BINMASTER
Level Controls and Software

ToughSonic®
TS-100

Ultrasonic Distance Sensors
PC Configurable and/or Push-Button Teachable

INSTALLATION & OPERATING INSTRUCTIONS

CE

BinMaster Lincoln, NE
402-434-9102 | info@binmaster.com | www.binmaster.com | 2023 v3.6.3 | 925-0457

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Product Declarations

Document Revisions

Initial Release	31 May 2015
General corrections	8 Apr 2016
General corrections	9 Nov 2016
New products added	19 Aug 2019
New products added	1 July 2020
Old Products Removed	29 Feb 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/SensorView™-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® 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.

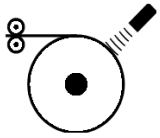
> Distance Proportional Output
The sensor's outputs are proportional or affected by the measured target distance.

> 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.

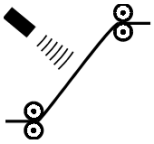
> Sensitive
Detects large and small objects (smaller objects must be closer)

Typical Applications



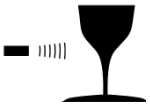
Roll Diameter
Measure the size of a roll to control tension or speed or determine when full or empty.

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

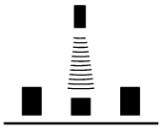


Web Break
Rapidly detect a broken web in a printing press or paper machine.

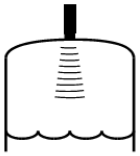
Dimensioning
Determine the size of an object for information or to determine its volume or width.



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® TS-100 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.

Pushbutton "Teachable"

Some models utilize a rear TEACH button to make many common adjustments. See the Teach Adjust section. Rear indicators provide target and output status. The TEACH button can be disabled for security using SensorView™. The TEACH button is unavailable on the ToughSonic® 50 and 50E models and serial-only models.

Packaging

ToughSonic® models are housed in rugged 316 stainless steel or durable PVC, with permanently attached interface cables. Sensors are potted and sealed to operate in wide humidity and temperature ranges.

Industry Standard Interfaces

Multiple simultaneous outputs, each with many SensorView™ 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

Model Name Part number, Metric Part number, NPT	ToughSonic® TS-100.3.XXXX	ToughSonic® TS-100.14-XXXX
Photo		
Maximum Range Deadband (minimum)	3 ft (91cm) 1.75 in (4.4 cm)	14 ft (4.3m) 4 in (10.2cm)
Optimum Range (small targets, dry materials, hot)	1.75 in (4.4 cm) to 24 in (61 cm)	4 in (10.2cm to 10 ft (3m)
Outputs, full-featured models: Table	Two outputs: SenixVIEW selectable as 0-10 VDC (or custom), 4-20 mA (or custom) sourcing, PNP or NPN switches	
	Switches: 150 mA, SenixVIEW configured as PNP (@ input voltage) or NPN (external 40 VDC max.), setpoint mode or window mode	
Outputs, Serial-only: NONE	Voltage: 0-10 or SenixVIEW configured, 10 mA max (min 15 VDC input for full 10 VDC output)	
	Current Loop: 4-20 mA or SenixVIEW configured, 450Ω max @ >15VDC, 250Ω max @ 10 VDC	
Indicators	**Round LED:** Power/Target. **Square & Rectangular LEDs:** Data, switch or analog status (configurable)	
	Serial-only models: Round LED Power/Target	
Serial interface, Interface protocol	Modbus slave, ASCII, or SYNCH. RS-232 or RS-485 interface, depends on model. RS-485 models are 2-wire multi-drop addressable (addresses 1-247). Baud rate 9600 - 115200, none or even parity, 8 bits, one stop bit. SenixVIEW configured.	
Power Input	10-30 VDC @ 55 mA max	
DC Current @ typical 24VDC input +I/O	Typical 45 mA @ 24VDC input +I/O	
DC Current, Serial-only	Typical 30 mA @ 24 VDC	Typical 35 mA @ 24VDC
Environmental	**Ingress**: IP-68, NEMA-4X Humidity: 0-100% (avoid heavy condensation) Temp: -40 to +158 F (-40 to +70 C)	
Transducer frequency	240 KHz	120 kHz

Model Name Part number, Metric Part number, NPT	ToughSonic® TS-100.14-XXXX	ToughSonic® TS-100.3.XXXX
Transducer, Beamwidth	Rugged piezoelectric nominal mean width ~12 degrees @ -3db, approx. conical shaped pattern.	Rugged piezoelectric, nominal beam width ~12 degrees @ -3 dB, approx. conical shaped pattern
Measurement rate	Default: 50 msec (20 Hz)	
	Adjustable from 50 msec to 2.8 hours; faster rates limit max target distance	
Performance	Repeatability: Greater of +/-0.03 in. (0.76 mm) or 0.25% of target distance in stable environment Accuracy: Better than 0.5% of target distance in stable, homogeneous air environment; affected by temperature gradients, target echo strength, speed of sound in air or vapors.	
Resolution (analog)	4100 steps over 0-10 VDC and 3279 steps over 0-20 mA (scaled between user-set distance endpoints)	
Resolution (serial data)	0.0034 in. (0.086 mm)	
Temperature	-40 to +158F (-40 to +70C) Temperature Compensated by internal sensor or external Reference Target	
Adjustments	Pushbutton Teach (except in serial-only version) or SenixVIEW software (included)	
Cable, full outputs (embedded)	6.5-ft (2m) 6-wire with shield, tinned ends, PUR. Longer cables available. M12 connector on 18" cable available with extension cables available	
Cable, serial-only (embedded)	6.5-ft (2m) 4-wire with shield, tinned ends, PUR. Longer cables available. M12 connector on 18" cable available with extension cables available	
Max serial cable length	RS-232: 50ft (15 m), RS-485: 3937ft (1200m).	
Weight	10.3 oz (0.29 kg)	10.4 oz (0.29 kg)
Housing material, Mount	316 Stainless, M30x1.5 mm thread OR 316 Stainless, 1-in NPT thread	
Dimensions (Dia x Length)	1.2 in. (30.4mm) x 4.064 in. (103mm)	
Default: RangeMIN RangeMAX Switch #1 Setpoint Switch #2 Setpoint Analog Low Endpoint Analog High Endpoint	1.75 in (4.4 cm) 36 in (91 cm) 12 in (30.5 cm) 18 in (46 cm) 1.75 in (4.4 cm) 24 in (61 cm)	4 in. (10.2 cm) 168 in. (427 cm) 12 in. (30.5 cm) 24 in. (61 cm) 4 in. (10.2 cm) 120 in. (305 cm)
Configuration Options		
Interface	RS-232 or RS-485	
Mounting Method	m30x1.5 or 1-in NPT thread	
Outputs	Serial Output and two configurable analog outputs / Serial Output only for Serial Only Models.	

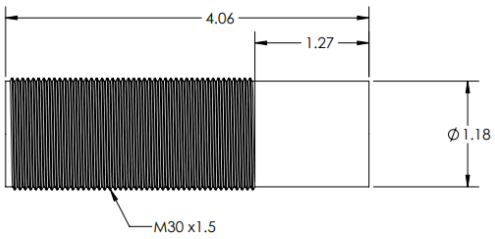
Model Name Part Number	ToughSonic® 30 TS-100.30.XXXX	ToughSonic® 50 TS-100.50.E.XXXX TS-100.50.D.XXXX	ToughSonic® 50F TS-100.50.F.XXXX
			
