



# SINGLE CHANNEL ANALYZER

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## GENERAL INFORMATION

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### Product Description

The Single Channel Analyzer (SCA) is designed for the continuous measurement of dissolved oxygen, suspended solids, pH or ORP in aqueous solutions. The microprocessor-based electronics of the SCA provides a high degree of flexibility and ease of use. The SCA has two isolated analog outputs and a Modbus interface. Also included are three programmable set-point relays and one relay to control self-cleaning.

The SCA is designed to operate with any one of the following InsiteIG sensors in a variety of applications.

**The M10** Dissolved Oxygen sensor is designed for the continuous monitoring of dissolved oxygen in water and wastewater where parts per million accuracy is required. The M10 sensor is an optical type sensor that measures the fluorescence and quenching reactions of a ruthenium complex that is immobilized in a sol-gel matrix. The SCA will display dissolved oxygen content in PPM, mg/l or %SAT. The resolution in PPM and mg/l mode is 0.01 over a range of 0.00 to 3.99 and 0.1 over a range of 4.0 to 25.0. The resolution in %SAT mode is 0.1%SAT over a range of 0.0 to 99.9%SAT and 1%SAT over a range of 100 to 300%SAT. Temperature is displayed in 0.1 degree Celsius increments over a 0.0 to 50.0 degree Celsius range or 1 degree Fahrenheit increments over a 32 to 122 degree Fahrenheit range. The sensor incorporates self-cleaning optics via air or water jet.

**The M15** TSS sensor has been designed for medium ranges (0 to 30,000 mg/l) as commonly found in aeration basins of wastewater treatment plants. **The M15L** sensor has been designed for low ranges (0 to 1500 mg/l) as commonly found in effluent streams. Both SS sensors operate on the principle of single gap light absorption as a means of detecting the presence of suspended solids. Both sensors utilize an infrared emitter to minimize color effects and compensate for emitter variations due to temperature by measuring source brightness. They incorporate self-cleaning optics via air or water jet.

**The M50** is a microprocessor based preamp interface for use with the **M51** pH or **M52** ORP electrodes. (Please specify pH or ORP when ordering the **M50**.) The pH and ORP sensors are flat glass electrodes designed for maximum durability in waste water environments. The SCA can display the pH value in 0.01 pH resolution over a range of zero to 14.00 pH. However, the standard M51 pH electrode is only rated for a pH range of 2 to 12. Water temperature is also measured for automatic temperature compensation. The temperature is displayed in 0.1 degree Celsius increments or 1 degree Fahrenheit increments. The SCA can display the ORP value in 1 mV resolution over a range of -2000 to 2000 mV. The M50 incorporates self-cleaning via air or water jet.

### Packaging

The SCA is housed in a NEMA 4X enclosure (see Drawing IIG01N111 for Outline and Mounting) and is designed for outdoor mounting. For areas where the environmental temperature is expected to drop below 14 degrees Fahrenheit (-10 degrees Celsius) for extended periods of time, the optional automatic heater assembly is recommended.

## INSTALLATION

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1. The SCA should be located conveniently for an operator to read and a technician to install and maintain. A handrail mounting kit is available for the SCA enclosure (see Drawing IIG01N110). This mounting kit is designed for a standard 2" handrail but can be adapted to square or angle handrails as well.



Use a QR reader app on a mobile device to scan for the Analyzer Mounting video or **CLICK HERE**

**DO NOT! Locate the analyzer where it is likely to be damaged during unrelated or other periodic maintenance such as pressure washing catwalks.**

2. Consult the following drawings for sensor mounting options and location guidelines:
  - IIG01N005 – Sensor Handrail Mounting for Open Basin or Channel Applications
  - IIG02N004 – M10 D.O. Sensor Outline
  - IIG03N004 – M15 TSS Sensor Outline
  - IIG03N010 – M15L Low Range SS Sensor Outline
  - IIG07N201 – M50 pH/ORP Electrode Interface Outline
  - IIG03N006 – TSS sensors for pipe “T” mounting: M15T (PVC) or M15PI (SS)
  - IIG03N007 – Installation Diagram for a M15T By-Pass Line.



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**DO NOT install a pH/ORP holder (M50) without a pH cartridge (M51) or an ORP cartridge (M52) installed and properly seated in the pH/ORP holder. Installing a pH/ORP holder without a pH or an ORP cartridge will void the warranty.**



**WARNING! – Before opening; switch off the analyzer line power at the circuit breaker to avoid risk of shock. Line power is present on terminals even when analyzer is switched off.**



**WARNING! – Circuit breaker meeting IEC-947-3 must be on line supply, in close proximity to equipment and shall be marked as the disconnecting device for the equipment.**

3. Open the enclosure of the SCA. Pass all connection cables through glands or ½" conduit in the bottom of the enclosure (gland and conduit are not supplied). The sensor input connections are made to terminal block TB5 (labeled SENSOR 1) see drawing IIG01R111. The four wires are color coded and there is a cable shield. Connect the RED wire to the terminal labeled "RED". Connect the GREEN wire to the terminal labeled "GRN". Connect the WHITE wire to the terminal labeled "WHT". Connect the BLACK wire to the terminal labeled "BLK". Connect the cable SHIELD to the terminal labeled "SHLD". The analog outputs are available on the terminal block labeled TB1 and the relay outputs are available on the terminal block labeled TB6.
4. Power Selector Switch: Check switch S4 on the circuit board to be sure that it is set for the type of power being used (115 volts or 230 volts). Power connections should now be made to the terminal block labeled TB3. Turn power "on" by using switch S3. Close and secure the enclosure.
5. Switch the circuit breaker on and the unit will now power up.
6. Once the SCA is turned on, the unit will initialize and then jump into the "RUN" mode and begin displaying readings appropriate for the connected sensor. (Sensor type selection is automatic.)

**Note: In order for the sensors to operate properly, the frequency select parameter must be set to the power line frequency (50/60 Hz). See sensor setup section for details.**

7. The first time the unit is powered up with the sensor in the process, 15 minutes are required for the sensor to stabilize. The reading will drift slightly during this period. After approximately 15 minutes the sensor will respond correctly. In the event the sensor is removed from the process for a short period of time, the sensor should be allowed to stabilize for approximately 10 minutes after it is put back in the process.

## **Analog Outputs**

Two isolated 4-20 or 0-20 milliamp signals capable of driving 600 ohms are available from the terminal block labeled TB1. See drawing IIG01R111 for details. The analog #1 output, for the sensor's primary measurement, is labeled "I 1" and the analog #2 output, for the sensor's temperature if available, is labeled "I 2". The common or ground for these signals are labeled "ICOM".

## **Digital Output**

A Modbus communications (RS-485) output is available from TB2. This is a three wire signal with a transmit/receive plus (labeled X+), a transmit/receive minus (labeled X-), and a signal ground or common (labeled X COM). The Modbus interface uses 8 bits, no parity, 1 stop bit. See drawing IIG01R111 for details. The RS-485 interface is electrically isolated from the measurement and microprocessor circuitry of the SCA. The communications protocol for the Digital Output is fully described in Appendix A.

## **Relay Outputs**

There are three independent programmable set point control relays. Two of these relays are Form-C and one relay is Form-A with contacts rated 10/6 amps resistive load at 125/250 VAC. One Form-A relay with contacts rated 10/6 amps resistive load at 125/250 VAC is used for the jet clean function. The connections for the relay outputs are available from TB6. See drawing IIG01R111 for connection details.



**Note! – In “Normal Operation” the hinge cover is to remain tightly screwed closed. Under no circumstance is it necessary for the operator to open the enclosure during normal operation.**

### Run Mode

The RUN mode is the normal operating mode of the SCA and begins automatically at power-up. When the Run mode is begun, the SCA will determine what type of sensor is attached. The supplied sensor has been calibrated at the factory. The display is continuously updated with the current measurement values. Also, the analog output and the relays are updated according to the current conditions and their programmed functions. In the event of an error or alarm condition the display will indicate the problem in plain English text.

Sensor field calibration information is stored in non-volatile memory of the SCA. If a M15/M15L is connected to the SCA, and the sensor has not been previously “Zeroed” on this SCA, the SCA will display a configuration message. The configuration message for the M15/M15L TSS sensor is “\*\*Zero sensor\*\*”. These messages will appear whenever a different M15/M15L is connected to the SCA. See the SS sensor section.

While in the RUN Mode, the time to next scheduled clean cycle can be viewed by pressing and holding either arrow key. A clean cycle can be demanded by pressing the ENTER key while in the RUN Mode, see the section on Demand Clean.

### Main Menu

The Main Menu is accessed by pressing the “MENU” key while in the RUN mode of operation. There are three options selectable from the main menu. Use the arrow keys to switch between RUN, SETUP, or TEST, and then press the “ENTER” key to select.

### Setup Mode

This mode of operation allows the user to customize the unit to the specific operation and needs of the facility. There are a total of four subcategories that may be adjusted.

