



# OPERATING INSTRUCTIONS

## RANGER TWO™ LTRP-2 ULTRASONIC LEVEL TRANSMITTER



## Principle of Operation

*Please read carefully! No liability can be accepted for damage caused by improper use or installation of the Ranger Plus™ Level Transmitter.*

The Ranger Two™ LTRP-2 Ultrasonic Level Transmitter is designed for level and distance measurement in remote monitoring and other difficult outdoor applications. The Ranger Two™ features surge protection which assures reliable performance in lightning prone areas. The Ranger Two™ is able to measure distance of level with a range of 1ft. up to 30ft. Features include a stainless steel housing for rugged indoor or outdoor use, surge protection, and the ability to connect to one sensor up to 32 sensors optimized with RS-485 output to the CONNEX 3D Cellular Monitor. Serial data is addressable in MODBUS RTU protocol and options include ASCII. These all-weather sensors survive submersion and provide years of maintenance free service.

## Safety Precautions

If you are unsure of the suitability of a Ranger Two™ Ultrasonic Level Transmitter for your installation, please consult your FLO-CORP representative for further information.

**NOTE: REMOVE ALL PACKING INSERTS BEFORE OPERATING LEVEL TRANSMITTER.**

## Authorized Personnel

All operations described in this operating instructions manual must be carried out only by trained specialist personnel authorized by the plant operator. During work on and with the device the required personal protection equipment must always be worn.

## Warning about misuse

Inappropriate or incorrect use of the instrument can give rise to application-specific hazards, e.g. vessel over fill or damage to system components through incorrect mounting or adjustment.

## General Safety Instructions

The user must take note of the safety instructions in this operating instructions manual, the country specific installation standards as well as all prevailing safety regulations and accident prevention rules. The instrument must only be operated in a technically flawless and reliable condition. The operator is responsible for trouble-free operation of the instrument. During the entire duration of use, the user is obliged to determine the compliance of the required occupational safety measures with the current valid rules and regulations and also take note of new regulations.

## Disclaimer

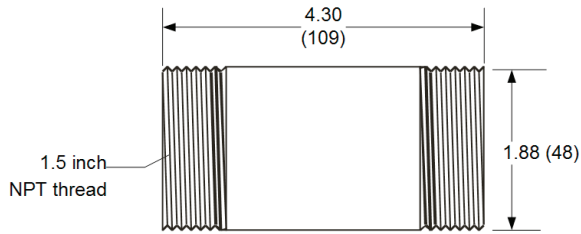
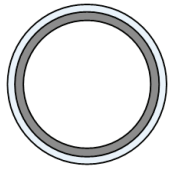
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## FEATURES & BENEFITS

- Long range, short dead band
- Unaffected by optical factors like color and transparency
- Surge protection
- Low power consumption
- Stainless 316 housing
- Connect to one sensor, up to 32 sensors
- Optimized with RS-485 output
- Narrow beam with adjustable sensitivity
- Temperature Compensated
- No warmup mode, ready to measure with 1 sec.

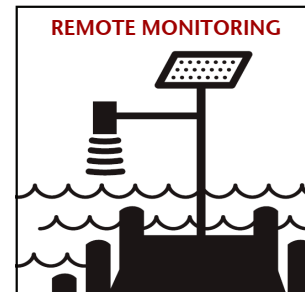
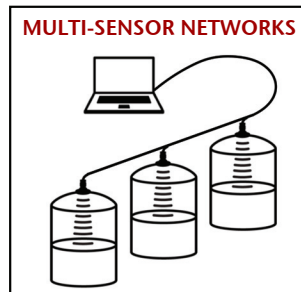
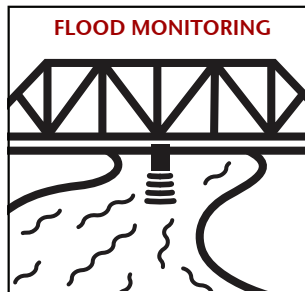
## DIMENSIONS

Dimensions in  
Inches (mm)



### NOTES:

- **Dimensions:** Inches (mm)
- **Mounting:** 1.5 in. NPT thread, top or bottom
- **Standard Cable:** 6.5 ft (2m)
- **Total Weight:** 22.6 oz (0.64 kg)



## SPECIFICATIONS

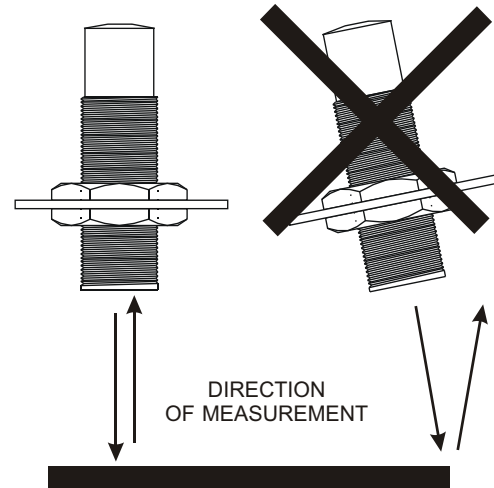
<b>Maximum Range</b>	30 feet (9.1 m)
<b>Optimum Range</b>	20 ft. (6.1 m)
<b>Deadband</b>	Typ. < 10 in. (254 mm)
<b>Beam Width</b>	7.5° 1° off axis @ -3db
<b>Configuration</b>	Stored in sensor's non-volatile memory
<b>Data Output</b>	Modbus, ASCII streaming, specials
<b>Transducer</b>	75 kHz, Ruggedized Piezoelectric
<b>Protection</b>	NEMA-4X, NEMA-6P, IP68
<b>Adjustment</b>	SenixVIEW PC Software
<b>Case Material</b>	316 Stainless Steel
<b>Temperature</b>	-40 to 158 F (-40 to 70 C)
<b>Humidity</b>	0 to 100% operating
<b>Compensation</b>	Selectable temperature Compensation
<b>Data Resolution</b>	0.0068 in. (0.172 mm) per count
<b>Repeatability</b>	Repeatability Nominal 0.2% of range @ constant temp. Affected by target, distance, environment
<b>Update Rate</b>	10 Hz (100 ms), Software adjustable; also affected by filter selections
<b>Modbus Protocol</b>	Modbus RTU, 9600 to 115200 baud, 8 data bits, 1 stop, no parity
<b>ASCII Protocol</b>	Five ASCII distance characters followed by Carriage Return; for single sensor connections only
<b>RS-485 Networks</b>	From 1 to 32 sensors can operate in an addressable multi-drop network

<b>Resolution</b>	Digital: 0.0034 inches (0.086 millimeters); Analog:4099 steps (0-10 VDC), 3279 steps (4-20 mA)
<b>Ready Time</b>	< 1 second after power application
<b>Cable</b>	2m standard length, potted into sensor body, PUR with shield and drain, other lengths available
<b>Conformance</b>	CE, RoHS, Surge protection exceeds IEC 61000-4-5
<b>Compatibility</b>	Compatible with the CONNEX 3D™ Cellular Monitor
<b>Target Requirements</b>	
<b>Objects</b>	Detects liquid surface, flat or curved objects. Surface must reflect ultrasound to sensor
<b>Distance Ranges (*)</b>	Affected by size, shape, orientation of target (sound level reflected back to sensor), environment Restrict use to Optimum Range when using over a wide range of environmental conditions
<b>Orientation</b>	Sensor should be oriented perpendicular to liquid surface for maximum reflection
<b>Optical</b>	Unaffected by target color, light, transparency or other optical characteristics

*Specifications are subject to change without notice.*

## MOUNTING AND INSTALLATION

If mounted incorrectly the sensor can receive acoustic energy through the sensor body. For that reason it is recommended that the sensor be mounted in a plastic threaded adapter rather than a metal one. Also, only hand tighten the sensor and never apply a wrench to the body. When tank mounting to a domed or round tank, adjust the sensor mount until it is square with the target surface. Mount the sensor directly to the tank ceiling at a flanged opening. If a riser is added, it must be of sufficient diameter to cause no inner wall reflections. The sensor ultrasonic output is roughly 12 degrees conical at the -3dB point, however lesser energies can return echoes as well. Round off the lower edge of the riser. Provide a sun shade for outside installations to prevent the sensor body from heating and causing erroneous measurements. The sensor body should stay equal to the ambient air temperature so the sensor's temperature compensation can work correctly.



## ORIENTATION

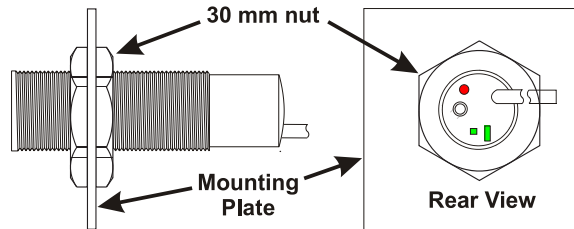
Orient the sensor perpendicular to the target object for best results as shown above. Ultrasound energy must reflect back to the sensor or the sensor will not detect the target. Curved or spherical objects can make good targets because they generally reflect a portion of the energy back to the sensor. A flat surface, however, is detected at a greater distance. Make sure that other closer unintended targets are not visible to the sensor.

## MAINTENANCE & CLEANING

Dust accumulation on the sensor face can be cleaned by blowing pressurized air across the sensor face. In general, dust does not affect performance unless it totally blocks the sound path. Positioning the sensor facing downward rather than upward will minimize material accumulation. The sensor face can be cleaned with alcohol or window cleaner. DO NOT use solvents such as MEK or acetone on sensors.

## MOUNTING

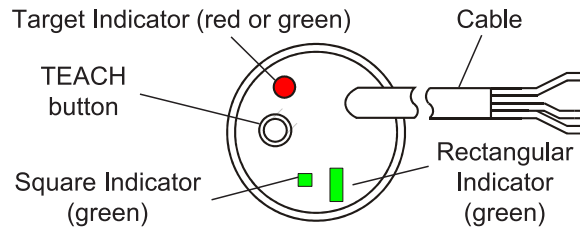
The Ranger Two™ sensors are shipped with two 30mm stainless nuts. The sensor mounts through a 1.25" (31mm) hole in a mounting plate as shown below. This hole may be a component of the user equipment or a FLO-CORP bracket, and must be rigid for best performance. Position the sensor in the hole and fasten it to the plate with the two nuts provided. The sensor position can be altered a couple of inches depending on where the nuts are placed on the body. If accurate short range distance is important, position the sensor so the closest target is always beyond the deadband (also see Range MIN on page 30).



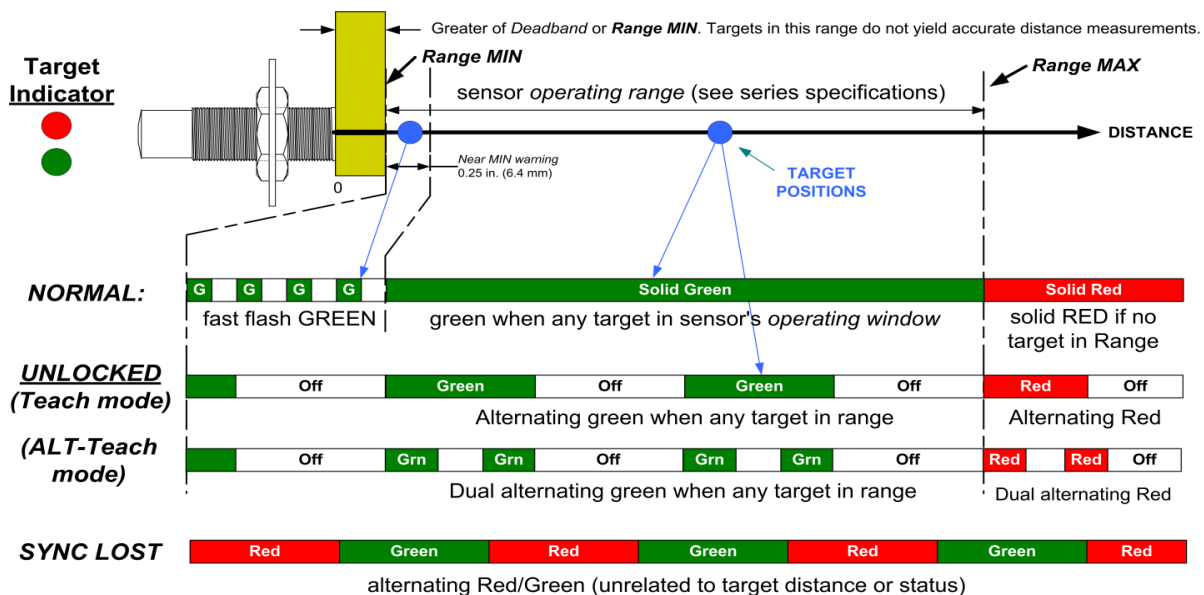
## SOFTWARE AND INTERCONNECTION

There are four control features available: The TEACH button can be used to make sensor adjustments on Ranger One™ sensors (or can be disabled using the software).