Maximum Range Deadband	30 ft (9.1 m) 10 in (25.4 cm)	50 ft (15.2 m)	12 in (30.5 cm)
Optimum Range (small targets, dry materials, hot)	20 ft (6.1 m)	33 ft (10.1 m)	
Outputs, full-featured models: Table	Five Outputs: 0-10 VDC, 4-20 mA sourcing, 4-20 mA sinking, two switches		
	Switches: 150 mA, SenixVIEW configured as PNP (@ input voltage) or NPN (external 40 VDC max.)		
Outputs, Serial-only: NONE	Voltage: 0-10 or SenixVIEW configured, 10 mA max (min 15 VDC input for full 10 VDC output)		
	Current Loop: 4-20 mA or SenixVIEW configured, 450Ω max @ >15VDC, 250Ω max @ 10 VDC		
Indicators	Round LED: Power/Target. Square & Rectangular LEDs: Data, switch or analog status (configurable) 50RM and 50RM Serial only: None		
	Serial-only models: Round LED Power/Target (except 50RM)		
Serial interface, Interface protocol	Modbus slave, ASCII, or SYNCH. RS-232 or RS-485 interface, depends on model. RS-485 models are 2-wire multi-drop addressable (addresses 1-247). Baud rates 9600 - 115200, none or even parity, 8 bits, one stop bit. SenixVIEW configured.		
Power Input	10-30 VDC @ 70 mA max		
DC Current @ typical 24VDC input +I/O	Typical 45 mA @ 24VDC input +I/O		
DC Current, Serial-only	55 mA max, Typical 35 mA @ 24VDC		
Environmental	Ingress: IP-68, NEMA-4X Humidity: 0-100% (avoid heavy condensation) Temp: -40 to +158 F (-40 to +70 C)		
Transducer, Beamwidth	Rugged piezoelectric, nominal beam width ~12 degrees @ -3 dB, approx. conical shaped pattern		
Transducer frequency	75 kHz	50 kHz	50 kHz
Measurement rate	Default: 100 msec (10 Hz)	Default: 200 msec (5 Hz)	
	Adjustable from 5 msec to 2.8 hours; affected by filter selections		

Model Name Part Number	ToughSonic® 30 TS-100.30.XXXX	ToughSonic® 50 TS-100.50.E.XXXX TS-100.50.D.XXXX	ToughSonic® 50F TS-100.50.F.XXXX
Performance	Repeatability: 0.2% of target distance in stable environment Accuracy: Better than 0.5% of target distance in stable, homogeneous air environment; affected by temperature gradients, target echo strength, speed of sound in air or vapors.		
Resolution (analog)	4100 steps over 0-10 VDC and 3279 steps over 0-20 mA (scaled between user-set distance endpoints)		
Resolution (serial data)	0.0068 in. (0.172 mm)	0.0135 in. (0.343mm)	
Temperature	-40 to +158F (-40 to +70C) Temperature Compensated by internal sensor or external Reference Target		
Adjustments	Pushbutton Teach (except on serial-only models) or SenixVIEW software (included)	SenixVIEW software (included)	
Cable, full outputs (embedded)	6.5-ft (2m) 9-wire with shield, tinned ends, PUR. Longer cables available. M12 connector on 18" cable available with extension cables available		
Cable, serial-only (embedded)	6.5-ft (2m) 4-wire with shield, tinned ends, PUR. Longer cables available. M12 connector on 18" cable available with extension cables available		
Max serial cable length	RS-232: 50ft (15 m), RS-485: 3937ft (1200m).		
Weight	22.6 oz. (0.64 kg)	29.9 oz (0.82 kg)	29.1 oz (0.82 kg)
Housing material, Mount	316 Stainless, Dual 1.5 in NPT	316 Stainless cylinder, Clamp to mount 50RM: rear 1.5 in NPT	PVC, Dual 2.5 in NPT
Dimensions (Dia x Length)	1.2 in. (30.4mm) x 4.064 in. (103mm)	50: 2.3 in (59mm) x 4.8 in (122 mm) 50RM: 2.5 in (63 mm) x 5.9 in (150mm)	2.5 in (63.5 mm) x 5.0 in (127 mm)
Default: RangeMIN RangeMAX Switch #1 Setpoint Switch #2 Setpoint Analog Low Endpoint Analog High Endpoint	10 in. (25.4 cm) 30 ft. (9.1 m) 36 in. (91.4 cm) 48 in. (121.9 cm) 10 in. (25.4 cm) 240 in. (609 cm)	12 in. (30.5 cm) 50 ft. (15.2 m) 36 in. (91.4 cm) 48 in. (121.9 cm) 12 in. (30.5 cm) 400 in. (1016 cm)	12 in. (30.5 cm) 50 ft. (15.2 m) 400 in. (1016 cm) 18 in. (45.7 cm) 400 in. (1016 cm) 12 in. (30.5 m)
Options Interface:	RS-232 or RS-485		
Mount method:	1.5 in NPT both ends	Clamp. (50RM: rear thread 1.5-in NPT)	2.5 in NPT either end
Outputs:	Five outputs or serial only		

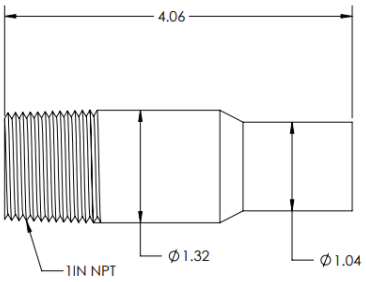
Mechanical Details

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

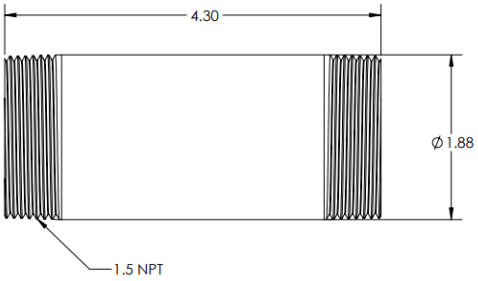
ToughSonic® 3 & 14A (30mm)



ToughSonic® 3 & 14B (1" NPT)



ToughSonic® 30C



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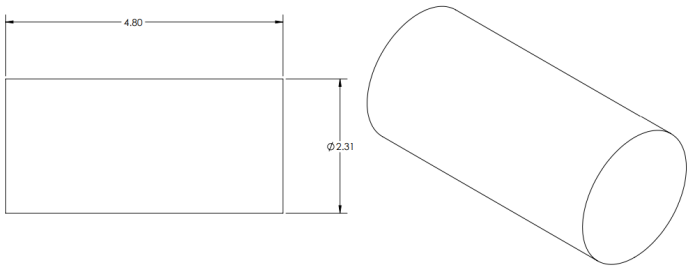

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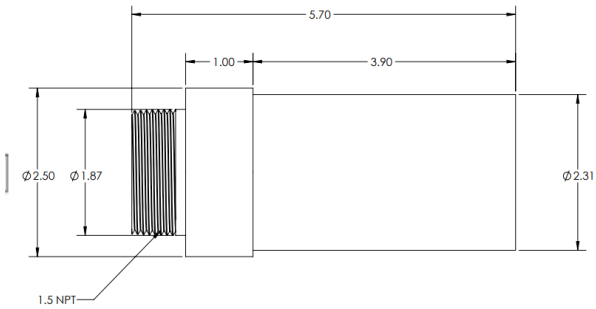
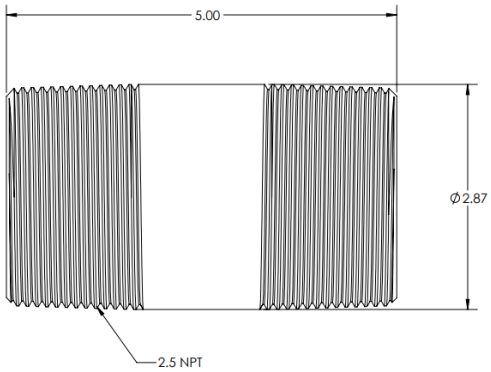


ToughSonic® 50F



Mounting & Installation Precautions

Only hand tighten the sensor and never apply a wrench to the body. When tank mounting to a domed or round tank, mount the sensor perpendicular to the target surface. Mount teh sensor directly to the tank ceiling at a flanged opening. If a riser is added, it must be smooth-walled and a minimum 3-in diameter.

The sensor beam width is nominally 12-14 degrees at the -3dB boundary, however, surfaces outside can return echoes as well. Round off the lower ID of the riser to prevent detection. Provide shade for outside installations to prevent erronious measurements due to artificial heating of the sensor when temperature compensation is active. Mount the sensor away from the inner walls of tanks. Seams and fixtures can interfere with measurements.

Orientation

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

SENSOR ORIENTATION

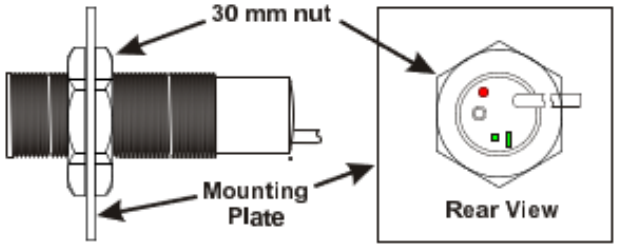
Ultrasound energy must be returned to the sensor, or the sensor will not detect a target. Curved or spherical objects generally reflect a portion of the energy back to the sensor but with lower reflected energy. A flat surface, however, is detectable at a greater distance. Foreground interfering objects can be ignored by setting the Range MIN value in SensorView.