Operation of the SETUP MODE proceeds as follows:

First, after pressing the “MENU” key, use the “ARROW” keys to move the cursor to the SETUP option, then press the “ENTER” key. A menu with four options will be displayed. The M10/M50 options are;

- Relays
- Analog Output
- Modbus
- Sensor Setup

The M15/M15L options are:

- Sensor Cal.
- Relays
- Analog Output
- Modbus

Second, use the “ARROW” keys to move the cursor to the desired setup function, then press the “ENTER” key. The sub-menu for that group will be displayed. Use the “ARROW” keys to move the cursor to the specific item to be changed, then press the “ENTER” key. When the user is finished making the

adjustment, press the “MENU” key to return to the previous page.

Finally, to return to the RUN MODE, press the “MENU” key until the MAIN MENU is displayed. Use the “ARROW” keys to move the cursor to the RUN option, then press the “ENTER” key.

## Relay

From the setup menu, use the “ARROW” keys to move the cursor to the “1-Relays” option, and then press the “ENTER” key. There are 16 menu options for configuring the relays.

#1 Op Mode –	defines operational mode of relay 1
#1 ON Setpt –	defines when relay 1 will energize
#1 OFF Setpt –	defines when relay 1 will de-energize
#1 Fail Mode –	defines the relay 1 state during an alarm condition
#2 Op Mode –	defines operational mode of relay 2
#2 ON Setpt –	defines when relay 2 will energize
#2 OFF Setpt –	defines when relay 2 will de-energize
#2 Fail Mode –	defines the relay 2 state during an alarm condition
#3 Op Mode –	defines operational mode of relay 3
#3 ON Setpt –	defines when relay 3 will energize
#3 OFF Setpt –	defines when relay 3 will de-energize
#3 Fail Mode –	defines the relay 3 state during an alarm condition
CIn Schedule –	defines how often relay 4 will energize cleaning
CIn Jet Time –	defines duration of time the clean relay will be energized
CIn Recovery –	defines how long the reading holds after the clean cycle
CIn TSS Thres –	defines what TSS value will cause a clean cycle

The following section is a brief discussion of considerations for configuring relays 1, 2 and 3.

**Note: Do not attempt to adjust relay set point values until a working sensor has been connected to the SCA. Otherwise, the analyzer may not display the correct measurement units for the channel.**

### Low Setpoint

If a relay “Op Mode” has been set as a Low Setpt, then the corresponding relay will energize if the reading falls below the value set in the “ON Setpt” parameter. Once the relay has been energized by a low reading, it will not be de-energized until the reading rises above the value set in the “OFF Setpt” parameter. The relay “OFF Setpt” value MUST be greater than or equal to the “ON Setpt” value in this mode.

### High Setpoint

If a relay “Op Mode” has been set as a High Setpt, then the corresponding relay will energize if the reading rises above the value set in the “ON Setpt” parameter. Once the relay has been energized by a high reading, it will not be de-energized until the reading falls below the value set in the “OFF Setpt” parameter. The relay “OFF Setpt” value MUST be less than or equal to the “ON Setpt” value in this mode.

### Alarm

If a relay “Op Mode” has been set as an Alarm, then the corresponding relay will indicate alarm or error conditions. In this mode, the relay is energized during normal operation and will become de-energized if an error condition occurs. Consequently, loss of power can be sensed remotely as an alarm condition. In this mode the ON Setpt and the OFF Setpt parameters are ignored.

## Clean Mode

The jet clean system is intended to be controlled by the SCA through relay 4. The relay is connected to the InsiteIG compressor (CA-1) or a customer supplied air or water source and a shut-off valve. See drawing IIG01R113 and IIG01R112 for details.



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The CIn Schedule program parameter determines how often the jet clean cycle will occur. This parameter can be set to values of 10 minutes to 24 hrs. Typically, a clean interval of 2 hrs works well for aeration basins. In colder climates, condensation may form then freeze in the jet-clean tubing. To prevent this, set the clean interval to 10 or 20 minutes. This parameter may be set to "OFF" or "Demand only".

The CIn Jet Time program parameter determines how long the jet clean cycle will last. The clean pulse can be set to values of 5-seconds to 90-seconds with a 1-second resolution. Typically, a clean pulse of 30-seconds works well for aeration basins. The SCA will hold the measurement reading during the clean cycle and the "CIn Recovery" time period.

The CIn Recovery parameter determines how long the SCA will hold the reading after the CIn Jet Time has expired. The default setting is 1 minute which is adequate in most applications. However, increased recovery time may be required for applications where the sensor is in stagnant water or dead zones.

## Demand Clean

When the analyzer is in the RUN mode and the CIn Schedule parameter is set to something other than "OFF", pressing the "ENTER" button will cause a cleaning cycle to begin immediately. Demanding a clean cycle in this manner doesn't affect the normal cleaning schedule.

## Analog Output

**Note: Do not attempt to adjust analog full and min values until a working sensor has been connected to the SCA. Otherwise, the analyzer may not display the correct measurement units.**

From the SETUP menu, use the ARROW keys to select the “Analog Output” option, then press the ENTER key.

The M10 Analog Output Setup menu has the following 5 configuration parameters:

- Analog 1 Type – Select either 4-20mA or 0-20mA operation for the Analog 1 output.
- DO Full Scale – Defines the value that will cause the Analog 1 output to go to 20mA.
- Ana1 Fail Mode – Defines the value of the Analog 1 output during an alarm or error condition; choose between holding the last good reading, 0/4mA, or 20mA.
- Analog 2 Type – Select either 4-20mA or 0-20mA operation for the Analog 2 (temperature) output. This output scale is fixed at 0 to 50 degrees C.
- Ana2 Fail Mode – Defines the value of the Analog 2 output during an alarm or error condition; choose between holding the last good reading, 0/4mA, or 20mA.

The M15/M15L Analog Output Setup menu has the following 4 configuration parameters:

- Analog 1 Type – Select either 4-20mA or 0-20mA operation for the Analog 1 output.
- TSS Full Scale – Defines the value that will cause the Analog 1 output to go to 20mA.
- TSS Min Scale – Defines the value that will cause the Analog 1 output to go to 0/4mA.
- Anal Fail Mode – Defines the value of the Analog 1 output during an alarm or error condition; choose between holding the last good reading, 0/4mA, or 20mA.

The M50/M51 Analog Output Setup menu has the following 6 configuration parameters:

- Analog 1 Type – Select either 4-20mA or 0-20mA operation for the Analog 1 output.
- pH Full Scale – Defines the value that will cause the Analog 1 output to go to 20mA.
- pH Min Scale – Defines the value that will cause the Analog 1 output to go to 0/4mA.
- Ana1 Fail Mode – Defines the value of the Analog 1 output during an alarm or error condition; choose between holding the last good reading, 0/4mA, or 20mA.
- Analog 2 Type – Select either 4-20mA or 0-20mA operation for the Analog 2 (temperature) output. This output scale is fixed at 0 to 50 degrees C.
- Ana2 Fail Mode – Defines the value of the Analog 2 output during an alarm or error condition; choose between holding the last good reading, 0/4mA, or 20mA.

The M50/M52 Analog Output Setup menu has the following 4 configuration parameters:

- Analog 1 Type – Select either 4-20mA or 0-20mA operation for the Analog 1 output.
- ORP Full Scale – Defines the value that will cause the Analog 1 output to go to 20mA.
- ORP Min Scale – Defines the value that will cause the Analog 1 output to go to 0/4mA.
- Anal Fail Mode – Defines the value of the Analog 1 output during an alarm or error condition; choose between holding the last good reading, 0/4mA, or 20mA.

## Modbus Setup Mode

From the setup menu, use the “ARROW” keys to select the “MODBUS” option, then press the “ENTER” key. There are three menu options for configuring the serial digital output.

- Comm Address – Defines the Modbus address (1 to 247) for the SCA
- Comm Baud Rate – Defines the baud rate of the Modbus port
- Comm Mode - Defines the communications mode as RTU or TCP.

Appendix A describes the Modbus protocol implementation in the SCA.

## SENSOR SETUP

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Each type of sensor has its own sensor setup menu. The SCA will select the appropriate menu for the type of sensor that is currently connected.

### DO Sensor

#### GENERAL

The M10 sensor has been designed to require very infrequent calibration. Unlike polarographic systems, light fouling of the sensing element should not affect the accuracy of the reading, but should only slow the response time of the system. However, heavy biological fouling that prevents reasonable sensor contact with the water will cause erroneous readings. With the sensor kept reasonably clean, the calibration should hold for 6 months to 2 years, depending upon conditions.

**Note: The M10 D.O. sensor undergoes a thorough and accurate test and calibration procedure before shipment from the factory. Calibration of the D.O. reading at startup is not necessary and is not recommended.**

The SCA allows the user to perform two types of calibration. The normal preferred calibration is a single-point calibration (Sens Ref Cal) procedure. However, a more thorough 2-point calibration (Sens Slope Adj) option is available, but generally unnecessary and should only be used if it is apparent that the sensor output has been significantly altered.

