REP RATE	45 mA typical at default rate. Add 20 mA if using sourcing current loop. Add sourcing switch loads.			
DC CURRENT, SERIAL ONLY @ 24VDC INPUT	29 mA at default rate			

Model Name	ToughSonic® TS-200.14G.XXXX	ToughSonic® TS-200.20.H.XXXX	ToughSonic® TS-200.20.J.XXXX
Environmental	Ingress: IP-68, NEMA-4X Humidity: 0-100% (avoid heavy condensation) Temp: -40 F to 158F (-40 C to +70 C)		
Temperature Compensation	SensorView™ configured: Internal sensor (constant power), Internal sensor (periodic power), Custom offset, Reference Target (external), or None		
Threads, Upper	1" NPT	1" NPT	1" NPT
Threads, Lower	1.5" NPT	1.5" universal non-tapered	1.5" universal non-tapered
Dimensions (Dia x Length)	3.05 (77mm) x 7.5 in (193mm) 2.0 in (5.08 cm) Inserted length	3.05 (77mm) x 5.62 (143mm) 2.60 (66mm) inserted length	3.05 (77mm) x 5.59 (142mm) 2.60 (66mm) inserted length
Weight	21.2 oz. (0.60 kg)	21.7 oz. 0.62 kg.	24.7 oz. 0.70 kg.
Ordering: Full Outputs	LVL-140-232 LVL-140-485	LVL-300-232 LVL-300-485	LVL-500-232 LVL-500-485
Ordering: Serial Only	LVL-140-232A LVL-140-485A	LVL-300-232A LVL-300-485A	LVL-500-232A LVL-500-485A

Mechanical Details

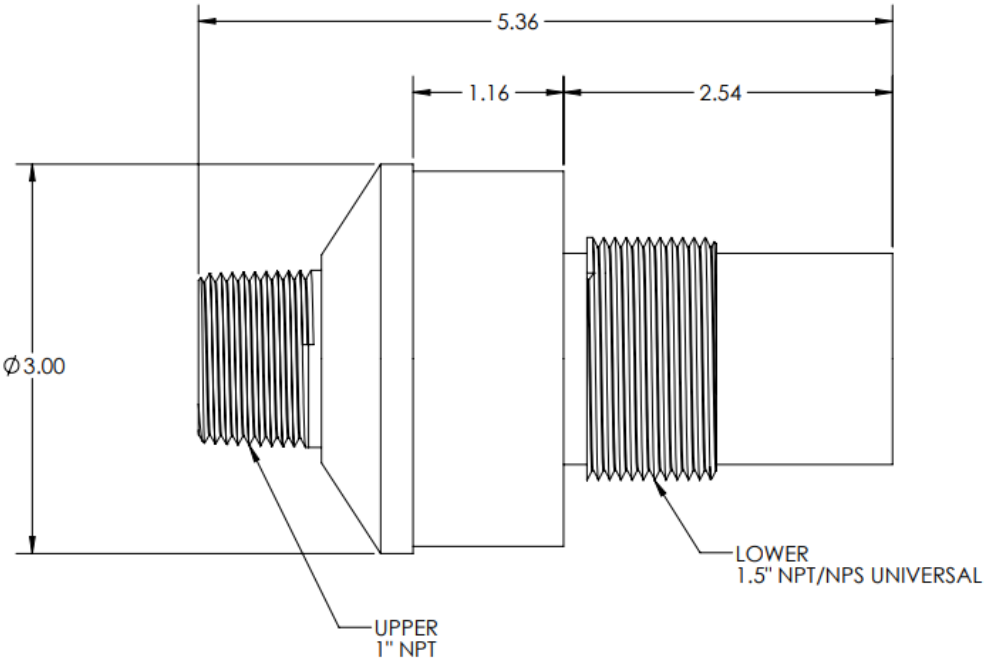
Dimensions are inches (mm). Distance is measured between the ultrasonic transducer face (the end opposite the cable) and the target.

TS-200.14.G

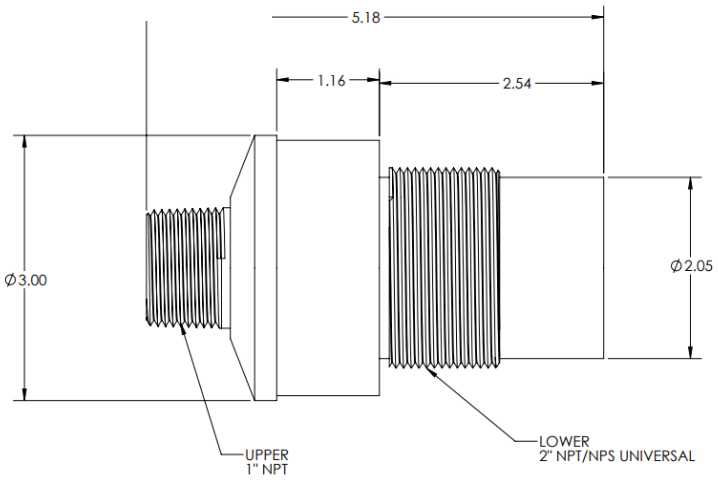


> Direction of Measurement

TS-200.20.H



TS-200.35.J



Maintenance & Cleaning

Dust accumulation on the sensor face can be cleaned by blowing pressurized air across the sensor face. The sensor face can be cleaned with alcohol or any cleaner compatible with Kynar (PVDF).