Maintenance & Cleaning

Dust accumulation on the sensor face can be cleaned by blowing pressurized air across the sensor face. Dust does not affect performance unless it builds on the transducer. Position the sensor facing downward rather than upward will minimize material accumulation in some applications. The sensor face can be cleaned with isopropyl alcohol or window cleaner. DO NOT use solvents such as MEK or acetone on ToughSonic sensors.

ToughSonic® 3 & 14

These sensors are shipped with two 30mm stainless nuts. The sensor mounts through a 1.18in (31mm) hole in a mounting plate as shown in Figure 3. This hole may be a component of the user equipment or a bracket and must be rigid for best performance. Position the sensor in the hole and fasten it to the plate with the two nuts provided. The sensor position can be altered a couple of inches depending on the nut positions. If accurate close-range distance is important, position the sensor so the closest target is always beyond the deadband.



30MM MOUNTING

NPT ToughSonic® 3 & 14

These sensors have 1-in NPT male threads at the front end to install in a 1-in NPT threaded hole, flange or 90-degree adapter. The sensor can also be held by clamp.

Mounting Hardware & Accessories

Metric ToughSonic® 3 & 14 series

	**UA-MB30-SS** Stainless steel, flat bracket, non-adjustable angle
	**UA-MB30-SS90** Stainless steel, 90-degree mounting, non-adjustable angle
	**UA-MB30-NYBM** Nylon, clamps to sensor, non-adjustable angle.
	**UA-MB30-NYSW** Nylon adjustable angle bracket with internal 30mm thread. Adjust sensor angle, then tighten to lock sensor in position
	**UA-SWD-30-2NPT** Delrin adapter allows 30mm threaded sensor to mate with 2-in. NPT flange or nipple. Elevates 2-in for use with 2-in flange.
	**UA-SWED-30-2NPT** Delrin adapter allows 30mm threaded sensor to mate with 2-in. NPT flange or nipple. Elevates 4-in for use with 2-in flange.
	**UA-NUT30-SS** One pair (SS316) stainless steel m30x1.5 nuts (Included with new sensor)
	**UA-90D-1N** 90 Degree Mounting adapter, external style with target for 1 in. NPT Thread

	**UA-RT1-30** Reference Target Adapter, external style with target for 30mm Thread
	**UA-RT1-1N** Reference Target Adapter, external style with target for 1 in. NPT Thread

ToughSonic® 30 Series

The ToughSonic® 30 threads into a 1.5" NPT Flange or pipe thread

	**UA-CLIC-15** PVC bracket Optional for ToughSonic 30
	UA-FM-15 Gray PVC flange for 1.5-in NPT
	**UA-FM-SS15** Stainless steel flange. Fits rear mount ToughSonic 50RM

ToughSonic® 50 Series

ToughSonic® 50 series include stainless steel and PVC housing.

	UA-CLIC-21 PVC bracket Included with ToughSonic® 50D
	UA-MB-SS Stainless steel clamp bracket bolts to surface in fixed position. Optional for ToughSonic® 50D
	UA-FM-SS15 Stainless steel flange. Fits rear mount ToughSonic® 50E
	UA-FM-15 Gray PVC flange Fits rear mount ToughSonic® 50E

ToughSonic® 50F Series

ToughSonic® 50F series model threads into a 2.5” NPT flange or pipe nipple. Observe precautions (p.11)

	UA-FM-25 Gray PVC flange with 2-in NPT thread. FitsToughSonic 50F
	UA-FM-SS25 Stainless steel flange. Fits ToughSonic® 50F

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 Senix for ordering details and prices.

Wire Color	Wire Function	
	ToughSonic® 3, 12 & 14 Series (6-wire cable)	ToughSonic® 30 & 50 Series (9-wire cable)
Brown	+DC input voltage (Power Input)	
Blue	-DC input and signal common (Ground)	
Gray *(data #1)* *(Note 2)*	RS-232 models: RS-232 out	
	RS-485 models: RS-485 -	
Yellow *(data #2)* *(note 2)*	RS-232 models: RS-232 in	
	RS-485 models: RS-485 +	
Silver	Cable shield (bare stranded wire), unterminated at sensor end	
Colors below are not on Serial Only models		
Black	**Output #1** *(note 1)* 4-20 mA sourcing loop *(note 3)* OR Sinking Switch #1 OR Sourcing Switch #1 or OFF	Sinking Switch #1 *(note 3)* OR Sourcing Switch #1
White	**Output #2** *(note 1)* 0-10 VDC *(note 3)* OR Sinking Switch #2 OR Sourcing Switch #2 OR OFF	Sinking Switch #2 *(note 3)* OR Sourcing Switch #2
Green	These wires are not on ToughSonic® 3 or 14 sensors	Current sourcing output
Orange		Current sinking output
Violet		Voltage output

Notes:
(1) Output selection for the black and white wires of ToughSonic 3 and 14 sensors are made via SenixVIEW.
(2) Output determined by sensor model. The gray and yellow wires are also used for synchronization.
(3) Factory default selections (can be changed using SenixVIEW)

Tinned ends are standard. Connectorized cables are also available, as are other cable lengths.

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. When power is applied, the rear LED target indicator will light, and the sensor operates as described on page 18.

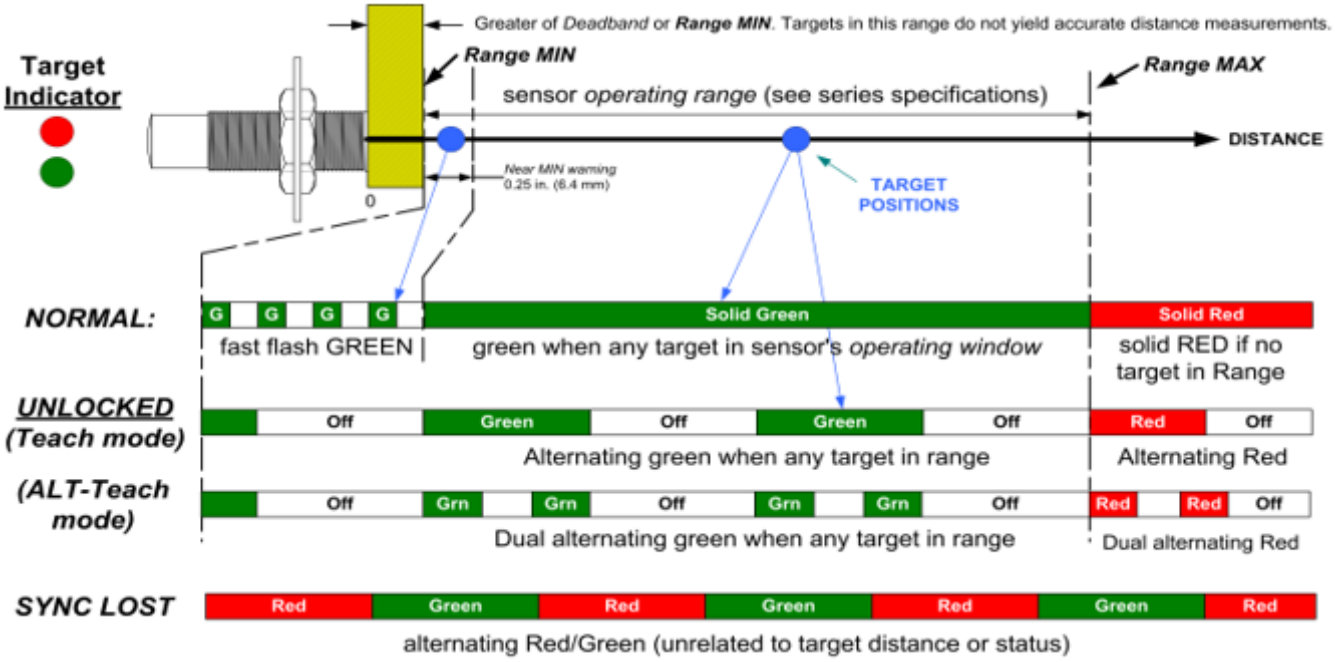
ToughSonic® 3 & 14 Outputs (black & white)
Each output can be either an analog, a switch, or turned OFF. Analog interfaces are described on page 22. Output selections require SensorView™ (see the SensorView™ manual).