The target indicator (round) shows the target status and other conditions. It is always ON when power is applied and will be either RED or GREEN. The square status indicator and rectangular status indicator show sensor outputs status. Status Indicator assignments can be changed using the software. The factory defaults by model are:



Square = Analog, Rectangular = data TX



## TARGET INDICATOR

The target indicator is a 2-color LED and provides status for the following purposes:

- Power ON
- Target status & near MIN
- Data communications
- “No SYNC” warning
- Unlocked status
- TEACH feedback

### 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.

### Target Status & Near MIN

This is the primary operational purpose of the target indicator. The target status displays follows:

- 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.

When unlocked the sensor’s target indicator continues to operate but slowly alternates on and off to indicate TEACH readiness.

### Unlocked Status

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

When using the TEACH features to make sensor adjustments the Target Status Indicator will SLOW BLINK RED (unless the TEACH functions are disabled using the software 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

Ranger Two™ sensors have two output status indicators on 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 the software.

In a typical installation the analog output is operating within a user-calibrated range and the normal indication is a continuously 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.

### Default Indicator Assignments

Square = Analog, Rectangular = data TX

### Square Green Indicator

The square status indicator can be configured using the software to any of the status options (analog, switch, serial data receive, serial data transmit or OFF). If selected for a switch it displays the status for Switch #1.

### Rectangular Green Indicator

The rectangular status indicator can be configured using the software to any of the status options (analog, switch, serial data receive, serial data transmit or OFF). If selected for a switch it displays the status for Switch #2.

### 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

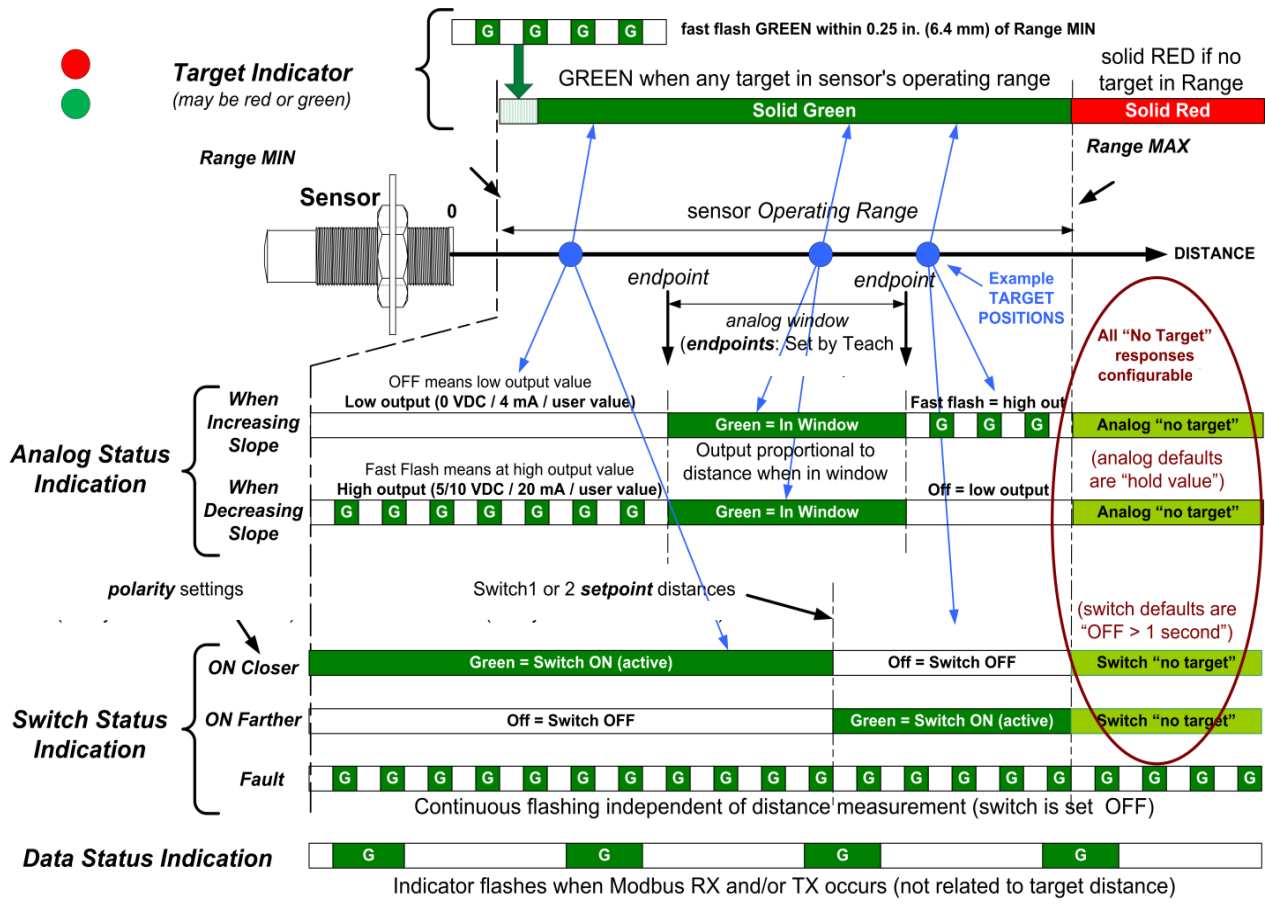
When a status indicator is selected for analog status it shows the current status of the analog output(s). The analog status is the same for voltage and current loop outputs since they share common endpoint distances. The analog status indicator:

- 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 software 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 software adjusted high analog output value.

### Serial Data Status

In systems using serial data communications a status indicator(s) can be configured using the software to either (a) flash upon receiving any data (regardless of validity or baud rate), or (b) 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.





**Output Status Indicators** (■ & ■): Analog, switch and/or data status is shown on the square indicator (■) and/or rectangular indicator (■). Default assignments may be changed using the software. Analog status appears for current loop or voltage outputs, and Switch Status for sinking or sourcing switch outputs.

**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 software). 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 software). 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 it is 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 the software by 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.

## WIRING IDENTIFICATION

WIRE COLOR	WIRE FUNCTION
<b>BROWN</b>	+ DC Input Voltage (Power Input)
<b>BLUE</b>	- DC Input and signal common (Ground)
<b>BLACK</b>	OUTPUT #1 4-20 mA sourcing loop (note 2) or Sinking Switch #1 or Sourcing Switch #1 or OFF
<b>WHITE</b>	OUTPUT #2 0-10 VDC (note 2) or Sinking Switch #2 or Sourcing Switch #2 or OFF
<b>GRAY</b>	RS-232 out / RS-485 - (note 1)
<b>YELLOW</b>	RS-232 in / RS-485 + (note 1)
<b>SILVER</b>	Cable shield (bare stranded wire), unterminated at sensor end

Notes:

(2) The gray and yellow wires are also used for synchronization

(3) Factory default selections (can be changed using the software)

### 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.

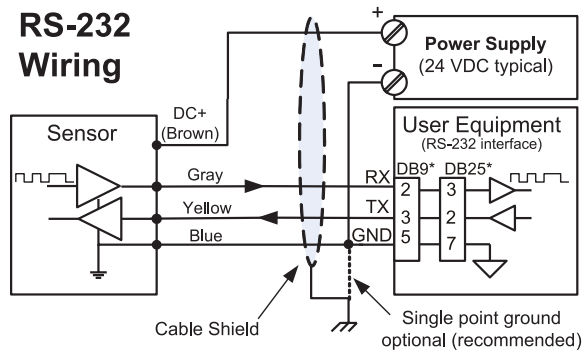
### Power Input (brown wire)

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.

### Data Connections (gray & yellow)

Used for:

- Software PC configuration
- Synchronization
- User communications between the sensor and an external data communications device.



\* Typical personal computer connections for 9 and 25-pin serial COM connectors

### ANALOG OUTPUTS

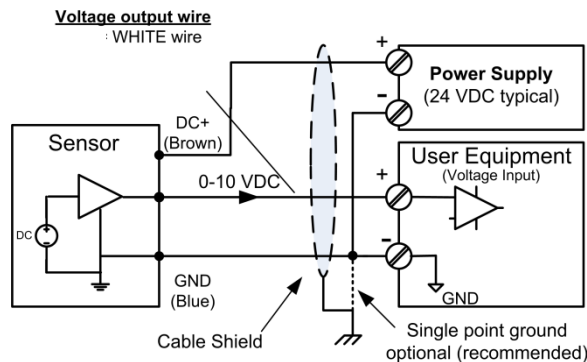
- Voltage and sourcing current loop outputs
- Output selection is accomplished using the software. Defaults are I and V.

### Analog Status Indication

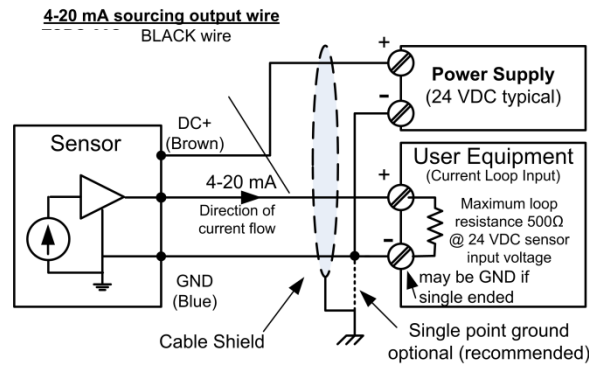
Rear status indicators show whether the analog output is at the high value, low value or between those values.

### Voltage Output

This figure shows a voltage output connection:



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 the software (see i & j below). 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 software.



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 the software. 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).

## ANALOG TEACH ADJUSTMENTS

The following analog adjustments can also be accomplished 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 the Ranger software can be used to display and/or save the new configuration. The TEACH button may be disabled in the software to prevent unwanted changes.

## Endpoints and Slope

The voltage and current loop(s) are spanned between the same two endpoint distances.

Endpoints can be set anywhere in the sensor's operating range using the TEACH button or Ranger software. All analog outputs must have the same slope, i.e., increase or decrease in value in proportion to distance. The high and low output values (voltages and currents), however, are independently adjustable in the software for voltage and current loops.

## Response Time

Analog response time is affected by measurement rate and filter selections.

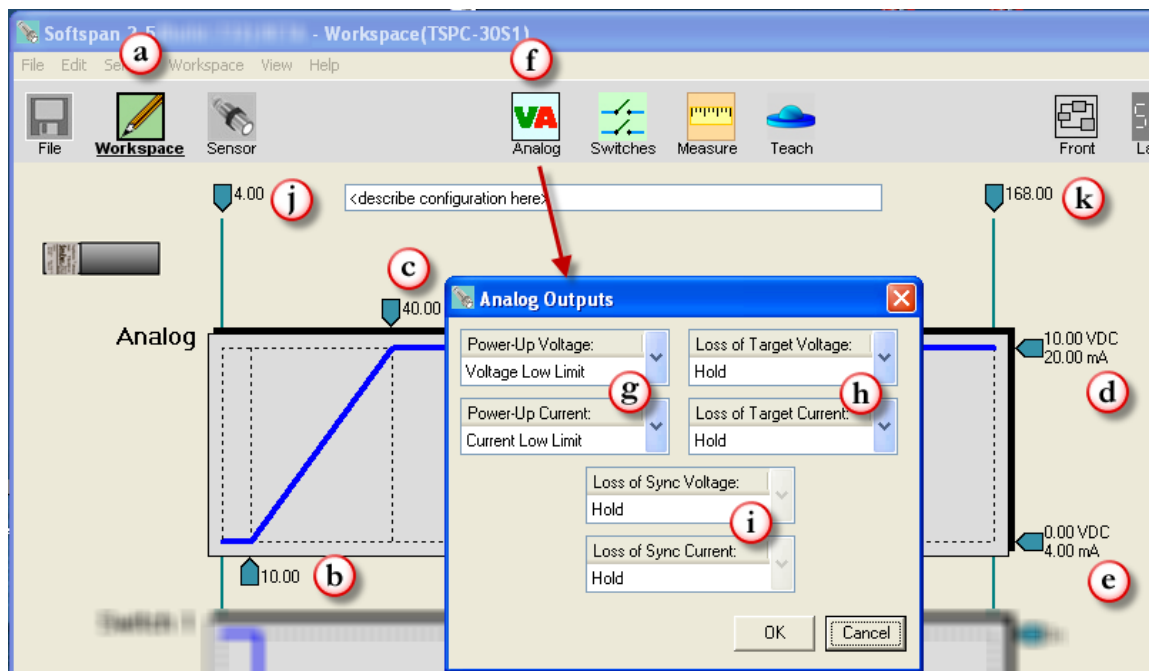
## Analog Displays

The sensor's calculated analog output values are shown in real time on the software meter displays.