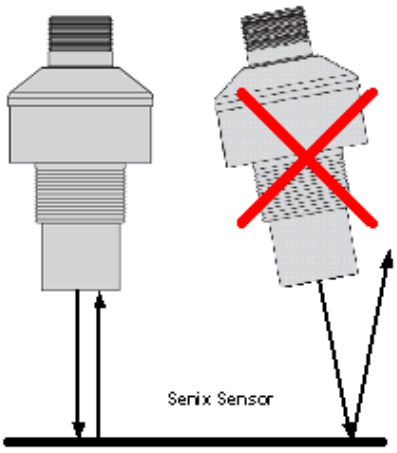
Mounting and Installation

Precautions

- Keep unintended targets from the transducer's field of view in its acoustic cone area. Keep the beam shape in mind.
- Keep the transducer away from ultrasonic noise sources, such as pressurized air nozzles.
- Do not allow material to build up on the sensor face or sensor performance may be affected.

Orientation

Orient the sensor perpendicular to the liquid surface or target object for best results as shown below.



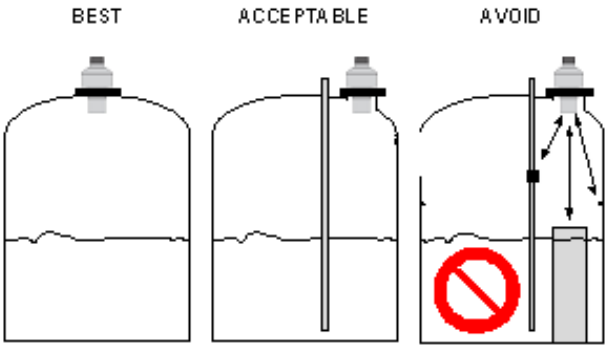
Ultrasound energy must reflect to the sensor, or the sensor will not detect the target and may detect a later multi-bounce echo (which would "measure" as a lower tank level).

Maintenance & Cleaning

Dust accumulation on the sensor face can be cleaned by blowing pressurized air across the sensor face. The sensor face can be cleaned with alcohol or any cleaner compatible with Kynar (PVDF).

Location and Obstacles

The sensor mounting location should be chosen so there are no obstacles in the beam path that reflect the ultrasound beam back to the sensor.



The sensor can be mounted close to a vertical pipe or tank wall if the wall or pipe surfaces are smooth (see “Acceptable” above).

Make sure that unintended targets between the sensor and liquid surface are not in the sensor’s beam area. Keep the sensor away from horizontal pipes, inflow points, vertical pipe seams, or tank seams if they are large enough to reflect the ultrasound. The sensor measures the closest target and will detect submerged equipment if the level drops below the equipment. Position the sensor to avoid these issues (see “Avoid” illustration above).

Mounting

Typical tank installations have the sensor threaded into a flange as shown above or threaded into a nipple welded to the top of the tank. A plastic nipple or flange adapter is preferred. In both cases the mounting should ensure that the sensor is facing perpendicular to the liquid surface. Use no wrenches when screwing the sensor into the nipple or flange.

Accessories

The following accessories are available.

	**SensorView™ Software** Configure, test and clone sensors. Compatible with all ToughSonic® models. Download free from www.senix.com
	**UAN-KIT-USB-232** **UAN-KIT-USB-485** PC Interface kits. Choose RS-232 or RS-485 to match sensor. Converter, terminal block, power supply, data cable included.
	**UAN-KIT-USBM12-232** **UAN-KIT-USBM12-485** PC Interface kits for sensors with M12 connectors. Serial converter, M12 mate, power supply, data cable. For either RS-232 or RS-485 sensors.
	**UA-USB-232-ISO** Serial converter, isolated inputs for permanent installation. Use with UA-CC-232. 3 ft USB cable
	**UA-USB-485-ISO** Serial converter, isolated inputs for permanent installation. Use with UA-CC-485. 3 ft USB cable
	**UA-CC-232** **UA-CC-485** DB9 adapter and 6-ft data cable. Joins ISO converter to termination boards.
	**UA-USB-232-TB** **UA-USB-485-TB** Non-isolated serial converter to USB with termination board and 3-ft USB cable

	UA-TS-TB Termination Board to connect any model sensor, user equipment, power, and serial interface cable. DIN rail mounts included
	**UA-TS-TB-2RYC** Termination board with 2 relays (driven by sensor switch outputs), power input, serial interface jack. For any model sensor
	**UA-JBOX-485** RS-485 Serial and Power wiring junction box, used on all serial-only sensor networks
	**UA-DATACORD** 6-ft with RJ11 each end. For patching termination board and serial converter.
	**UA-FM-15** Gray PVC flange. Fits CHEM 10, CHEM 14, CHEM 20 lower thread
	**UA-FM-20** Gray PVC flange. Fits CHEM 35 lower thread
	**UA-FM-SS-15** Stainless steel flange. CHEM 10, CHEM 20 lower thread
	**UA-FM-20-SS** Stainless steel flange. Fits CHEM 35 lower thread

AirWire Wireless Data Transmission

BinMaster TS-200 serial only sensors are compatible with AirWire transmittters and receiver-gateways. See AirWire at www.senix.com.

Software & Interconnection

The following accessories are available.

