AUTOMATION PRODUCTS

Operator's Manual

IRU-2000

and

IRU-3000

(US25 and US35 Series)

Rev. 1c, 3/03

Scientific Technologies Inc.
Automation Products Group
STI...Providing tailored solutions for measurement applications
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A Single Source for Automation Products

After introducing its first infrared solid-state proximity photoelectric control more than 28 years ago, Scientific Technologies Inc. has grown to be a leading supplier of automation sensors in the United States and is recognized throughout the world for its superior products and services.

STI products help people be more productive and safe in automated factories that produce a variety of complex and important products such as automobiles, computers, electronics, and food and beverages. STI Automation Products include ultrasonic sensors, infrared sensors, capacitance sensors, float switches, pressure transducers and magnetostrictive sensors. In addition to STI's Automation Products, we offer a range of machine safeguarding products including safety light curtains, interlocks, relays and mats.

Our Mission Statement

"Providing tailored solutions for measurement applications."

STI is Proud to Supply Automation Sensors to Customers Around the Globe. They Include:

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• Warranty

The manufacturer has warranted this product for 18 months from date of purchase. This warranty is limited to the products manufactured by STI, which under normal use and service appear to have been defective in materials or workmanship. STI will repair or replace, at no charge to the customer, any defective products, which upon their return to STI for inspection shall be found to be defective in material or workmanship.

This warranty does not apply if the products are misused, damaged or installed in applications not suited for this ultrasonic sensor.

No warranty of any device is made or authorized to be made by the seller other than the above specified. The seller makes no warranty whatever in regard to trade accessories, such being subject to the warranty of their respective manufacturers, and the seller's warranty does not obligate it to bear the cost of labor in replacement parts.

Before any product can be returned to the factory, a returned materials authorization (RMA) number must be obtained from STI's Customer Service Department at (888) 525-7300. Be sure to include the RMA number on the mailing label of the returned product. The returned product should be packaged securely and shipped insured and prepaid.

NOTE: Packages without a returned material authorization (RMA) number on the outside of the box will not be accepted by STI and will be returned to the customer.

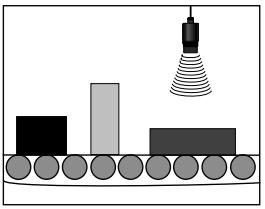
• Introducing

The IRU-2000/3000 series of self-contained ultrasonic sensors are designed for a wide range of industrial automation applications. The IRU-2000 sensors have an operating range of 1 to 25 ft. The IRU-3000 sensors have an operating range of 1.25 to 35 ft. Sensors are available in the following configurations:

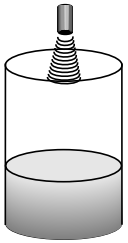
- Isolated 4-20 mA
- 4-20 mA with 2 NPN Trip Points (300 mA max.)
- Single Solid State Relay (130 mA max)

The analog output models come from the factory with the 4-20 mA output scaled from 1 to 25 ft (IRU-2000) or 1.25 to 35 ft. (IRU-3000), and will operate in many applications without any special adjustments. The sensors are adjusted utilizing an RS-232 interface or potentiometers. Not all models are equipped with potentiometers. Making adjustments through the RS-232 interface requires an **RST-2001** programming module (ordered separately) and a user friendly Windows or Palm Pilot based program. Using the RS-232 interface, various sensor options such as the filtering and output adjustments can be programmed into the sensor. The IRU-2000/3000 sensors also have internal temperature compensation for increased accuracy under varying environmental conditions.

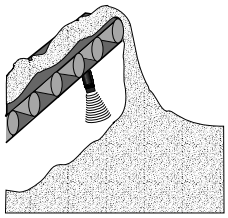
The sensors are housed in PVC, or UV resistant ABS to seal out moisture and are resistant to many chemicals. The IRU-2000/3000 series are designed to utilize a 24 VDC power supply (500 mA minimum).



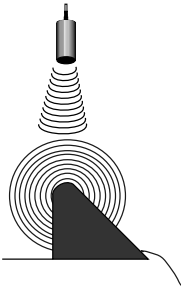
Product Dimension and Sorting



Tank Level Elevation



Conveyor Belt Monitoring

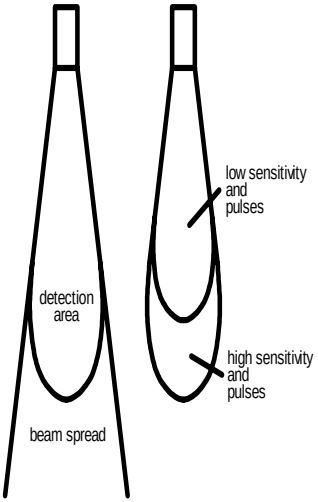


Measurement of Roll Diameter

• Understanding Ultrasonics

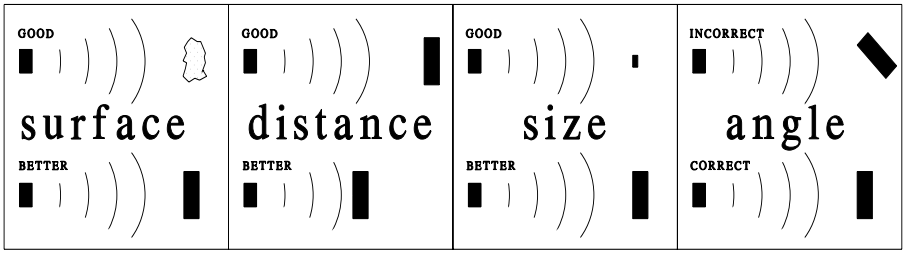
Ultrasonic sensors measure distance using a transducer to send out ultrasonic bursts. Each burst contains a series of 1-20 pulsed sound waves that emit in the shape of a cone, reflect off the target, and are received by the sensor. The time required for the sound burst to travel to and from the target is converted into a distance measurement by the sensor.