Factory calibration values are stored in the nonvolatile memory of the M10 sensor itself, so if a sensor is moved to a different SCA unit, the SCA will report values based on the original factory calibration. "Field calibration values are stored in the SCA, and will not automatically travel with the sensor. The original factory calibration values for the sensor are never erased from the sensor memory, so a sensor may be restored to its original factory calibration condition if it is believed that the current calibration condition is erroneous.

#### Sens Ref Cal



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Calibration to a known reference is the preferred method of calibration when calibration is required. This method allows the operator to make adjustments to the D.O. reading to agree with any other source of D.O. information. Although any known D.O. level may be used, Insite IG strongly urges its customers to use a zero dissolved oxygen solution as a reference for this calibration because it is easy to prepare a very accurate solution. Sodium Sulfite powder can be dissolved in clean water at about 2% concentration by weight to create a solution that will remain at zero dissolved oxygen level for several days. Practically speaking, this amounts to about 1 tablespoon of this powder dissolved in 1 quart of clean water. For best accuracy, use water that is already at the ambient temperature level.

**THIS CALIBRATION PROCEDURE MUST ONLY BE USED ON A CLEAN SENSOR. IF THE SENSOR IS READING ERRONEOUSLY DUE TO HEAVY BIOLOGICAL FOULING, USE OF THIS CALIBRATION METHOD WILL RESULT IN UNRELIABLE RESULTS.**

The sensor must be stable in the water to be used as a reference before beginning this procedure. From the SENSOR SETUP menu, choose the "Sens Ref Cal" option, and press ENTER. The analyzer will now

read the sensor for the period of time indicated by the “dampening” parameter, and display the result as D.O. in PPM. If this result matches the reference, simply press ENTER to exit. Otherwise, use the arrow keys to adjust the reading to match the reference value, and then press ENTER to store this new value. This procedure is primarily an adjustment to the offset value of the sensor, but an adjustment in slope will also be made when this procedure is performed. If a sodium sulfite solution is being used as a reference, Insite IG recommends entering a value of 0.02 PPM.

### **Sens Slope Adj (NOT RECOMMENDED)**

If performed correctly, the previously described “Sens Ref Cal” should be all that is required by the user. “Sens Slope Adj” should only be attempted if it is apparent that a major shift in calibration has occurred.

“Sens Slope Adj” procedure requires 3 steps that MUST be performed in the following order:

1. Erase all previous field calibration data by restoring factory defaults.
2. Calibrate the first point, which MUST be a zero oxygen solution.
3. Calibrate the second point, which should be near saturation levels.

As with Sens Ref Cal, the sensor must be clean in order for this procedure to be successful. The first calibration point will use the same sodium sulfite zero oxygen solution described in the previous section (1 tablespoon of sodium sulfite dissolved in 1 quart of water at ambient temperature). Allow the sensor to soak in this solution for at least 10 minutes before proceeding. Make sure that no air bubbles are trapped on the face of the sensing element during the soak. Once the sensor is stable, use the “Sensor Calibration to a Reference” procedure described previously to set the D.O. reading to 0.02 PPM. YOU MUST ACTUALLY PERFORM THE CAL TO REFERENCE PROCEDURE IN ZERO WATER EVEN IF THE SENSOR READS ZERO FROM THE RUN MODE. [NOTE: If the user’s application requires a zero that is absolutely accurate (frequent readings below 0.5 PPM), then the zero solution needed for this procedure should be mixed 12 to 24 hours before use, and distilled water should be used in place of tap water. Freshly mixed solution actually has a value of about 0.04 PPM, but a calm solution at rest for 12 hours will drop down very close to absolute zero.

Once a sensor has been properly zeroed, a slope adjustment may be made. Although water of any known D.O. concentration may be used, Insite IG strongly encourages the user to create an air saturated solution of clean water. A bucket of very clean water, heavily aerated for at least 20 minutes with a normal aquarium style aeration stone, will make a good 100% saturation reference. Otherwise, if another known oxygen level is used, this level should be near or above the maximum reading expected of the sensor in normal operation. The sensor should be rinsed to remove all zero solution before placing it in an aerated container. The sensor should be allowed to stabilize for at least 10 minutes before proceeding.

Choose the sensor slope adjustment calibration procedure as option 2 “Sensor Slope Adj” from the SENSOR SETUP menu, and press ENTER. Press ENTER again to bypass the “!Warning! Proper Zero Required” message. The analyzer will now read the sensor for the period of time indicated by the “dampening” parameter, and display the result as D.O. in PPM. If this result matches the reference, simply press ENTER to exit. Otherwise, use the arrow keys to adjust the reading to match the reference value, and then press ENTER to store this new value.

### **Fact. Default**

The Factory Default parameter allows the user to restore the sensor characteristic values of zero and slope to the original factory settings.

### **Temp. Units**

The temperature units parameter allows the user to specify Celsius or Fahrenheit for the displayed temperature units.

### **Dampening**

The dampening parameter will allow the adjustment of the amount of averaging taking place. This is entered in the amount of time it will take to achieve a stabilized reading, in seconds. This may be useful when using the system in a new application or trouble shooting.

**Salinity**

This option allows for the correction of salts in the water. The salinity correction range is 0 to 45 ppt with a resolution of 1 ppt. Average sea water is about 34 ppt.

**Display Mode**

This option allows the dissolved oxygen to be displayed in either PPM or %SAT.

**Freq. Select**

This option allows the power line notch filter to be set for 50Hz or 60 Hz.

**Passcode**

The passcode parameter will allow the operator to limit access to the sensor setup parameters. The passcode may be set to any three-digit number.

## SS SENSOR

### GENERAL

To do a complete calibration, three steps are required. The sensor must first be zeroed, and then a sample/snapshot is taken. After the sample has been analyzed, the span of the sensor can be adjusted to the sample. As long as the lenses are kept clean, frequent recalibration should not be necessary. Every six months should be more than adequate for a complete calibration.

Any optically based device for measuring suspended solids should only be span calibrated against a typical sample of the actual process water being measured. Synthetic laboratory standards will add unnecessary inaccuracies to the system and are not recommended. The SCA utilizes its microprocessor memory in a unique way to make span calibration as easy and accurate as possible. This calibration is performed as a two step process. First, the SNAPSHOT SAMPLE function of the analyzer is used to store actual process conditions to the instrument's memory. Later, when standard laboratory analysis results are available for those previous conditions, the SCA's SPAN function will recall the stored value and allow the user to adjust the span value accordingly.

The range of operation of the M15 sensors is 0-30,000 mg/l total suspended solids. Within this range, accuracy and repeatability are only specified over a range of +/- 50% of the user's point of calibration. Accuracy will be +/- 5% of the current reading or +/- 100 mg/l, whichever is greater. Repeatability will be +/- 1% of the current reading or +/- 20 mg/l, whichever is greater.

The range of operation of the M15L sensor is 0-1500 mg/l total suspended solids. Within this range, accuracy and repeatability are only specified over a range of +/- 50% of the user's point of calibration. Accuracy will be +/- 5% of the current reading or +/- 2 mg/l, whichever is greater. Repeatability will be +/- 1% of the current reading or +/- 2 mg/l, whichever is greater.

### Sensor Zero

Establishing the zero point for a M15/M15L sensor is simply a matter of submerging the clean sensor in a container of clean water. Potable water is generally OK for this use, but distilled water is ideal. Never use plant process water as a zero reference. First, clean the sensor with a clean damp cloth. Next, let the sensor soak in this water for about 10 minutes before beginning the ZERO procedure to allow time for temperature stabilization and complete wetting of the sensor surfaces. Just before beginning the procedure, check to see if air bubbles have formed on the interior sensor faces, and dislodge any that may have appeared.



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Select the "Sensor Zero" option from the Sensor Cal. menu using the up and down arrow buttons. Press the "ENTER" button. After the sensor has been submerged in clean water for about 10 minutes, press "ENTER". The SCA will take about sixty seconds to zero. The display will return to the calibrate menu automatically when it is finished. Press the "MENU" button to exit or use the up and down arrow buttons to select another calibration mode.

### Snapshot

For a truly meaningful calibration of the span of the sensor, the sensor should be calibrated in the process water itself against a number derived from laboratory analysis of that water. Since the laboratory analysis takes considerable time, the "Snapshot" procedure causes the SCA to store the optical conditions seen by the sensor at the time the physical sample is taken. The "Snapshot" procedure does not yet alter the calibration, but merely stores information for later use. With the sensor submerged in the process to be measured and stable, select the "Snapshot" option from the Sensor Cal. menu using the up and down

arrow buttons. Press the "ENTER" button. Pressing the "ENTER" button again will cause the SCA to take a snapshot of the conditions. The SCA will take about sixty seconds to obtain a sample value. The display will return to the calibrate menu automatically when it is finished. Press the "MENU" button to exit or use the up and down arrow buttons to select another calibration function.