Configuration and Communication	
	**UAN-KIT-USB-232** **UAN-KIT-USB-485** PC Interface kits. Choose RS-232 or RS-485 to match sensor. Converter, terminal block, power supply, data cable, thumb drive included.
	**UA-USB-232-ISO** Use with UA-CC-232 to connect to a USB port at the PC with Isolated inputs. 3 ft USB cable
	**UA-USB-485-ISO** Use with UA-CC-485 to connect to a USB port at the PC with Isolated inputs.
	**UA-CC-232** **UA-CC-485** DB9 adapter and 6-ft data cable. Joins ISO converter to termination boards.
	**UA-USB-232-TB** **UA-USB-485-TB** Non-isolated serial converter to USB with termination board and 3-ft USB cable
	**UA-TS-TB** Termination Board to connect any model sensor, user equipment, power, and serial interface cable. DIN rail mounts included
	**UA-TS-TB-2RYC** Termination board with 2 relays (driven by sensor switch outputs), power input, serial interface jack. For any model sensor
	**UA-JBOX-485** RS-485 Serial and Power wiring junction box, used on all serial-only sensor networks
	**UA-DATACORD** 6-ft with RJ11 each end. For patching termination board and serial converter.

Connectors

Sensors can be ordered with 5-pin M12 connectors or with 6- or 8-pin Deutsch connectors. Standard sensor cable length is 12 inches to the connector. Standard and Custom pin assignments are available. Standard mating cable length is 6ft and custom mating cable lengths are available. Contact BinMaster for ordering details and prices.

Interfaces

Wire Color	Wire Function
Brown	+DC input voltage (Power Input)
Blue	-DC input and signal common (Ground)
Gray *(data #1)* *(note 1)*	LVL-xxxx-232: RS-232 out
	LVL-xxxx-485: RS-485 -
Yellow *(data #2)* *(note 1)*	LVL-xxxx-232: RS-232 in
	LVL-xxxx-485: RS-485 +
Silver	Cable shield (bare stranded wire)
Full build models have 5 additional conductors with the following assignments	
Black	Sinking Switch #1 *(note 2)* Sourcing Switch #1 or None (default)
White	Sinking Switch #2 *(note 2)* Sourcing Switch #2 or None (default)
Green	4-20 mA sourcing loop
Orange	4-20 mA sinking loop
Violet	0-10 VDC

Notes:
(1) The gray and yellow wire functions depend on sensor model and can be used for synchronization.
(2) Factory default selections (can be changed using SenixVIEW)

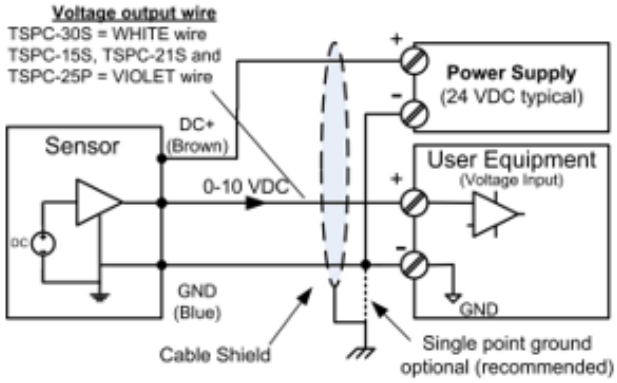
Ground (blue wire)
The ground wire is common to both the power supply and the output circuits.

Cable Shield (bare wire)
The cable shield is not terminated at the sensor. This wire should be terminated to equipment ground near the user equipment, preferably to a single point ground for all equipment. This is important if the cable is lengthened and/or routed near electrically noisy wiring or equipment.

Power Input (brown wire)
Connect a DC power supply to the DC+ (Brown) and GND (Blue) wires. These colors conform to EU standards. Reversing the power connections will not damage the sensor. A power supply voltage between 15-30 VDC is recommended. A +24 VDC supply is a commonly used standard. Target sensitivity and the maximum voltage output value is reduced at power supply voltages below 15 VDC.

Data Connections (gray & yellow wire)
Serial data interfaces are described on page 17. They are used for:
> SensorView™ PC configuration (see SensorView™ manual).
> Synchronization (see SensorView™ manual).
> User communications between the sensor and an external data communications device.
> All ToughSonic® serial RS-232 models can connect to a PC USB port for SensorView™.

Voltage Output

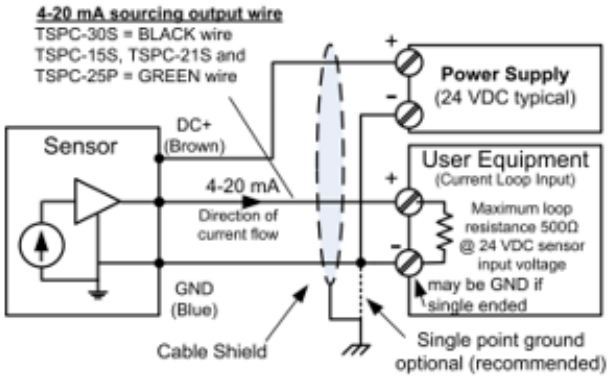


VOLTAGE OUTPUT WIRING

The default voltage output is a 0-to-10-volt DC signal proportional to the measured distance between the endpoints set by the user. The voltage range can be changed to 0-5 VDC using the TEACH 30 or can be set to a custom output range with values between 0 and 10 volts using SensorView™. The analog slope can increase or decrease with distance, but all analog outputs must have the same slope. The voltage is measured relative to GND (BLUE wire). The 0- and 10-volt endpoint distances affect both voltage and current loop outputs and can be set anywhere in the sensor's operating range using the TEACH button or SensorView™.