## RANGER SOFTWARE ANALOG ADJUSTMENTS

Use the software to tailor the sensor for best results in the application. The letters used below are keyed to the figure shown below:

- a) Click the Workspace icon to edit parameters
  - b) Low Endpoint: Click the numeric value to set the distance of the low analog values (e).
  - c) High Endpoint: Click the numeric value to set the distance of the high analog values (d).
  - The analog slope will automatically reverse if the Low and High Endpoint distances (b & c) are set in reverse order
  - d) High Value: Click the numeric value to change the maximum voltage or current value. The voltage and current limits are independent.
  - e) Low Value: Click the numeric value to change the minimum voltage or current value. The voltage and current limits are independent.
  - f) Click the Analog icon for additional features.
  - g) Select the output values set at power-on. These values exist until the first measurement process is completed.
  - h) Select the output values to be set if no target is detected in the Operating Range (j to k).
  - i) If this sensor is a synchronized slave (page 29) select the output values to be set if the master SYNC input is missing. These selections are grayed out if the sensor is not a slave.
  - j) Range MIN: The closest distance the sensor will measure distance (see page 30).
  - k) Range MAX: The farthest distance the sensor will detect a target (see page 30).
- All sensor parameters are described in on page 44. Workspace parameter changes must be saved to the sensor to take effect, and can also be saved to disk for later recall as described on page 37



## SWITCH OUTPUTS

The switch outputs must be selected using the Ranger Software. If selected, switch #1 is on the black wire and/or switch #2 on the white wire.

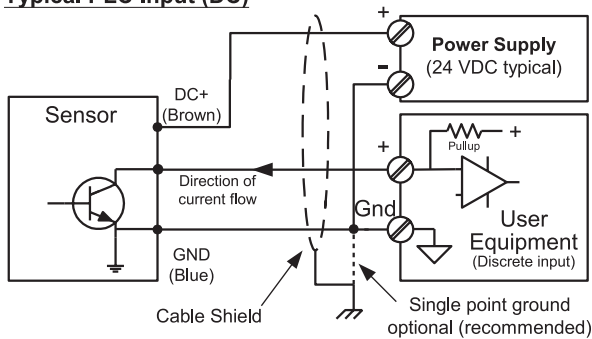
The switch type can be selected as either sinking (NPN), sourcing (PNP) or OFF using the software.

## SWITCH STATUS & OUTPUT VOLTAGE

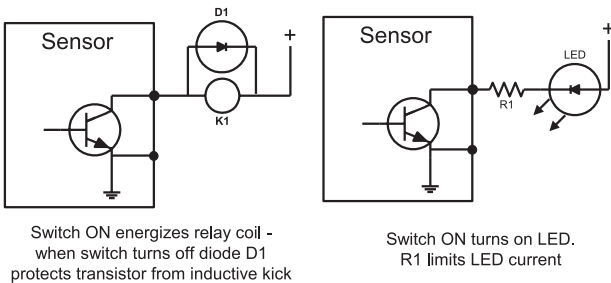
Switch outputs normally have a corresponding rear output status indicator (■ = #1, ■ = #2) that is lit when the switch is ON and vice versa (page 15). The indicators also provide warning of a safe shutdown under overload or over temperature conditions. They can, however, be reassigned using Ranger Software. When a sinking switch is ON the voltage of the switch wire will be near 0 VDC, and when OFF will be near the voltage of the external "pull-up" source. When a sourcing switch is ON the voltage of the switch wire will be near the sensor's power supply voltage and when OFF will be near 0 VDC.

## SINKING SWITCH OUTPUT

### Typical PLC Input (DC)



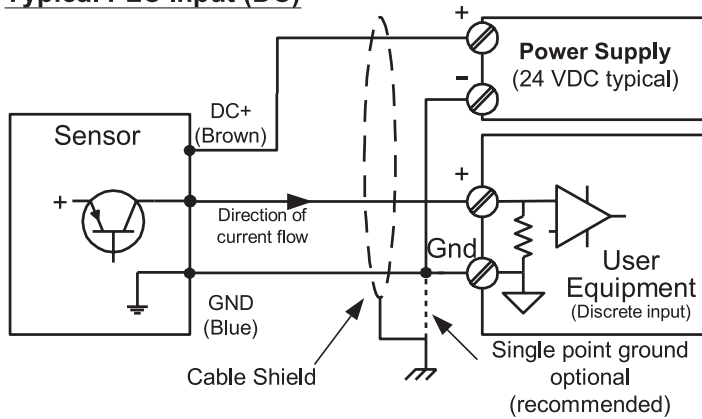
### Other Typical Uses



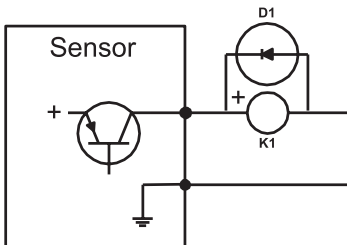
A sinking switch is an open collector transistor (solid state switch) that sinks current through an external load to GND when ON. The external device can be powered from a source different from the sensor.

## SOURCING SWITCH OUTPUT

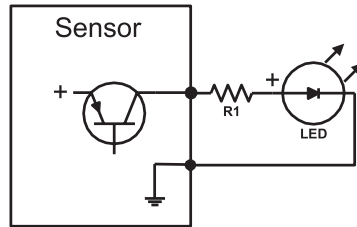
### Typical PLC Input (DC)



### Other Typical Uses (power & GND not shown)



Switch ON energizes relay coil K1 -  
when switch turns off D1  
protects transistor from inductive kick



Switch ON turns on LED.  
R1 limits LED current

A sourcing switch provides current to an external load to turn that load ON or OFF as shown above. Current is sourced by the sensor's power supply.

## SWITCH RESPONSE TIME

Switch response times are affected by measurement rate and filter selections.

## SWITCH DISPLAYS

The sensor's calculated switch output states are displayed in real time in the Ranger Software.

# SWITCH TEACH ADJUSTMENTS

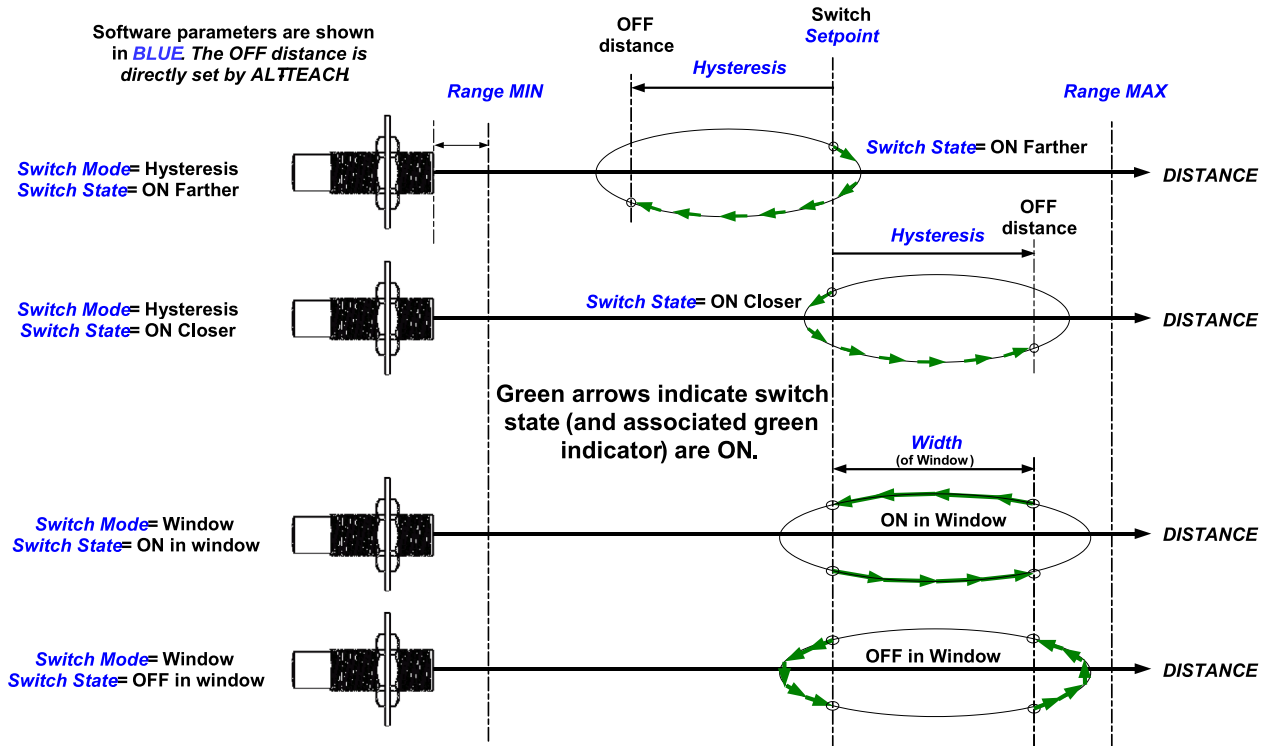
Switch adjustments can be accomplished using the TEACH button.

Each switch setpoint and polarity can be changed, and the no target delay can be turned on or off. After teach adjustments are performed the Ranger Software can be used to display and/or save the new configuration.

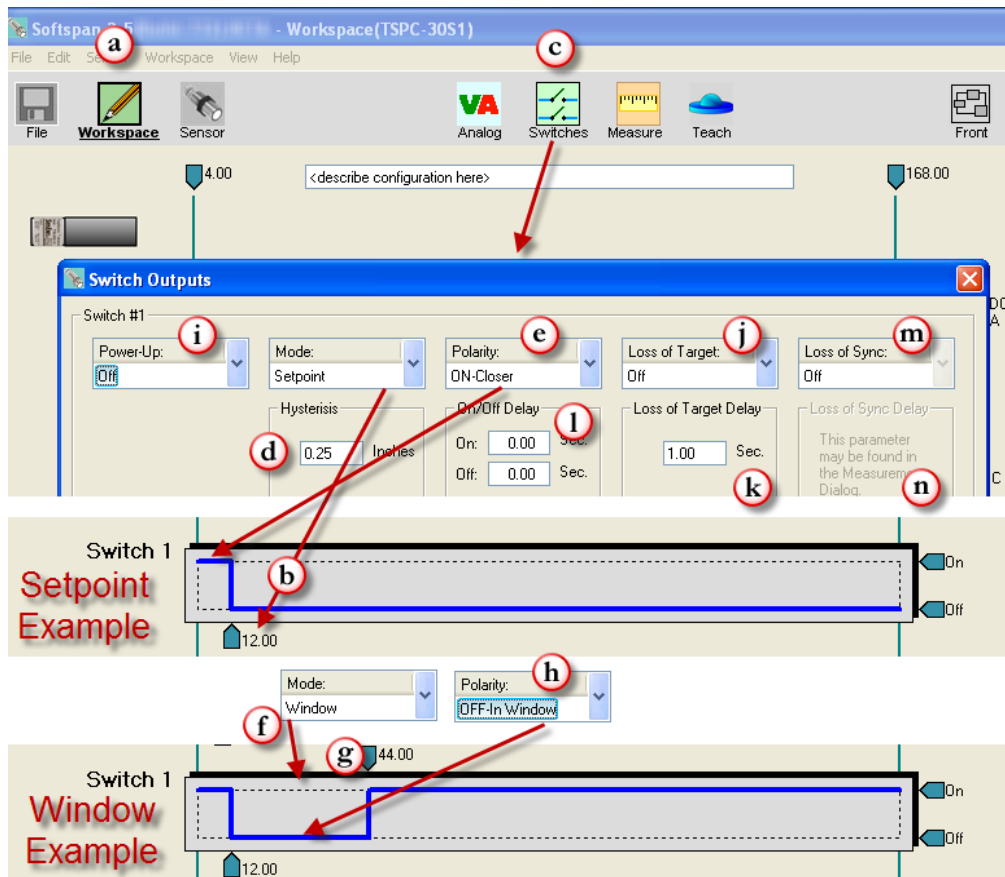
## ADJUSTABLE SWITCH FEATURES IN RANGER SOFTWARE

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 (see below)
- ON and OFF time delays for state changes
- No Target state and time delay
- Power-up state
- No SYNC states







## SOFTWARE SWITCH ADJUSTMENTS

Use Ranger Software to tailor the sensor for best results.

