IRU Series Ultrasonic Sensors User Manual

IRU-2000's, IRU-3430's, IRU-5000's, IRU-6420's, & IRU-9420's

APG®

Table of Contents

Introduction

Thank you for purchasing an IRU ultrasonic sensor from APG. We appreciate your business! Please take a few minutes to familiarize yourself with your IRU and this manual.

The IRU series is APG's line of general purpose ultrasonic sensors. With a choice of operating ranges from just a few inches to as far as 50 feet, the IRU product line is designed to fit a wide range of industrial automation applications. Sensor adjustments, such as sensitivity and filtering options, are made by interfacing the sensor to a PC using an RST module and APG's free Windows based programming software. IRU sensors incorporate internal temperature compensation for increased accuracy under varying environmental conditions. The sensors are housed in PC/PET or UV resistant ABS to seal out moisture and resist a wide range of chemicals.

Reading your label

Every APG instrument comes with a label that includes the instrument's model number, part number, serial number, and a wiring pinout table. Please ensure that the part number and pinout table on your label match your order. The following electrical ratings and approvals are also listed on the label. Please refer to the Certificate of Compliance and Declaration of Conformity at the back of this manual for further details.

Electrical ratings

Input: 12 to 28 Volts DC, 80mA max; Outputs: 4-20mA, NPN
Class I Division 2; Groups C, D T6
Class I, Zone 2, Group IIB
AEx nA IIB T6: Ta: -30°C to 60°C; IP65
Ex nA IIB T6: Ta: -30°C to 60°C; IP65

IRU models: IRU-2423, IRU-2425, IRU-3433, IRU-3435, IRU-5413, IRU-5415, IRU-5423, IRU-5425. Models listed are rated for Pollution Degree 2, Installation Category II.

Input: 12 to 28 Volts DC, 80 mA max; Outputs: 4-20mA, solid state relay, NPN
Listed for General Purpose
Ta: -30°C to 60°C;

IRU models: IRU-2002, IRU-2003, IRU-2005, IRU-2423, IRU-2425, IRU-3433, IRU-3435, IRU-5413, IRU-5415, IRU-5423, IRU-5425, IRU-5429, IRU-6429, IRU-9423, IRU-9425, IRU-9429
Models listed are rated for Pollution Degree 2, Installation Category II.

> ❶ IMPORTANT: Your IRU must be listed above and installed as shown on drawing 9003066 to meet listed approvals. Faulty installation will invalidate all safety approvals and ratings.

Warranty and Warranty Restrictions

This product is covered by APG's warranty to be free from defects in material and workmanship under normal use and service of the product for 24 months. For a full explanation of our Warranty, please visit https://www.apgsensors.com/about-us/terms-conditions. Contact Technical Support to receive a Return Material Authorization before shipping your product back.

Scan the QR code below to read the full explanation of our Warranty on your tablet or smartphone.

APG

Chapter 1: Specifications and Options

- **Dimensions**

3.25"
82.55mm

2.60"
66.04mm

3.25"
82.55mm

1.63"
41.40mm

3.10"
78.74mm

2.50"
63.50mm

Liquid Tight
Strain Relief

IRU-200x

3/4" ø NPT
Threads

2" ø NPT
Threads

7.21"
183.13mm

5.08"
129.03mm

3.05"
77.47mm

1.47"
37.34mm

1.98"
50.29mm

IRU-242x & IRU-642x

3/4" ø NPT
Threads

3" ø NPT
Threads

7.76"
197.10mm

2.27"
57.66mm

5.63"
143.00mm

2.80"
71.12mm

3.00"
76.20mm

IRU-343x

3/4" ø NPT
Threads

6.10"
154.94mm

3.97"
100.84mm

2.73"
63.34mm

1" ø NPT
Threads

0.68"
17.27mm

IRU-541x

3/4" ø NPT
Threads

5.74"
145.80mm

3.61"
91.69mm

2" ø NPT
Threads

3.05"
77.47mm

IRU-542x & IRU-942x

APG
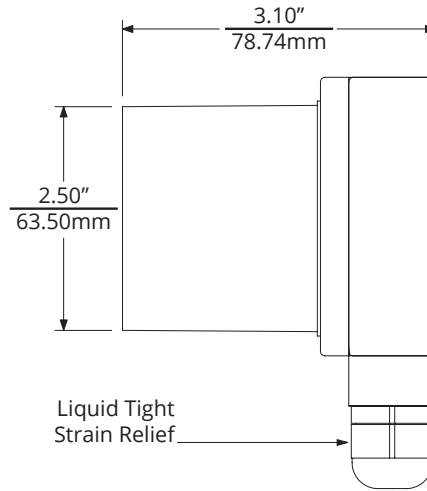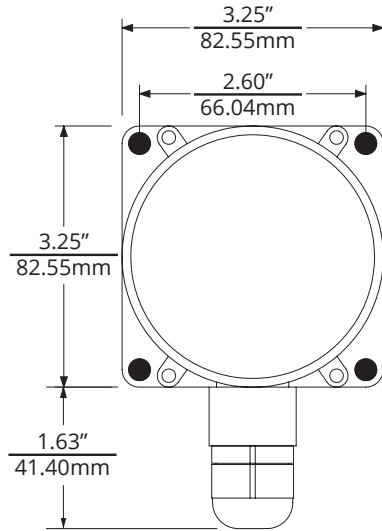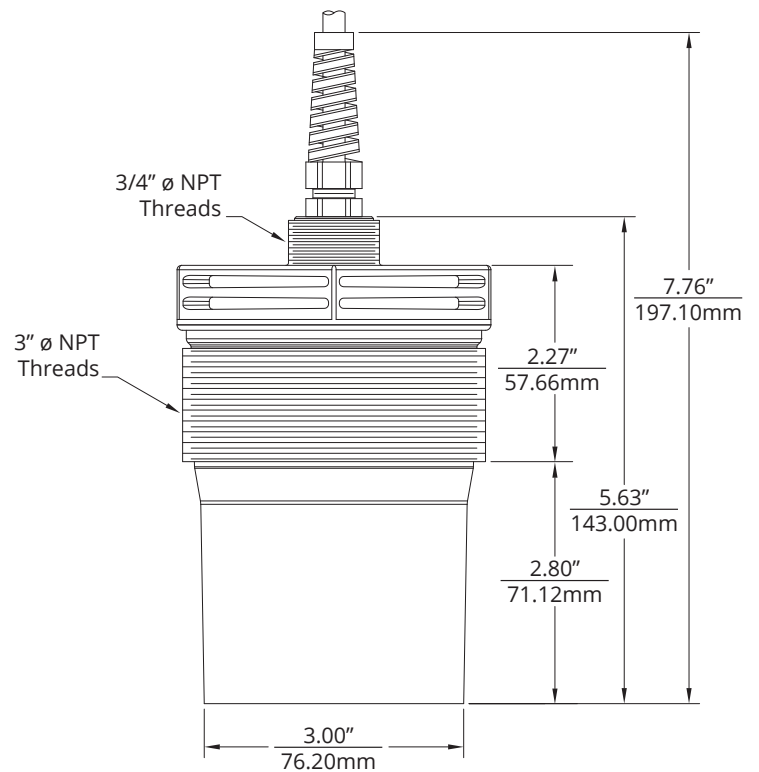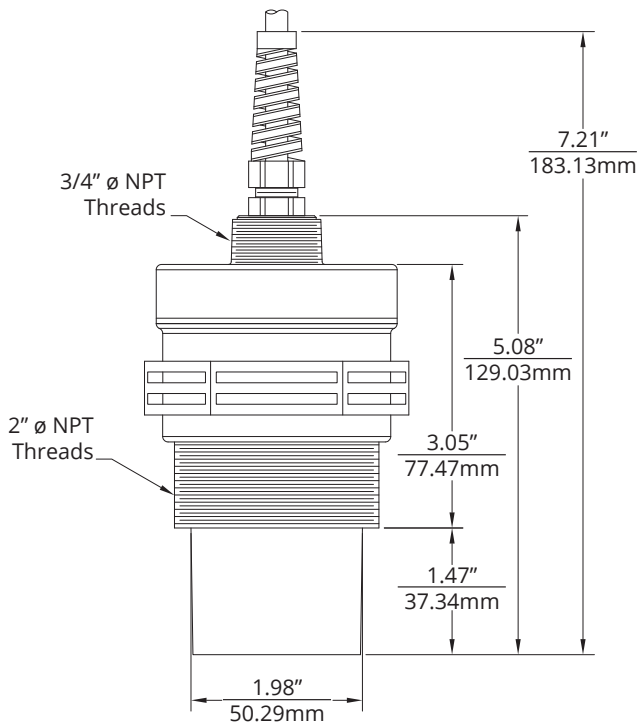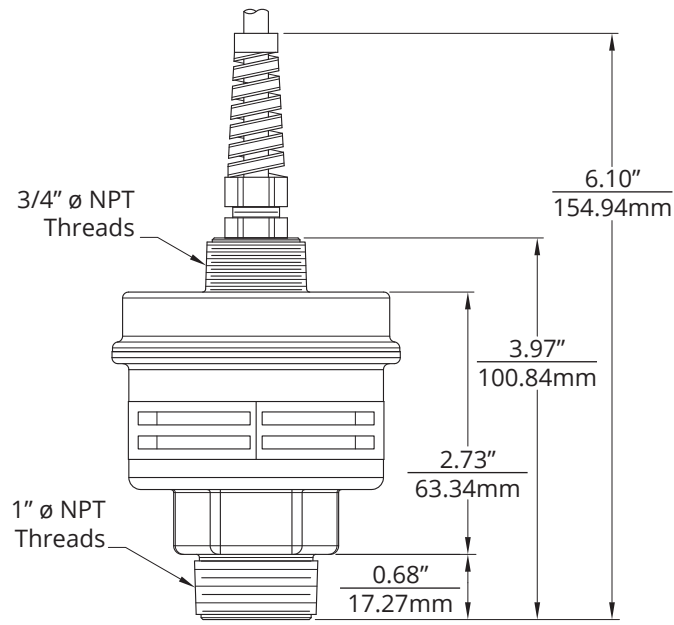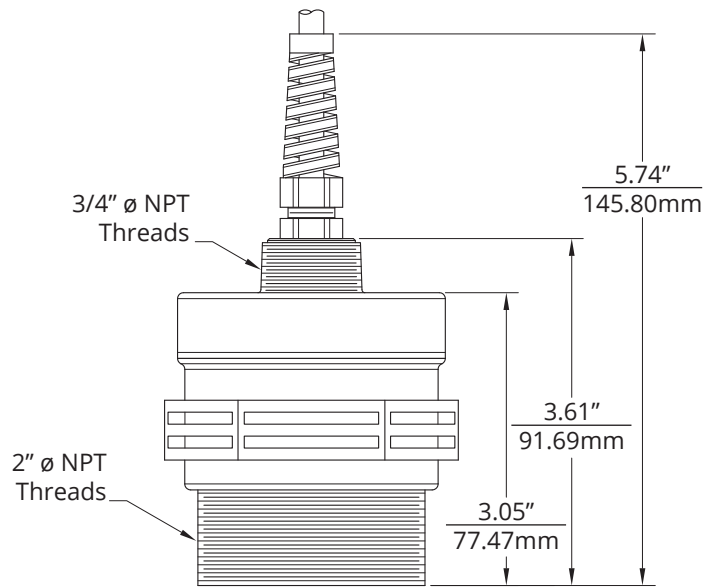
- ## Specifications