ToughSonic® 30 and 50 Outputs
These models provide simultaneous 0-10 VDC, 4-20 mA sourcing, 4-20 mA sinking, and two switch outputs. The default switch outputs are sinking (NPN type) but may be changed to sourcing (PNP type) or turned OFF using SensorView™.

Data Connections (gray & yellow)
Serial data interfaces are described on page 24. 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.

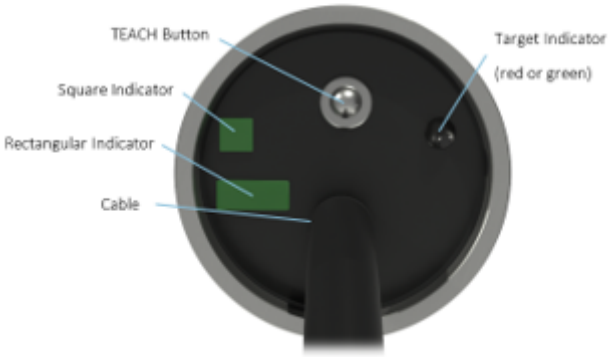
> All ToughSonic® serial RS-232 models can connect to a PC USB port for SensorView™ configuration with UAN-KIT-USB-232 and optional UA-USB-232-ISO adapter, See Software and Interconnection (pg. 15).

> RS-485 models require the RS-485 interface kit, UAN-KIT-USB-485 and UA-USB-485-ISO adaptor for USB port connection, or the full kit UAN-KIT-USB-485. See Software and Interconnection (pg. 15).



TARGET INDICATOR FUNCTIONS

Rear Features



There are four control features available:

- The ***Target Indicator*** (round)
- The ***TEACH button.***
- The ***square status indicator*** and ***rectangular status indicator*** show sensor outputs status. Status Indicator assignments can be changed using SenixVIEW. The factory defaults by model are:
  - ToughSonic 3 and 14:
    Square = Analog, Rectangular = data TX
  - ToughSonic 30:
    Square = Switch #1, Rectangular = Switch #2
  - ToughSonic 50:
    Square = Switch #1, Rectangular = Switch #2
  - ToughSonic® TS-100.50RM & TS-100.50E
    No pushbuttons or LEDs
  - ToughSonic® TS-100.50F
    Square=data RX, Rectangular=data TX
    No pushbutton

Target Indicator

As shown in Figure 6 above, the *target indicator* is a bi-color LED and provides status for the following purposes:

- Power ON
- Target status & near MIN
- Data communications
- "No SYNC" warning
- Unlocked status
- TEACH feedback (ToughSonic 3, 14, and 30)

Power ON Status
When sensor power is ON the target indicator will be RED or GREEN. It may also be flashing at a slow or fast rate under other conditions described below and shown in the figure on the previous page.

Target Status & Near MIN
This is the primary operational purpose of the target indicator. The target status displays the following:
> GREEN is a normal indication, indicating a target is detected within the sensor's operating range.
> RED indicates no target is detected within the sensor's operating range.
> FAST FLASH GREEN warns that the target is within 0.25 in. (6.4 mm) of range MIN.

Unlocked Status (ToughSonic® 3, 14, and 30)
The sensor must be unlocked for TEACH adjustment. When unlocked the target indicator will continue to indicate target status (Red or Green) but will blink slowly on and off to signify TEACH readiness. ALT-Teach status is indicated by an alternating "double blink". All filters are turned OFF when unlocked.

TEACH and ALT-Teach Feedback (ToughSonic® 3, 14, & 30)
When using the TEACH features to make sensor adjustments the Target Status Indicator will SLOW BLINK RED (unless the TEACH functions are disabled using SensorView™ and the sensor is not a SYNC master or slave) as operator feedback while the TEACH button is pressed. The user must count these flashes, then release the TEACH button after a specific number of flashes to complete a particular TEACH feature. ALT-Teach feedback is indicated by a slow "double blink".

"No SYNC" Warning
If the SYNC feature is used and a slave sensor does not detect a master SYNC input, the slave will stop measuring and the Target Status indicator will slowly alternate between RED and GREEN until SYNC is restored (or the TEACH button is used on certain models).

Output Status Indicators
Some ToughSonic® sensors have two output status indicators at the rear of the sensor. These indicators can each show status of the analog, switch, or serial data interfaces, or can be turned OFF. Indicators have default assignments and can be reassigned using SensorView™. Indicator operations are shown on pg. 19.

In a typical installation the analog output is operating within a user-calibrated range and the normal indication is a continuous ON indicator. An OFF or blinking indicator could indicate a potential problem because the sensor is detecting a target outside the calibrated (expected) distance range.

Square Green Indicator ■
The square status indicator can be configured using SensorView™ to any of the status options (analog, switch, serial data receive, serial data transmit, Reference Target, or OFF). If selected for a switch it displays the status for Switch #1. The #1 output must be configured to be a switch to choose Switch as the indicator. Similarly, Reference Target temperature compensation must be chosen before assigning Reference Target to the square indicator.

Rectangular Green Indicator ▮
The rectangular status indicator can be configured using SensorView™ to any of the status options (analog, switch, serial data receive, serial data transmit, Reference Target, or OFF). If selected for a switch it displays the status for Switch #2. The #2 output must be configured to be a switch to choose Switch as the indicator. Similarly, Reference Target temperature compensation must be chosen before assigning Reference Target to the square indicator.

Switch Status

When a status indicator is selected as a solid-state switch, it operates as follows:
> Indicator ON if switch is ON.
> Indicator OFF if switch is OFF.
> Indicator blinks on and off continuously while the switch is in a safe shutdown mode due to over current or temperature.

The Output Selection for a Switch may be either sinking or sourcing but the status indication is the same. A switch is considered ON when it is conducting current.

Analog Status

When a status indicator is selected for analog status, it shows the status of the analog output(s). The analog status is the same for voltage and current loop outputs since they share common endpoint distances. The analog status indicator:
> is ON if the target distance is between the two analog endpoint distances over which the analog output is spanned, or
> is OFF if the target distance is equal to or outside the low value endpoint distance. The sensor output will be 0 VDC, 4 mA or the SensorView™ adjusted low analog output value, or
> blinks ON-OFF if the target distance is equal to or outside the high value endpoint distance. The sensor output will be 5/10 VDC, 20 mA or the SensorView™ adjusted high analog output value.

Serial Data Status

In systems using serial data communications a status indicator(s) can be configured using SensorView™ to either (a) RX flash upon receiving any data (regardless of validity or baud rate), or (b) TX flash upon transmitting data (responding to a valid command). A TX indicator will also flash each time data is transmitted in the ASCII streaming mode.