Switch features are shown above. The letters used below are keyed to that figure:

- a) Click the Workspace icon to edit parameters
- b) Setpoint: Click the numeric value to set the distance where the switch turns ON (the switch turns OFF by reverse hysteresis distance (d))
- c) Click the Switches icon for additional features.
- d) Hysteresis is the distance the target must move in the reverse direction of the Setpoint to turn OFF.
- e) The polarity can be either ON CLOSER or ON FARTHER than the Setpoint. This is like setting a normally open or normally closed condition. Reversing the switch polarity also reverses the hysteresis (d) direction!
- f) Window is an alternate mode where the switch state is Polarity (h) inside the window (over a range of distances) and the reverse if outside.
- g) Click these numbers to enter the window far distance.
- h) The Polarity can be either ON or OFF for targets within the window. This example shows OFF
- i) Select the switch state to set at power-on. This state exists until the first measurement process is completed.
- j) If the sensor loses the target the state can be held or set on or off (after delay k).
- k) If the sensor loses a target for this time period the no target state (j) is set.
- l) Time delays can be required before turning a switch on or off. A switch state is set if a target continuously satisfies that state's requirements for the full delay time period.
- m) If this sensor is a synchronized slave select the output state to set if the master SYNC input is missing (on, off or hold, and after time delay (n)). These selections are grayed out when the sensor is not a slave.
- n) If the sensor is a synchronized slave, a time delay can be required before engaging the No Sync response (m). This delay is set in the Measure dialog since it also affects the analog outputs.
- o) Range MIN: The closest point the sensor will measure distance.
- p) Range MAX: The farthest distance the sensor will detect a target.

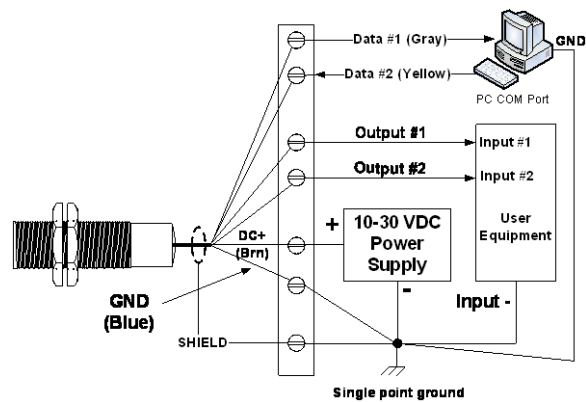
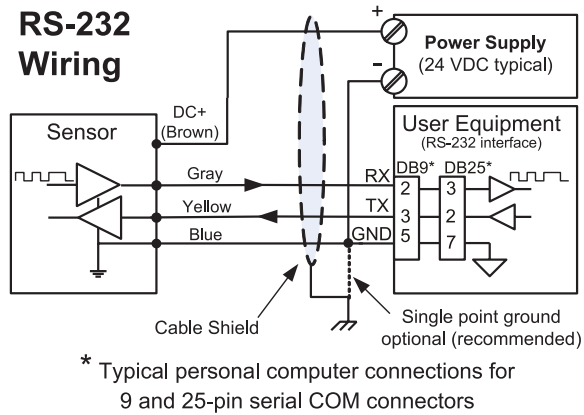
# SERIAL DATA INTERFACE

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

1. Setup – Connect to a PC running 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.

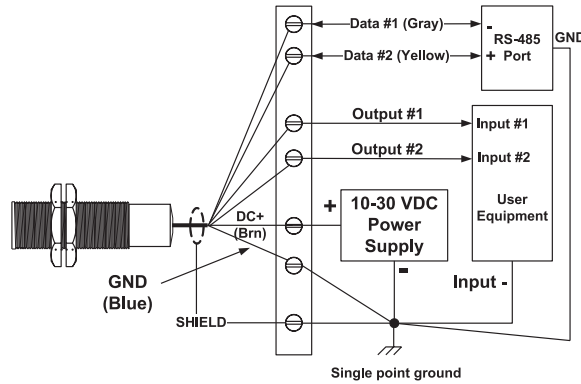
The electrical interface can be RS-232 or RS-485

## RS-232 (PC COM Port)



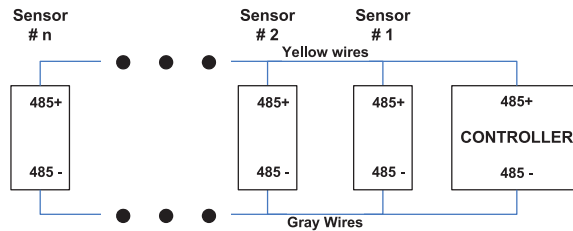
## RS-485 (Multi-Drop Addressable)

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



## Sensor Networks (RS-485)

The Ranger One™ sensors can be configured into RS-485 addressable multi-drop networks as shown below.



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-FLO-CORP) 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.

## SERIAL PARAMETERS

The default parameters are 9600 baud, no parity, one stop bit (8N1), and sensor address 1.

### Baud Rate Options

The baud rate is software adjustable to 9600, 19200, 38400, 57600 or 115200 baud. The slower 9600 baud rate is recommended for best performance over longer cables. The 115200 baud rate is only available if measurement activation is "Start on Poll". The selected baud rate is used for all protocols (Modbus, ASCII streaming and SYNC).

### Parity

The default parity is "none". Sensors with V27 firmware or later will automatically change parity to even based on the incoming packet. One packet error will occur, then the sensor will operate on even parity.

### Sensor Address

The default sensor address is 1. The address is software adjustable from 1 to 247. The Ranger Software requires a correct sensor address to establish a connection. In general, leave the address at 1 unless using the sensor in a network.

Each sensor being connected to a multi-sensor addressable network must first be assigned a unique address. Sensors with the same address will conflict and appear non-functional. Addressable multi-sensor networks are only possible with an RS-485 interface. A unique address is not required for SYNC groups, however, a SYNC group can also be an addressable network when the SYNC Master is turned off. Ranger Software includes a Group Control feature to disable the SYNC Master to allow sensor reconfiguration and/or monitoring, then re-enable the Master and resume.

### Sensor Address

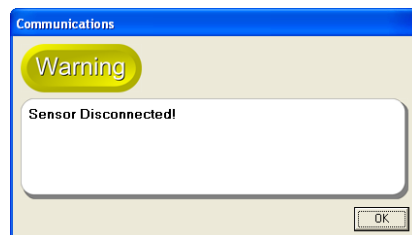
A single sensor in the factory configuration, wired to either an RS-232 or RS-485 interface, connects to the software using the default serial parameters. Serial data parameters are not affected by selecting the factory default configuration (menu: Workspace –Default Settings, or TEACH-17)

If multiple sensors are connected into an RS-485 network each must be assigned a unique network address. The baud rate and address are changed in the software as:

1. Connect to the sensor (menu: Sensor – Connect).
2. Select the communications parameter (from Communications) and see:



3. Select a different baud rate, or enter a unique address from 1 and 247, then click OK and see:



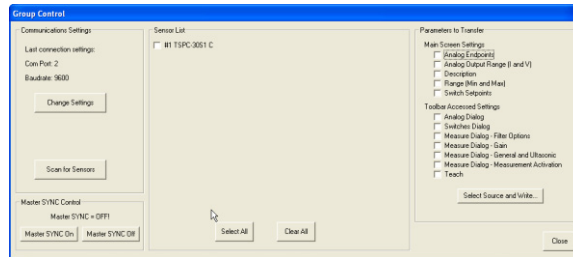
4. The sensor will now connect (menu: Sensor – Connect) only using the new parameter values.

## Network Connect

The software is fully functional when connected to a single sensor on an RS-485 network (menu: Sensor – Connect). Simply enter the correct baud rate and network address to establish the connection.

## Group Control

The software can update selected parameters quickly to a group of RS-485 connected sensors using menu: Sensor – Group Control. When Master Synch is turned OFF (lower left), the group is scanned and a list of connected sensors produced. Selected parameters can then be written to selected sensors. First, enter the parameter values to transfer into the Workspace, disconnect the current sensor, and then select menu: Sensor – Group Control to produce the following control dialog:



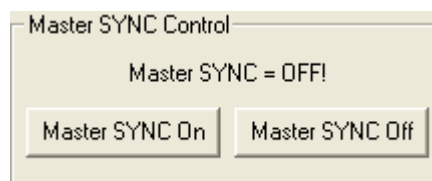
Click Scan to initiate a sensor search of all network addresses. Master Synch must be OFF to search. Use the buttons in the lower left of the dialog to control the Master Synch. Up to 32 found sensors will be listed in the center display area with (a) a check box, (b) the model number and (c) the activation mode (C=continuous, P=start on poll, Mx=master x phases, Sx=slave phase X). The check boxes can be individually selected, all checked using Select All, or all cleared using Clear All. The “Parameters to Transfer” section on the right side lists parameter collections that can be selected for upload to all checked sensors. Check the desired collection(s) then click Write to begin the batch transfer.

Group operations require the software to operate as the bus Master. Any other bus master must first be disabled or disconnected.

## SYNC Group

Regardless of the model, when sensors are connected in a SYNC group the communications interface operates as RS-485. With an RS-485 connection, the Ranger Software can communicate with the sensors using Group Control (above).

In a SYNC group one sensor operates as a master control. The master must be shut down before the software can take control. The Ranger Software will automatically detect an active SYNC master and provides the following indication and controls:



If a Master is detected, click “Master SYNC off” then confirm the status as “No Active Master!” to enable the Group Control features. When finished, click “Master SYNC On” to restore SYNC operation.

## SERIAL DATA PROTOCOLS

The Ranger One™ sensors offer these protocol options:

1. Modbus Slave – This default protocol is used by the software and supports sensor communications by address, typically in RS-485 networks.
2. ASCII Streaming – A simpler continuous ASCII protocol for one-way transmission of data to external devices.
3. SYNC – SYNC master and slave sensors use the serial interface for synchronization.

### Modbus Protocol

The sensors and software use the industry standard Modbus protocol for all serial data bus communications except SYNC. Other user controllers can use this interface to obtain distance measurements or control sensor parameters.

## OPERATION

### Power Up

The following occurs within 1200 ms of power ON:

- Target indicator set to RED
- Outputs and their status indicators set to their power-up states (software selected)
- Sensor begins first measurement or becomes available for slave or start-on-poll activation
- The analog and switch outputs are set, and distance data becomes available, after completing the first measurement process all sensor outputs and status indicators remain in their power-up conditions until the first measurement process has completed.

## MEASUREMENT ACTIVATION

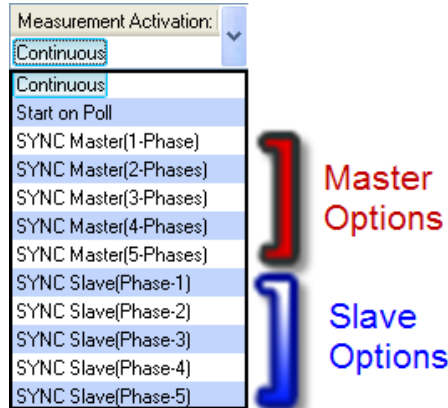
Sensor measurements can be activated in four ways – continuous, start-on-poll, master and slave. The factory default and most common is continuous. The activation options are set using the software by clicking the Measure icon then using the Measurement Activation selector. Master, slave and continuous activation selections are also TEACH selectable in certain models except in start-on-poll mode.

Sensor features affected by the activation mode are summarized in Table 3 below.