IRU-200X and 242X

Performance

Operating Range	1 - 25 ft. (0.3 - 7.6 m) on liquids and hard, flat surfaces
	1 - 10 ft. (0.3 - 3 m) on bulk solids
Analog Output	1 Solid State Relay, Isolated 4-20 mA, 4-20 mA,
	4-20 mA with 2 NPN Trip Points, 0-2.5 VDC / 0-5 VDC
Digital Output	RS-485 with 1 NPN Trip Point, RS-232 option
Display Output	For interface with APG digital display (IRU-2002,
	IRU-2003 only)
Beam Pattern	9° off axis
Transducer Frequency	69 kHz
Response Time	Programmable, 55 ms min @ 25 ft. (or 18 Hz max)

Accuracy

Accuracy	±0.25% of detected range
Resolution	0.1 inch (2.54 mm)

Environmental

Operating Temperature	-40 to 60°C (-40 to 140°F)
Internal Temperature Compensation	Yes
Enclosure Protection	IP65 (IRU-242X)
NEMA rating	4X (IRU-2000X only)
CSA Certifications	See page iii (IRU-242X only)

Electrical

Opperational Supply Voltage (at sensor)	12-28 VDC
Excitation Supply Voltage	5 VDC min. (0-2.5 / 0-5 VDC output only)
Programming Supply Voltage	15-28 VDC (12-28 VDC via RS-232)
Current Draw	80 mA max @ 24 VDC and 4 Hz (IRU-200X)
	75 mA max @ 24 VDC and 4 Hz (IRU-242X)
Current Output	300 mA max (NPN Trip Points)
	130 mA max (SSR, 120 VDC or VAC)

Materials of Construction

Transducer Housing	ABS with UV inhibitor (IRU-200X)
	PVDF (Kynar®) (IRU-242X)
Upper Housing	PC/PET (IRU-242X)
Transducer Type	ABS (IRU-200X)
	Ceramic, PVDF faced (IRU-242X)

Mounting

IRU-200X	Surface Mount with Four Screws
IRU-242X	2" Ø NPT (front), 3/4" Ø NPT (rear)

IRU-343X

Performance

Operating Range	1.25 - 50 ft. (0.4 - 15.2 m)
Analog Output	4-20 mA
	4-20 mA with 2 NPN Trip Points
Digital Output	N/A
Beam Pattern	9° off axis
Transducer Frequency	43 kHz
Response Time	Programmable, 100 ms min @ 50 ft. (or 10 Hz max)

Accuracy

Accuracy	±0.25% of detected range
Resolution	0.1 inch (2.54 mm)

Environmental

Operating Temperature	-40 to 60°C (-40 to 140°F)
Internal Temperature Compensation	Yes
Enclosure Protection	IP65
CSA Certifications	See page iii

Electrical

Opperational Supply Voltage (at sensor)	12-28 VDC
Programming Supply Voltage	15-28 VDC
Current Draw	75 mA max @ 24 VDC and 4 Hz

Materials of Construction

Transducer Housing	PC/PET
Upper Housing	PC/PET
Transducer Type	Ceramic, PVDF faced

Mounting

IRU-343X	3" Ø NPT (front), 3/4" Ø NPT (rear)

APG

IRU-54XX

Performance

Operating Range	0.33 - 6.58 ft. (0.1 - 2.7 m)
Analog Output	4-20 mA
	4-20 mA with 2 NPN Trip Points
	0-2.5 VDC / 0-5 VDC
Digital Output	N/A
Beam Pattern	9° off axis
Transducer Frequency	143 kHz
Response Time	Programmable, 22 ms min @ 6.58 ft. (or 45 Hz max)

Accuracy

Accuracy	±0.25% of detected range
Resolution	0.1 inch (2.54 mm)

Environmental

Operating Temperature	-40 to 60°C (-40 to 140°F)
Internal Temperature Compensation	Yes
Enclosure Protection	IP65
CSA Certifications	See page iii (IRU-54XX only)

Electrical

Opperational Supply Voltage (at sensor)	12-28 VDC
Excitation Supply Voltage	5 VDC min. (0-2.5 / 0-5 VDC output only)
Programming Supply Voltage	15-28 VDC
Current Draw	75 mA max @ 24 VDC and 4 Hz
Current Output	300 mA max (NPN Trip Points)

Materials of Construction

Transducer Housing	PC/PET
Upper Housing	PC/PET
Transducer Type	Ceramic, PVDF faced

Mounting

IRU-541X	1" Ø NPT (front), 3/4" Ø NPT (rear)
IRU-542X	2" Ø NPT (front), 3/4" Ø NPT (rear)

IRU-642X

Performance

Operating Range	1.0 - 30.0 ft. (0.3 - 9.1 m)
Analog Output	0-2.5 VDC / 0-5 VDC
Digital Output	RS-232 option
Beam Pattern	9° off axis
Transducer Frequency	69 kHz
Response Time	Programmable, 64 ms min @ 30 ft. (or 15 Hz max)

Accuracy

Accuracy	±0.25% of detected range
Resolution	0.1 inch (2.54 mm)

Environmental

Operating Temperature	-40 to 60°C (-40 to 140°F)
Internal Temperature Compensation	Yes
Enclosure Protection	IP65

Electrical

Opperational Supply Voltage (at sensor)	12-28 VDC
Excitation Supply Voltage	5 VDC min.
Programming Supply Voltage	15-28 VDC
	12-28 VDC (via RS-232)
Current Draw	75 mA @ 24 VDC and 4 Hz
Serial Communications	RS-232 (IRU-6429S only)
	9600 baud, 8 bit, 1 stop bit, No parity

Materials of Construction

Transducer Housing	PVDF (Kynar®)
Upper Housing	PC/PET
Transducer Type	Ceramic, PVDF faced

Mounting

IRU-642X	2" Ø NPT (front), 3/4" Ø NPT (rear)

APG

IRU-942X

Performance

Operating Range	0.5 - 35 ft. (0.2 - 10.7 m)
Analog Output	4-20 mA
	4-20 mA with 2 NPN Trip Points
	0-2.5 VDC / 0-5 VDC
Digital Output	RS-232 option (with 0-2.5 / 0-5 VDC only)
Beam Pattern	9° off axis
Transducer Frequency	50 kHz
Response Time	Programmable, 73 ms min @ 35 ft. (or 13 Hz max)

Accuracy

Accuracy	±0.25% of detected range
Resolution	0.1 inch (2.54 mm)

Environmental

Operating Temperature	-40 to 60°C (-40 to 140°F)
Internal Temperature Compensation	Yes
NEMA rating	12

Electrical

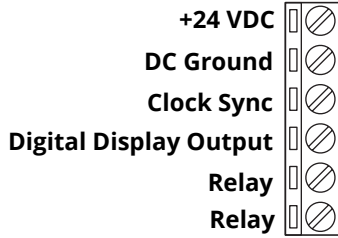|	
Opperational Supply Voltage (at sensor)	12-28 VDC
Excitation Supply Voltage	5 VDC min. (0-2.5 / 0-5 VDC output only)
Programming Supply Voltage	15-28 VDC
	12-28 VDC (via RS-232)
Current Draw	75 mA max @ 24 VDC and 4 Hz
Serial Communications	RS-232 (IRU-9429S only)
	9600 baud, 8 bit, 1 stop bit, No parity

Materials of Construction

Transducer Housing	PC/PET
Upper Housing	PC/PET
Transducer Type	Electrostatic

Mounting

IRU-942X	2" Ø NPT (front), 3/4" Ø NPT (rear)

• Electrical Connectors and Pinout Tables

IRU-2002

+24 VDC	⬜⊘
DC Ground	⬜⊘
Clock Sync	⬜⊘
Digital Display Output	⬜⊘
Relay	⬜⊘
Relay	⬜⊘