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At this time, take a physical sample of the process water from the same location so that it can be analyzed using standard laboratory techniques to determine suspended solids concentration. This value will be used during the span calibration.

### **Sensor Span**

This step is performed when an accurate laboratory value has been obtained from the sample previously taken during the "Snapshot" procedure. Select the "Sensor Span" option from the Sensor Cal. menu using the up and down arrow buttons and press the "ENTER" button. The value that was previously saved during snapshot will be displayed. Use the up and down arrow buttons to adjust the SCA reading to agree with the value from the laboratory analysis. Press the "Enter" button when done. The system is now calibrated and ready for normal operation. Press the "MENU" button to exit or use the up and down arrow buttons to select another calibration mode.

### **Default Span**

This calibration mode will replace the current span calibration value with the factory default value. This may be useful when using the system in a new application. If the sensor has been properly zeroed in clean water, the SCA will read values that are typical for an average waste treatment plant. No absolute accuracy is guaranteed after this procedure, but the numbers will, in the least, be useful for observing trends in the suspended solids concentration over time.

### **Response Time**

The response time parameter will allow the adjustment of the amount of averaging taking place. This is entered in the amount of time it will take to achieve a stabilized reading, in seconds. This may be useful when using the system in a new application or trouble shooting.

### **Sensor Curve**

The sensor curve parameter will allow the selection of a standard TSS sensor curve which should be used for most applications or a special TSS sensor curve which can be used for applications when the standard curve does not apply. Contact the factory for details on using the special curve setting.

### **Freq. Select**

This option allows the power line notch filter to be set for 50Hz or 60 Hz.

### **Passcode**

The passcode parameter will allow the operator to limit access to the sensor setup parameters. The passcode may be set to any three-digit number.

## pH SENSOR

The pH sensor consists of two parts; the M50 Holder and the Electrode (M51). They are shipped separately and must be assembled prior to installing the sensor into the process. The pH electrode must be properly seated in the pH holder to ensure reliable operation and proper cleaning. This is achieved by first ensuring that there is silicone lubricant on the O-rings and seat and then by screwing the electrode into the holder until the top of the electrode is even with the line etched onto the jet clean boss. **NOTE: Installing a pH/ORP holder without a pH or an ORP electrode properly seated will void the warranty.**

Calibration of pH electrodes have been greatly simplified, with “One Point” or “Two Point” calibration modes available.

pH buffers are special solutions which are used in the standardization or calibration of pH measuring electrode systems. They are special because they have the ability to resist changing pH due to contamination or dilution. The most common buffer dilutions are 4, 7 and 10 pH values. Other special values can be purchased, and buffers for special biological and chemical applications are common.

pH buffers are supplied in either a powdered form to be mixed with distilled water or a premixed liquid form. For pH buffers greater than 7, it is recommended that liquid buffer solutions be used because they tend to be more accurate. However, liquid buffer solutions have a short shelf life (typically 3 months) which must be considered when ordering.

### One Point Cal

Select “One Point Cal” from the setup menu. Submerge the sensor in the buffer solution. Press the ENTER key. After the SCA has acquired data, the pH value will be displayed. Use the UP and DOWN arrow keys to change to the correct pH value and then press the ENTER key. The calibration is stored in the non-volatile memory of the SCA.

**Note: This method of calibration only adjusts for asymmetry in the electrode and thus should only be used in applications where the process has a small range of pH values.**

### Two Point Cal

Select “Two Point Cal” from the setup menu. Submerge the sensor in the first buffer solution. Press the ENTER key. After the SCA has acquired data, the pH value will be displayed. Use the UP and DOWN arrow keys to change to the correct pH value and then press the ENTER key. Submerge the sensor in the second buffer solution. Press the ENTER key. After the SCA has acquired data, the pH value will be displayed. Use the UP and DOWN arrow keys to change to the correct pH value and then press the ENTER key. The calibration is stored in the non-volatile memory of the SCA.

### Fact. Default

The Fact. Default parameter allows the user to restore the sensor characteristic values of zero and slope to the original factory settings.

### Temp. Units

The temperature units parameter allows the user to specify Celsius or Fahrenheit for the displayed temperature units.

### Passcode

The passcode parameter will allow the operator to limit access to the sensor setup parameters. The passcode may be set to any three-digit number.

## ORP SENSOR

The ORP sensor consists of two parts; the M50 Holder and the Electrode ( M52). They are shipped separately and must be assembled prior to installing the sensor into the process. The ORP electrode must be properly seated in the ORP holder to ensure reliable operation and proper cleaning. This is achieved by first ensuring that there is silicone lubricant on the O-rings and seat and then by screwing the electrode into the holder until the top of the electrode is even with the line etched onto the jet clean boss. **NOTE: Installing a pH/ORP holder without a pH or an ORP electrode properly seated will void the warranty.**

### Sensor Type

Displays are normally in the American convention which produces a negative voltage during a reduction of the platinum and a positive reading during the oxidation of the platinum. The European convention reverses the polarities.

### ORP Offset

Calibration of an ORP electrode is normally accomplished by equating millivolt levels to concentration. This may be accomplished by noting the reading of the ORP electrode and relating the reading to a laboratory analysis. Calibration standards may be generated by dissolving quinhydrone to saturation in a pH 4 Buffer at 25 degrees Celsius, which should produce a millivolt reading of approximately 250. By utilizing a pH 7 Buffer solution with quinhydrone, the generation should be approximately 90 millivolts.

Select ORP OFFSET from the setup menu. Submerge the sensor in the buffer solution. Press the ENTER key. After the SCA has acquired data, the ORP value will be displayed. Use the UP and DOWN arrow keys to change to the correct ORP value and then press the ENTER key. The calibration is stored in the non-volatile memory of the SCA.

### Fact. Default

The Fact. Default parameter allows the user to restore the sensor zero offset to the original factory settings.

### Passcode

The passcode parameter will allow the operator to limit access to the sensor setup parameters. The passcode may be set to any three-digit number.

## Test Mode

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This mode of operation allows the user to perform basic test functions to aid in troubleshooting. Each sensor has its own test mode menu. The SCA will select the appropriate menu for the type of sensor that is currently connected.

### DO Sensor

There are a total of 13 tests which may be performed.

Operation of the TEST MODE proceeds as follows. From the Main Menu use the arrow keys to move the cursor to the TEST option, then press the "ENTER" key. Use the arrow keys to select the desired test, and then press the "ENTER" key.

#### View Sens Data

This test is intended primarily to aid the InsiteIG technical support engineers in troubleshooting. Press the MENU key to exit.

#### View Sens S/N#

This test is intended primarily to aid the InsiteIG technical support engineers in troubleshooting. The serial number of the connected sensor will be displayed. Press the MENU key to exit.

#### View Sens Clk

View Sensor Clk displays the selected notch filter frequency. Press the MENU key to exit.

#### Cal Analog 1

Cal analog 1 will cause the SCA to generate full scale output of 20mA on analog output 1. Use the UP and DOWN arrows keys to adjust the output, then press the ENTER key to save.

#### Cal Analog 2

Cal analog 2 will cause the SCA to generate full scale output of 20mA on analog output 2. Use the UP and DOWN arrows keys to adjust the output, then press the ENTER key to save.

#### Test Relay 1

Test Relay 1 displays the current status of relay 1. To toggle relay 1, press the "ENTER" button. The new status of relay 1 will be displayed. To exit, press the "MENU" key.

#### Test Relay 2

Test Relay 2 displays the current status of relay 2. To toggle relay 2, press the "ENTER" button. The new status of relay 2 will be displayed. To exit, press the "MENU" key.

#### Test Relay 3

Test Relay 3 displays the current status of relay 3. To toggle relay 3, press the "ENTER" button. The new status of relay 3 will be displayed. To exit, press the "MENU" button.

#### Test Cln Rly

Test Clean Relay displays the current status of relay 4. To toggle relay 4, press the "ENTER" button. The new status of relay 4 will be displayed. To exit, press the "MENU" button.

## **Test Modbus**

Test Modbus will test the RS-485 communication port.

## **Software Version**

Software Version displays the current version of software in the SCA. To exit, press the "MENU" button.

## **View Sen Char**

This test is intended primarily to aid the InsiteIG technical support engineers in troubleshooting. The characteristics for the connected sensor are displayed. To exit, press the "MENU" button.

## **Tau Values**

This test is intended primarily to aid the InsiteIG technical support engineers in troubleshooting. The Tau value for the connected sensor is displayed. To exit, press the "MENU" button.

## **TSS Sensor**

There are a total of 12 tests which may be performed.

Operation of the TEST MODE proceeds as follows. From the Main Menu use the arrow keys to move the cursor to the TEST option, then press the "ENTER" key. Use the arrow keys to select the desired test, and then press the "ENTER" key.

## **View Sens Data**

This test is intended primarily to aid the InsiteIG technical support engineers in troubleshooting. Press the MENU key to exit.