Measurement Activation Mode Selected	When the Measurement Starts	Features Allowed						When the Analog and Switch outputs are updated	Serial Data Bus (RS-232 or RS-485)
		TEACH	Filters						
			X of Y	Closer of M	Farther of M	Averaging	Rate of change		
<b>Continuous</b> <i>(factory default)</i>	Repetitively at the <i>measurement interval</i>							After each measurement or <i>measurement process</i>	Last <i>measurement process</i> distance sent in response to distance poll
<b>Start on Poll</b>	Distance poll received (& current <i>measurement process</i> finishes)							After the measurement or <i>measurement process</i> triggered by the distance poll	Last <i>measurement process</i> distance sent in response to distance poll
<b>SYNC Master</b>	Repetitively at the [ <i>measurement interval</i> * <i>SYNC phases</i> ]							After each measurement	Sends SYNC commands (distance not sent)
<b>SYNC Slave</b>	Upon receiving a master SYNC command.								Receives SYNC commands (distance not sent)

## Activation Selection

Click the Measure icon in the software then locate the following Measurement Activation drop down menu:



## Continuous Activation

This is the factory default. Measurements repeat continuously at the measurement interval. The analog and switch outputs are updated, and the distance data is stored, at the end of each measurement process. At any time a serial data controller can retrieve the last stored distance data by issuing a serial data read poll without effecting ongoing measurements.

Continuous mode is generally used unless:

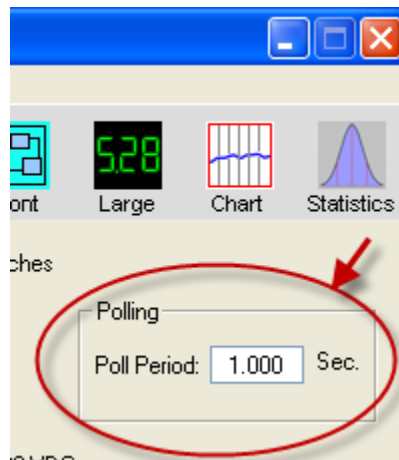
- There is an advantage to having the sensors measure only on request (see Start on Poll)
- Multiple sensors are connected in a synchronized group (see SYNC modes)

The software will detect this mode when the Sensor icon is clicked, then repeatedly issue read polls to display the distance measurements.

## Start on Poll Activation

Measurement begins when the sensor receives a serial data distance read poll from an external controller (or software). Upon completing the measurement process the analog and switch outputs are updated, the distance measurement stored, and the sensor stops measuring. The data retrieved by the poll is that of the prior distance measurement.

The Ranger software detects start-on-poll mode when the Sensor icon is clicked, and displays polling controls in the upper right corner of the screen.



## SYNC Master and Slave Activation

Synchronization (SYNC) is an interconnection of one Master sensor and one or more Slave sensors in a group, often used to prevent sensor crosstalk in close setups. Using the Measurement Activation drop down menu, configure one master to the desired number of SYNC phases, and each slave sensor to its required phase. The master's serial data interface is used only to control slave sensor timing and no distance data is transmitted or available to Ranger software. Sensor analog and switch outputs continue normally in SYNC mode, including from the master. Hints & Recommendations:

Setup and test each sensor in the software before selecting SYNC and connecting it to the SYNC group.

- After setting SYNC activation, RS-232 models lose communications with the software PC because the serial interface changes to RS-485. To restore communications disconnect the sensor from the SYNC group, use TEACH 15 to turn SYNC off, and reconnect to the PC.
- With an RS-485 PC connection, the Ranger software can communicate with an operating SYNC group using the Sensor – Group Control menu selections. To allow this ability each sensor in the group must be assigned a unique network address (Sensor – Communications menu) before connecting it to the SYNC group.

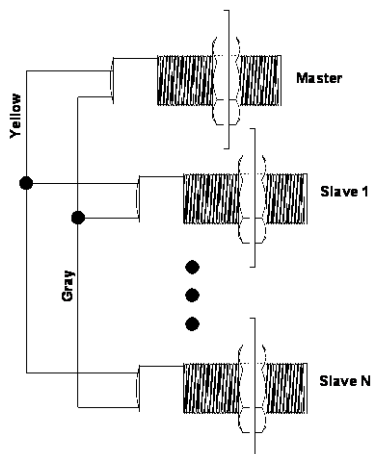
## SYNCHRONIZATION

Groups of 2 to 32 sensors can be connected together and time synchronized for these purposes:

- Prevent sensors in close proximity from interfering with one another (“cross-talk”)
- Enable a group of sensors to measure a common target(s) at the highest possible rate

The symptom of sensor interference is an output (analog or switch) jumping intermittently but usually somewhat periodically to a value or state representing a target closer to the sensor than the actual target. This symptom may disappear or be less severe when filters are used. If interference is suspected, turn power off to all but one sensor to determine if the powered sensor's output stabilizes (keep filters off).

A SYNC group is created by connecting together all yellow wires of all sensors, then all gray wires of all sensors, as shown below (the power, analog and/or switches are wired as required for the application). One (and ONLY one) sensor is then defined as Master and all others as Slaves.



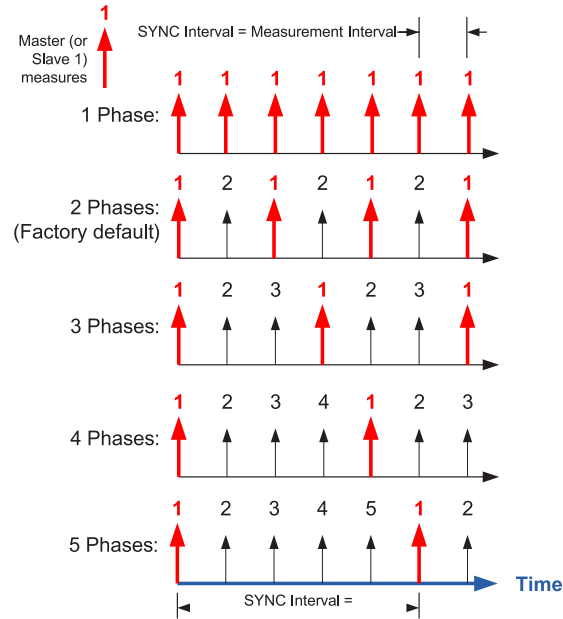
Master and slave assignments can be set in advance in the software Measure dialog, or after they are wired using the TEACH pushbutton. The software must be used to (a) set a master to generate 1, 3, 4 or 5 SYNC phases (the default is 2), or (b) to set a slave to phase 3, 4 or 5 (see following).

Master sensors cannot communicate with the software until Group Control or TEACH 13, 14 or 15 turns off the master. However, analog and switch outputs remain active on all sensors in SYNC mode grouping. Group Control is found in the software under the Sensor pull-down menu.



Master measurements repeat continuously at the sync interval which is the sync phases x measurement interval (see figure below). Slave measurements are similarly affected but offset in time according to their phase assignment (1 through 5). The sync interval increases as the number of sync phases increases, therefore slowing the measurement process timing for all sensors in the group.

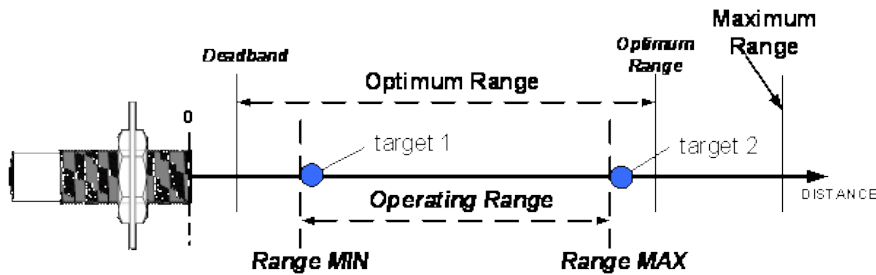
With a master in 1-Phase and slaves in slave phase 1 all sensors operate simultaneously as shown in 1 phase below. When the master is in 2 through 5 phases, each slave must be set for phase 2, 3, 4, or 5. Do not set a slave phase higher than the number of phases of the master or it will not operate.



The SYNC connections use the sensor's serial data interface to control sensor timing and serial distance data is not available.

SYNC and serial data communications cannot occur simultaneously. Removing the master re-enables communications. If the master input is missing the slave sensors stop measuring, begin flashing the target indicator redgreen as a warning, and after the no sync delay time set analog outputs to their no sync values and switch outputs to their no sync states. These conditions reverse when SYNC is reestablished.

## OPERATING RANGE



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

### Range Min

The Range MIN (also called Deadband) is the closest distance that the sensor will report an accurate distance (see Specifications). Targets closer than Range MIN may be detected, especially at close range, but the measured distance will be Range MIN (or greater for secondary echoes). If the near distance is important keep the target 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. If a target is not detected closer than Range MAX a “No Target” condition exists.

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

The “No Target” controls can be an important and useful tool to control system response by limiting the distance the sensor will consider a target valid.

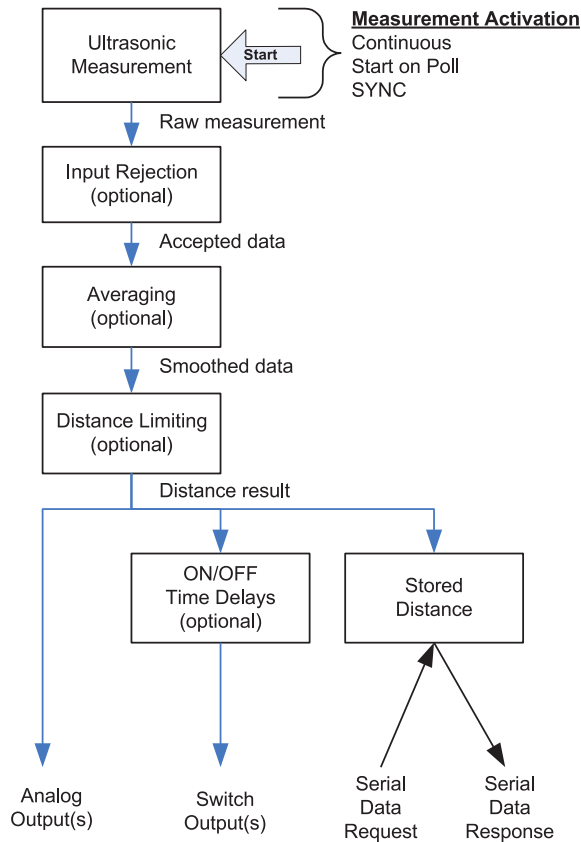
### Factory Defaults

The factory default range values are:

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

## MEASUREMENT PROCESS

The measurement process includes the raw distance measurement, followed by one or more filter options, then any switch time delays before the result is reflected in the sensor outputs.



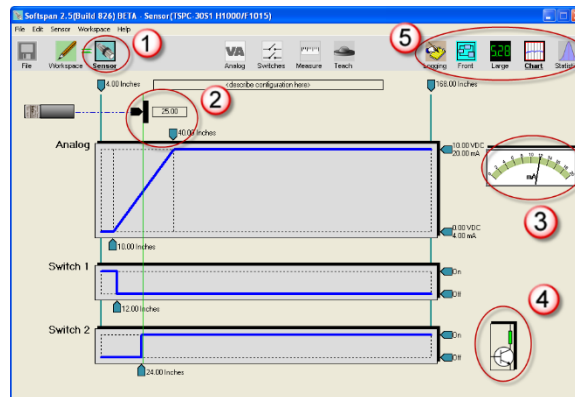
In Start on Poll activation the entire process is performed once per poll, i.e., M Input Rejection x N Averaging measurements. Some filters are disallowed in Start on Poll. If a poll is received before an ongoing measurement process finishes, the ongoing process will run to completion then another measurement process will begin. Switch time delays can be set to implement special control functions. The most recent distance result can also be requested by an external controller over the serial data bus.

## SENSOR VIEWING

When connected to a sensor (Sensor icon clicked), distance measurements are viewed in the Ranger Software in several ways. The software obtains the measurements via serial data interface requests in the continuous or start-on-poll mode. The values or states of the selected output(s) are also displayed (sensors operating in SYNC modes cannot be viewed).