IRU-2003

+24 VDC	⬜⊘
DC Ground	⬜⊘
Clock Sync	⬜⊘
Digital Display Output	⬜⊘
4-20mA Circuit Power (+24 VDC)	⬜⊘
4-20mA Output	⬜⊘
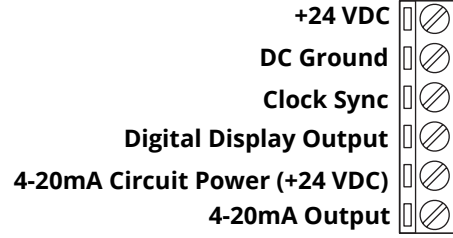
3/C Cable	**IRU-XXX3-C**
Red	+24 VDC
Black	DC Ground
White	4-20 mA Out

4-pin MC	**IRU-XXX3-M**
1 Brown	+24 VDC
2 White	Not used
3 Blue	DC Ground
4 Black	4-20 mA Out
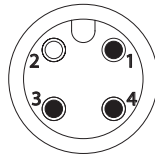
8/C Cable	**IRU-XXX9S-C**
Red	+24 VDC
Black	DC Ground
Orange	Excitation
White	Voltage Out
Green	Analog Ground
Brown	RS-232 Ground
Yellow	RS-232 TX
Blue	RS-232 RX

8-pin MC	**IRU-XXX9S-M**
1 White	Voltage Out
2 Brown	+24 VDC
3 Green	Analog Ground
4 Yellow	RS-232 TX
5 Grey	RS-232 Ground
6 Pink	RS-232 RX
7 Blue	DC Ground
8 Red	Excitation

6/C Cable	**IRU-2004-C**	**IRU-2005-C**
Red	+24 VDC	+24 VDC
Black	DC Ground	DC Ground
Green	Clock Sync	Clock Sync
White	NPN trip	NPN 2
Blue	T (+) or (A)	NPN 1
Orange	T(-) or (B)	4-20 mA Out

5/C Cable	**IRU-XXX5-C**	**IRU-XXX9-C**
Red	+24 VDC	+24 VDC
Black	DC Ground	DC Ground
White	NPN 1	Voltage Out
Orange	4-20 mA Out	Excitation
Green	NPN 2	Analog Ground

5-pin MC	**IRU-2004-M**	**IRU-2005-M**	**IRU-XXX5-M**	**IRU-XXX9-M**
1 Brown	+24 VDC	+24 VDC	+24 VDC	+24 VDC
2 White	T (+) or (A)	NPN 1	NPN 1	Voltage Out
3 Blue	DC Ground	DC Ground	DC Ground	DC Ground
4 Black	T(-) or (B)	4-20 mA Out	4-20 mA Out	Analog Ground
5 Grey	NPN trip	NPN 2	NPN 2	Excitation

APG⬜
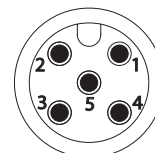
# • Model Number Configurator

The IRU sensor series offers a wide range of housing, outputs, and performance specifications. Please refer to each sensor family's datasheet for a full list of available configurations. Datasheets can be found at http://apgsensors.com/support.

Model	Range	Frequency	Mounting	Output
2002	1-25 ft / 0.3-7.6 m	69kHz	Surface/Screws	(1) Solid-State Relay
2003	1-25 ft / 0.3-7.6 m	69 kHz	Surface/Screws	Isolated 4-20mA
2004	1-25 ft / 0.3-7.6 m	69 kHz	Surface/Screws	RS-485, 1 NPN Trip
2005	1-25 ft / 0.3-7.6 m	69 kHz	Surface/Screws	4-20mA, 2 NPN Trip
2009S	1-25 ft / 0.3-7.6 m	69 kHz	Surface/Screws	0-2.5/0-5 VDC, RS-232
2423	1-25 ft / 0.3-7.6 m	69 kHz	2" NPT Threads	4-20mA
2425	1-25 ft / 0.3-7.6 m	69 kHz	2" NPT Threads	4-20mA, 2 NPN Trip
3433	1.25-50 ft / 0.4-15.2 m	43 kHz	3" NPT Threads	4-20mA
3435	1.25-50 ft / 0.4-15.2 m	43 kHz	3" NPT Threads	4-20mA, 2 NPN Trip
5413	0.33-6.56 ft / 0.1-2.7 m	143 kHz	1" NPT Threads	4-20mA
5415	0.33-6.56 ft / 0.1-2.7 m	143 kHz	1" NPT Threads	4-20mA, 2 NPN Trip
5419	0.33-6.56 ft / 0.1-2.7 m	143 kHz	1" NPT Threads	0-2.5/0-5 VDC
5423	0.33-6.56 ft / 0.1-2.7 m	143 kHz	2" NPT Threads	4-20mA
5425	0.33-6.56 ft / 0.1-2.7 m	143 kHz	2" NPT Threads	4-20mA, 2 NPN Trip
5429	0.33-6.56 ft / 0.1-2.7 m	143 kHz	2" NPT Threads	0-2.5/0-5 VDC
6429	1-30 ft / 0.3-9.1 m	69 kHz	2" NPT Threads	0-2.5/0-5 VDC
6429S	1-30 ft / 0.3-9.1 m	69 kHz	2" NPT Threads	0-2.5/0-5 VDC, RS-232
9423	0.5-35 ft / 0.2-10.7 m	50 kHz	2" NPT Threads	4-20mA
9425	0.5-35 ft / 0.2-10.7 m	50 kHz	2" NPT Threads	4-20mA, 2 NPN Trip
9429	0.5-35 ft / 0.2-10.7 m	50 kHz	2" NPT Threads	0-2.5/0-5 VDC
9429S	0.5-35 ft / 0.2-10.7 m	50 kHz	2" NPT Threads	0-2.5/0-5 VDC, RS-232

- **Wiring Diagrams**

IRU-2003 Isolated 4-20 mA Source Wiring
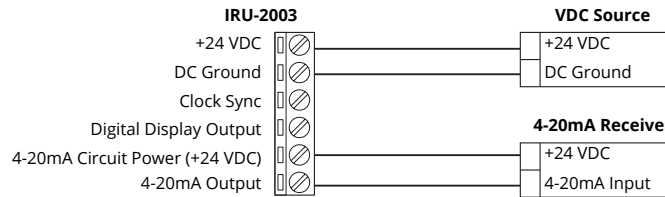
Figure 1.1 - Isolated VDC Source Wiring
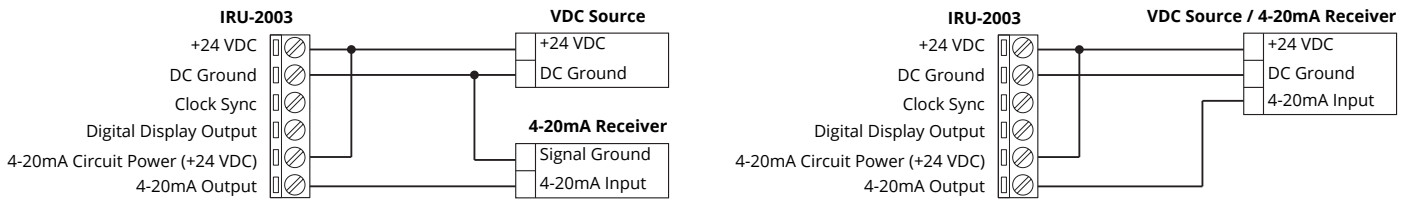
Figure 1.2 - Single VDC Source Wiring

The IRU-2003 is equipped with an isolated 4-20 mA output. This means that the 4-20 mA circuit can be powered by the 4-20 mA signal receiver or a source independant of the receiver. An isolated source must be wired correctly to prevent potential ground loops that can exist in instances where the IRU and receiver are not sharing the same power source (See Figure 1.1). The 4-20 mA circuit can also be wired as a standard current sourcing 4-20 mA loop simply by powering the circuit from the same power source used by the main IRU sensor circuit (See Figure 1.2).

APG

RST-3001/2 Programming Module Wiring

All IRU sensors (excluding the IRU-6429S and IRU-9429S) are fully programmable using an RST-3002 programming module, which acts as an interface between the sensor and a personal computer. The RST-3002 is both 32- and 64-bit Windows compatible.
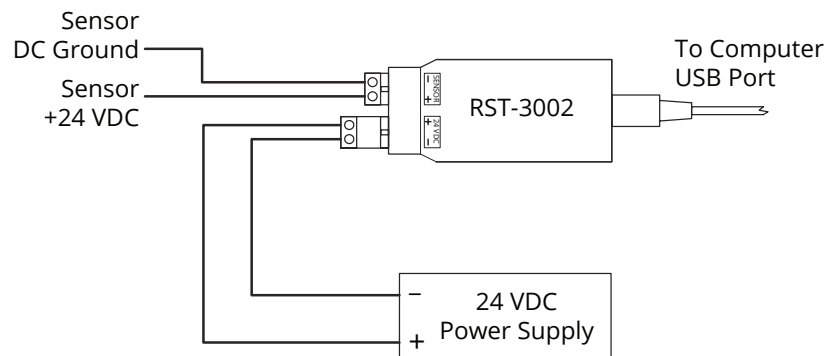
Figure 1.3

The RST-3002 is connected in series between the sensor and its power source using the two 2-pin Phoenix connectors on the module (See Figure 1.3). 15-28 VDC from the power source is connected to one 2-pin connector, while the VDC + and DC Ground of the sensor is connected to the module through the second 2-pin connector. When power is applied, the red LED between the Phoenix connectors on the RST should illuminate and the sensor should start audibly "ticking". The operating parameters of the sensor can then be adjusted using the Windows-based utility software.

> ✎ NOTE: The utility software can be downloaded at www.apgsensons.com/support.