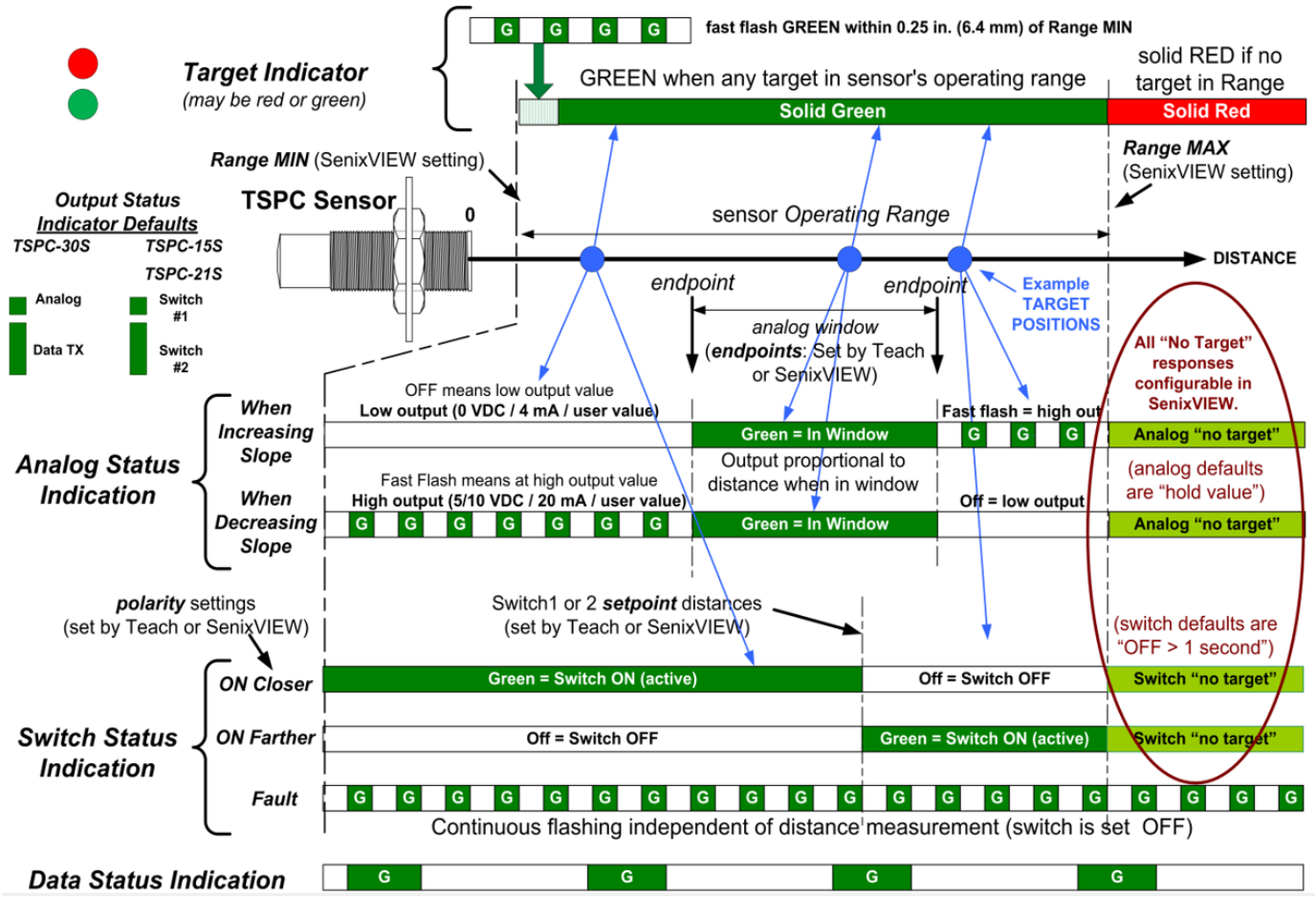
Reference Target Status

Either status indicator can be configured to light when the reference target is available and go out if it is lost. Available only in Reference Target temperature compensation mode. Unavailable in Serial Only models.

Output Status Indicators (■ & ▮): Analog, switch, reference target, and/or data status is shown on the square indicator (■) and/or rectangular indicator (▮). Default assignments may be changed using SensorView™. Analog status appears for current loop or voltage outputs, and Switch Status for sinking or sourcing switch outputs. Reference target is to monitor for that type of temperature compensation.

Analog Status: The above two analog examples show an increasing analog slope (top) and decreasing analog slope (bottom). An increasing

(continued next page)



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slope means the output value increases proportional to the measured distance and vice-versa. A fast-flashing analog indicator means the analog output is at the high endpoint voltage or current output value (10 VDC, 5 VDC, 20 mA, or user value entered in SensorView™). An OFF-analog indicator means the analog output is at the low endpoint voltage or current output value (0 VDC, 4 mA, or user value entered in SensorView™). The analog status is solid green when the measurement is within the normal (calibrated) range.

Switch Status: The indicator will light green when the associated switch is ON. An ON-switch means is it conducting current, and an OFF switch not. A sinking switch output that is ON will have an output value near ground (0 volts). A sourcing switch output that is ON will have an output value near the power supply voltage. The three switch examples shown above demonstrate a switch that is ON at distances closer than the setpoint (ON closer), farther than the setpoint (ON Farther) and a FAULT condition (overload or over temperature). During a FAULT the switch is turned OFF. Normal switch operation restores automatically when the fault is removed.

Analog and Switch Outputs if No Target: If no target is detected (target indicator is red) the analog output will hold the last value and the switch outputs will turn off after 1 second. These responses can be changed in SensorView™ by

(continued next page)

(continued from previous page)

changing the “No Target Voltage” and “No Target Current” selections.
Data Status: The status indicator will flicker ON when the sensor receives (RX status) or responds (TX status) to a Modbus command over the serial data interface.

ToughSonic® 3 & 14 Output Selection

The ToughSonic® 3 & 14 series sensors have two user-selected outputs. These outputs connect via the black and white wires of the sensor cable.

The factory default selections are a 4-20 mA current loop connected to the black wire and a 0-10 VDC output to the white wire. Using SensorView™, one or both analog outputs can be changed to either a sinking (NPN) or sourcing (PNP) switch or can be turned off. If turned off the associated rear status indicator is also turned off.

Make the output selections before connecting the sensor to equipment!

Output selections are not affected by a TEACH 17 reset.

NOTE: Output selection is NOT REQUIRED for ToughSonic® 30 and 50 series sensors. All outputs are independently wired and simultaneously run.

Analog Outputs

ToughSonic® 3 & 14 Analog Outputs

The above sensors have these analog outputs:
> Voltage and sourcing current loop outputs.
> Output selection is accomplished using SensorView™.
Defaults are I and V.

ToughSonic® 30, 50, and 50F Analog Outputs

These sensors have three analog outputs - voltage, sourcing loop and sinking loop. They are simultaneously available on separate wires and do not require selection using SensorView™.

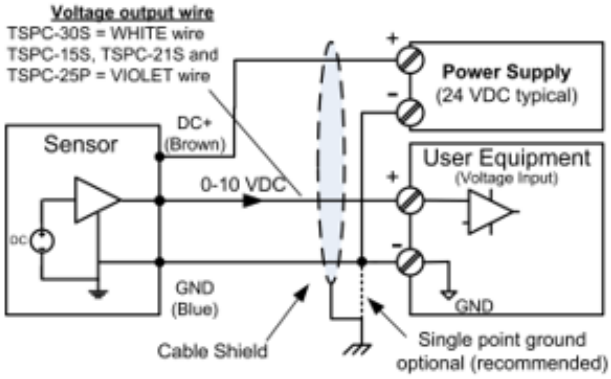
Analog Status Indication

Rear status indicators show whether the analog output is at the high value, low value or between those values as shown in Reference Target Status
Either status indicator can be configured to light when the reference target is available and go out if it is lost. Available only in Reference Target temperature compensation mode. Unavailable in Serial Only models.

Output Status Indicators (■ & ▌): Analog, switch, reference target, and/or data status is shown on the square indicator (■) and/or rectangular indicator (▌). Default assignments may be changed using SensorView™. Analog status appears for current loop or voltage outputs, and Switch Status for sinking or sourcing switch outputs. Reference target is to monitor for that type of temperature compensation.

Analog Status: The above two analog examples show an increasing analog slope (top) and decreasing analog slope (bottom). An increasing slope means the output value increases proportional to the measured distance and vice versa. A fast-flashing analog indicator means the analog output is at the high endpoint voltage or current output value (10 VDC, 5 VDC, 20 mA, or user value entered in SensorView™). An OFF-analog indicator means the analog output is at the low endpoint voltage or current output value (0 VDC, 4 mA, or user value entered in SensorView™). The analog status is solid green when the measurement is within the normal (calibrated) range.

Voltage Output



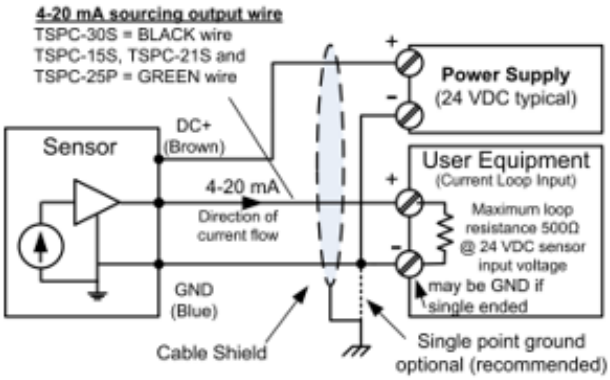
VOLTAGE OUTPUT WIRING

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 SenixVIEW. 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 SenixVIEW.

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 SenixVIEW 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).