Ultrasonic sensing is affected by several factors including the target surface, distance, size, and angle. The following considerations will help ensure the best possible target conditions.



Surface

The ideal target surface is hard and smooth and perpendicular to the face of the transducer. This surface will reflect a greater amount of signal than a soft, sound wave absorbent surface. A target with poor sound wave reflection characteristics will reduce the operating distance of the sensor and decrease its accuracy.



Distance

The shorter the distance from the sensor to an object, the stronger the returning echo will be. Therefore, as the distance increases, the object requires better reflective characteristics to return a sufficient echo.

Size

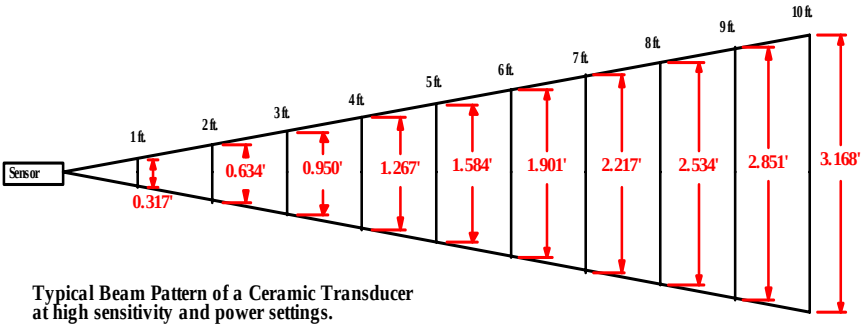
A large object will have a greater surface area to reflect the signal than a small one, therefore, a large target will be detected at a greater distance than a small target. The surface area recognized as the target is generally the portion closest to the sensor.

Angle

The inclination of the object's surface facing the ultrasonic sensor affects the reflectivity of the object. The portion perpendicular to the sensor returns the echo. If the entire surface is at a great enough angle, the signal will be reflected away from the sensor and no echo will be detected. Generally a target at an angle greater than 5 degrees off perpendicular will not be detected.

Environmental Conditions

Temperature, humidity, gases, dust, and pressure may also affect the sensor's performance. STI ultrasonic sensors automatically compensate for many of these conditions. However, these conditions can degrade the sensor performance enough it may be necessary to use a longer-range sensor than normal conditions would require.



Typical Beam Pattern of a Ceramic Transducer at high sensitivity and power settings.

- **Wiring**

The IRU-2000/3000 sensors are equipped with either a terminal wiring strip, or a six conductor cable (see diagrams below). The sensors are powered from 24 VDC. A quality regulated linear power supply is recommended. Switching power supplies should not be used.

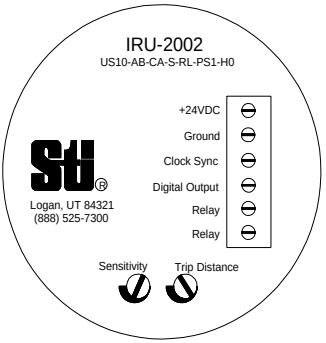
The CLOCK SYNCHRONIZATION is used when multiple sensors are located in close proximity. When a connection is made between the clock sync. terminals (green wires) of two or more sensors, the sensors will transmit at the same time. This will help prevent cross talk between sensors in most situations. The sensors must have a common ground for the clock synchronization to function.

The DIGITAL output is used to interface with an STI digital readout, part no. ACC-1007or ACC-1008. This output is a 0-5 V signal that goes high when the sensor transmits, and is pulled low when the sensor received the echo. The time interval the signal is high corresponds to the total time of flight for the transmitted sound wave. Using the speed of sound, the distance to the target can be determined. In order for the digital readout to function, it must have a common ground with the sensor.

Trip Point/Relay Output (IRU-2xx2 & 3xx2)

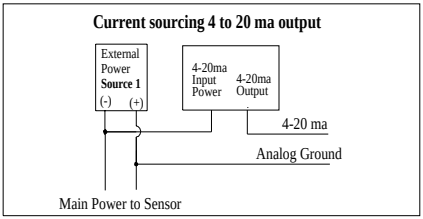
6-Conductor Cable

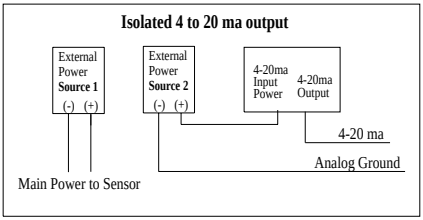
RED ..... +24VDC
BLACK ..... Ground
GREEN ..... Clock Sync.
WHITE ..... Digital Output
ORANGE ..... Relay
BLUE ..... Relay



4-20mA Output

Models equipped with an **Isolated 4-20 mA** analog output require power to be supplied to the 4-20mA circuit in order for it to operate. This output may operate with PLCs, digital displays, or other analog devices. If the equipment the sensor is interfaced with is current sinking, the sensor can be jumpered to provide a current source. Wiring for current sourcing and isolated outputs is indicated below.