Excitation Wiring for IRU-XXX9 Sensors
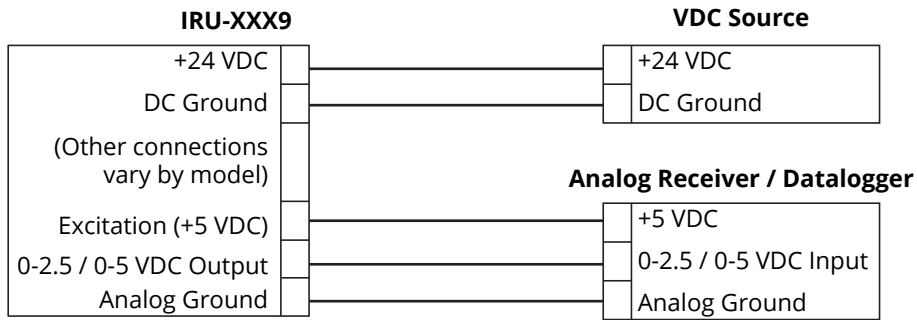
Figure 1.4

0-2.5 / 0-5 VDC IRU sensors include an +5 VDC Excitation input. (See Figure 1.4) If voltage is not applied at the Excitation input, the sensor will not communicate for programming, nor will it provide the 0-2.5 / 0-5 VDC output.

In essence, this allows for a small VDC supply, such as +5 VDC from a datalogger, to "wake" the sensor for output recording, and subsequently put the sensor back to "sleep."
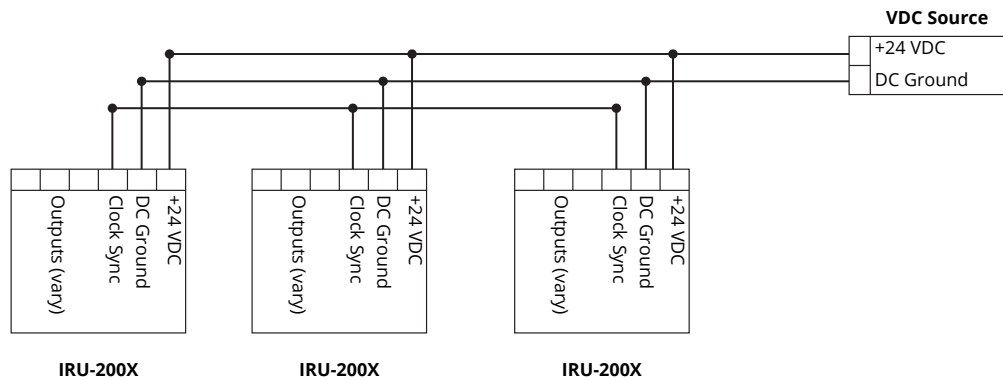
IRU-200X Clock Synchronization Wiring

Figure 1.5

IRU-2002, IRU-2003, IRU-2004-C, and IRU-2005-C sensors are equiped with a clock synchronization to prevent cross-talk between sensors located in close proximity. When the clock sync terminals of two or more sensors are connected (See Figure 1.5), the output signals will synchronize. The sensors must share a common ground in order for the clock synchronization feature to function.

APG

Chapter 2: Installation and Removal Procedures and Notes

- ## Tools Needed

Tools are necessary only for the screws used to install the surface mount IRU-200X, and to access the terminal strips inside IRU-2002 and IRU-2003 sensors. All other models can be mounted via NPT threads on the sensors.
If you are using a stand pipe to mount your IRU, you will probably need tools to install the stand pipe.

> ✏ NOTE: Terminal strips for IRU-2002 and IRU-2003 sensors are internal to the sensor and must be connected before sensors are mounted.

IRU-2002

APG▦
Logan, UT 84321
(888) 525-7300

+24V
GND
CLK
DIG
RLY
RLY

Sensitivity   Trip Distance

Figure 2.1

IRU-2003

APG▦
Logan, UT 84321
(888) 525-7300

+24V
GND
CLK
DIG
4-20 (+)
4-20 (-)
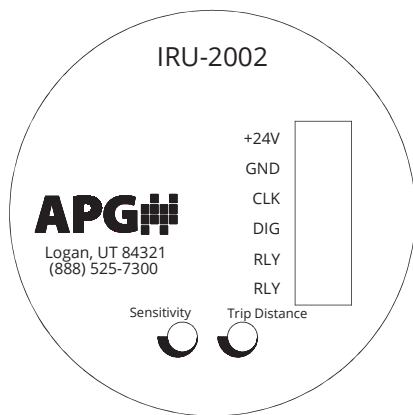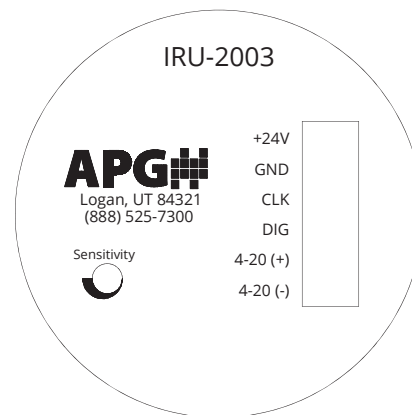
Sensitivity

Figure 2.2

Potentiometers for setting or adjusting *Trip Distance* (IRU-2002 only) and *Sensitivity* (IRU-2002 and IRU-2003) are located inside the sensor housing along with terminal strips (See Figures 2.1 and 2.2). Both settings can also be controlled via the I2000SWR software (See Figure 3.3).

- ## Installation Notes

  - Mount your IRU sensor so that it has a clear, perpendicular sound path to the surface being monitored. Your sensor should be mounted away from tank or vessel walls and inlets. (See Figure 2.3)
  - The sound path should be free from obstructions and as open as possible for the 9° off axis beam pattern.
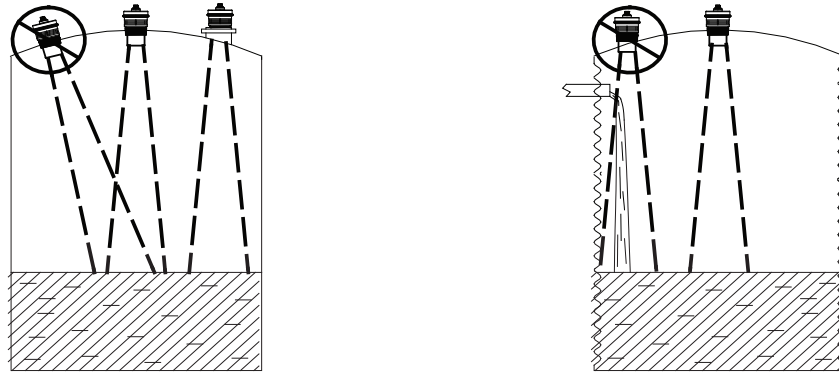 - If you are using a stand pipe, please see our guide to stand pipes on our website: http://www.apgsensors.com/about-us/blog/how-to-install-a-stand-pipe.

Figure 2.3

> ✏️ NOTE: Do not mount the sensor where the beam will intersect objects such as fill streams, pipes, ladder rungs, wall seams, or corrugated tank walls.

• **Mounting Instructions**

Mounting your IRU is easy if you follow a few simple steps:

- For IRU-200X sensors, use the necessary screws or bolts (not provided by APG) to mount the sensor.

For all other IRU models:

- Never over-tighten the sensor.
- Always screw in your sensor by hand to avoid cross-threading. Thread failure can be a problem if you damage threads by over-tightening them or by crossing threads.

> ℹ️ IMPORTANT: Do not over tighten! The sensor should be threaded in only hand tight.

- **Electrical Installation**

  - Check the pinout table on your IRU against your order
  - Check that your electrical & control system wiring matches the pinout table on your IRU.
  - For sensors with connectors, make the connection. For instruments with pigtails, run the cable to a junction box in a suitable location to connect to your system.
  - For IRU-2002 and IRU-2003 sensors, sytem wiring must be connected to internal terminal strups prior to physical installation. (See Figures 2.1 and 2.2)

  > ✏ NOTE: Please see wiring diagrams in Chapter 1 for RST Module Programming Wiring and other special wiring configurations.

- **Software Installation**

  - Download the RST-3002 software zipfile from http://apgsensors.com/support.
  - Open the zip file.
  - Choose "Install" from the options at the top of the zip file window.
  - The installation process will prompt you as needed to complete the installation.
  - The software will create I2000SWR.exe which will run from a folder in your start menu titled "APG/I2000SWR".

  > ⓘ IMPORTANT: RST-3002 is compatible with computers running 32- and 64-bit Windows systems.

- **Removal Instructions**

  - Ensure that power to the sensor is off
  - Disconnect cable to sensor.
  - Remove the sensor and store it in a dry place, at a temperature between -40° F and 180° F.
  - If the sensor was installed in a hazardous location, ensure that the cable will not energize while the sensor is disconnected.

  > 🚚 DANGER: Do not disconnect equipment installed in hazardous locations unless power has been switched off or area is known to be non-hazardous.

Chapter 3: Set Up and Operation

• User Interface

IRU sensors use one of two methods for user interface: RS-232 serial communications (IRU-6429S and IRU-9429S) or I2000SWR, the Windows-based utility software (all other models).

RS-232 Serial Communication

Sensors with the built-in RS-232 communications will accept one ASCII command (SEND), and return distance and temperature values in ASCII. When the sensor receives the SEND command (all capital letters), the sensor will transmit the distance in feet, followed by a comma, and then the temperature in degrees Celsius, followed by a carriage return and line feed. The distance will be five characters (e.g. 05.25) and the temperature will have a + or - followed by one or two characters (e.g. +22).