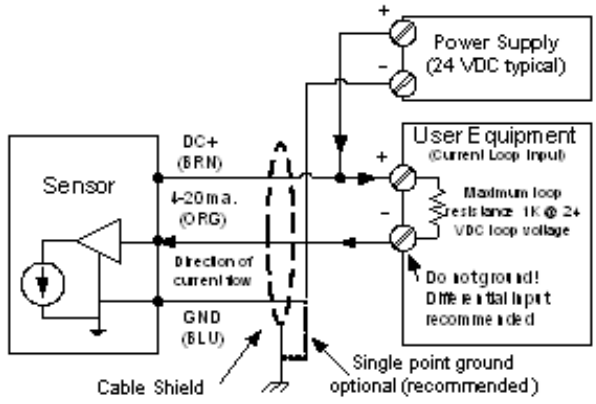
Sourcing Current Loop Output



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 in Figure 10 are either differential (both + and – terminals) or single ended (+ and GND terminals). Differential input is recommended for 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:

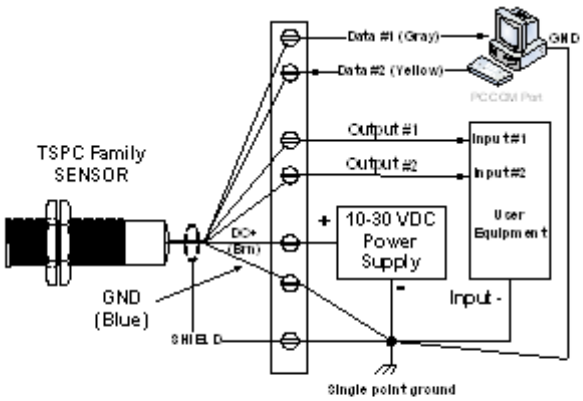
1. **Setup** – Connect to a PC running SenixVIEW™ software for setup, calibration, analysis, and rapid sensor cloning.
2. **User Applications** – Connect to an external system and provide distance measurement data. Several operating modes are available.
3. **Synchronization (SYNC)** – Time-synchronize 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)

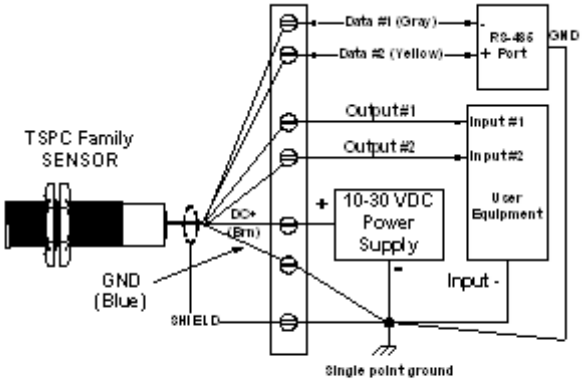
Serial RS-232 models use a serial data RS-232 interface directly compatible with a PC COM port.



RS-232 PC COM PORT CONNECTIONS

RS-485 (Multi-Drop Addressable)

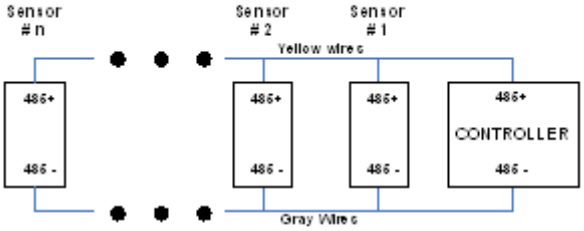
Serial RS-485 models use a serial data RS-485 interface that can be used over long distances. Up to 32 addressable sensors can connect to the bus. A single sensor is shown below connected to an RS-485 port. To use SenixVIEW with these models the PC must have an RS-485 adapter connected. Adapters are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

Teach Adjust

On the ToughSonic® 3, 14, and 30 series models many sensor features can be adjusted using the rear TEACH button and Target Status Indicator. These are called “teach-able” because, for some features, the sensor stores actual target measurements as calibration distances for analog endpoints and switch setpoints. All changes are stored in non-volatile memory and retained without supply power. A list of Teach features is included in the appendix on page 30. Document references such as “TEACH-3” correspond to the features listed in that table.

TEACH usage is not required. All adjustments can be done in SensorView™, where additional features are available that cannot be set with TEACH.

For security, the Teach button can be disabled using SensorView™. Teach 12-15 remain enabled in a

sensor.

When setting analog or switch distances keep the tar get farther than the greater of the deadband or Range MIN or invalid settings will occur.

Unlock, Lock and ALT-Teach

Locking prevents using Teach to change sensor features. The sensor is initially “locked” and must be unlocked using TEACH-3 before other Teach adjustments can be made. When unlocked the target status indicator color indicates target status but slowly flashes on and off (pg. 19, Target Indicator). An unlocked sensor will re-lock:

> When TEACH-3 is used again (manual re-lock)
> 15 minutes after last use of the TEACH button.
> When input power is cycled off and on.

Additional features are available using ALT-Teach. ALT-Teach is entered using TEACH-3 followed by TEACH-2 (see pg. 28). ALT-Teach status is indicated by a double flashing indicator.

Analog Teach Adjustments

The following analog adjustments can also be accom-plished using the TEACH button where equipped:
TEACH 4: Analog Low Endpoint (b above)
TEACH 5: Analog High Endpoint (c above)
TEACH 30: Set voltage range to 0-5 VDC (d & e)
TEACH 31: Set voltage range to 0-10 VDC (d & e)
TEACH 35, 36, 37: no target response (h)
TEACH 17: Resets all factory defaults.

After TEACH adjustments are performed SensorView™ can be used to display and/or save the new configuration. The TEACH button may be disabled in SensorView™ to prevent unwanted changes.

Analog Output Adjustments

The voltage and current outputs operate over adjustable distances (span) defined by setting the endpoints. The volt-age and/or current loop outputs vary linearly with the target distance between the endpoints. Endpoints can be set anywhere between the RangeMIN and RangeMAX using TEACH-4 and TEACH-5.

The analog low value (0VDC, 4 mA or SensorView™ low values) endpoint is adjusted using TEACH-4 and the high value (10VDC, 20 mA or SensorView™ high values) endpoint using TEACH-5. The endpoints can be adjusted in any sequence. The endpoint distances can be in any order, allowing increasing or

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decreasing analog slope. Adjustment is made easy by pointing the sensor at the actual target then using the TEACH button to memorize each endpoint. Settings take effect only if the target indicator is green. Endpoints are common to both the voltage and current outputs.

The default range for the voltage output is 0-10 VDC but can be changed to 0-5 VDC using TEACH-30.

The no-target response can be set using TEACH-35-37.

Switch Output Adjustments

Switch outputs turn ON at their setpoint distances, set using TEACH-7 for a switch on Output #1 (BLACK wire) and TEACH-9 for a switch on Output #2 (WHITE wire). The OFF distances are set using ALT-TEACH-7 and ALT-TEACH-9 respectively or are the factory default of 0.25 in. (6.35 mm). Both switches turn OFF if no target is detected for 1 second (disable this feature using TEACH-20).

The polarity of each switch can be changed between ON Closer than the setpoint or On Farther than the setpoint using TEACH-8 for Output #1 and TEACH-10 for Output #2.

NOTE: This reverses the direction of the OFF distance from the Setpoint!

Other TEACH Features

These and more can also be set in SensorView™:

Measurement rates are set using Teach-24 to 28. More options are available using SensorView™.

SYNC and Continuous Activation modes are set using Teach 12-14 are used to select SYNC modes and Teach-15 to revert to continuous operation.

Temperature compensation is OFF by default. It can be turned ON using TEACH-32 or OFF using TEACH-33.