## **View Sens S/N#**

This test is intended primarily to aid the InsiteIG technical support engineers in troubleshooting. The serial number of the connected sensor will be displayed. Press the MENU key to exit.

## **View Sens Clk**

View Sensor Clk displays the selected notch filter frequency. Press the MENU key to exit.

## **View Zero Cal**

View Zero Cal displays the zero calibration factor ratio. Press the MENU key to exit.

## **View Span Cal**

View Span Cal displays the span calibration factor ratio. Press the MENU key to exit.

## **Cal Analog Out**

Cal analog out will cause the SCA to generate full scale output of 20mA on analog output 1. Use the UP and DOWN arrows keys to adjust the output, then press the ENTER key to save.

## **Test Relay 1**

Test Relay 1 displays the current status of relay 1. To toggle relay 1, press the "ENTER" button. The new status of relay 1 will be displayed. To exit, press the "MENU" key.

## **Test Relay 2**

Test Relay 2 displays the current status of relay 2. To toggle relay 2, press the "ENTER" button. The new status of relay 2 will be displayed. To exit, press the "MENU" key.

## **Test Relay 3**

Test Relay 3 displays the current status of relay 3. To toggle relay 3, press the "ENTER" button. The new status of relay 3 will be displayed. To exit, press the "MENU" button.

## **Test Cln Rly**

Test Clean Relay displays the current status of relay 4. To toggle relay 4, press the "ENTER" button. The new status of relay 4 will be displayed. To exit, press the "MENU" button.

## **Test Modbus**

Test Modbus will test the RS-485 communication port.

## **Software Version**

Software Version displays the current version of software in the SCA. To exit, press the "MENU" button.

## **pH Sensor**

There are a total of 13 tests which may be performed.

Operation of the TEST MODE proceeds as follows. From the Main Menu use the arrow keys to move the cursor to the TEST option, then press the "ENTER" key. Use the arrow keys to select the desired test, and then press the "ENTER" key.

### **View Sens Data**

This test is intended primarily to aid the InsiteIG technical support engineers in troubleshooting. Press the MENU key to exit.

### **View Sens S/N#**

This test is intended primarily to aid the InsiteIG technical support engineers in troubleshooting. The serial number of the connected sensor will be displayed. Press the MENU key to exit.

### **View Sens Clk**

View Sensor Clk displays the selected notch filter frequency. Press the MENU key to exit.

### **View pH Scale**

View pH Scale displays the pH calibration scale. Press the MENU key to exit.

### **View pH Offset**

View pH Offset displays the pH calibration offset. Press the MENU key to exit.

## **Cal Analog 1**

Cal analog 1 will cause the SCA to generate full scale output of 20mA on analog output 1. Use the UP and DOWN arrows keys to adjust the output, then press the ENTER key to save.

## **Cal Analog 2**

Cal analog 2 will cause the SCA to generate full scale output of 20mA on analog output 2. Use the UP and DOWN arrows keys to adjust the output, then press the ENTER key to save.

## **Test Relay 1**

Test Relay 1 displays the current status of relay 1. To toggle relay 1, press the "ENTER" button. The new status of relay 1 will be displayed. To exit, press the "MENU" key.

## **Test Relay 2**

Test Relay 2 displays the current status of relay 2. To toggle relay 2, press the "ENTER" button. The new status of relay 2 will be displayed. To exit, press the "MENU" key.

## **Test Relay 3**

Test Relay 3 displays the current status of relay 3. To toggle relay 3, press the "ENTER" button. The new status of relay 3 will be displayed. To exit, press the "MENU" button.

## **Test Cln Rly**

Test Clean Relay displays the current status of relay 4. To toggle relay 4, press the "ENTER" button. The new status of relay 4 will be displayed. To exit, press the "MENU" button.

## **Test Modbus**

Test Modbus will test the RS-485 communication port.

## **Software Version**

Software Version displays the current version of software in the SCA. To exit, press the "MENU" button.

## **ORP Sensor**

There are a total of 11 tests which may be performed.

Operation of the TEST MODE proceeds as follows. From the Main Menu use the arrow keys to move the cursor to the TEST option, then press the "ENTER" key. Use the arrow keys to select the desired test, and then press the "ENTER" key.

### **View Sens Data**

This test is intended primarily to aid the InsiteIG technical support engineers in troubleshooting. Press the MENU key to exit.

### **View Sens S/N#**

This test is intended primarily to aid the InsiteIG technical support engineers in troubleshooting. The serial number of the connected sensor will be displayed. Press the MENU key to exit.

### **View Sens Clk**

View Sensor Clk displays the selected notch filter frequency. Press the MENU key to exit.

### **View ORP Offset**

View ORP Offset displays the ORP calibration offset. Press the MENU key to exit.

### **Cal Analog Out**

Cal analog out will cause the SCA to generate full scale output of 20mA on analog output 1. Use the UP and DOWN arrows keys to adjust the output, then press the ENTER key to save.

### **Test Relay 1**

Test Relay 1 displays the current status of relay 1. To toggle relay 1, press the "ENTER" button. The new status of relay 1 will be displayed. To exit, press the "MENU" key.

### **Test Relay 2**

Test Relay 2 displays the current status of relay 2. To toggle relay 2, press the "ENTER" button. The new status of relay 2 will be displayed. To exit, press the "MENU" key.

### **Test Relay 3**

Test Relay 3 displays the current status of relay 3. To toggle relay 3, press the "ENTER" button. The new status of relay 3 will be displayed. To exit, press the "MENU" button.

### **Test Cln Rly**

Test Clean Relay displays the current status of relay 4. To toggle relay 4, press the "ENTER" button. The new status of relay 4 will be displayed. To exit, press the "MENU" button.

### **Test Modbus**

Test Modbus will test the RS-485 communication port.

### **Software Version**

Software Version displays the current version of software in the SCA. To exit, press the "MENU" button.

## Error Messages

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During operation, the SCA may determine that an error condition exists. If this happens, the display will contain an error message. The 4 possible error messages are as follows:

### **\*\*SENSOR NOT RESPONDING\*\***

This error message indicates that the SCA is not receiving any data from the sensor. Check to see that the sensor is properly connected, and there is no damage to the sensor cable. The error may also be caused by a faulty ground connection (check the power (chassis) ground and shield connections), severe electrical noise, or faulty electronics.

### **\*SENSOR ERROR\***

This error message indicates that the sensor is communicating with the SCA, but cannot produce a reasonable measurement. Loose connections, or connections that have been disconnected and reattached while power is turned on may cause these issues. These may be cleared by turning off power at the SCA for 30 seconds, then turning the unit back on again. This error may also be caused by a faulty ground connection (check the power (chassis) ground and shield connections), severe electrical noise, or faulty electronics.

### **\*\*Zero Sensor\*\* (M15/M15L only)**

The SCA is indicating that a zero cal operation is required for proper operation. This error will appear if a new or different SS sensor has been connected to the SCA (the serial number of the sensor has changed). The error can also appear if the sensor is trying to produce a negative SS value, which should be impossible if a proper zeroing of the sensor had been performed.

### **\*Ambient Error\* (M15/M15L only)**

This error message will be displayed if the sensor is exposed to too much ambient light (exposed to direct sunlight) or the sensor LED is faulty.

With any of these errors, you may call the factory for assistance.

## MAINTENANCE

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The SCA does not require any periodic maintenance. However, it may be necessary to periodically clean the exterior of the SCA. This may be done with a soft brush, broom or low pressure water rinse.

**DO NOT! use hi-pressure water or a pressure washer to clean the SCA. It is likely to be damaged during pressure washing.**

The sensor must be kept clean for accurate readings. Normally, the jet clean system will adequately perform this function.

**M10 D.O. Sensor:** In normal wastewater aeration basins the M10 Sensor will probably not require a jet clean system; however it is important that the aqueous sample to be measured be allowed to come in contact with the measuring surface. The sensor should be visually inspected on a monthly basis to insure that rags and hair have not completely covered the measuring surface. During this time we recommend rinsing the sensor with a water hose.

In systems with high bio-slime and scaling, the integrated jet clean system is recommended to be used to prevent the slime and scale from attaching itself to the measuring surface. If wiping the sensing element is required, use a wet cloth, do not use a brush.

Fouling conditions at wastewater treatment facilities varies considerably from plant to plant. Experience gained during the first few months of sensor operation will allow the plant operators to determine their own reasonable schedule of sensor inspection. In no case should this inspection interval exceed one year.

**M15/M15L TSS Sensor:** The sensor must be kept clean for accurate readings. Normally, the jet clean system will adequately perform this function. However, the sensor should be retrieved and cleaned manually on a periodic basis to remove the heaviest fouling that may impair the performance of the sensor. The frequency of this cleaning will vary depending on the application.