> ℹ️ IMPORTANT: The sensor will return ASCII characters, not numeric values.

> ✏️ NOTE: If your sensor is turned off between readings, you must allow time for the sensor to initialize and process readings through filtering parameters before polling for output readings with a SEND command. Depending your filter settings, this can take between 3 and 30 seconds, or longer.

APG⠿

Windows-based Utility Software: I2000SWR

I2000SWR software user interface is one screen with three primary areas (See Figure 3.1). The primary portion of the screen is two columns of Sensor Parameters. The Sensor Readings and Communication Status area is below the Sensor Parameters, in two uneven columns. Finally, the Control Buttons area is located across the bottom of the screen.

Only the fields in the Sensor Parameters are editable by the user. All of the fields in the Sensor Readings and Communication Status area are display only.
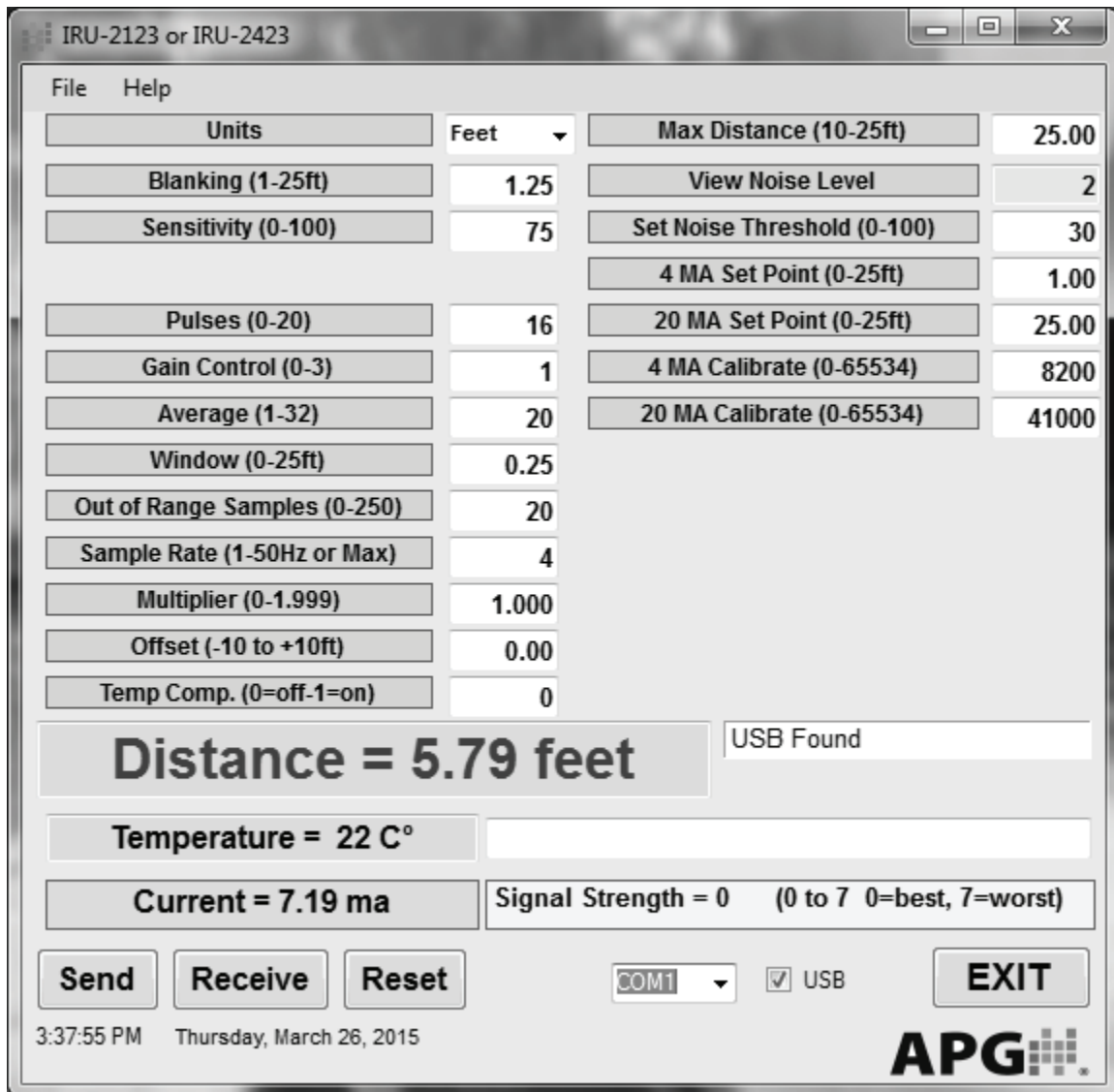
Figure 3.1

The top and middle Communication Status boxes in the right column show the status of communication between the I2000SWR software and the RST-3002, and between the I2000SWR software and the sensor (See Figure 3.2).
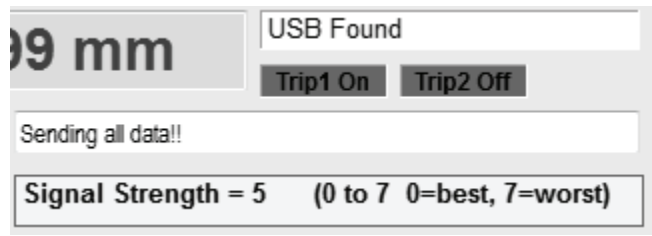

Figure 3.2

When the I2000SWR software is started it will attempt to establish communications with your IRU sensor via the RST-3002 module. The Send button will grey-out and the *Sensor Communication Status* will display "Receiving all data!!" During this initial communication, the software will determine the model number of your sensor (IRU-XXXX), configure the available parameters accordingly, and load the current parameter values from the sensor.

If the sensor model in the upper left-hand corner of the window does not change from the default (IRU-2003), then a communication error has occured. Check all wiring to ensure proper connections have been made (See Figure 1.3). Then close (*Exit*) the software and open it again.

Changes to parameters are written to the sensor by clicking on the *Send* button. During the writing process, the *Sensor Communication Status* will display "Sending all data!!" The message will then change to "Communication Error!!!" and the parameter fields will briefly change to green. The fields will then blank to white and the *Sensor Communication Status* will display "Receiving all data!!" At this point the parameter fields will turn greyish-blue and be populated with the new values read from the sensor.

The "Communication Error!!!" message in this process is a result of the brief time needed for the sensor to switch from receiving the new paramters to sending all the parameters back to the software. As long as your changes are reflected in the final read of the sensor data, there has not been an actual communication error.

APG

- ## IRU Sensor Parameters

PARAMETER	RANGE
Units	Feet
	Inches
	mm

Units is used to select the units of measurement for parameter display. The units will also determine the resolution of the display and the outputs. The resolution is: feet 0.01, inches 0.1, and millimeters 1.
When a new unit of measure is selected, the software will automatically communicate with the sensor and update appropriate paramters.

PARAMETER	RANGE
Blanking	Determined by sensor model

Blanking sets the blanking distance, which is the zone from the Zero Point of the sensor to the point from which the first echo will be accepted. While blanking distance can be used to ignore unwanted targets--such as welds, seams, pipe fittings, or gaskets--between the sensor and the closest acceptable target level, such objects generally create additional reflections and echoes, which are hard to filter out. More often, blanking distance is used for a sensor installed in a stand pipe.

Because of the physical properties of an ultrasonic sensor, objects cannot be detected closer than approximately 1 foot from the face of most transducers (4 inches for IRU-5XXX, and 6 inches for IRU-942X). However, this distance varies according to how much energy is being transmitted (*Pulses*) and the installation.

> ❶ IMPORTANT: *Blanking* is always measured from the Zero Point of the sensor. See Figures 3.4 - 3.6.

PARAMETER	RANGE
Sensitivity	0 - 100%

Sensitivity sets the level of gain that is applied to the echo. When operating in AutoSense, Hard-Target, or Soft-Target (see *Gain Control*), *Sensitivity* sets an upper limit for the amplification that can be applied to the echo. If operating in Manual, this parameter sets the gain.

When using manual gain control, set *Sensitivity* to the minimum value that will allow the target to be reliably tracked through the full range of expected environmental conditions.

PARAMETER	RANGE
Sens/Trip Control	0 = manual (potentiometer)
IRU-2002 , IRU-2003 only	1 = program (software)

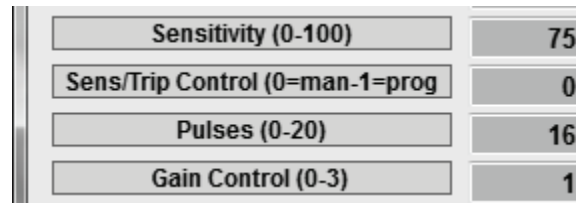For IRU-2002 sensors, *Sensitivity/Trip Point Control* is used to select between potentiometer or software control of *Sensitivity* and *Relay Trip Point*. (See Figure 2.1)

For IRU-2003 sensors, *Sensitivity/Trip Point Control* is used to select between potentiometer or software control of *Sensitivity*. (See Figure 2.2)

Figure 3.3

PARAMETER	RANGE
Pulses	0-20

Pulses sets the maximum number of pulses the sensor can transmit when operating in AutoSense, Hard-Target, or Soft-Target (see *Gain Control*), or sets the number of pulses when operating in Manual. The more pulses that are sent in a burst, the stronger the returning echo.

When operating in Manual, increase the strength of the transmission by increasing *Pulses* for detecting soft targets in damping environments. In acoustically active environments or small enclosed areas, decrease *Pulses* to reduce multiple echoes.