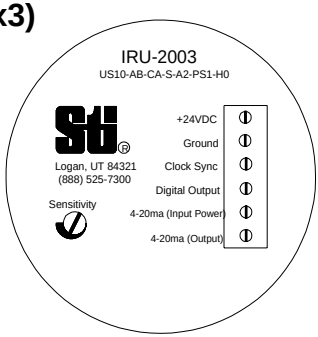


NOTE: For models equipped with an isolated 4-20 mA output. If the mA circuit power (orange) is being sourced by the main sensor power (red), then the output may be unstable while communicating through the RST-2001 module.

Isolated 4-20 mA Output (IRU-2xx3 & 3xx3)

6 -Conductor Cable

RED ..... +24 VDC
BLACK ..... Ground
GREEN ..... Clock Sync.
WHITE ..... Digital Output
ORANGE ..... Analog Circuit Power (+24 VDC)
BLUE ..... 4-20 mA Output



4-20 mA with 2-NPN Trip Points (IRU-2xx5 & 3xx5)

6 -Conductor Cable

RED ..... +24 VDC
BLACK ..... Ground
GREEN ..... Clock Sync.
ORANGE ..... 4-20 mA Output
BLUE ..... NPN Output 1
WHITE ..... NPN Output 2

• Mounting

General Mounting

Mounting is a critical factor for successful operation of an ultrasonic sensor. The IRU-2000/3000 sensors have the following mounting options available: Surface mount (only available on 2000 series), NPT mount, 150# flange mount, or sanitary tri-clamp mount.

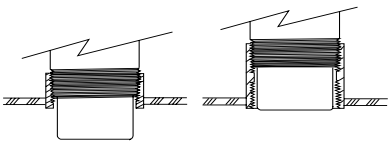
Direct sunlight can affect the accuracy of the sensor when the temperature compensation is activated. The radiant heat can cause the sensor to over compensate for ambient temperature changes. If the sensor is used outdoors, it should be shaded from direct sunlight.

If the sensor is mounted in an area where extreme dirt may accumulate, or product may cake on the sensor, periodic inspection and cleaning is recommended. Cleaning can be accomplished with a mild detergent and water. High power sprayers are not recommended, however if one is used avoid direct blasts around the O-ring seal on surface mount models.

Always mount above the highest anticipated target level by at least the published minimum blanking distance. It is always advisable to allow as much headroom as possible to keep the target from entering the blanking area. **If a target enters into the blanking area, error in the detection will occur.** Install so that there is a clear sound path perpendicular to the target surface. If the target is more than 3°-5° off perpendicular, it may not be detected. The beam angle is approximately 9° off axis. To avoid false echoes, install so that the beam will not intersect vessel *fill spouts, rough vessel walls, ladders…etc. (*if heavy foam is expected, it is often helpful to mount near a fill spout where the foam is dispersed.)

NPT and Flange Mounting (read general mounting before continuing)

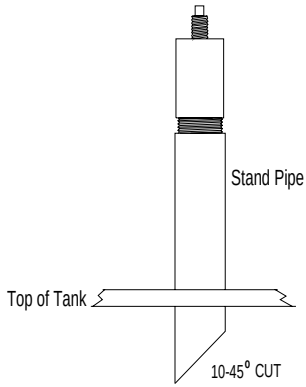
Mount the sensor in a coupler or half coupler welded to the top of tank. The coupling should extend through the top of tank. The coupler must be aligned perpendicular to the target level. **Screw sensor in only hand tight.** Soft gasket material is recommended with flange mounting.



BEST *OK*

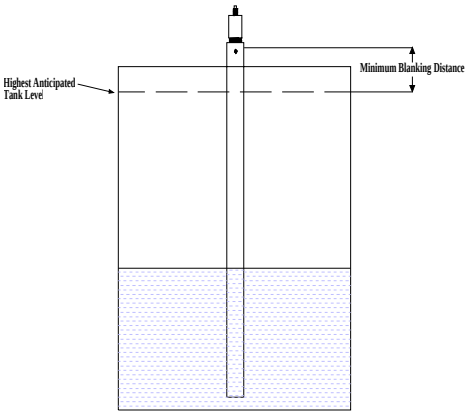
Stand Pipe Mounting (read general mounting before continuing)

Stand pipes are used to provide tank headroom when the target is expected to come closer to the sensor face than the minimum blanking distance. Using a stand pipe can degrade the performance of the sensor. The stand pipe should be installed perpendicular to the target. The pipe must have smooth walls (no joints) and no burs or obstructions on the end of the pipe. If possible, cut the end of the pipe at a 10°-45° angle (see drawing). Use the largest diameter pipe and shortest length possible. As a general rule the diameter of the pipe should be 1/2 the length. The ID of stand pipe must stay the same into the tank.