Sinking Current Loop (orange wire)
This output is NOT available in the ToughSonic® 3 and 14 series. The default sourcing loop output is a 4 to 20 mA signal proportional to the measured distance between two endpoints set by the user. The current range and slope are SensorView™ adjustable and identical to that set for the sourcing loop described above. Current flows from the power supply through the user equipment then INTO the sensor (ORG wire).

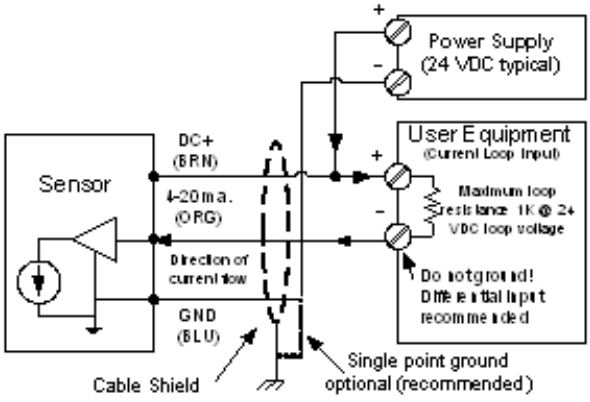
Sourcing Current Loop Output



SOURCING CURRENT LOOP WIRING

The default sourcing loop output is a 4 to 20 mA signal proportional to the measured distance between two endpoints set by the user. The current range can be set to any values between 0 and 20 mA using SenixVIEW. The slope can increase or decrease with distance, but all analog outputs must have the same slope. In a sourcing loop current flows out of the sensor, through the user equipment and back to the sensor GND (BLUE wire).

The analog inputs of User Equipment are either differential (both + and – terminals) or single ended (+ and GND terminals). Differential input is recommended at the user equipment. If the user equipment is single ended (+ input and GND) the sensor and user equipment cannot share a common ground, or the current loop will not work.



SINKING CURRENT LOOP WIRING

Serial Data Interface

The YELLOW and GRAY serial data communications wires are used for three purposes:

Setup - Connect to a PC running SensorView™ software for setup, calibration, analysis, and rapid sensor cloning.

User Applications – Connect to an external system and provide distance measurement data. Several operating modes are available.

Synchronization (SYNC) – Time-synchronize a group of 2-32 sensors readings.

The serial interface can be RS-232 or RS-485:

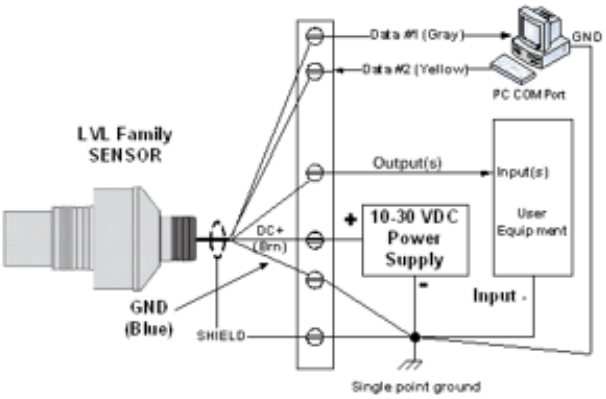
Models ending in 232 are RS-232.

Models ending in 485 are RS-485.

All models are RS-485 in SYNC modes.

RS-232 (PC COM Port)

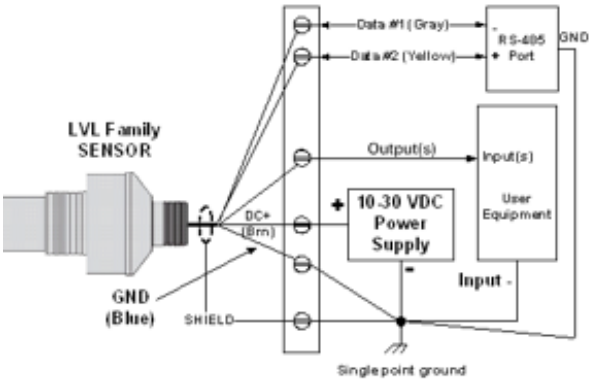
Serial RS-232 models use a serial data RS-232 interface directly compatible with a PC COM port. The PC COM wiring is shown in Figure 12.



RS-232 PC COM PORT CONNECTIONS

RS-485 (Multi-Drop Addressable)

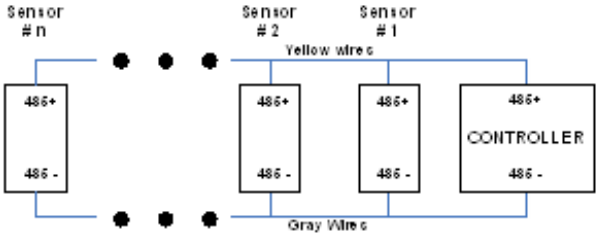
Serial RS-485 models use a serial data RS-485 interface that can be used over long distances. Up to 32 addressable sensors can connect to the bus. A single sensor is shown below connected to an RS-485 port. To use SenixVIEW with these models the PC must have an RS-485 adapter connected. Adapters are available to convert COM or USB ports to RS-485.