**M51/M52 pH/ORP Sensor:** The electrodes are shipped with a protective boot over the pH glass. This boot should be used to keep the electrode glass wet while the electrode is out of service. If the electrode system has been unused for a long period of time, immerse the flat glass end of the electrode(s) in tap water for at least 30 minutes. This hydrates the pH flat glass and prepares the liquid junction of the reference electrode for contact with the test solution. To maintain response, the electrode system should always remain wet. The preferred storage solution is pH 4.0 buffer with saturated KCl added. Tap water will suffice for short term storage.

**NOTE: Do not soak in distilled water. Utilize the pliable storage boot provided with the electrode(s) for storage.**

Electrodes which are not broken or cracked can be restored, or rejuvenated, to full response by the following procedures:

- **Inorganic Scale Deposits** – Dissolve the deposit by immersing the electrode first in 0.1M HCl, then in 0.1 M NaOH, and again in 0.1 M HCl. Each immersion should be for a 5 minute period.
- **Organic Oil or Grease Films** – Wash electrode tip in a liquid detergent and water. If film is known to be soluble in a particular organic solvent, wash with this solvent. Rinse electrode tip in tap water.

If these procedures fail to rejuvenate the electrode, the problem is probably a clogged reference junction in the reference electrode portion of the electrode system. Cleaning the reference junction involves heating a diluted KCl solution to 60 – 80 degrees Celsius. Place the electrode tip in the heated KCl solution for approximately ten minutes. Allow the electrode to cool naturally before re-testing. If these steps fail to improve the electrode response, replace the electrode.

Successful long term storage of an InsiteIG electrode depends entirely upon the care taken to assure that the glass and reference junction remain immersed in the recommended storage solution. Electrodes in storage with the protective rubber boot should be checked at least every 2 months to be sure that there is an adequate amount of storage liquid. Electrodes stored in this manner will normally last for 2 years. If a stored electrode is allowed to dry, the reference junction may become clogged with dried electrolyte. Should this occur, attempt to rejuvenate the reference junction using the "Cleaning Electrodes" procedure for reference junctions discussed earlier.

## **GUARANTEE AND REPAIR POLICY**

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The SCA, M15/M15L sensors, M50 electrode holder and related items are guaranteed for two years against defective materials and workmanship. The M10 Dissolved Oxygen Sensor is guaranteed for five years against manufacturing defects. They will be replaced or repaired free of charge during the guarantee period. Call the factory at 985-639-0006 for a return authorization number for traceability. Mark the package to the attention of the RMA number and address it to the factory at 80 Whisperwood Blvd., Suite 107, Slidell, LA 70458. Freight to the factory is to be paid by the customer and items should be insured in case of damage or loss of shipment.

All shipments are insured. If you receive a damaged unit, please notify InsiteIG immediately at 985-639-0006.

Repairs to the equipment not covered by the guarantee will be billed per standard service charges.

## Appendix A - Modbus Protocol

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Insite IG analyzers support communication with other devices via the Modbus protocol using RTU or TCP transmission mode. The Modbus protocol defines a message structure that controllers will recognize and use, regardless of the type of networks over which they communicate. It establishes a common format for the layout and contents of message fields. Transactions use a master-slave technique, in which only one device (the master) can initiate transactions (called queries). The other devices (the slaves) respond by supplying the requested data to the master and by taking the action requested in the query. Insite IG analyzers operate as slaves to other modbus devices. . When TCP mode is selected, all requests and responses are prefixed by a six byte header and the CRC field is not included.

The six byte header is as follows:

Byte 0: transaction identifier – copied by server – usually 0

Byte 1: transaction identifier – copied by server – usually 0

Byte 2: protocol identifier = 0

Byte 3: protocol identifier = 0

Byte 4: length field (upper byte) = 0 (since all messages are smaller than 256)

Byte 5: length field (lower byte) = number of bytes following

### Message framing

Messages start with a silent interval of at least 3.5 character times followed by 4 fields and then followed by another silent interval of at least 3.5 character times. The first field contains the device address. The second field contains the function code. The third field contains the data. The fourth field contains the CRC value. Each byte has 1 start bit, 8 data bits, no parity, and 1 stop bit.

### Address field

The address field contains one byte. Valid slave device addresses are in range 1 to 247 decimal.

### Function code field

The function code field contains one byte. See the section titled Function codes supported by the SCA.

### Data field

The data field contains one or more byte. This information is used by the analyzers to take the action defined by the function code.

### CRC field

The CRC (cyclical redundancy check) field is two bytes, containing a 16-bit binary value. The CRC value is calculated by the transmitting device, which appends the CRC to the message. The receiving device recalculates a CRC during receipt of the message, and compares the calculated value to the actual value it received in the CRC field. If the two values are not equal, the message will be discarded.

The CRC is started by first preloading a 16-bit register to all 1's. Then a process begins of applying successive 8-bit bytes of the message to the current contents of the register. During the generation of the CRC, each 8-bit character is exclusive ORed with the register contents. Then the result is shifted in the direction of the least significant bit (LSB), with a zero filled into the most significant bit (MSB) position. The LSB is extracted and examined. If the LSB was a 1, the register is then exclusive ORed with a preset fixed value. If the LSB was a 0, no exclusive OR takes place.

The process is repeated until eight shifts have been performed. After the last (eight) shift, the next 8-bit byte is exclusive ORed with the register's current value, and the process repeats for eight more shifts as described above. The final contents of the register, after all the bytes of the message have been applied, is the CRC value.

When the CRC is appended to the message, the low-order byte is appended first, followed by the high-order byte.

## Function codes supported by the SCA

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### 01 Read Coil Status

#### Description

Reads the ON/OFF status of the relays in the SCA.

#### Query

The query message specifies the starting relay and quantity of relays to be read. Relays are addressed starting at zero. Relays 1 – 4 are addressed as 0 – 3.

Below is an example of a request to read relays 1 – 4 from SCA with slave address 1.

Field Name	Example
Slave Address	01
Function	01
Starting Address Hi	00
Starting Address Lo	00
No. of Relays Hi00	
No. of Relays Lo	04
CRC	--

The coil status in the response message is packed as one relay per bit of the data field. Status is indicated as: 1 = ON; 0 = OFF. The LSB of the first data byte contains the relay addressed in the query. The other relays follow toward the high order end of this byte.

Below is an example of a response to the previous query.

Field Name	Example
Slave Address	01
Function	01
Byte Count	01
Data	05
CRC	--

The status of relays 1 and 3 is ON and the status of relays 2 and 4 is OFF.

## 04 Read Input Registers

Reads the binary contents of input registers in the SCA.

### Query

The query message specifies the starting register address and the quantity of registers to be read. The SCA input registers are as follows:

Address	Register
0000	Sensor status
0001	Sensor primary measurement
0002	Sensor secondary measurement
0007	Last 4 digits of the sensor serial number

The channel status is reported as follows:

Status	Description
0000	Normal
0001	Sensor not responding
0002	Sensor error
0003	Sensor requires a zero calibration (M15/M15L only)

The M10 sensor will report D.O. as the primary measurement and temperature as the secondary measurement. The units for D.O. are hundredths of ppm and the units for temperature are tenths of °C.

The M15/M15L sensor will report TSS as the primary measurement and the secondary measurement is undefined. The units for TSS are mg/l.

The M51 sensor will report pH as the primary measurement and temperature as the secondary measurement. The units for pH are hundredths of pH and the units for temperature are tenths of °C.

The M52 sensor will report ORP as the primary measurement and the secondary measurement is undefined. The units for ORP are mV with a 2000 mV bias to make all readings positive.

Input Registers 3, 4, 5, and 6 are internal calculation values used by the factory for testing.

Below is an example of a request to read the sensor status, sensor primary measurement and secondary measurement registers from an analyzer with the slave address of 1.

Field Name	Example
Slave Address	01
Function	04
Starting Address Hi	00
Starting Address Lo	00
No. of Regs. Hi	00
No. of Regs. Lo	03
CRC	--

Below is an example of a response to the previous query where the SCA is connected to a M10 D.O. sensor measuring 8.3 ppm at 25.0°C.

Field Name	Example
Slave Address	01
Function	04
Byte Count	06
Data Hi (Reg 0)	00
Data Lo (Reg 0)	00
Data Hi (Reg 1)	03
Data Lo (Reg 1)	3E
Data Hi (Reg 2)	00
Data Lo (Reg 2)	FA
CRC	--

## 06 Preset Single Register

Presets a value into a single register of the SCA.

### Query

The query message specifies the register to be preset. The demand clean cycle register is the only register in the SCA which can be written to. When any value is written to this register, a clean cycle is initiated. The address of the demand clean cycle register is 238C (hex).

Below is an example of a request for a demand clean cycle on an analyzer with the slave address of 1.

Field Name	Example
Slave Address	01
Function	06
Reg. Address Hi	23
Reg. Address Lo	8C
Data Hi	00
Data Lo	00
CRC	--

The normal response is an echo of the query.

## 17 Report Slave ID

Returns a description of the type of device at the slave address.

### Query

Below is an example of a request to report the ID and status of slave address 1.

Field Name	Example
Slave Address	01
Function	11
CRC	--

The normal response of the SCA is shown below.