Stilling Well Mounting (read general mounting before continuing)

Stilling wells provide access to difficult areas and help eliminate problems with foam. The pipe must have smooth walls (no burs or joints). The sound waves from the sensor concentrate and propagate down the inside walls of the tube. Any irregularities on the tube walls may produce echo returns and cause false readings. Stilling wells are limited to liquid targets that will not leave deposits on the tube walls. Because the sound waves stay concentrated inside the tube, it is usually necessary to reduce the sensors pulses and sensitivity settings. **A vent hole must be provided at the top of the tube.** Keep the vent hole inside the blanking distance.



• Sensor Adjustment

There are two methods for adjusting the sensors: 1) potentiometers (provide only limited adjustment capabilities) or 2) programming through a serial interface. The option available depends on the specific model. Only select models in the surface mount housings are equipped with potentiometer(s). All models have the serial interface option.

The adjustment using the potentiometers is limited to the sensitivity, plus the trip distance on relay output versions.

In order to take advantage of the full programmability of the IRU-2000/3000 series sensors, an external programming module is required. The RST-2001 programming module is available from STI Automation Sensors. This module acts as an interface between the sensor and a personal computer. The DB-9 connector allows a connection to the PC with a standard cable to COM1 or COM2. Power (24 VDC, 500 mA min.) must be supplied to the programming module through a 2 pin Phoenix connector. The sensor's DC + (RED) and Common (BLACK) are then connected to the programming module with another 2 pin Phoenix connector. Applying power to the RST-2001 will power the sensor. The operating parameters of the sensor can be adjusted using the WINDOWS program provided.

Before running the programming software, power must be supplied to the RST module. Follow the connection diagram below. The sensor should start audibly "ticking" when power is supplied.

• Programming

The utility program used for setting up the sensor is supplied on two 3.5 in. floppy disks. Install the software by running the "SETUP.EXE' program on disk 1. The installation process will prompt you as needed to complete the installation. This will load the operating program to your hard drive. The setup program can be run from the Windows START menu RUN option by entering the file location and name, or by going to Windows Explorer, locating the file and double clicking on SETUP.EXE. Either method will run the executable program file. The setup program will create an STI folder under the windows start menu. The software for the trip/relay model sensor is called I2002, and the software for the 4-20 mA models is call I2003 or I2005 (either will work).

When the program screen comes up, there are several buttons and windows to view information. The lower left corner of the screen contains a window indicating the communication status of the sensor and computer. It will indicate "ERROR No Communication", or "Communication OK". If an error is indicated, then click on the "Com Port" button. This will change the communication from com port 1 to com port 2 or vice versa. After changing com ports, allow a moment for the communication to be established while watching the status window to indicate "Communication OK". If this fails to establish communication, plug the serial cable into the second serial port on the back of the computer and retry both "com port 1" and "com port 2" settings in the software. If communication is still not established, check the wiring, cable connection to the computer and ensure that power is supplied to the RST-2001 module. If the wiring and connections are good and no communication has been established, then you may have a computer "com port" conflict. If devices drivers have been loaded on your computer for a device used on a com port (such as a serial mouse), then the drivers must be removed before another device (such as a ultrasonic sensor) will be able to use the com port to communicate with the computer. Com port conflicts are most common on laptop computers where a serial mouse has been used. After communication is established, click on the **"Receive"** button to load the sensor setting into the programming windows. Changes to the parameters are accomplished by clicking in the appropriate window, entering the desired value, then clicking the **"Send"** button. The **"Reset"** button will load the factory settings into the sensor. The program is closed by clicking on the **"Exit"** button.

There are four or five windows (model dependant) that indicate the sensor status; "Distance", "Current", "Temperature", "Communication" and "Signal Strength/AutoSense Disabled". Distance indicates the distance from the sensor face to the target being detected. Current indicates the value of the 4-20 mA output signal based on the target distance and the 4-20 mA settings. Communication indicates the status of communication between the sensor and the computer. The Signal Strength window indicates how well the sensor is detecting the target if AutoSense is active. The Signal Strength will vary from 0 to 7. A value of 0 indicates the sensor is easily detecting the target, while a value of 7 indicates the sensor is not detecting a target. "AutoSense Disabled" indicates the sensor is in manual mode.

RS-232 Sensor Programming

The programming options for the sensor can be broken into four groups; **Control, Filtering, Calibration, and Analog Scaling /Trip Point Control.** The programming parameters will vary depending on output type, either analog, or trip point.

Control

Units: allows the user to select the unit of measure for screen programming. The options are feet, inches and millimeters where 1= ft., 2 = in., and 3 = mm.

Blanking: sets a dead band distance in front of the sensor. When the sensor transmits the ultrasonic pulse, the transducer does not stop vibrating instantaneously. It takes about 1-3 milliseconds to send the burst and then ring-down, depending on the number of pulses sent in the burst. Any echoes that return before the sensor finishes transmitting can not be received by the sensor. This is the reason for the minimum distance specification. The minimum setting for the2000 series is 10 in. The 3000 series has a minmum blanking of 1 foot.