PARAMETER	RANGE
Gain Control	0 = Manual
	1 = AutoSense
	2 = Hard-Target
	3 = Soft-Target

Gain Control selects the control mode for the sensor's gain settings (*Sensitivity* and *Pulses*). In AutoSense, the sensor automatically adjusts the sensitivity and pulses for the best quality return signal. Manual, Hard Target, and Soft Target are user controlled scenarios. In Manual, the user is in full control of *Sensitivity* and *Pulses*. For Hard and Soft Target, the user sets maximum *Sensitivity* and *Pulses*, but the overall gain is either ramped up slowly (Hard Target) or quickly (Soft Target) by the sensor.

PARAMETER	RANGE
Average	1-32

Average sets the number of qualified received signals to average for the displayed reading. Qualified received signals are placed in a first-in, first-out buffer, the contents of which are averaged for the displayed output. The larger the number of qualified received signals being averaged, the smoother the output reading will be, and the slower the reading will be to react to quickly changing targets.

APG

PARAMETER	RANGE
Window	Determined by sensor model

Window determines the physical range of qualified received signals, based on the current reading. Signals beyond the +/- *Window* range of the current reading will not qualify unless the average moves. Signals outside the extents of the *Window* are written to the *Out of Range Samples* buffer.

PARAMETER	RANGE
Out of Range Samples	0-250

Out of Range Samples sets the number of consecutive samples outside the *Window* necessary to automatically adjust the current reading and move the *Window*.

PARAMETER	RANGE
Sample Rate	1 Hz to sensor Maximum

Sample Rate is the number of samples taken by the sensor every second. While higher sample rates allow for quicker sensor response times to changing levels, lower sample rates reduce the likelihood of echo-based false positives. Also, lower sample rates result in longer sensor life.

PARAMETER	RANGE
Multiplier	0 - 1.999

Multiplier is used to calibrate the sensor for variations in the speed of sound due to variations in atmospheres. The default of 1.000 is used for most applications. See the Calibration section of Chapter 4.
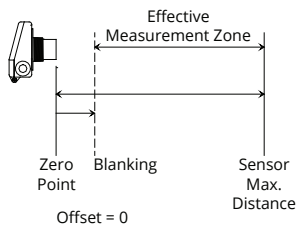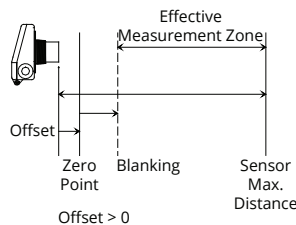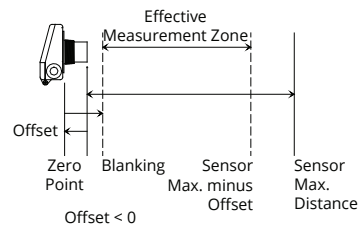
Figure 3.4   **Figure 3.5**   **Figure 3.6**

PARAMETER	RANGE
Offset	-10 ft - + 10ft

Offset is used to change the Zero Point of the sensor. This is not the zero output (4 mA, 0 V, etc.) point of the sensor. The Zero Point of the sensor is the point from which the calculated distance is measured. When the Offset is set to 0, the Zero Point of the sensor is at the face of the transducer (See Figure 3.4). A positive setting will move the Zero Point forward, in front of the sensor face (See Figure 3.5). Setting the Offset to a negative number will move the Zero Point backward, behind the sensor face (See Figure 3.6).

In all cases, Blanking is measured from the end of Offset, and the effective measurement zone of the sensor begins at the forward end of Blanking. If Offset is more negative than Blanking is positive, the net difference will be a loss in sensor maximum range (See Figure 3.6).

PARAMETER	RANGE
Temp Comp.	0 = Off
	1 = On

Temperature Compensation activates or deactivates the IRU's internal temperature compensation circuit. The speed of sound changes with changes in temperature, therefore changes in temperature can affect distance measurements. These effects can be minimized by activating temperature compensation.

> ✏ NOTE: If the internal temperature compensation is enabled and the sensor is exposed to direct sun light, the radiant heat can warm the sensor housing above the ambient temperature, which can affect the internal temperature sensor and cause overcompensation.

PARAMETER	RANGE
Max Distance	Determined by sensor model

Maximum Distance sets the maximum acceptable signal range for the sensor, measured from the Zero Point. Signals beyond the *Maximum Distance* are ignored. Under Loss of Echo conditions, the software distance reading will display the *Maximum Distance*.

PARAMETER	RANGE
View Noise Level	0 - 100
Read Only	

View Noise Level displays the number of echoes being picked up by the sensor. The presence of more than 30 echoes often indicates a noise source (acoustical or electrical) that could hamper sensor operation. Reducing the *Sensitivity* and *Pulses* may help cut down the influence of noise.

PARAMETER	RANGE
Set Noise Threshold	0 - 100

Set Noise Threshold sets an activation level for the sensor's noise filter. When the noise level exceeds the threshold, the filter activates a steady reading on the sensor until the noise level returns below the threshold. If periodic, short-term noise sources are known to be operating near the sensor, this threshold can be set to prevent false readings during noise-source activities.

APG⸬

PARAMETER   **RANGE**

4 MA Set Point   0 - Sensor Max Distance
Sensor Models with 4-20 mA output only

4 mA Set Point sets the distance at which the output is 4 mA. This distance is measured from the Zero Point. See Figures 3.3 and 3.4.

PARAMETER   **RANGE**

20 MA Set Point   0 - Sensor Max Distance
Sensor Models with 4-20 mA output only

20 mA Set Point sets the distance at which the output is 20 mA. This distance is measured from the Zero Point. See Figures 3.7 and 3.8.

For Distance configuration (i.e., greater mA output for target surface further from sensor), set the *4 mA Set Point* to be less than the *20 mA Set Point*. See Figure 3.7.
For Fill configuration (i.e., greater mA output for target surface closer to sensor), set the *4 mA Set Point* to be greater than the *20 mA Set Point*. See Figure 3.7.
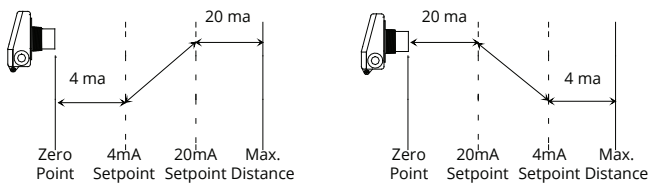
Figure 3.7

Figure 3.8

PARAMETER   **RANGE**

0 VDC Set Point   0 - Sensor Max Distance
Sensor Models with 0-2.5 / 0-5 VDC output only

0 VDC Set Point sets the distance at which the output is 0 VDC. This is measured from the Zero Point. (See Figures 3.9 and 3.10)
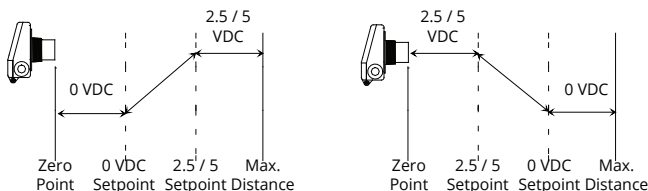

Figure 3.9

Figure 3.10

PARAMETER	**RANGE**
5 VDC Set Point	0 - Sensor Max Distance
2.5 VDC Set Point	0 - Sensor Max Distance

Sensor Models with 0-2.5 / 0-5 VDC output only

5 VDC Set Point and *2.5 VDC Set Point* set the distance at which the output is high voltage (2.5 or 5 VDC). This is measured from the Zero Point (See Figures 3.9 and 3.10). Use the *Max Voltage* parameter to select the high voltage output.

For Distance configuration (i.e., greater VDC output for target surface further from sensor), set the *0 VDC Set Point* to be less than the *2.5/5 VDC Set Point*. (See Figure 3.9)
For Fill configuration (i.e., greater VDC output for target surface closer to sensor), set the *0 VDC Set Point* to be greater than the *2.5/5 VDC Set Point*. (See Figure 3.9)

PARAMETER	**RANGE**
Max Voltage	0 - 2.5V
	1 - 5V

Sensor Models with 0-2.5 / 0-5 VDC output only

Max Voltage selects the maximum DC voltage sourced on the analog output. (See Figure 3.10)

PARAMETER	**RANGE**
5 Volt Calibrate	0 - 4096
2.5 Volt Calibrate	Default: 4095

Sensor Models with 0-2.5 / 0-5 VDC output only

5 Volt Calibrate and *2.5 Volt Calibrate* fine tune the maximum DC voltage sourced on the analog output.

PARAMETER	**RANGE**
4 MA Calibrate	0 - 65534
	Default: 8200

Sensor Models with 4-20 mA output only

4 mA Calibrate fine tunes the minimum current sourced on the analog output. (See Figure 3.8)

PARAMETER	**RANGE**
20 MA Calibrate	0 - 65534
	Default: 41000

Sensor Models with 4-20 mA output only

20 mA Calibrate fine tunes the maximum current sourced on the analog output. (See Figure 3.8)

APG

- ## Relay and NPN Trip Output Configuration

Along with, or instead of, an analog output, some IRU sensors have relay (IRU-2002) or NPN Trip (IRU-2004, IRU-XXX5) outputs.The relay or NPN can be configured to turn on or off based on the measurement of the sensor. (See Figure 3.11)

Trip Distance 1 (0-2438mm)	1500
Trip Window 1 (0-2438mm)	2000
Trip Type 1 (0-5)	Inclusive ▼
Trip Distance 2 (0-2438mm)	0
Trip Window 2 (0-2438mm)	0
Trip Type 2 (0-5)	Near ▼

Figure 3.11

PARAMETER	RANGE
Trip Distance	0 - Sensor Max Distance

Trip Distance sets the distance to the trip position closest to the sensor face.