Factory Configuration

TEACH-17 will restore factory default operation and the default values described in Table 3. **The output selections, communications parameters and number of SYNC phases are not affected.**

TEACH COUNT (Note 4)	TEACH Feature Description (ToughSonic 3, 14, and 30 models)	Factory Defaults Set by TEACH 17			Note
		ToughSonic 14	ToughSonic 3	ToughSonic 30	
3	**TEACH**: Unlock (or re-lock) sensor's TEACH capability. Sensor automatically locks 15 minutes after last use of the *TEACH button* or is power cycled. **ALT-TEACH**: First unlock with TEACH-3, then hold button for 2 more flashes to enter (2 again to exit). See ALT-TEACH features listed at bottom of this table.				*1*
4	Use present measured target distance as the 0 VDC/4 mA/or custom low *endpoint*	4 in. 10 cm	1.75 in. 4.4 cm	10 in. 25.4 cm	*2,3,5*
5	*Use present measured target distance as the 10 VDC/20 mA/or custom hi endpoint*	*120 in.* *427 cm*	*24 in.* *61 cm*	*240 in* *610 cm*	*2,3,5*
6	*Toggle Slow-Fast filter ON and OFF (exit TEACH to enable filter!)*	*OFF*			*2,5*
7	*Use present measured target distance as the switch #1 setpoint*	*12 in.* *30.5 cm*	*12 in.* *30.5 cm*	*36 in.* *91 cm*	*2,3,5*
8	*Reverse (toggle) switch #1 polarity (ON closer than setpoint/ ON farther)*	*ON Closer*			*2,8*
9	*Use present measured target distance as the switch #2 setpoint*	*24 in.* *61 cm*	*18 in.* *46 cm*	*48 in.* *122 cm*	*2,3,5*
10	*Reverse (toggle) switch #2 polarity (ON closer than setpoint/ ON farther)*	*ON Farther*			*2,8*
12	*Set Activation to SYNC MASTER*				*6,7*
13	*Set Activation to SYNC SLAVE phase 1*				*7*
14	*Set Activation to SYNC SLAVE phase 2*				*7*
15	*Set Activation to CONTINUOUS (exit SYNC Master or Slave activation)*	*Factory Default = Continuous (SYNC off)*			*2,7*
17	Set FACTORY DEFAULT CONFIGURATION: Restores all parameters to the Factory Setting shown in the List of Adjustable Parameters, Appendix B, including those shown in columns 3-6 of this table. ***The following are NOT affected***: Interface selections (black & white wires), communications (network address and baud rate), Master SYNC number of phases	**Teach 17 Sets these values** ↕			
20	Switch NO TARGET delay = ON (delay = 1 second)	*Factory Default = 1 second delay*			*2*
21	Switch NO TARGET delay = OFF (delay = 0)				
24	Set *measurement rate* to default	*20 per second*		*10 per sec*	*2*

TEACH COUNT (Note 4)	TEACH Feature Description (ToughSonic 3, 14, and 30 models)	Factory Defaults Set by TEACH 17			Note
		ToughSonic 14	ToughSonic 3	ToughSonic 30	
25	Set *measurement rate* to 2x default				
26	Set *measurement rate* to 5x default				
27	Set *measurement rate* to 10x default				
28	Set *measurement rate* to 1/Sec				
30	Set voltage output range to 0-5 VDC				
31	Set voltage output range to 0-10 VDC	*Factory Default = 0-10 VDC*			2
32	Temperature compensation ENABLED (last mode configured, or else Constant PWR mode)				
33	Temperature compensation DISABLED	*Factory Default = DISABLED*			2
35	Analog NO TARGET response = HOLD (no change)	*Factory Default = HOLD*			2
36	Analog NO TARGET response = LOW OUTPUT (4 mA, 0 VDC or custom low)				
37	Analog NO TARGET response = HI OUTPUT (20 mA or 5/10 VDC, or custom hi)				
ALT-TEACH (see TEACH-3 at top of table)					
7	Use present measured target distance as the switch #1 OFF distance.	*12.25 in. 31.1 cm*	*12.25 in. 31.1 cm*	*36.25 in. 92.1 cm*	2,3,5,8
9	Use present measured target distance as the switch #2 OFF distance.	*23.75 in. 60.3 cm*	*17.75 in. 45.1 cm*	*47.75 in. 121.3 cm*	2,3,5,8

Notes:

1. The sensor must first be UNLOCKED (3 blinks) before making any of the Teach adjustments shown in this table. The *target indicator* will indicate the unlocked condition.
2. When a Factory Default configuration is set using TEACH-17 this feature is set to this value.
3. The sensor must be detecting the intended target in range (GREEN *Target Status Indicator*) while setting this feature.
4. When the *TEACH, button* is held pressed the *Target Status Indicator* will blink RED. The TEACH COUNT column shows the number of times the indicator must blink to set the listed TEACH feature. Release the *TEACH button* after the indicated number of blinks. If the *TEACH button* is released mid-blink, that partial blink is included in the count.
5. In the TEACH mode all enabled sensor filters are disabled to allow the sensor outputs to quickly reflect the actual target distances during the calibration process.
6. The factory default Master Number of Phases is 2. If the number of phases is adjusted using SenixVIEW it is unaffected by any TEACH feature, including Teach 17.
7. If the Teach button is disabled using SenixVIEW, teach features 12 through 15 remain enabled in sensors set as a SYNC Master or Slave to permit mode changes without

TEACH COUNT (Note 4)	TEACH Feature Description (ToughSonic 3, 14, and 30 models)	Factory Defaults Set by TEACH 17			Note
		ToughSonic 14	ToughSonic 3	ToughSonic 30	
	SenixVIEW. An RS-232 sensor placed in SYNC mode will no longer connect to SenixVIEW via RS-232 until reverted to normal operation using TEACH-15. 8. When reversing a switch polarity using Teach-8 or Teach-10, the OFF distance of that switch (set by ALT-Teach-7 or 9) is reversed in direction about the setpoint by the "hysteresis" distance (the difference between the ON and OFF distances). The Teach reversal is not executed if the OFF distance would be out of sensors *Operating Range*.				

TABLE 3 - PUSHBUTTON TEACH FEATURES LIST

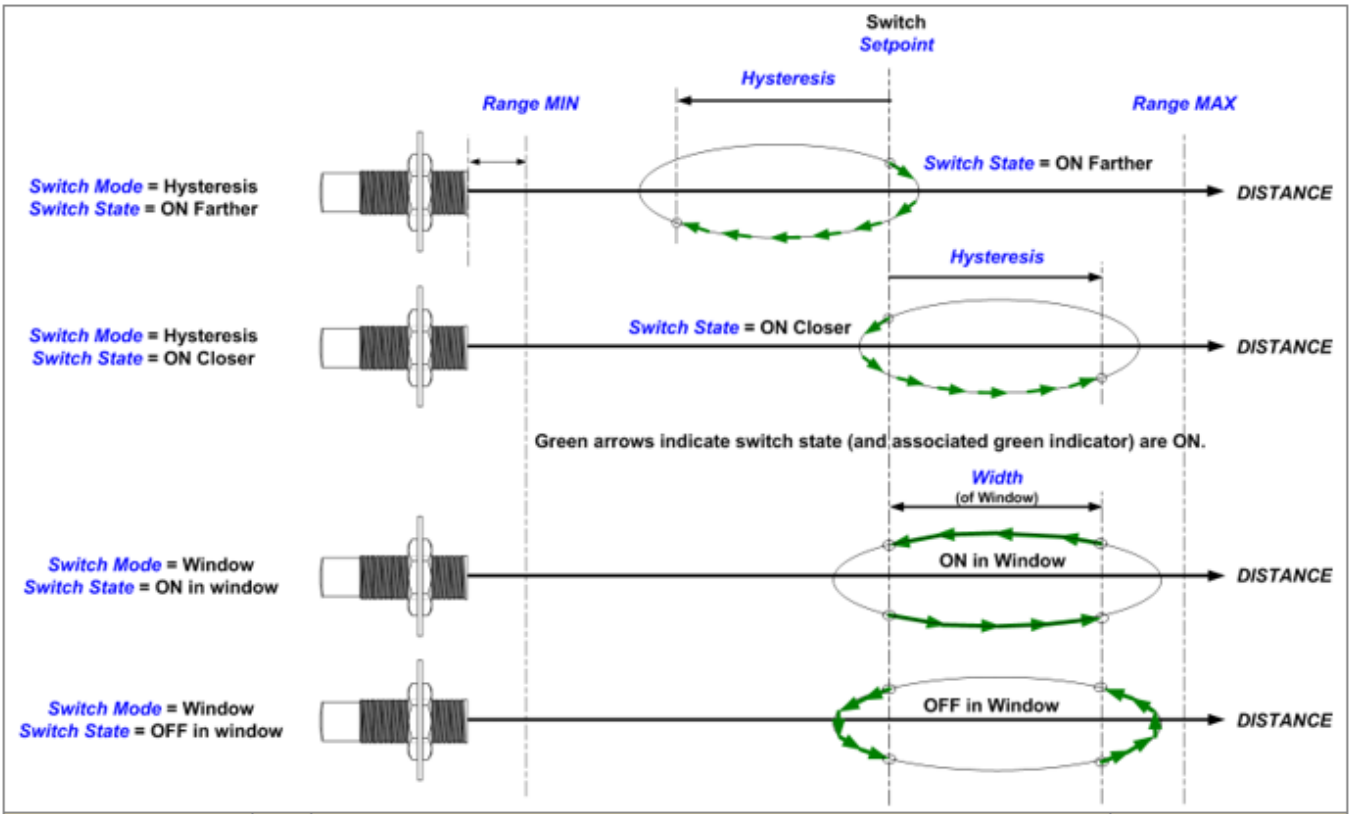
Appendix A – List of Adjustable Features