The blanking may be set at distances greater than the minimum. There are instances when an object close to the sensor is being detected, preventing the sensor from detecting the intended target beyond. Setting the blanking distance greater than the unwanted object can help eliminate the interference. Care must be taken that the intended target does not come closer to the sensor than the blanking distance. **If the target is closer than the blanking distance, errors in the distance measurement will occur.**

Sensitivity: controls the gain or amplification setting of the sensor. This setting can be adjusted using the potentiometer on the back of the sensor (if equipped with the potentiometer), or in the software using the utility program. The Sensitivity Select provides the option to change between potentiometer and software control. If the sensor is not quipped with a potentiometer, the setting should be set for software control. Those models with a potentiometer use a single turn pot. Turning clockwise increases the sensitivity.

In the utility program, the sensitivity is expressed as a percentage of maximum with options of 0 to 100%. The ideal setting is as low as possible while still allowing reliable tracking of the target. The lower the sensitivity setting, the less likely the sensor will be affected by ambient noise, either electrical or acoustical. A low setting will also help reduce the possibility of detecting unwanted echoes reflected from objects in the area near the detection pattern of the sensor.

The soundwave signals from the sensor are affected by temperature. At warmer temperatures the sensor will be less sensitive than at cooler temperatures. If a sensor is set up when the temperature is cool, and the temperature is expected to increase, the sensitivity level should be increased 10 to 20% after determining the ideal setting at the present temperature. This will help offset the decreased sensitivity as the temperature rises.

The sensitivity can be used to eliminate the detection of unwanted echoes. If the sensor periodically outputs a distance that is closer than the target, reducing the sensitivity will help eliminate the detection of the unwanted echoes and noise.

Sensitivity Select: provides the option to change between potentiometer and software control of the sensitivity adjustment. Setting to 0 will allow potentiometer adjustment, while setting to 1 will use the program setting. This setting should be set to 0 only if the sensor is equipped with a potentiometer.

Pulses: control the number of ultrasonic waves sent in each burst. The greater the number of pulses the stronger the transmitted signal. For most open air applications this should be set between 15 and 20. For small enclosed areas the number of pulses may need to be reduced to limit the amount of energy transmitted into the area. Targets with good reflective characteristics do not require as high a setting as those targets with poor reflective characteristics.

The range of adjustment is from 0-20 pulses. If this parameter is set to 0, the-

sensor will not transmit. This is useful to troubleshoot problem applications. When set to 0, the detected distance should go to the maximum operating range of the sensor as set in **Max Distance.** If the distance reading does not go to the maximum distance, this is a good indication there is an electrical or acoustical noise source present.

AutoSense: The most reliable distance readings are obtained when the minimum transmitted energy (pulses) and sensitivities are used. To aid the user in setup and accuracy, the **AutoSense** feature is available in this sensor. AutoSense automatically adjusts the **sensitivity** and **pulses** to a minimal setting based on the signal strength of the return echo. If AutoSense is activated, the maximum sensitivity and pulses are limited by the setting selected in those fields. For example, if the sensitivity is set to 65, then the maximum sensitivity the AutoSense feature can use is 65. If the potentiometer is activated, the sensitivity will be limited by the potentiometer setting. The pulses are also limited. AutoSense is most effective when used on liquid targets, and is usually not recommended with bulk solids.

Filtering

The filtering settings in the sensor help the user to determine what echoes qualify as legitimate targets. There are three parameters that affect the filtering: Average, Window, and Out of Range Samples.

Average: defines the number of sensor readings (samples of a target) that will be averaged together by the sensor. Each qualified sample is placed into a First-In First-Out (FIFO) buffer and averaged with the previous samples to generate a steady output. A qualified sample is one that falls within the boundaries set in the WINDOW parameter. The higher the number of samples averaged, the greater the smoothing effect of the measurement. A higher average setting will result in a slower response to changes in measurement. A fast moving target may require a lower average setting.

Window: specifies a range in which target readings will be accepted. Any reading that falls within this range is accepted as a valid target and is figured into the averaging buffer. The acceptance window is **plus** or **minus** the specified distance from the present distance reading. If the sensor is detecting a target at 5 ft. and the WINDOW is set at 1 ft., then any target detected between 4 ft. and 6 ft. will be accepted.

Out of Range Samples: indicates the number of consecutive readings (samples) outside the Window that will need to be detected before the sensor recognizes them as legitimate targets. Suppose the **Window** is set at 1 ft. and the **Out Of Range Samples** is set to 10. The current distance reading is at 5 ft. If a new target entered the detection area of the sensor at a distance less than 4 ft. or the target suddenly moved to a distance greater than 6 ft., the target would need to be present in the new location long enough for the sensor to receive 10 consecutive samples outside the original window before the sensor would recognize the reading as a target. If the target were outside the window for only 9 samples, then returned to the original 5 ft. distance, the sensor would retain the 5 ft. distance reading. The sudden change, or the new target would be ignored.

Sample Rate: adjusts the speed of the sensor readings. The sample rate is express in Hertz. Options allow for rates from 1 to 50 Hz. **The sample rate is limited by the Max Distance setting.** The longer the maximum distance-

setting, the lower the maximum sample rate can be set. A higher sample rate will cause a more rapid response, but may decrease the stability of the measurement.