PARAMETER	RANGE
Trip Window	0 - Sensor Max Distance

Trip Window sets the distance from the first trip position to the trip position farthest from the sensor face.

Trip Type

0 - Near

Near activates the output whenever the target surface is closer than the *Trip Distance* setting.

Trip Type

1 - Exclusive

Exclusive activates the output whenever the target surface is closer than the *Trip Distance* setting OR beyond the *Trip Distance + Trip Window* setting.
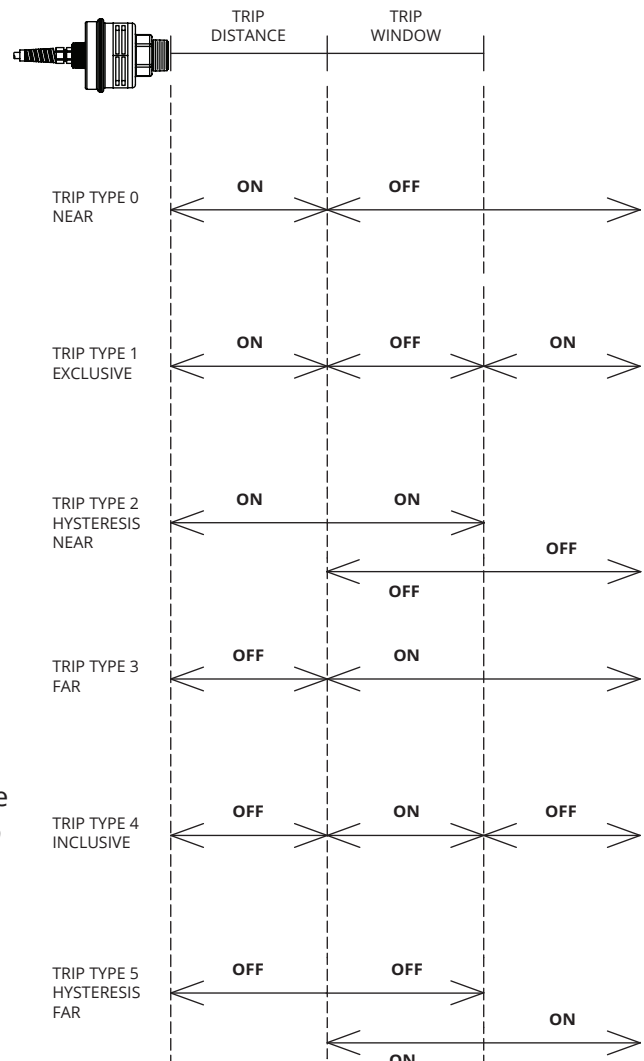

Figure 3.12

APG

Trip Type

2 - Hysteresis Near

Hysteresis Near activates the output whenever the target surface moves closer than the *Trip Distance* setting. The output remains activated until the target surface moves beyond the *Trip Distance + Trip Window* setting. The output remains off until the target surface moves closer than the *Trip Distance* setting again.

Trip Type

3 - Far

Far activates the output whenever the target surface is beyond the *Trip Distance* setting.

Trip Type

4 - Inclusive

Inclusive activates the output whenever the target surface is beyond the *Trip Distance* setting AND closer the *Trip Distance + Trip Window* setting.

Trip Type

5 - Hysteresis Far

Hysteresis Far activates the output whenever the target surface moves beyond the *Trip Distance + Trip Window* setting. The output remains activated until the target surface moves closer than the *Trip Distance* setting. The output remains off until the target surface moves beyond the *Trip Distance + Trip Window* setting again.
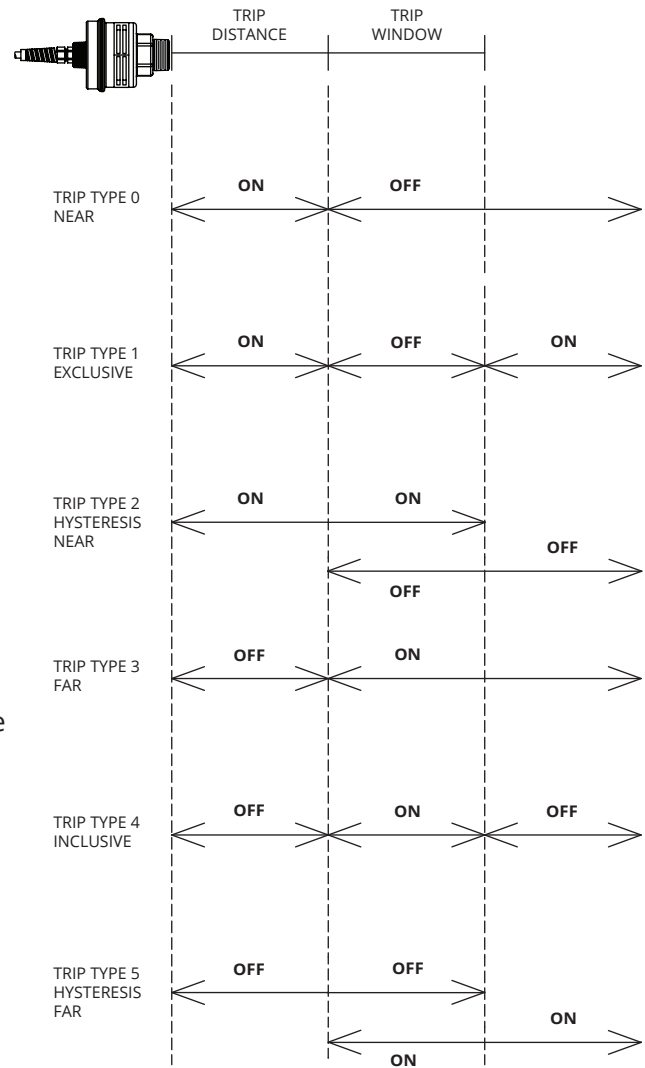

Figure 3.12

- ## Sensor Readings and Communication Status

Below the Sensor Parameters and Output Configuration is the Sensor Readings and Communication Status area. On the left side are three sensor reading displays: Distance, Temperature, and Analog Output (current or voltage). On the right side are three or four communication status displays: *USB status*, *Trip 1*, *Trip 2*, or *Relay Status* (depending on sensor model), *Sensor Communication Status*, and *Signal Strength Status*. (See Figure 3.13)
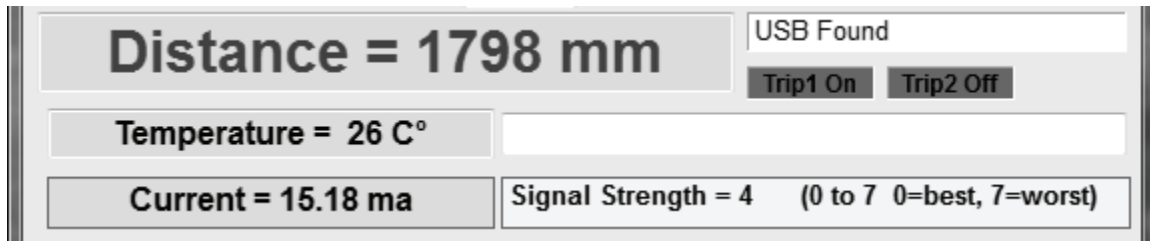
APG

Figure 3.13

Reading Type

Distance

Distance displays the current output of the sensor in the units selected in the *Units* parameter above.

Reading Type

Temperature

Temperature displays the current temperature of the thermal device in the IRU sensor body.

Reading Type	**Range**
Analog Output	Current (4-20 mA sensors)
	Voltage (0-2.5 / 0-5 VDC sensors)

Analog Output displays the current analog output (all models except IRU-2002 and IRU-2004) of the sensor.

Communication Type	**Range**
USB Status	USB Not Found
	USB Found

USB Status displays the status of the USB connection between the I2000SWR software and the RST-3002 as detected when the software initiated.

Communication Type	**Range**
Trip 1 Status	On
Trip 2 Status	Off
Relay Status	

Trip Status displays the status of the relay (IRU-2002), NPN Trip (IRU-2004), or NPN Trips (IRU-XXX5).

Communication Type	**Range**
Sensor Com Status	Receiving all data!!
	Sending all data!!
	Commmunication Error!!!

Sensor Communication Status displays the current status of communication between the I2000SWR and the IRU sensor. Typically this box is blank. The three messages--"Receiving all data!!", "Sending all data!!", and "Communication Error!!!"--only display while their respective events are happening.

Communication Type	Range
Signal Strength Status	0 - 7
	Default

Signal Strength Status displays the strength of the signal being received by the sensor. 0 represents the highest quality signal, and 7 represents the lowest quality. For some sensor models, the *Signal Strength Status* may show "Default" if the sensor is not fully communicating with the I2000SWR software. Other models only display "Default," and never show the 0-7 range.

• Control Buttons

Below the Sensor Readings and Communication Status area are four Control Buttons. On the left side are three sensor communication buttons: Send, Receive, and Reset. In the middle are a dropdown box and check box for selecting the communication channels. On the right side is the Exit button. (See Figure 3.14)
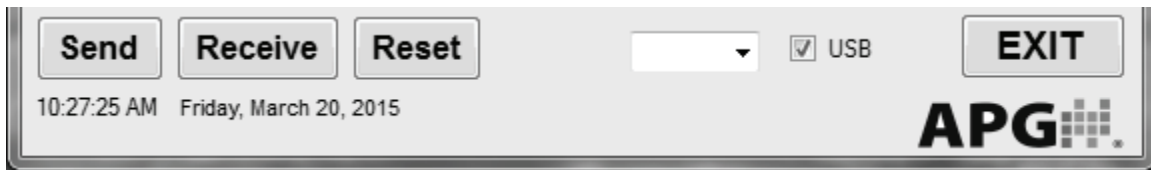
Figure 3.14

Control Button
Send

Send sends all the user-entered values for sensor parameters to the sensor. After sending the parameters to the sensor, the software will automatically poll the sensor to receive back all parameters. The *Sensor Communication Status* display will show the progression of the writing and reading of sensor parameters.