SERIAL-485-CONNECTIONS

Sensor Networks (RS-485)

ToughSonic® sensors can be configured into RS-485 addressable multi-drop networks as shown below.

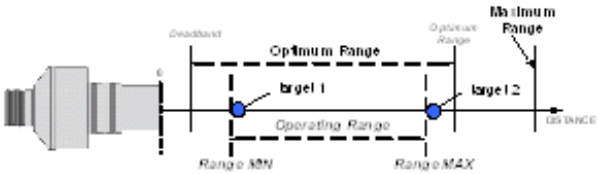


RS-485 NETWORK WIRING

Before connecting to a network each sensor must be assigned a unique address and all sensors must be configured to the baud rate of the network controller, as described in following. The address assignments must also be different from other connected (non-Senix) devices.

Sensors used in an RS-485 network must be configured in *continuous* or *start-on-poll* measurement activation depending on the needs of the system. Sensors used in a SYNC group must be configured with one SYNC master and the rest as slaves (this is accomplished within SenixVIEW, see SenixVIEW manual).

Operating Range



The sensor measures the distance to targets within the *Operating Range* (target 1 to target 2). This range can be set in SensorView™ by adjusting the Range MIN and Range MAX parameters. The factory default is the widest possible, *deadband* to *maximum range* (see specifications, page 7).

Range Min

The *Range MIN* is the closest distance that the sensor will report an accurate distance. Targets closer than *Range MIN* may be detected at close range but display as double the actual distance if they are secondary echoes. If the near distance is important, mount the sensor so the target is beyond *Range MIN*.

Range Max

The *Range MAX* is the farthest distance that the sensor will detect a target. Targets farther than *Range MAX* are ignored. SenixVIEW prevents setting the *Range MAX* parameter to a value greater than Maximum Range for the sensor product.

Under "No Target" conditions the analog and switch output values or states can be configured to either hold their prior level or set specific values or states, either immediately or after adjustable time periods.

The "Range MIN and Range Max" controls can be an important and useful tool to control system response by defining the window the sensor will consider a target valid.

Factory Defaults

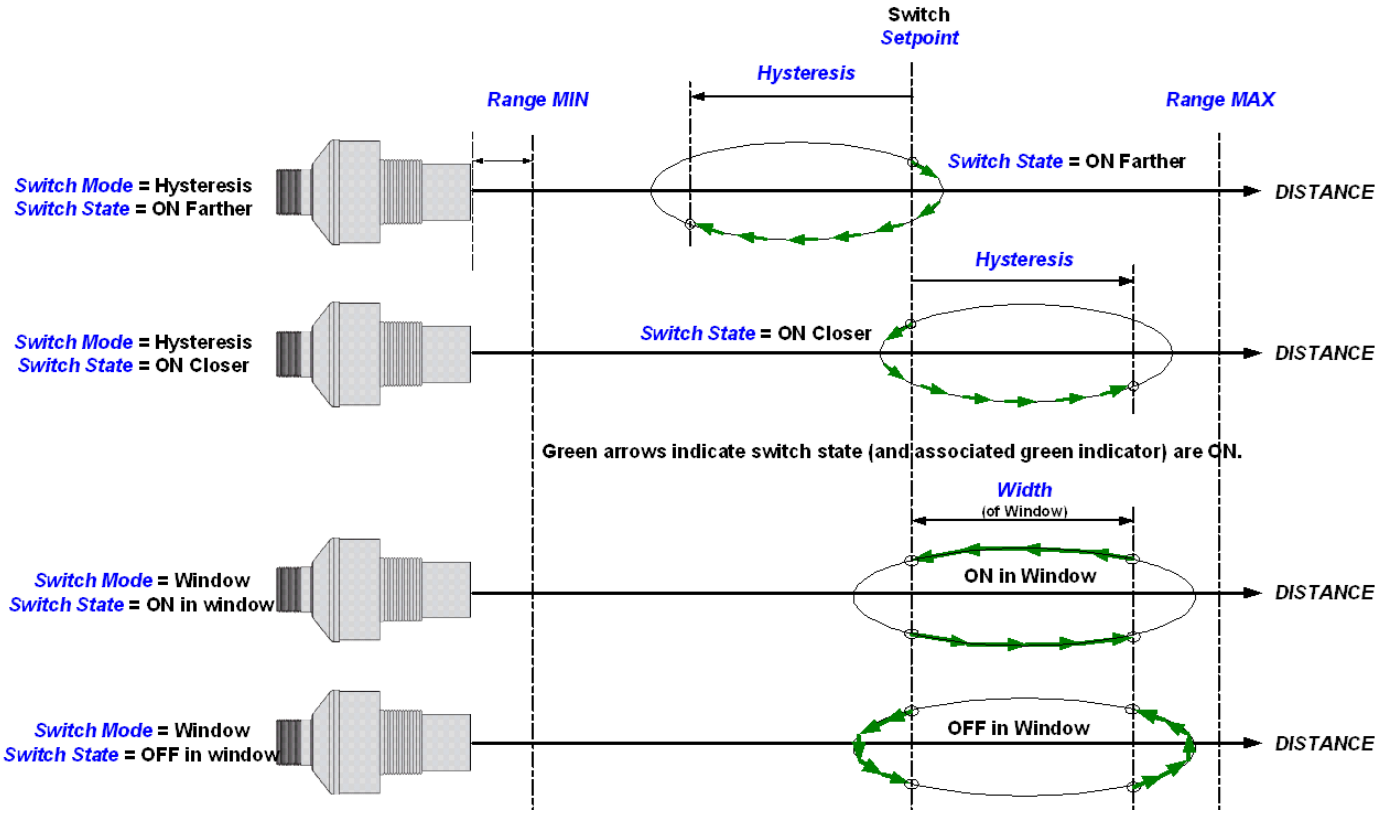
The factory default range values are:

- Range MIN = deadband
- Analog far setpoint = Optimum range
- Range MAX = Maximum Range

TS-200 Adjustable Switch Features

Basic and extended features assure optimum system settings and control functions that otherwise require external logic or time delay relays. Each switch has the following configurable features:

> Setpoint (ON switching distance)
> Polarity (ON closer or farther than setpoint)
> Mode = Setpoint (with Hysteresis) or Window
> ON and OFF time delays for state changes
> "No Target" state and time delay
> Power-Up State



Appendix A - List of Adjustable Features

These parameters can be changed using SensorView™ app. Parameters are permanently stored in the sensor memory.
♦ = implied parameters (not directly settable)

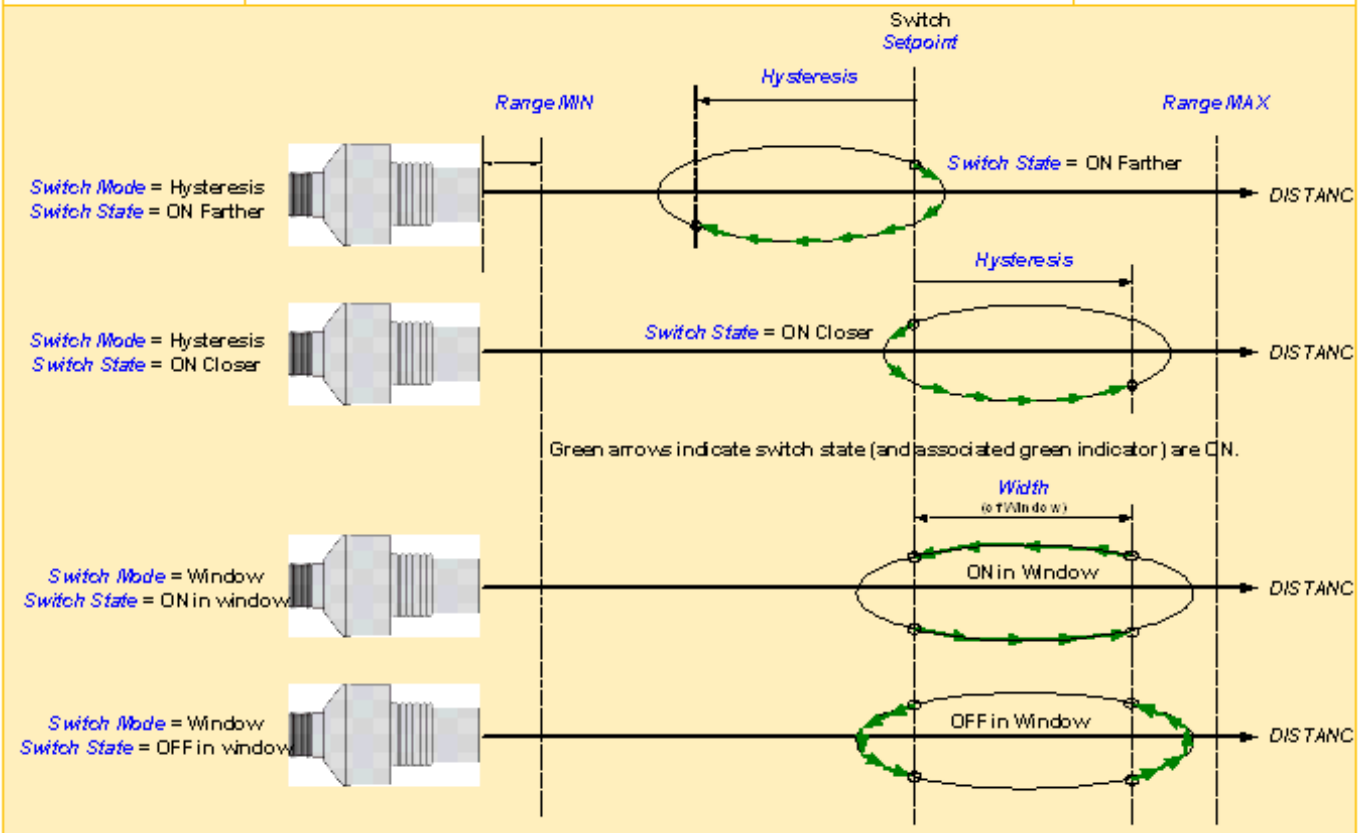
Feature	Description	As Shipped from Factory
General Parameters These parameters are available on the SenixVIEW Main Screen.		
Description	A 32-character text field to describe the application setup. This serves as a reminder when a setup is retrieved from a sensor or disk file. It is only for reference and does not affect sensor operation.	This text: <describe configuration here>
Range Min	The shortest distance the sensor will provide target measurements. Closer targets may have multiple reflections resulting in an incorrect measurement at a multiple of the actual distance.	See pg. 5
Range Max	The farthest distance the sensor will provide target measurements.	See pg. 5
Operating Range ♦	The range of distances between the *Range Min* and *Range Max*, between which the sensor will detect a target. Targets closer than Range Min may still be detected (at incorrect distance) due to multiple reflections.	
Parameters that Affect Measurements These parameters are available by clicking the SenixVIEW MEASURE icon.		
Measurement Interval	The period between measurements. Values can range from 5 ms to 1.275 sec at 5 ms resolution.	See pg. 5
Temperature Compensation	Temperature compensation can be turned ON or OFF	ON
Filters	Filter options include Closest or Farthest of M, X of Y, Running or Boxcar average of N, Max Rate and Slow/Fast Rate	All filters OFF
Measurement Activation	Continuous (at *measurement interval*) Start on Poll (Measure upon receiving serial data read poll) SYNC Master (continuous at *sync interval*) SYNC Slave 1, 2, 3, 4 or 5 (at *sync interval*, measures when receive associated SYNC input from SYNC Master) (*SYNC interval* = *measurement interval* x *SYNC phases*)	Continuous
SYNC Phases	The number of SYNC phases generated by a SYNC Master	2