Field Name	Example
Slave Address	01
Function	11
Byte Count	02
Sensor type	00=M10 10=M15 20=M15L 30=M51 31=M52
Run status	00=Off, FF = On
CRC	--

## Exception Responses

---

If the SCA receives a query without a communication error, but cannot handle it, an exception response will be returned.

In a normal response, the SCA echoes the function code of the original query in the function code field of the response. In an exception response, the SCA sets the MSB of the function code to 1. This makes the function code value in an exception response exactly 80 hexadecimal higher than the value would be for a normal response.

The data field in an exception response contains an exception code. The exception codes supported by the SCA are:

Exception code	Description
01	Illegal function code
02	Illegal data address

## Appendix B – CA-1 Jet Clean System

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The InsiteIG cleaning system uses a pressurized stream of air or water to remove bio growth or other debris from the optical surfaces of our sensors. The InsiteIG analyzers control the frequency and duration of the clean cycle through relay #4. (see drawing IIG01R112 & IIG01R113) This relay is programmable through the setup menu, see Relays section of this manual for more detail.

The InsiteIG Model CA-1 Compressor consists of a compressor pump which delivers a sufficient blast of air to clean debris from the optics in most wastewater treatment plant basins. It is housed in a UL, NEMA 4X, polycarbonate enclosure (see drawing IIG01N030) with quick disconnect ¼" tubing fittings provided on the bottom of the enclosure. The power requirements are 110/120 VAC @ 50/60 Hz and 1.8A. The unit is fused at 3 amps with a 1¼ x ¼" time delay fuse. The ambient operating conditions are a temperature of 0 degree Celsius to 55 degree Celsius and 0 to 100% humidity. A ¼" OD flexible tube with a 70 psi rating (customer supplied) connects the sensors to the compressor assembly. Quick disconnect fitting are supplied on both the sensor heads and compressor. The tubing length should be as short as possible. (If over 100' please consult the factory).

The compressor system should be mounted as close to the sensor as possible. The tubing connection, input power and relay connection to the analyzer are on the bottom of the enclosure. Handrail brackets are available for the compressor enclosure. See drawing IIG01N030 and IIG01R112.

If plant water, or shop air, is being used, the customer must supply clean water at 35 to 50 psig or air at 40 to 60 psig. The supply water (or air) is connected to the 2-way solenoid valve and the SCA need only open the valve to provide the cleaning blast. A ¼" quick disconnect fitting is supplied with the sensor. See drawing IIG01R113 for wire details. There are no changes required in the sensor head for use with water or shop air.

All of the InsiteIG sensors have the jet clean design built-into the sensor housing. The sensors are constructed of impact resistant epoxies and polyurethanes, suitable for most waste treatment. The nozzle aims the water, or air, stream across the measuring surface(s) of the sensor, removing any debris that may cause fouling.

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REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED

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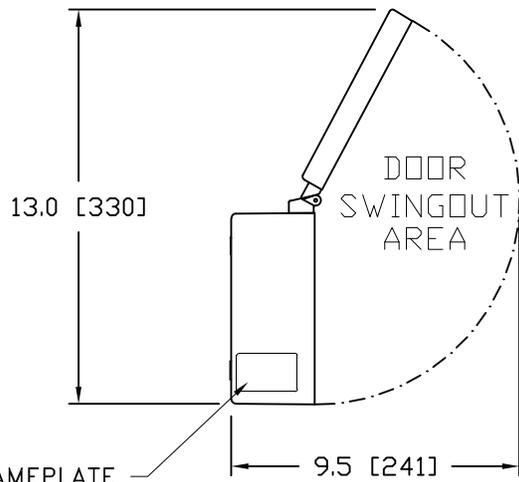
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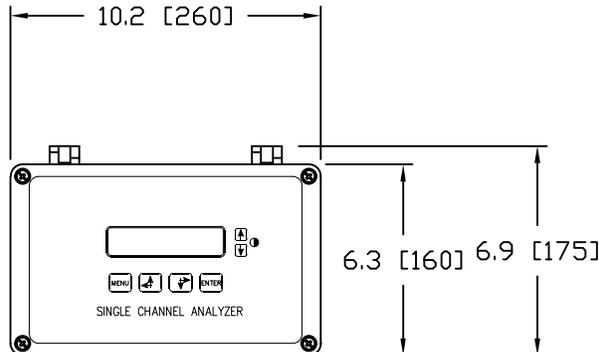
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SIDE VIEW



PLAN VIEW

Notes:

1. Construction: Fiberglass, NEMA 4X, IP66, IP67, IP68  
Enclosure is UL Listed BE-097461
2. Approximate Weight: 6 LB..



In "Normal Operation" the hinged cover is to remain tightly screwed closed. Under no circumstance is it necessary for the operator to open the enclosure.



Warning! - Before opening; switch off the analyzer power at the circuit breaker to avoid risk of shock.

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES TOLERANCES DECIMALS    ANGULAR .XX ±.010    X° ±1° .XXX ±.005 DO NOT SCALE DRAWING	CONTRACT NO.		 80 Whisperwood Blvd. Suite 107 Slidell, LA 70458	
	DRAWN	DATE		
	MATERIAL	CHECK	TITLE	
	FINISH	DESIGN	OUTLINE & MOUNTING INSITE ANALYZER	
SPEC.	APPROVED	SIZE	DWG. NO.	REV
	CUSTOMER	C	IIG01N111	A
		SCALE NTS		SHEET 1 OF 2

REV. A

DWG. No IIG01N111

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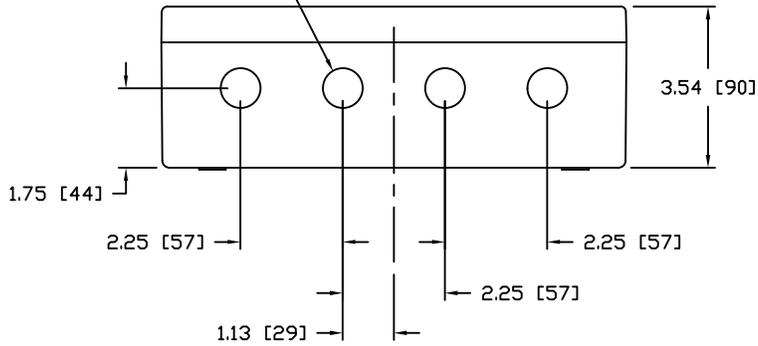
REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED

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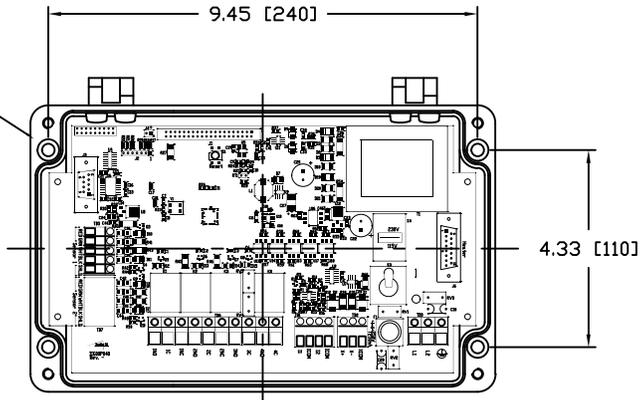
D

1/2" Conduit Hole  
 $\phi 0.875$   
 4 pls.

Mounting Holes,  
 #10-32 Pan-Head  
 4 Pls.



Bottom View



Plan View w/o Cover

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REV. A  
 DWG. No IIG01N111

SIZE	DWG NO.	REV
C	IIG01N111	A
SCALE NTS	SHEET 2 OF 2	

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REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED

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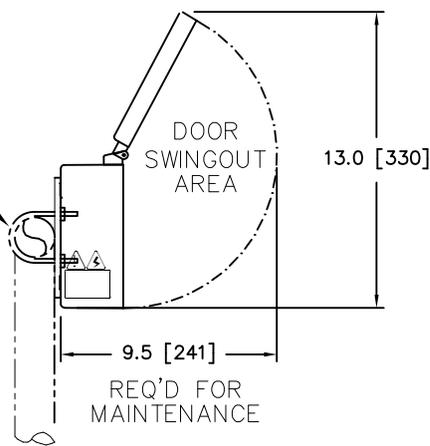
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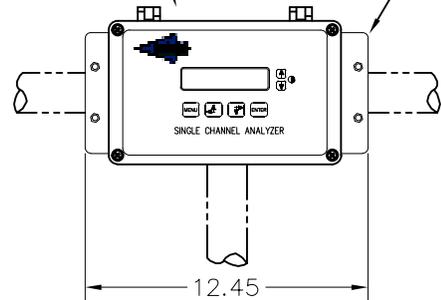
U-BOLT FOR  
2" HANDRAIL  
(2 SUPPLIED)



SIDE VIEW

InsitelG Analyzer

REAR RAIL  
MOUNTING KIT



PLAN VIEW

NOTES:

- CONSTRUCTION: FIBERGLASS, NEMA 4X TYPE ENCLOSURE MOUNTED ON .125" PASSIVATED STAINLESS STEEL BRACKETS.
- APPROXIMATE WEIGHT: 7 LBS.