View Noise Level: indicates the number of echoes being detected by the sensor. Noise levels in excess of 20 to 30 is an indication that noise sources are present and may interfere with the sensor operation. Reducing the sensitivity may help reduce the amount of noise detected.

Set Noise Threshold: controls a filter that will eliminate interference from temporary high noise levels. If a noise level exceeds this threshold, the sensor will maintain the last measurement before the high noise level was detected. The measurement will be maintained until the noise level drops below the threshold setting. Sources of noise could be pneumatic equipment, machine presses, shears, or other manufacturing equipment.

Calibration (no adjustments needed for most applications)

The sensor can be adjusted so the detected distance is equal to the measured distance. There are various factors that will affect the speed of sound such as temperature, humidity, pressure, and chemical fumes. For most accurate measurement the sensor will need to be calibrated in the environments in which it will be operating. If the sensor is in an environment where the temperature will be cycling, the temperature compensation should be turned on or an external means of temperature compensation should be implemented. When the temperature compensation is used, it should be turned on before the sensor is calibrated.

Multiplier: is used to bring the detected distance in line with the physical measurement. The speed of sound is not constant through all environments and temperatures. The multiplier enables the user to compensate for the change in the speed of sound for a variety of environments. To determine the multiplier to setting, measure from the face of the transducer to the intended target. Divide the measured distance by the distance reading in the sensor software and enter resulting value in the multiplier. For example, a target is placed 2.5 ft. from the sensors face; the displayed distance is 2.68 ft. The multiplier is 2.5/2.68 = 0.9328. This value is entered into the multiplier setting.

Offset: adjusts the zero point of the sensor. When the offset is set to 0, the electrical zero of the sensor is approximately 0.86 in. behind the face of the transducer. The factory setting of 16 adjusts the zero point to the leading edge of the transducer. The options for this setting are 0-255. The number represented is equal to counts of the microprocessor. Each count of the processor is approximately equal to 0.054 in.

Temp_Comp: turns the temperature compensation ON or OFF. The speed of sound through air changes about 0.18% for every degree Celsius. If temperature changes are experienced, the distance measurement will vary according to this percentage. Using the internal temperature compensation will reduce the effects of temperature changes by 50% or more. The sensor will need to be calibrated after switching the temperature compensation on or off. Follow the instructions provided in the Multiplier section.

NOTE: If the internal temperature compensation is used, care must be taken that the sensor is not exposed to direct sun light. The radiant heat of the sun can heat the sensor above the ambient temperature causing the sensor to over compensate for temperature changes.

External Temp_Comp: a correction factor for the change in the temperature compensation may be achieved by using an external temperature probe in conjunction with a PLC and applying a correction formula to the sensor output. In some circumstances this may achieve better results than using the internal temperature compensation.

The formula for the change in the speed of sound is:

((T1 - T2 + 273)/273)^0.5

where: T1 = present temperature in °C,

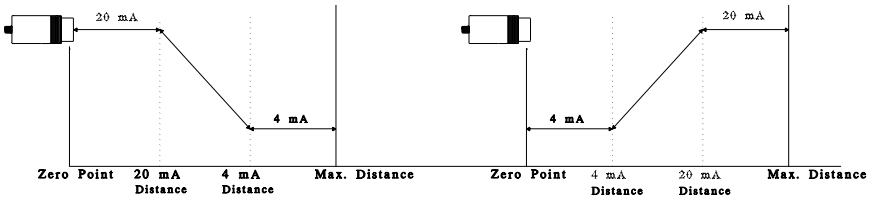
T2 = temperature when sensor was calibrated.

There are two approaches for using the correction formula. One uses the factory calibration with the sensor's multiplier set to 1.00. The factory calibration is based on a temperature of 25°C. Therefore, T2 will equal 25. The next approach is to calibrate the sensor as outlined in the multiplier section then apply the temperature correction. In this case, T2 becomes the temperature at the time of calibration.

Analog Scaling/

Scaling of the analog signal is accomplished using the **20 mA Distance** and the **4 mA Distance** parameters. Scaling the output is accomplished by entering a distance value for the 4 mA endpoint and the 20 mA endpoint. The analog output will be scaled between the distance point entered in each of these settings. The output can be inverted by interchanging the values in each parameter. If the detected target is outside the scaling range, the sensor will output either full scale or minimum scale depending on the location of the target.

For example, the 20 mA distance is set to 2 ft., and the 4 mA distance is set to 8 ft. If the target is closer than 2 ft., the output will be 2 0mA. As the target distance increases beyond 2 ft., the output will change linearly with distance to 8 ft. where the output will be 4 mA. If the target distance exceeds 8 ft., the output will remain at 4 mA.



Analog Calibration (No adjustments needed in most applications)

Calibration of the analog signal is accomplished using the 4 mA Calibration and the 20 mA Calibration parameters. To calibrate the output, the sensor must be outputting full scale (20 mA) or minimum scale (4 mA). Increasing or decreasing the value in each parameter will increase or decrease the corresponding mA output value. For example, the 4 mA distance is set to 2.00 ft., and the 20 mA distance is set to 6.00 ft. A target is being detected at 1.7 ft., but the output is 4.3mA instead of 4 mA. The output can be adjusted to 4 mA by decreasing the calibrations value in the 4 mA Calibration field until the output is equal to 4 mA.