Control Button
Receive

Receive polls the IRU sensor to read all the sensor parameters into the software. The Sensor Communication Status display will show the progression of the reading of sensor parameters.

Control Button
Reset

Reset returns all sensor parameters to their factory settings. After reseting the parameters on the sensor, the software will automatically poll the sensor to receive back all parameters The *Sensor Communication Status* display will show the progression of the resetting and reading of the sensor parameters.

APG

Dropdown Box	**Range**
Com Channel	No Selection
	1

Com Channel selects the computer's communication port used for RS-232 serial communication between the I2000SWR software and the IRU sensor. If you are using an RST-3002 via USB you do not need to use this dropdown box.

Check Box

USB

The *USB* checkbox directs the I2000SWR software to use communicate with the IRU sensor via USB and an RST module. If the box is unchecked, the software will use RS-232 via the selected com port in the *Com Channel* dropdown box.

Control Button

Exit

Exit closes the I2000SWR software. Sensor parameters that have been successfully written to the sensor will be stored in non-volatile memory on the IRU.

- ## Saving and Loading Parameter Files

In the File Menu are options for saving and loading parameters in text (.txt) files. Save Parameters will write the current values for all parameters in the I2000SWR software to a .txt file. Load Parameters will load all the parameters in a .txt file into the I2000SWR software. The parameters will not be written to the IRU until the *Send* button is clicked. Similarly, to ensure that the current parameters in the IRU are written to a file, *Receive* must be clicked before choosing File>Save Parameters.

Saving and loading parameters is especially helpful for setting up several identical sensors in identical settings. Once the parameters for the first sensor are configured appropriately, the parameters can be saved in a .txt file and subsequently loaded into the remaining sensors.

Chapter 4: Maintenance

- ## General Care

  Your IRU ultrasonic sensor is very low maintenance and will need little care as long as it was installed correctly. However, in general, you should:
  - Avoid applications for which the sensor was not designed, such as extreme temperatures, contact with incompatible corrosive chemicals, or other damaging environments.
  - Inspect the threads whenever you remove the sensor from duty or change its location (for sensors with NPT threads).

- ## Trouble Shooting

  Should you have problems with your IRU, here are some troubleshooting steps.
  - Check the *Signal Strength Status* (See Figure 3.9 on page 26 and explanation on page 27). If the signal strength is low, alternately increase *Pulses* and *Sensitivity* (pages 18 and 19) until the signal strength improves.
  - Ensure *Temperature Compensation* (page 21) is turned on.
  - Set *Gain Control* (page 19) to AutoSense.
  - Ensure that *Blanking* (page 18)is accurately set to account for any unwanted targets between the sensor and the closest acceptable target.
  - Ensure that the *Noise Threshold* is greater than the *Noise Level* (page 21).
  - Ensure that the settings for *Average* and *Window* (pages 19 and 20) allow for anticipated target surface movement without adversely effecting the output reading.

- ## Calibration

  This procedure uses targets at known distances to calibrate the sensor's accuracy. A wall or other large, flat object is recommended for the long range target.
  - Point the sensor at a target at a known distance near the maximum range of the sensor (See Figure 4.1).
  - Adjust the *Multiplier* until the distance reading on the sensor matches the actual measured distance to the target.
  - Point the sensor at a target near the minimum measurement range plus any *Blanking* distance (See Figure 4.2).
  - Adjust the *Offset* value until the distance reading on the sensor matches the actual measured distance to the target.
  - Repeat previous two steps until no further adjustment is required.

APG

measure

measure

Figure 4.1   **Figure 4.2**

> ✏ NOTE: The *Reset* button in the I2000SWR software will reset the IRU to factory default settings (See Figure 3.14).

• **Repair and Returns**

Should your IRU ultrasonic sensor require service, please contact the factory via phone, email, or online chat. We will issue you a Return Material Authorization (RMA) number with instructions.

- Phone: 888-525-7300
- Email: sales@apgsensors.com
- Online chat at www.apgsensors.com

Please have your IRU sensor's part number and serial number available. See Warranty and Warranty Restrictions for more information.

Chapter 5: Hazardous Location Drawing and Certification

- **Hazardous Location Drawing**

- **CSA Certificate of Compliance**

CSA INTERNATIONAL

Certificate of Compliance

Certificate:	1384697	**Master Contract:**	237484
Project:	2166699	**Date Issued:**	2010/02/19

Issued to: **Automation Products Group Inc**

1025 West 1700 North
Logan, UT 84321
USA
Attention: Karl Reid

The products listed below are eligible to bear the CSA Mark shown with adjacent indicators 'C' and 'US' for Canada and US or with adjacent indicator 'US' for US only or without either indicator for Canada only.

C CSA US

Issued by: Ron Wachowicz, C.E.T.

Authorized by: Gary Boswell, P.Eng., Product Group Manager

PRODUCTS

CLASS 2252 03   - PROCESS CONTROL EQUIPMENT
CLASS 2252 83   - PROCESS CONTROL EQUIPMENT - Certified to US Standards
CLASS 2258 02   - PROCESS CONTROL EQUIPMENT - For Hazardous Locations
CLASS 2258 82   - PROCESS CONTROL EQUIPMENT - For Hazardous Locations - Certified to US Standards

CLASS 2252 03 – PROCESS CONTROL EQUIPMENT

DQD 507 Rev. 2009-09-01

| **Certificate:** | 1384697 | **Master Contract:** | 237484 |
| **Project:** | 2166699 | **Date Issued:** | 2010/02/19 |

CLASS 2252 83 – PROCESS CONTROL EQUIPMENT – To U.S. Requirements

IRU Series Ultrasonic Sensors, Models IRU-2002**, IRU-2003**, IRU-2005**, IRU-2122, IRU-2123, IRU-2125, IRU-2423, IRU-2425, IRU-3133, IRU-3135, IRU-3433, IRU-3435, IRU-5113, IRU-5115, IRU-5119, IRU-5413, IRU-5415, IRU-5423, IRU-5425, IRU-5429, IRU-6429, IRU-9423, IRU-9425 and IRU-9429 input Rated 12 to 28Vdc, 80mA max; Outputs 4-20mA, solid state relay, NPN; Ambient temperature range -30°C to +60°C.

** designates the color of the housings BK = black, RD = red, default = blue

DST Series Ultrasonic Sensor Models DST-2421, DST-3431, DST-5111 and DST-9421 input Rated 12 to 28Vdc, 60mA max; Ambient temperature range -30°C to +60°C.

NOTE: The above models are Pollution Degree 2, Installation Category II.

CLASS 2258 02 – PROCESS CONTROL EQUIPMENT – For Hazardous Locations

CLASS 2258 82 – PROCESS CONTROL EQUIPMENT – For Hazardous Locations – To U.S. Requirements

Class I, Division 2, Groups C and D, T6; Ex nA IIB T6 (Canada), IP65; Class I, Zone 2; AEx nA IIB, T6 (USA), IP65:

IRU Series Ultrasonic Sensors, Models IRU-2125, IRU-3135, IRU-2423, IRU-2425, IRU-3433, IRU-3435, IRU-5413, IRU-5415, IRU-5423 and IRU-5425; input Rated 12 to 28Vdc, 80mA max; Outputs 4-20mA, NPN; Ambient temperature range –30°C to +60°C.

NOTE: The above models are Pollution Degree 2, Installation Category II.

APPLICABLE REQUIREMENTS

C22.2 No 0 - M1991 - General Requirements - Canadian Electrical Code Part II.

C22.2 No 0.4 - M1982 - Bonding and Grounding of Electrical Equipment (Protective Grounding).

C22.2 No 213 - M1987 - Non-Incendive Electrical Equipment for Use in Class I, Division 2 Hazardous Locations.

CAN/CSA-C22.2 No. 1010.1-92 - Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use, Part 1: General Requirements (Includes Amendment 1)

CAN/CSA-C22.2 No. 1010.1B 97 - Amendment 2 to CAN/CSA C22.2 No. 1010.1 92, "Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use, Part 1: General Requirements"

T.I.L. No I -29 - Additional Requirements For Process Control Equipment Certified to CSA Standard CAN/CSA C22.2 No 1010.1-92

| **Certificate:** | 1384697 | **Master Contract:** | 237484 |
| **Project:** | 2166699 | **Date Issued:** | 2010/02/19 |

ISA S82.01-1994 - Safety Standards for Electrical and Electronic Test, Measuring, Controlling, and Related Equipment - General Requirements

CAN/CSA E60079-0:07 - Electrical apparatus for explosive gas atmospheres - Part 0 - General requirements.

CAN-CSA E60079-15:02 - Electrical Apparatus for Explosive Gas Atmospheres - Part 15-Type of Protection n.

UL 1604, Third Edition - Electrical Equipment for Use in Class I and II, Division 2, And Class III Hazardous (Classified) Locations.

UL 60079-0, 4th Ed. - Electrical Apparatus for Explosive Gas Atmospheres - Part 0 - General Requirements.

UL 60079-15, 1st Ed. - Electrical Apparatus for Explosive Gas Atmospheres - Part 15 - Electrical Apparatus with Type of Protection n.

APG

®

Automation Products Group, Inc.
Tel: 1/888/525-7300 • Fax: 1/435/753-7490 • www.apgsensors.com • sales@apgsensors.com