These parameters can be changed using Senix SenixVIEW™. Those that can also be set using TEACH are indicated with a ▶ in the Teach? column. Parameters are permanently stored in the sensor memory. Features marked with ♣ in the Factory Settings column are NOT reset by TEACH 17. ♦ = implied parameters (not directly settable)

Feature	Teach?	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.	Software will display: "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 page 7
Range Max		The farthest distance the sensor will provide target measurements.	See page 7
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.	See page 8 ♦
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. ▶ TEACH 24-28 are used to select specific measurement intervals	See page 7
Temperature Compensation	▶	Temperature compensation can be turned ON or OFF. ▶ TEACH 32 = Enabled, TEACH 33 = Disabled (Last used mode reinstated, or default Constant PWR mode)	Disabled
Filters	▶	Filter options include Closest or Farthest of M, X of Y, Running or Boxcar average of N, Max Rate and Slow/Fast Rate ▶ TEACH 6 toggles the Slow-Fast filter on and off	All filters OFF

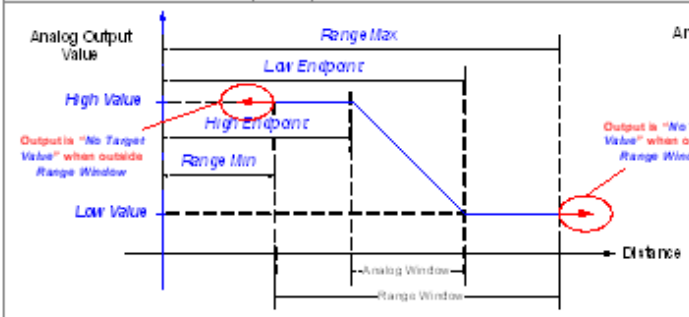
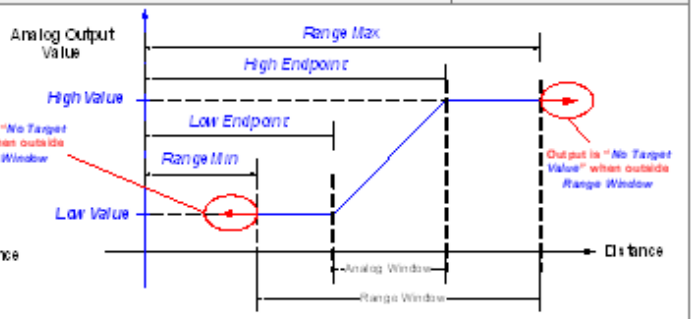
Measurement Activation	►	**Continuous** (at *measurement interval*) **Start on Poll** (Measure upon receiving serial data read poll) **SYNC Master** (continuous at *sync interval*) **SYNC Slave 1, 2, 3, 4 or 5** (at *sync interval*, measures when receive associated SYNC input from SYNC Master) (*Sync interval* = *measurement interval* x *SYNC phases*) ► TEACH 12,13,14 and 15 set activation modes	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
Security Parameter This parameter is toggled on and off by clicking the Teach icon.			
TEACH Pushbutton (select models)		The TEACH button can be disabled for security purposes. Options are Enabled and Disabled. TEACH is always enabled in a SYNC master or slave.	Enabled

		Parameters that Affect Switch Outputs (if selected) Setpoints are available on the SenixVIEW Main Screen. Other parameters are obtained by clicking the Switches icon.	
Switch Output Selection		**ToughSonic 3 and 14:** One or two switch outputs may be optionally selected. The factory default is none selected. When switch #1 is selected it exists on the BLACK wire. When switch #2 is selected it exists on the WHITE wire. Switches are configurable as sinking (NPN) or sourcing (PNP) type. If both are selected, they are independently adjustable. **ToughSonic 30, 50, and 50P**: Two switches always available, no selection required.	♠



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 *Window Near* and ending at *Window Far* from the sensor Options: **Setpoint** or **Window**	SW #1: Setpoint SW #2: Setpoint
Power-Up State		The switch state that is set 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. (▶ TEACH 7 = SW#1, TEACH 9 = SW#2)	See page 7
Polarity	▶	If Switch Mode = Hysteresis: Direction of target through Setpoint causing ON Options: **On Closer** or **ON Farther** If Switch Mode = Window: Switch state when target detected in window Options: **ON** or **OFF** (▶ TEACH 8 = toggle SW#1 state, TEACH 10 = toggle SW#2 state)	SW #1: ON Closer SW #2: ON Farther

No Target State		Switch action if no target is detected (TARGET LED = RED) for a 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) (► TEACH 20 = 1 second, TEACH 21 = 0 ms [OFF])	SW #1: 0 ms SW #2: 0 ms
Hysteresis		The distance a target must change in the reverse direction of the ON state (Setpoint) to turn OFF (Setpoint 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 (target indicator = red/green) 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
Window Far		The window distance farthest from the sensor for a switch in the *Window* mode.	*Setpoint* + 0.25 inches
Window Near	►	The window setpoint nearest to the sensor for a switch in the *Window* mode. (► TEACH 7 = SW#1, TEACH 9 = SW#2) NOTE: If *Window Near* is changed by TEACH the *Window Far* value will also change to maintain a constant window width.	Same as *Setpoint*

Feature	Teach?	Description	As Shipped from Factory
		Parameters that Affect Analog Outputs (if selected) Endpoints are available on the SenixVIEW Main Screen. Other parameters are obtained by clicking the Analog icon.	
 Decreasing *Analog Slope*		 Increasing *Analog Slope*	
Analog Selections		**ToughSonic 3 and 14**: Each analog output may be optionally selected (see page 47). The factory default is both selected. When Current Loop is selected it exists on the BLACK wire. When Voltage is selected it exists on the WHITE wire. **ToughSonic 30, 50, and 50P**: V and I always available, no selection required. Note: The voltage and current share the same *Analog Window*, *Analog Slope*, *No-Target Delay* and *No Sync Delay*.	Current Selected Voltage Selected ♠
Analog Window (Analog shared)		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 (Analog shared)		The analog slope increases or decreases with distance depending on the relative positions of the *Low Value Endpoint* and *High Value 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 ♦

Analog Low Value Endpoint	► 4	One end of the range of distances over which the analog outputs are scaled. At the *Low Value Endpoint* distance, the outputs are the Voltage *Low Value* and/or Current *Low 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 page 7
Analog High Value Endpoint	► 5	One end of the range of distances over which the analog outputs are scaled. At the *High Value Endpoint* distance, the outputs are the Voltage *High Value* and/or Current *High 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 page 7
Voltage High Value	►	Voltage output for targets detected at the *High Value Endpoint* (and outside the *High Value 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 *Voltage Low Value*. (► TEACH 30 sets this value to 5 VDC, TEACH 31 to 10 VDC)	10 VDC
Voltage Low Value	►	Voltage output for targets detected at the *Low Value Endpoint* (and outside the *Low Value 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 *Voltage High Value*. (► TEACH 30 or 31 sets this value to 0 VDC)	0 VDC
Current High Value		Current output for targets detected at the *High Value Endpoint* distance (and outside the *High Value 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 *Current Low Value*.	20 mA
Current Low Value		Current output for targets detected at the *Low Value Endpoint* distance (and outside the *Low Value 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 *Current High 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	LOW

		Voltage goes to *Voltage Low Value* or *Voltage High Value*.	
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 *Current Low Value* or *Current High Value*.	LOW
No Target Voltage		Voltage 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 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 (shared)		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 (target indicator = red/green) 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 (target indicator = red/green) 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