Trip Point Control

The trip point output has several options to provide a high degree of flexibility. Options are available to allow for presence detection, high and low alarms, and pump control.

Trip Select provides an option of using the potentiometer or the software to determine the trip distances. The options are 0 = manual (potentiometer) and 1 = program. If 1 is selected, the potentiometer is disabled. *NOTE: If a sensor is not equipped with a potentiometer this parameter must be set to the program option.*

Trip Distance: sets the distance from the sensor face to the nearest trip position. (see chart on the next page)

Trip Window: begins at the point of the "Tip Distance", and determines the far trip position. (see chart on the next page)

Trip Type: allows for different trip configurations based on the application need such as presence detection, high and/or low alarms, pump up and pump down. The five options are illustrated in the following chart.

The **"Type 0"** or Near trip setting will activate the trip output when a target come nearer the sensor than the BEGIN point as set by the Trip Distance. The trip will remain activated when a target is between the Blanking distance and the trip distance. This can be used for presence detection applications, stack height limits or high level alarms.

The **"Type 1"** or Exclusive trip setting will activate the trip when a target is closer than the trip distance setting (BEGIN) or farther than the trip distance plus the trip window distance (END). This setting can be used for both a high and low alarm, or a presence detection application.

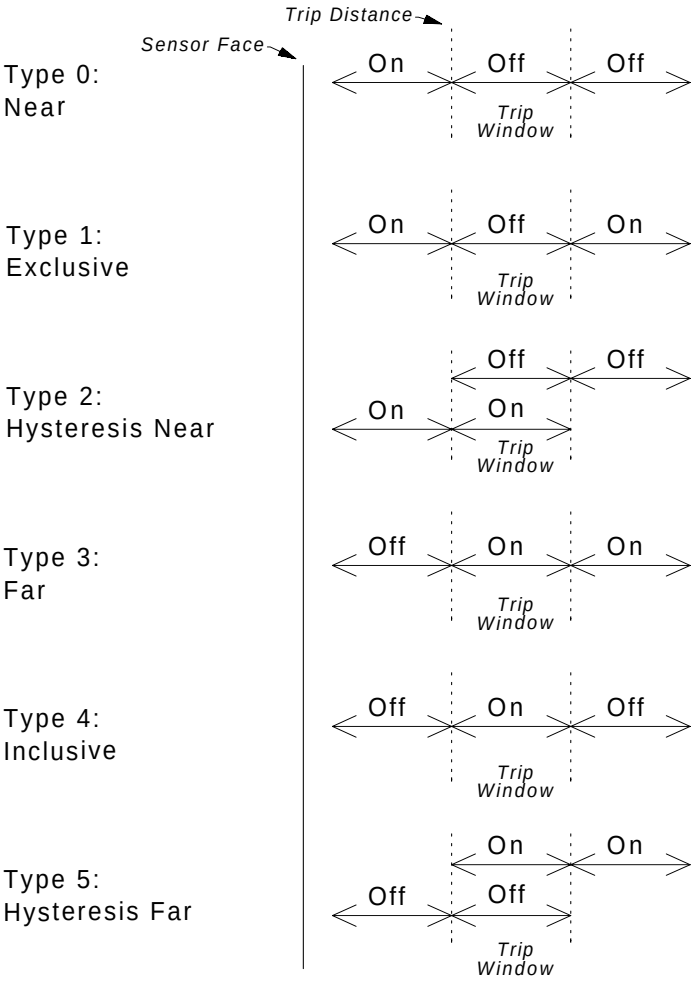
The **"Type 2"** Hysteresis Near functions as a pump down control, or as a high alarm with hysteresis to keep the relay from chattering. When the level reaches the BEGIN point, the relay will turn on and remain on until the level drops to the END location. The relay will remain off until the level rises to the BEGIN point at which time the relay will activate again.

The **"Type 3"** or Far activates when the target is beyond the trip distance. This can be used for a low alarm, or fail safe presence detection. For fail safe, the trip is activated when no target is present, but deactivates on detection. If-

the sensor fails due to power outage, the trip will deactivate providing an alarm function.

The **"Type 4"** or Inclusive activates when the target is within the trip window. This can be used for various presence detection application.

The **"Type 5"** or Hysteresis Far, is used for pump up applications, or for a low level alarm with hysteresis function. This is the opposite function of the Type 2.