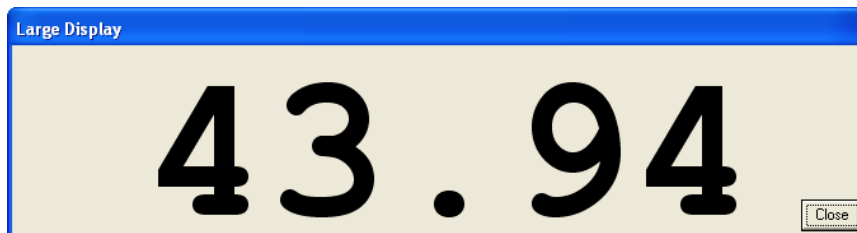
### Sensor screen

Connect the Ranger Software to the sensor (menu: Sensor – Connect). The software automatically selects the Sensor icon 1, displays the distance in real-time with a repositioning target symbol 2, shows analog output value(s) on meters 3 and shows switch state(s) as symbols 4. Additional display icons 5 offer features described below.



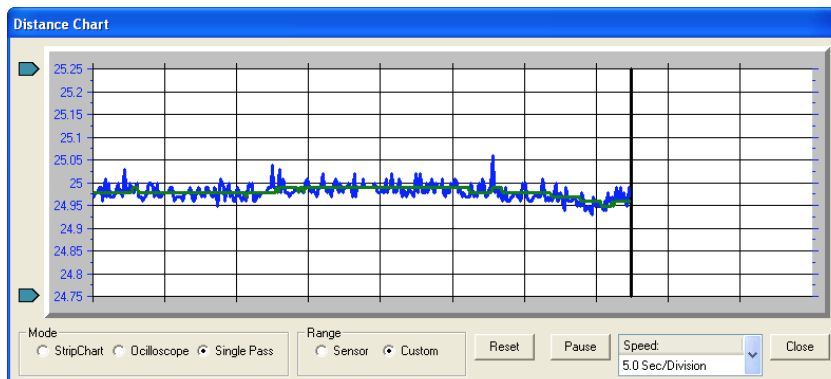
### Large Display

Click the Large icon to pop up a large digital display that can be viewed from afar.



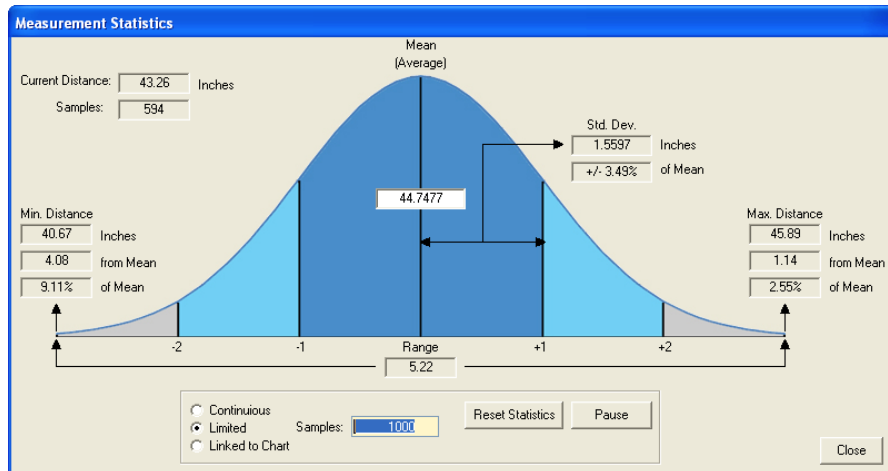
### Strip Chart

Click the Chart icon to view data in strip chart format. Both filtered and unfiltered data are displayed.



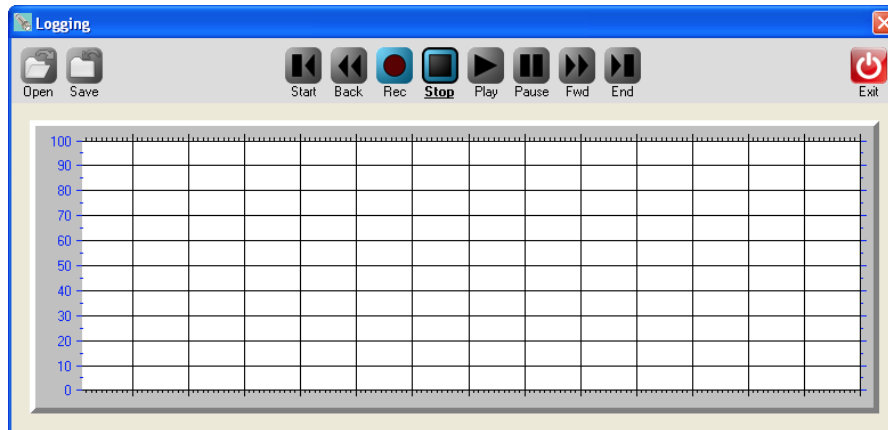
## Statistics

Click the Statistics icon to view statistics calculations.



## Data logging

Click the Logging icon to record data to disk for view or export to Excel.



## MEASUREMENT RATE

The measurement rate is how often the sensor measures the target distance. It does not require adjustment in most applications. Default rate is:

- 20 Hz (50 ms measurement interval)

To accommodate special requirements the rate can be adjusted from .0001 to 200 meas./sec (measurement intervals from 2.78 hours to 5 ms) using the software. Rate selections are also available using TEACH 24 through 28

TEACH-17 restores the default rate.

*Note: Sensor current consumption increases significantly at the smallest measurement intervals (fastest cycling).*

SYNC activation directly reduces the measurement rate by the number of master SYNC phases. For example, a the sensor (20 Hz default rate) set for 3 SYNC phases has the measurement rate reduced to 6.66/sec (20 divided by 3).

### Maximum Target Distance Effects

The time required to detect a target is affected by the speed of sound in air. Sound travels at about 1 ms/ft. (3.3 ms/meter) so a target at 10 feet (3m) results in an echo delay of about 20 ms (the sound has to travel out then back). If the measurement interval is less than that time the target echo will go undetected, or may be detected in the next cycle, causing erratic measurements.

The maximum distance a sensor can detect a target is the shorter of (a) the sensor model's maximum range, (b) the user-adjustable RangeMAX parameter, or (c) the farthest distance a target echo can return before the next measurement begins (measurement rate limited). Setting the measurement interval faster than the default may restrict the maximum detectable target distance (see below table).

Measurements per second	Measurement Interval ms	Approximate Max Range in. (cm)
5	200	1080 (2743)
10	100	540 (1372)
20	50	288 (732)
40	25	144 (366)
100	10	54(137)
200	5	24 (61)

### Measurement Stability Effects

If the measurement rate is set too fast the sensor may detect delayed echoes from a prior measurement cycle, causing measurement instability. This is more common at short distances but can also occur in large liquid tanks.

A delayed echo can be a more distant target or a multi-bounce echo from the primary target (echoes can bounce back and forth between two surfaces). This effect is also more prevalent at cold temperatures because sound absorption in cold air is lower and it takes longer for the echoes to decay.

Multi-echo issues are minimized by slowing the measurement rate, reducing the sensitivity, and/or using materials to absorb or deflect the ultrasound.

## OUTPUT RESPONSE TIME

The default response time for all outputs is the measurement interval. The analog, switch and serial ASCII streaming (if enabled) outputs are updated after each measurement cycle (serial data is not available in SYNC operation). The response time is affected by several sensor user-adjustable features using Ranger Software:

1. The measurement rate can be used to directly increase or decrease response time.
2. Filters can be selected to process measurements for improved stability. Some filters update outputs after each measurement interval while others require several intervals. Filters can decrease response time.
3. Time Delays can be used to create system responses that might otherwise require external controllers or time delay relays. They directly delay the response of the output(s) to which they are applied.
4. For SYNC master and slaves the Sync interval increases as a multiple of the measurement interval times the number of sync phases.

*The factory default settings are all filters off and all time delays set to 0. When testing a new application keep filters and time delays off for best visibility of measurement stability!*

## FILTERS

Filters are processing features that reject and/or smooth measurements, and/or limit the rate of change of the sensor distance (and therefore outputs). Their purpose is to improve sensor performance in real-world applications. The factory default is all filters OFF, where the sensor outputs are set immediately in response to each measurement (not including any switch time delays).

*Keep filters off during setup to understand measurement stability, then enable filters as required for the application.*

### Overview

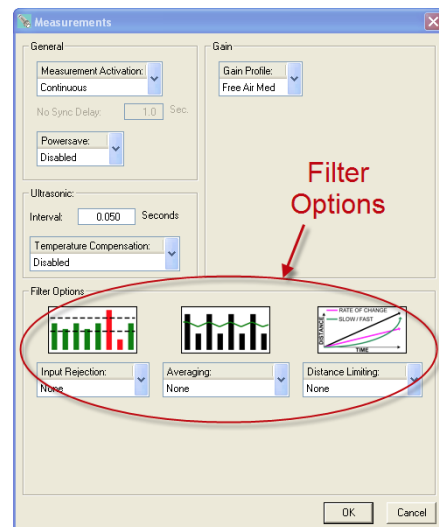
The figure below shows the flow of distance measurements through the filters to the outputs. Filters are applied in order of flow from left to right (input to output). None or one selection can be made from each category (Input Rejection, Averaging and Distance Limiting). As filters are enabled the output response time is generally slower. Some filter settings are not usable in applications requiring a fast response time.

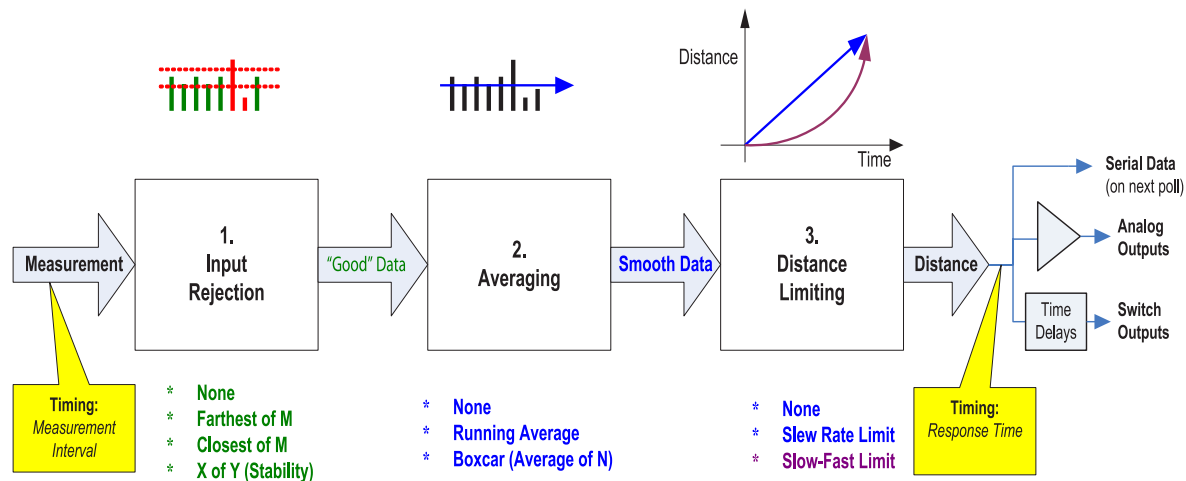
### Filter Selection

Click the Measure icon on the main screen to open the Measurements dialog. The location of the Filter Options is shown below.

All filters are turned off when the sensor is unlocked (TEACH mode)

When using filters, the first valid measurement after power ON becomes the initial condition for all further processing. The Filter Options are shown in block diagram below, followed by a description of each.





### Input Rejection Filters

Input rejection filtering precedes any averaging filtering. Input rejection filters ignore some measurements. The input to these filters is the raw sensor distance measurement. The output (“Good” data) is then input to an averaging filter (if used).

#### Closest of M Measurements

The sensor performs M distance measurements and rejects all except the closest. The number of samples (M) can be set to any value from 2 to 999. The response time is slowed by a factor of M. For example, if M=3 and the measurement interval is 50 ms the response time is 150 ms (not including any successive filters or switch time delays).

This filter is useful for applications where the desired result is the closest object detected in a given period of time. Examples include detecting the peak value of material flowing on a conveyor, or maintaining a measurement value of a poor target (weak or intermittent echo).

#### Farthest of M Measurements

The sensor performs M distance measurements and rejects all except the farthest. It is otherwise identical to the Closest of M filter described above.

This filter is useful to ignore an unintended or unwanted target that occasionally passes between the sensor and the intended target. Examples include ignoring mixer blades in tanks, ignoring traversing objects not the intended target, or rejecting sporadic interference (electrical, physical or acoustic).

#### X of Y Filter (Stability)

At least X measurements of the previous Y must be within +/- 6.25% of the latest measurement. All measurements are ignored until this condition is satisfied, i.e., the target must remain stable before the sensor will process it. If the target remains unstable a new distance measurement will never be established.