No Sync Delay	The time a SYNC Slave sensor must continuously fail to detect a SYNC input before setting the No SYNC switch state(s) or analog value(s). Values: 0 ms to 5.46 minutes (resolution 5 ms)	0 ms
PowerSave	PowerSave reduces average power consumption. Options: Enabled and Disabled.	Disabled

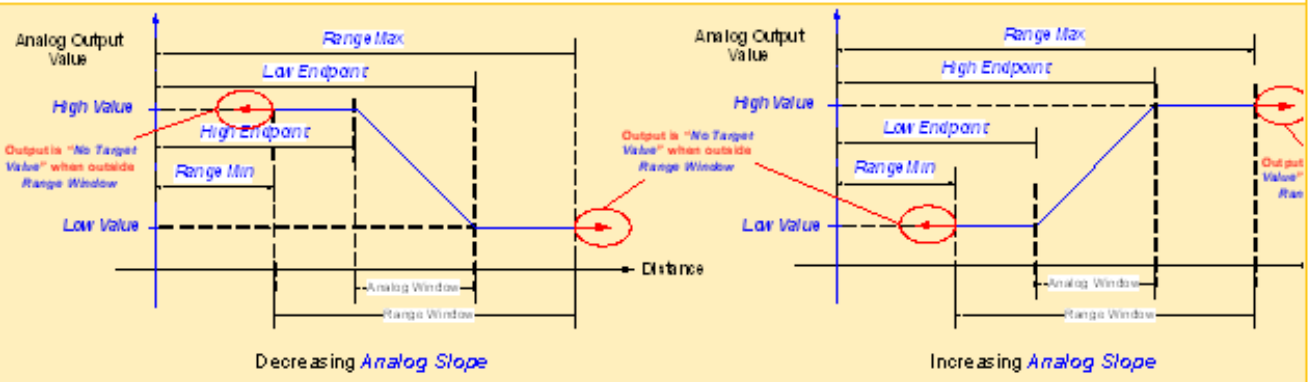
Parameters that Affect Switch Outputs (if selected)

Setpoints are available on the SenixVIEW Main Screen, other parameters by clicking the Switches icon.

Switch Output Selection	There are two switch outputs (see page 19). The factory default is both switches configured as sinking (NPN) outputs. Switch #1 is on the BLACK wire. Switch #2 is on the WHITE wire. Switches are configurable as sinking (NPN) or sourcing (PNP) type. If both are selected, they each are independently adjustable.	Reconfigure switch type menu selection Sensor - Wiring



Switch Mode	Hysteresis: Switch turns ON at the *Setpoint* and OFF after the distance reverses direction by at least *Hysteresis* Window: The Switch State is set in a distance window beginning at *Setpoint* and ending at *Setpoint* + Width from the sensor Options: Setpoint or Window	SW #1: Setpoint SW #2: Setpoint
Power-Up State	The state switch is set to when power is first applied. This state remains until completion of the first *Measurement Cycle* or *Measurement Process*. Options: ON and OFF	SW #1: OFF SW #2: OFF
Setpoint	The distance where a switch changes from OFF to ON.	See pg. 18-19
Polarity	If Switch Mode = Hyst: Direction of target through Setpoint causing ON Options: On Closer or ON Farther If Switch Mode = Wind: Switch state when target is detected in window Options: ON or OFF	SW #1: ON Closer SW #2: ON Farther
No Target State	Switch action if no target is detected (TARGET LED = RED) for a time period exceeding the switch's No Target Delay. Options: ON, OFF and HOLD (no change)	SW #1: OFF SW #2: OFF
No Target Delay	The minimum time the sensor must continuously fail to detect a target before setting the No Target State Values: 5 ms to 5.46 minutes (resolution 5 ms)	SW #1: 0 ms SW #2: 0 ms
Hysteresis or Width	A distance value representing either the amount of Hysteresis (Setpoint Mode) or the length of the Window (Window Mode) Values: 0 to 221.77 in. (5.63 m) Warning if result surpasses Range Window for selected Switch Mode)	SW #1: 0.25 in. (6.4 mm) SW #2: 0.25 in. (6.4 mm)
On Delay	The minimum time the sensor must continuously measure a distance representing an ON condition before setting the Switch State to ON Values: 0 ms to 5.46 minutes (resolution 5 ms)	SW #1: 0 ms SW #2: 0 ms
Off Delay	The minimum time the sensor must continuously measure a distance representing an OFF condition before setting the Switch State to OFF. Values: 0 ms to 5.46 minutes (resolution 5 ms)	SW #1: 0 ms SW #2: 0 ms
No Sync State	Switch state set by a SYNC Slave sensor with no master SYNC input for a period exceeding *No Sync Delay*. Options: ON, OFF and HOLD (no change)	SW #1: OFF SW #2: OFF
No Sync Delay	See description under *Parameters that Affect Measurements*. This parameter is shared by all analog and switch outputs.	0 ms