• Default Settings

The IRU-21xx/31xx series sensors factory default settings are as follows:

PARAMETER	SETTING	PARAMETER	SETTING
Units	1(feet)	View Noise Level	N/A
Blanking	1.00/1.25 ft.	Set Noise Threshold	30
Sensitivity	75	Multiplier	1.000
Sensitivity Select	1 (autosense)	Offset	0.00
Pulses	16	Temperature Comp.	0 (off)
AutoSense	0 (off)		
Average	20		
Window	1.00 ft.		
Out of range samples	10		
Sample Rate	4 Hz		
4mA Set Point	1.00 ft.		
20mA Set Point	25/35 ft.		
4mA Calibration	8200 (approx.)		
20mA Calibration	41000 (approx.)		
Max Distance	25 /35 ft.		
Trip Distance	3.00 ft.		
Trip Window	1.00 ft.		
Trip Type	0		

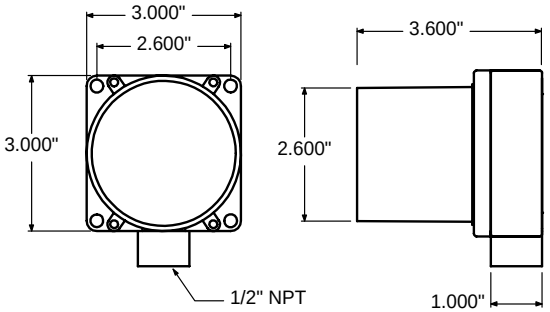
• Stand Alone Operation

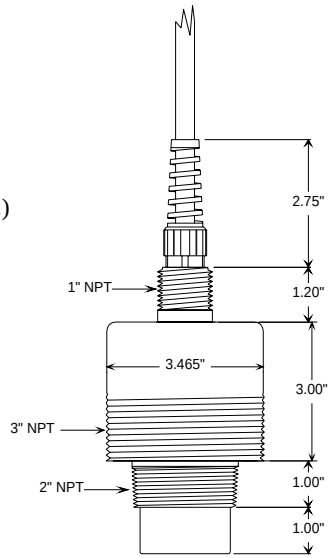
After programming the sensor is complete, the set up program may be exited and the sensor disconnected from the communication cable. The sensor should be wired as described in the Wiring section.

• IRU 2000 Series Specifications

Operating Range ..... 1to 25 feet (0.3 m to 7.62 m) on a hard target
Outputs ..... 4-20 mA, NPN Trip Points,
Solid State Relay.
(Relay = 130 mA max.)
(NPN Trips = 300 mA max.)
Supply Voltage ..... 24 VDC*
Total Current Draw ..... 80 mA @ 24 VDC
Maximum Power Rating . 2.5 Watts
Housing ..... ABS (Surface Mount), PVC (NPT), 150# PVC Flange
(Teflon Faced), PVC w/ 3" SS Tri-Clamp.
Transducer Type ..... Ceramic, 69 kHz
Rating ..... ABS Housing NEMA 4x
PVC Housing NEMA 6
Response Time ..... Programmable (20 mS min.)
Resolution ..... 0.1 in. (2.54 mm)
Accuracy ..... ±0.25% of range with no temp. gradient
Operating Temp ..... -40 to 60 °C
Temp Compensation ..... Internal
Sample Rate ..... Programmable 1-22 Hz
Beam Pattern ..... 9° off axis

*Sensor will operate from 12 to 28VDC.
(Sensor performance is diminished if less than 24VDC is applied. Minimum of 14VDC is needed to program the sensor using the RST module.)

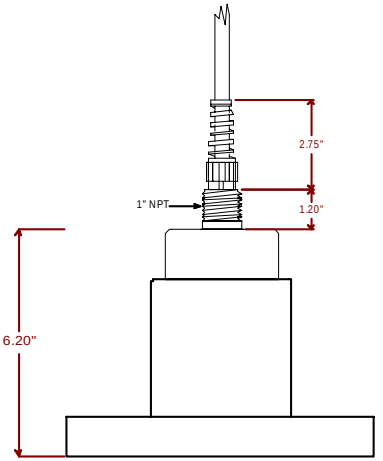




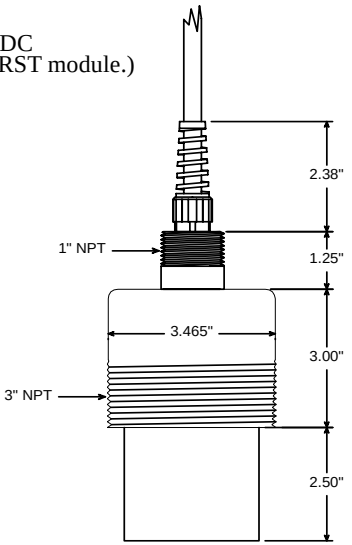
• IRU 3000 Series Specifications

Operating Range ..... 1.25 ft. to 35 ft. (0.38 m to 11.5 m)
Outputs ..... 4-20 mA with 2- NPN Trip Points.
(NPN Trips = 300 mA max.)
Supply Voltage ..... 24 VDC *
Total Current Draw ..... 80 mA @ 24 VDC
Maximum Power Rating . 2.5 Watts
Housing ..... PVC (NPT), 150# PVC Flange (Teflon Faced)
Transducer Type ..... Ceramic, 43 kHz
Rating ..... ABS Housing NEMA 4x
PVC Housing NEMA 6
Response Time ..... Programmable (20 mS min.)
Resolution ..... 0.1 in. (2.54 mm)
Accuracy ..... ±0.25% of range with no temp. gradient
Operating Temp ..... -40 to 60 °C
Temp Compensation ..... Internal
Sample Rate ..... Programmable 1-20 Hz
Beam Pattern ..... 9° off axis

*Sensor will operate from 12 to 28VDC.
(Sensor performance is diminished if less than 24VDC is applied. Minimum of 14VDC is needed to program the sensor using the RST module.)



3" Teflon Flange



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