Instability is different from the “no target” condition (red target indicator). A perfectly detected target (green) may be in motion and thereby unstable.

The degree of stability required is user adjustable by changing the values of X and Y. The range of values for X is 1 to 7 and for Y is 2 to 7.



As long as each new measurement X falls within bounds the sensor response time is unaffected and the latest X is available for output (excluding averaging and switch time delays used). If the input data fall out of bounds then a delay will occur before the filter criteria can again be satisfied. The delay for a re-stabilized target could range from 1 to X measurement intervals depending on the history of the prior Y measurements.

This filter is disallowed when using Start on Poll measurement activation.

### **Averaging Filters**

The averaging filters receive their distance data from the input rejection filters. The averaging filter response time is therefore affected by the rejection filter selections. If an unstable target is detected by the stability filter (x of y), the averaging filter and subsequent processing are suspended at the current distance until stability returns. The distance output of the averaging filters is rate-of-change restricted by a distance restriction filter (if used).

### **Boxcar Average**

This filter calculates the average of N inputs (N = 2 to 255) passing through the rejection filter. The process is repeated every N inputs. The response time is therefore slowed by a factor of N. For example, if M=3 for a rejection filter and N=10 for the Boxcar average then the update period at a 50 ms measurement interval is  $50 \times 3 \times 10 = 1500$  ms.

### **Running Average**

This filter calculates the average of N inputs (N = 2 to 255) passing through the rejection filter. The average is updated after each input rather than after N inputs as for the boxcar average. The output response of this filter is therefore smoother than the boxcar filter since the output is updated more frequently.

This filter is disallowed when using Start on Poll measurement activation.

### **Distance Limiting Filters**

The distance limiting filters clamp the rate of change of measured distance before setting sensor outputs. These filters limit the rate of change of data received from the input rejection and/or averaging filters (figure 28). The limited distance then drives the sensor outputs (not including switch time delays).

### **Rate of Change**

A maximum rate of change of distance ( $\Delta D/\text{sec}$ ) is limited to a maximum value, whether increasing or decreasing. The maximum value is a user-entered parameter with a range of .003 in./sec to 173 in./sec.

An example use of this filter is limiting the rate of change allowed when driving a motor or other mechanical system.

### **Slow-Fast**

In Slow-Fast, if the target position changes quickly, the sensor assumes it is a false change but starts to recalculate slowly toward the new position. If the new position remains stable the sensor gradually increases the rate of change of measurement toward the new position until it is reached.

TEACH-6 can be used to toggle this filter on and off, and the filter can be set OFF by TEACH-17.

When turned on using TEACH-6 the filter does not operate until TEACH mode is ended!

This filter is disallowed when using Start on Poll measurement activation.

This filter is used for targets that change position slowly but have occasional interruptions. Examples:

- Measuring a roll diameter - holds a stable roll measurement yet readjusts the measurement in a reasonable time during changeovers
- Mixer tanks - Ignores rotating mixer blades that pass occasionally between the sensor and liquid.
- Ignore unintended targets passing between the sensor and the intended target, such as a traversing mechanism on a printer ink well.

## TIME DELAYS

Time Delays are used to cause actions that might otherwise require external controllers or time delay relays. They delay the response of the output(s) to which they are applied, and are useful for control and alarm functions. All time delays are adjustable between 0 ms to 5.46 minutes at a 5 ms resolution.

### Switch Time Delays

Each switch has 3 independently adjustable delays:

- On Delay
- Off Delay
- No-Target Delay

A time delay begins when the condition that triggers it first occurs (a distance measurement that could turn a switch ON or OFF, or no target). Time delays are re-triggered, i.e., the trigger condition must remain active for the full time delay period or the time delay will be reset to zero. If the trigger condition remains for the full time delay period then the corresponding action takes place (switch turns on or off).

Examples uses include:

- Set an alarm if the sensor loses the target for an excessive time period, or material stops flowing on a conveyor (jam condition)
- Force a switch state for a minimum time to assure correct operation of other equipment

### Analog “No Target” Time Delay

Analog outputs can be set to their high value, low value or not change if no target is detected. The current loop and voltage have independent selections.

A time delay begins when the no target condition first occurs. The time delay can be re-triggered, i.e., no target must exist for the full time delay period or the time delay will be reset to zero. If the no target condition remains for the full time delay period then the analog outputs are set to their no target values.

Example uses include:

- Force a system shutdown on loss of a target
- Controller detection of no target by setting the output value outside the normal range

### No SYNC Time Delay

Under SYNC Slave activation the slave sensor measurement is triggered by a master input. If that input is missing for a period exceeding the No SYNC Time Delay the switches and analogs are set to their “No SYNC” states and values respectively.

## TEMPERATURE COMPENSATION

At room temperatures, a change of 10 degrees will result in approximately 1% change in the speed of sound and therefore the measured distance. Temperature compensation can be enabled to reduce the impact of temperature changes in some applications. This can be accomplished under the Software >Measure > Temperature Compensation selector, or by using TEACH 32/33. The default is DISABLED.

Ranger Two™ sensors have an internal temperature sensor. In applications where the sensor is continually powered a warm-up period of approximately 30 minutes should be allowed before calibrating. Best performance is obtained when the sensor body tracks the surrounding air temperature.

The sensor must be protected from the sun or other forms of radiant or conducted heating. The sensor will not compensate for rapid temperature changes or for temperature variations between the sensor and target.

Temperature compensation is less important if the temperature environment in which the sensor is used remains fairly constant.

### Precautions

- Keep unintended targets from the transducer's field of view. The beam pattern is slightly conical and spreads with distance.
- 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 suffer.

# RANGER TWO™ COMMUNICATION SOFTWARE

The Ranger Two™ software allows you to select and calibrate sensor outputs; modify sensor features (parameters); view, analyze and/or log measurements for performance evaluation; and save Setups to disk for later recall and application cloning.

## Installation

The Ranger Software runs on a Windows PC and connects to a Ranger Two™ sensor via a serial data COM port or, with suitable adapter, via a USB port.

Insert the CDROM (see pageError! Bookmark not defined.). Run setup.exe and follow the directions.

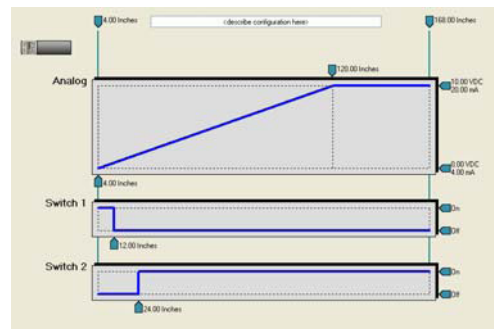
## Application Setup

A setup is a particular combination of sensor parameters that you establish for an application. Setups can be created or changed in the software workspace, or moved in/out of the workspace from/to the sensor or file as shown below:



## Main Screen

Setup parameters are viewed on the main screen

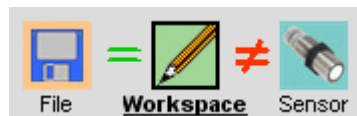


Or in pop-up dialogs by clicking one of these icons:



## Main Screen View

The main screen displays a setup of (a) an attached sensor, (b) a file stored on the computer disk, or (c) the workspace, as selected by these icons:



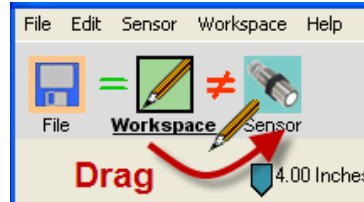
In this example the Workspace is displaying on the main screen (icon is outlined, with bold underlined title), and the workspace matches the file but not the attached sensor.

If the File icon is grayed out, clicking it will open a window to select a file from the computer disk. If the Sensor icon is grayed out, clicking it will open a Sensor Connect dialog to connect a sensor.

## Moving a Setup

Setups can be moved between the Workspace and a disk file, or between the Workspace and a sensor. Movement is accomplished in three ways:

1. Using Icons - use the mouse to either (a) right- drag or (b) shift-left-drag the Workspace icon to either the File or Sensor icon, or vice versa. All movement must be in or out of the workspace. For example, to move the workspace to the sensor drag the Workspace icon as shown below:



2. Using Menu selections:

File – Read File to Workspace

File – Write Workspace to File

Sensor – Move Sensor to Workspace

Sensor – Move Workspace to Sensor

3. When connecting a Sensor – When using menu Sensor – The software asks if you want the setup copied to the workspace – click Yes to copy it.

## Creating a Setup

Setups are created or modified in the workspace. There are 3 ways to create a new Setup:

1. Start with a Factory Default – Click Workspace icon, then select menu: Workspace – Default Settings. Select TSPC-XXXX Settings. Select the model of the sensor you intend to use with the new setup. When a sensor is connected, only the correct factory default can be selected.
2. Start with a Sensor – Move a setup from a connected sensor into the workspace.
3. Start with a File – Move a previously stored disk file into the workspace.

After loading the workspace the parameters can be modified, then moved to a file or sensor. If the setup is not moved it is lost when exiting the software.

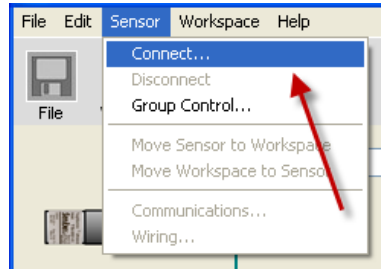
## Saving a Setup

Make the workspace changes you want to test, saving them to the sensor as often as needed until the sensor is operating as needed. When finished, save the workspace to a disk file for future reference or cloning (see Moving a Setup). Use a meaningful filename when saving. You are given opportunity to enter notes during the save operation. Notes are saved with the file and NOT loaded into the sensor with the setup later.

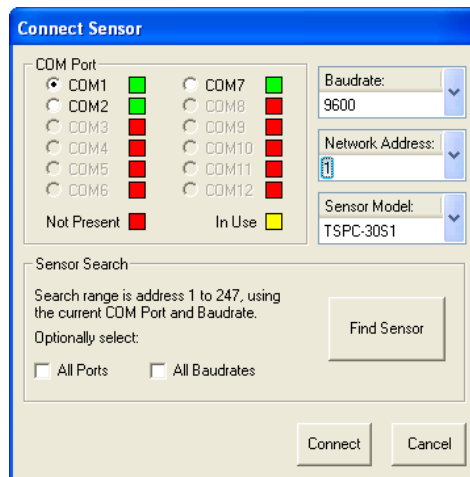
## CONNECTING A SENSOR

The Ranger Two™ Software requires both a physical and logical sensor-to-PC connection. Physical options include a direct 9-pin COM port connection or USB-to-COM adapter

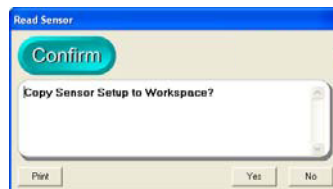
1. Install a cable between the sensor and COM port. Use the cable included with the software kit or wire it yourself.
2. Apply sensor power
3. Logical Connection: Connect the Ranger software to the sensor using menu selections Sensor – Connect.



4. The Connect Sensor dialog then appears with either the default values or your previous selections. Make any changes then click Connect:

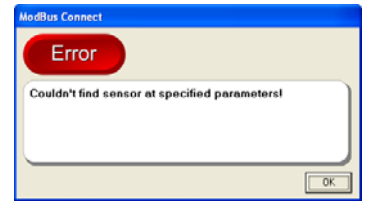


5. This message confirms a software-to-sensor link:

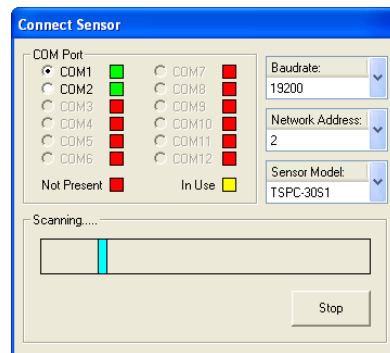


Move the parameters to the Workspace to (a) change them or (b) save them to disk. You can also move them later. If you intend to copy an existing Workspace to the sensor (cloning this sensor) then click No. The software then connects to the sensor (Sensor icon automatically selected) and offers sensor viewing.