Feature	Description	As Shipped from Factory
Parameters that Affect both Analog Outputs (if selected) Endpoints are available on the SenixVIEW Main Screen, other parameters by clicking the Analog icon.		
 Decreasing *Analog Slope* Increasing *Analog Slope*		
Analog Selections	There are three analog outputs on these wires. Voltage output is on the VIOLET wire. 4-20 mA current SOURCING output is on the GREEN wire. 4-20 mA current SINKING output is on the ORANGE wire. Note: The voltage and current share the same *Analog Window, Analog Slope, No-Target Delay* and *No Sync Delay*.	
Analog Window ♦	The range of distances between the *Low Endpoint* and *High Endpoint*, between which the voltage and current outputs are linearly scaled to change between their Low Values and High Values respectively.	Between the *endpoints* listed below
Analog Slope ♦	The analog slope either increases or decreases with distance depending on the relative positions of the *Low Endpoint* and *High Endpoint*. The current and voltage must have the same slope. The voltage min and max values must be separated by at least 0.1 VDC. The current min and max values must be separated by at least 0.2 mA.	Increasing

Low Endpoint	One end of the range of distances over which the analog outputs are scaled. At the *Low Endpoint* distance, the outputs are the *Low Voltage Value* and/or *Low Current Value*. If this distance is outside the sensor's *Operating Range* the value will not be reached but the sensor operates properly for in-range targets.	See pg. 18-19
High Endpoint	One end of the range of distances over which the analog outputs are scaled. At the *High Endpoint* distance, the outputs are the *High Voltage Value* and/or *High Current Value*. If this distance is outside the sensor's *Operating Range* the value will never be reached but the sensor operates properly for in-range targets.	See pg. 18-19
High Voltage Value	Voltage output for targets detected at the *High Endpoint* (and outside the *High Endpoint* side of the analog range) Either the standard default 10 VDC or a custom value can be entered. Values: 0.1 to 10 VDC in 50 mV steps Value must be at least 1.0 volts above the *Low Voltage Value*.	10 VDC
Low Voltage Value	Voltage output for targets detected at the *Low Endpoint* (and outside the *Low Endpoint* side of the analog range) Either the standard default 0 VDC or a custom value can be entered. Values: 0 VDC to 9.9 VDC in 50 mV steps Value must be at least 1.0 volts below the *High Voltage Value*.	0 VDC
High Current Value	Current output for targets detected at the *High Endpoint* distance (and outside the *High Endpoint* side of the analog range) Either the standard default 20 mA or a custom value can be entered. Values: 2.2 to 20 mA in 0.1 mA steps Value must be at least 2.0 mA above the *Low Current Value*.	20 mA
Low Current Value	Current output for targets detected at the *Low Endpoint* distance (and outside the *Low Endpoint* side of the analog range) Either the standard default 4 mA or a custom value can be entered. Values: 2 mA to 19.9 mA in 0.1 ma steps Value must be at least 2.0 mA below the *High Current Value*.	4 mA
Power-Up Voltage	The voltage output value set when power is first applied; remains until completion of the first *Measurement Cycle* or *Measurement Process.* Options: LOW or HIGH analog output value Voltage goes to *Low Voltage Value* or *High Voltage Value*.	LOW
Power-Up Current	Current loop output value set when power is first applied; remains until completion of the first *Measurement Cycle* or *Measurement Process.* Options: LOW or HIGH analog output value Current goes to *Low Current Value* or *High Current Value*.	LOW

No Target Voltage	Voltage value if no target is detected (TARGET LED = RED) for a period exceeding the analog *No Target Delay*. Options: LOW, HIGH, and HOLD (no change)	HOLD
No Target Current	Current loop output value if no target is detected (TARGET LED = RED) for a time period exceeding the analog *No Target Delay*. Options: LOW, HIGH, and HOLD (no change)	HOLD
No-Target Delay	The minimum time the sensor must continuously fail to detect a target before setting the No Target Value. Values: 0 ms to 5.46 minutes (resolution 5 ms)	0 ms
No Sync Voltage	Voltage value set by a SYNC Slave sensor with no master SYNC input for a period exceeding *No Sync Delay*. Options: LOW, HIGH, and HOLD (no change)	HOLD
No Sync Current	Current loop value set by a SYNC Slave with no master SYNC input for a period exceeding *No Sync Delay*. Options: LOW, HIGH, and HOLD (no change)	HOLD
No Sync Delay	See description under *Parameters that Affect Measurements*. This parameter is shared by all analog and switch outputs.	0 ms