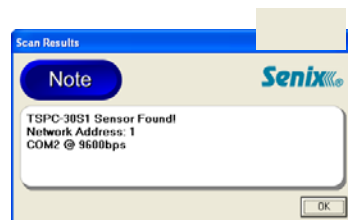
6. check the (a) wiring, (b) power and (c) interface selections. Check All Ports and use Find Sensor to scan all sensor addresses at each of 12 ports. Change the port range by clicking Edit >User Preferences... and changing Starting Com Port to a higher value. The Ranger Software will identify the first Sensor Model found with the chosen network address on a port. The default address is 1.



7. If the above error continues, use Find Sensor to scan all sensor interface combinations. The default is address is 1. Check the "All Ports" and/or "All Baud Rates" boxes if you are unsure of those. The software will identify the first Sensor Model found, starting at address 1 through 247. The window will appear as follows as the software searches for a sensor:



8. When a sensor is found this message appears:



Click OK and the Connect Sensor dialog is redrawn with the correct parameters (step 4).

**TROUBLE SHOOTING: Cannot find the sensor - Check the following:**

- Is the power ON?
- Check the wiring connections

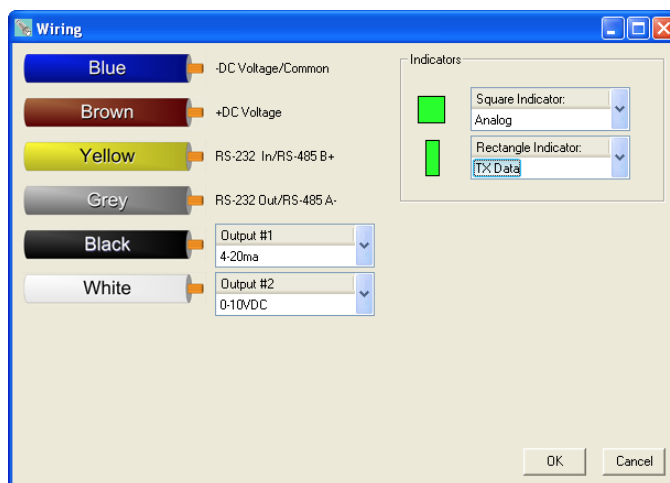
## OUTPUTS

Ranger Two™ sensors are factory configured with the voltage and current loop outputs selected. Other selections are possible.

After connecting a sensor, click this icon to select or reconfigure the outputs and indicators.

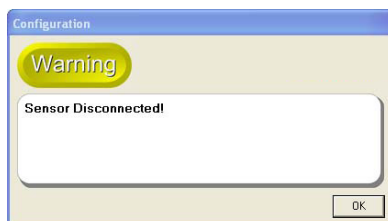


The factory default outputs are 4-20 mA current loop (black wire) and 0-10 VDC (White wire), and the square indicator displays analog status and the rectangular serial data TX.



Make output changes before connecting your equipment. Do not change outputs when connected to operating equipment!

If wiring changes are made and the OK button clicked, the changes are made and the sensor automatically disconnects from the software:



Reconnect software to the sensor and resume with new outputs.



## Analog Dialog

To modify analog output features not available on the Main Screen, click this icon to display the Analog dialog.



The Analog Outputs dialog box has a blue title bar with the text 'Analog Outputs' and a close button. It contains several dropdown menus and a text box. The 'Power-Up Voltage' dropdown is set to 'Voltage Low Value'. The 'No Sync Voltage' dropdown is set to 'Hold'. The 'Power-Up Current' dropdown is set to 'Current Low Value'. The 'No Sync Current' dropdown is set to 'Hold'. The 'No Target Voltage' dropdown is set to 'Hold'. The 'No Target Current' dropdown is set to 'Hold'. The 'No Target Delay' field is set to '0.0' with 'Sec.' to its right. There is an 'OK' button and a 'Cancel' button. A text box on the right side contains the text: 'No Sync Delay. This parameter is shared with the Switch outputs and is located in the Measurements dialog.'

## Switch Dialog

To modify switch output features not available on the Main Screen, click this icon to display the Switch dialog.



The Switch Outputs dialog box has a blue title bar with the text 'Switch Outputs' and a close button. It is divided into two sections: 'Switch #1' and 'Switch #2'. Each section has a 'Power-Up' dropdown (set to 'Off'), a 'Mode' dropdown (set to 'Setpoint'), a 'Polarity' dropdown (set to 'ON-Closer' for Switch #1 and 'ON-Farther' for Switch #2), a 'No Target' dropdown (set to 'Off'), and a 'No Sync' dropdown (set to 'Hold'). There is a 'Hysteresis' field set to '0.25' with 'Inches' to its right. There is an 'On/Off Delay' section with 'On' and 'Off' fields, both set to '0.00' with 'Sec.' to their right. There is a 'No Target Delay' field set to '1.00' with 'Sec.' to its right. A text box on the right side of each section contains the text: 'No Sync Delay. This parameter is shared with the Switch outputs and is located in the Measurements dialog.' There are 'Cancel' and 'OK' buttons at the bottom right.

## Measure Dialog

To modify measurement parameters not available on the Main Screen, click this icon to display the Measure dialog.



The Measurements dialog box has a blue title bar with the text 'Measurements' and a close button. It is divided into several sections. The 'General' section has a 'Measurement Activation' dropdown (set to 'Continuous'), a 'No Sync Delay' field (set to '0.5' with 'Sec.' to its right), a 'Power Save' dropdown (set to 'Disabled'), an 'Interval' field (set to '0.100' with 'Seconds' to its right), and a 'Temperature Compensation' dropdown (set to 'Disabled'). The 'Sensitivity' section has a 'Gain Profile' dropdown (set to 'Free Air Med'). The 'Filter Options' section has three small graphs: a bar chart, a line graph, and a line graph with a shaded area. Below the graphs are three dropdown menus: 'Input Rejection' (set to 'None'), 'Averaging' (set to 'None'), and 'Distance Limiting' (set to 'None'). There are 'OK' and 'Cancel' buttons at the bottom right.

## TEACH Enable / Disable

Once connected to the Ranger Software, the TEACH button will be displayed.

The button can be disabled for security so that changes cannot be made at the sensor.



To disable the sensor's TEACH button, click this icon. The left version of the icon shows TEACH enabled and the right version disabled. The button is disabled only after the configuration is moved to the sensor!

## SENSOR ADJUSTMENT

Sensor setups are made in the workspace then transferred to the sensor. The screen shot below shows the screen with the Workspace icon selected.

(a) Setups can be moved between the Workspace and a disk file or sensor



**Setup changes do not take effect until moved to the sensor! Remember to save setups to disk for future recall.**

(b) Click one of these ICONS for extended features associated with the analog outputs, switch outputs or measurements.

(c) Enter up to 32 characters to describe a setup. This reminder text is stored in the sensor or disk file when the parameters are moved or saved.

(d) Click the distance text to edit the Operating Range. Range MIN is the left parameter and Range MAX the right, e.g., clicking the 4.00 inch (left) value yields:

Range MIN:	<input type="text" value="4.00"/>
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Enter a new value then type <Enter>.

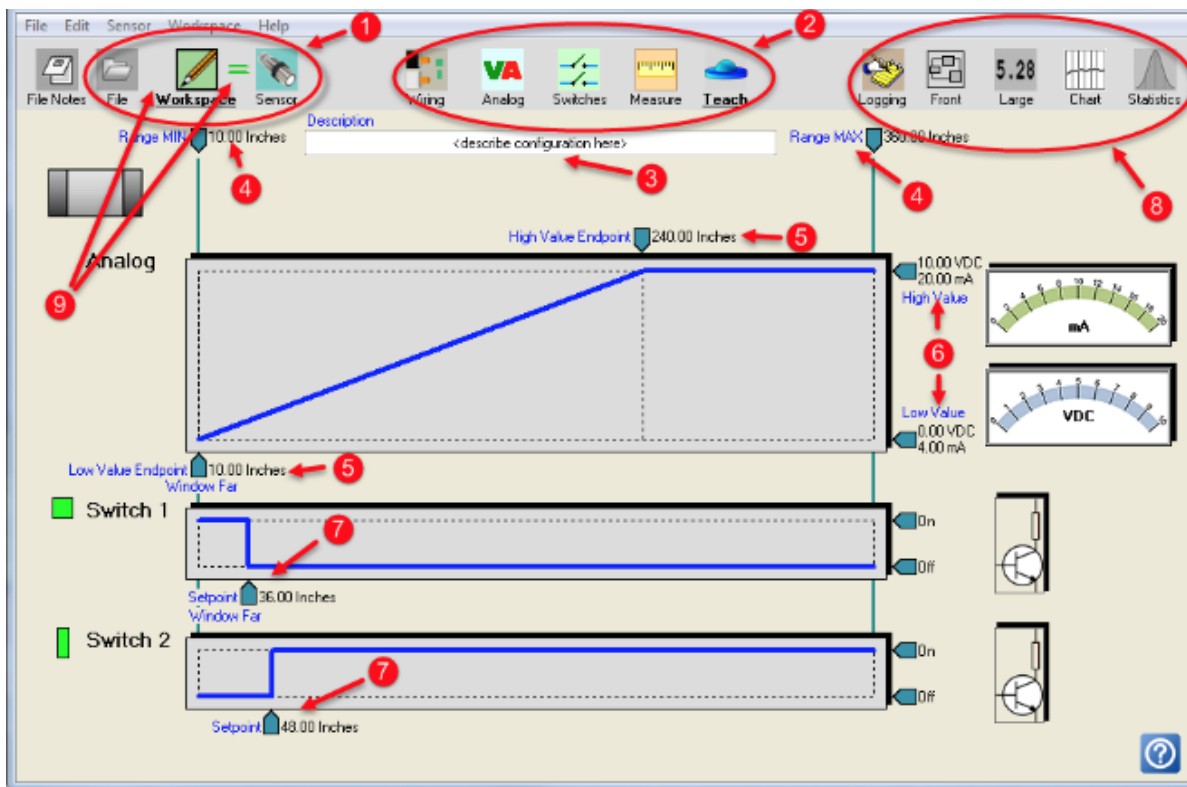
(e) Click the distance text of high and/or low analog endpoints to calibrate the analog outputs. The voltage and current outputs share the endpoints.

(f) Click text of the high and/or low values to change the output range. The voltage and current loop outputs are independently adjustable.

(g) Click the distance text of the switch setpoints to calibrate the switch ON distances. Hysteresis and window options are found by clicking the Switches icon.

(h) These icons are grayed out in Workspace but operate when connected to a sensor (click Sensor icon).

(i) Equality symbols indicate whether the Workspace is equal or not to the File and Sensor.



## TEACH ADJUST

The Ranger Two™ sensor features can be adjusted using the rear TEACH button and Target Status Indicator. These are called “teachable” 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 when power is off.

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 the software, where additional features are available that cannot be set with TEACH.

For security, the Teach button can be disabled using the software. Teach 12-15 remain enabled in a SYNC sensor. When setting analog or switch distances keep the target farther than the greater of the deadband or RangeMIN 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. 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. ALT-Teach status is indicated by a double flashing indicator.

## **Analog Output Adjustments**

The voltage and current outputs operate over adjustable distances (span) defined by setting the endpoints. The voltage 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 5.

The analog low value (0VDC, 4 mA or software low values) endpoint is adjusted using TEACH-4 and the high value (10VDC, 20 mA or software 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 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!

## **Factory Configuration**

TEACH-17 will restore factory default operation and the default values described in Table 6. The output selections, communications parameters and number of SYNC phases are not affected.

## **Other TEACH Features**

These and more can also be set in the Ranger Software:

Measurement rates are set using Teach-24 to 28. More options are available using the software.

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

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

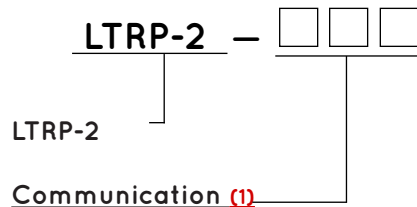
## Ordering Information

### FLO-CORP MODEL NUMBER BUILDER

For Assistance Call **877.356.5463**

Use the diagram below, working from left to right to construct your FLO-CORP Model Number. Simply match the category number to the corresponding box number.

**Example:** LTRP-2-485 Ranger Two™ Ultrasonic Level Transmitter (Up to 30ft) with RS-485 Communication Interface



**232)** Serial RS-232 Interface (limited to single sensor connections)

**485)** Serial RS-485 Interface (Allows addressable multi-sensor networks)

**Ordering Notes:**

(1) Select the best probe type based on your requirements