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES TOLERANCES DECIMALS    ANGULAR .XX ±.010    X° ±1° .XXX ±.005 DO NOT SCALE DRAWING	CONTRACT NO.	
	DRAWN D. RADLE	DATE 1/29/02
	CHECK	
	DESIGN D. RADLE	DATE 1/29/02
MATERIAL —	APPROVED	
FINISH —	CUSTOMER	
SPEC.		

 <b>InsitelG</b> 80 Whisperwood Blvd. Suite 107 Slidell, LA 70458	TITLE <b>HANDRAIL MOUNTING INSITE ANALYZER</b>	
	SIZE <b>C</b>	DWG NO. <b>IIG01N110</b>
SCALE NTS		REV <b>A</b>
SHEET 1 OF 1		

REV. A  
IIG01N110  
DWG. No

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REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED

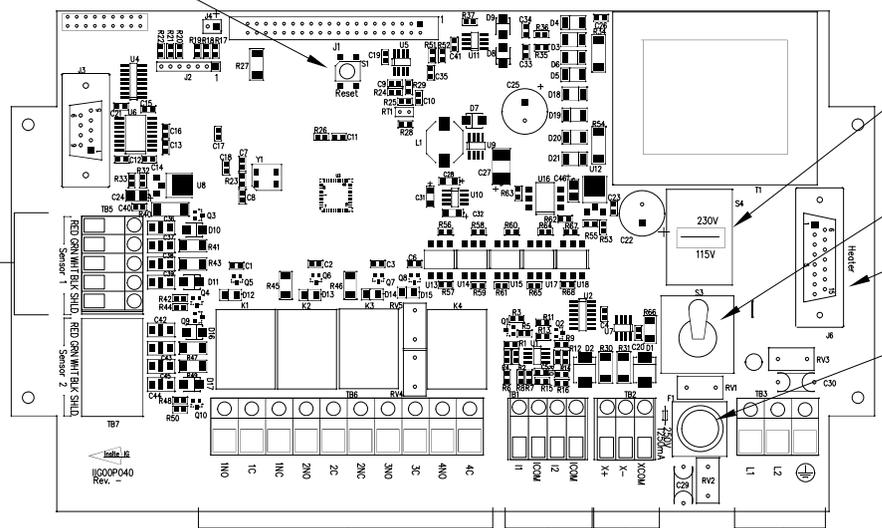
RESET SWITCH

115/230 VAC  
SELECTOR SWITCH

ON/OFF SWITCH

HEATER CONNECTOR  
HEATER CONSUMES 20 WATTS.  
5x20mm, 1/4 AMP, 250V  
TIME DELAY FUSE  
(GCD-250mA)

SENSOR INPUT



PROGRAMABLE RELAY CONTACTS  
RATED 6 AMPS AT 250 VAC  
RESISTIVE LOAD.

⚠ 115 OR 230 VAC @ 50 OR 60 HZ  
MAIN POWER CONNECTION  
AND WILL NORMALLY CONSUME LESS  
THAN 25 WATTS.

MODBUS INTERFACE (RS-485)

ANALOG OUTPUT (0-20 or 4-20mA)  
600 OHMS MAX. LOAD

⚠ Circuit Breaker meeting IEC-947-3 must be on line supply, in close proximity to equipment and shall be marked as the disconnecting device for the equipment.

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES TOLERANCES DECIMALS      ANGULAR .XX ±.010      ° ±1' .XXX ±.005		CONTRACT NO.		 80 Whisperwood Blvd. Suite 107 Slidell, LA 70458		
DO NOT SCALE DRAWING		DRAWN	DATE			
MATERIAL	—	CHECK		TITLE CUSTOMER CONNECTION INSITE IG ANALYZER		
FINISH	—	DESIGN				
SPEC.		APPROVED		SIZE	DWG. NO.	REV
		D. RADLE		C	IIG01R111	A
		CUSTOMER		SCALE	NTS	SHEET 1 OF 1

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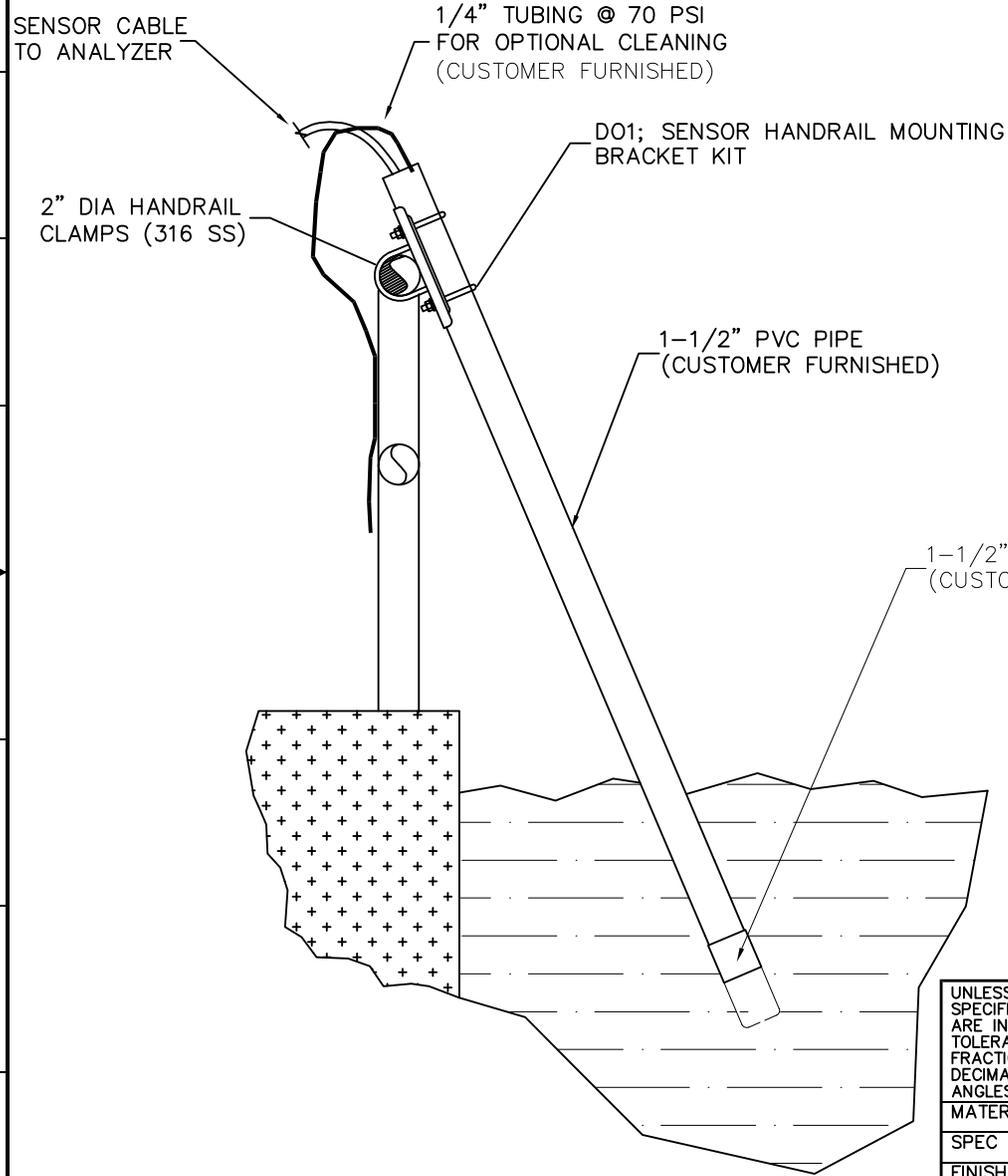
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REV. A  
DWG. No. IIG01R111

IIG01N005

REVISIONS

ZONE	REV	DESCRIPTION	DATE	APPROVED



Notes:

- 1) Material: Epoxy, Polyurethane, & PVC
- 2) For best accuracy, Measurements should be taken 2ft. below the surface and 3ft. from any wall.

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES  
 TOLERANCES ON:  
 FRACTIONS  
 DECIMALS  
 ANGLES  
 MATERIAL —  
 SPEC  
 FINISH —

CONTRACT NO.	
SIGNATURES	DATES
DRAFTSMAN	
CHECKER	
DESIGNER	
PROJ. ENGR.	
RELEASED	
APPROVAL	

**InsiteIG** 80 Whisperwood Blvd.  
 Suite 107  
 Slidell, LA 70458

Insite IG, D01  
 SENSOR HANDRAIL MOUNTING

SIZE	FSCM NO.	DRAWING NO.	REV
B		IIG01N005	—
SCALE	NTS	SHEET 1 OF 2	

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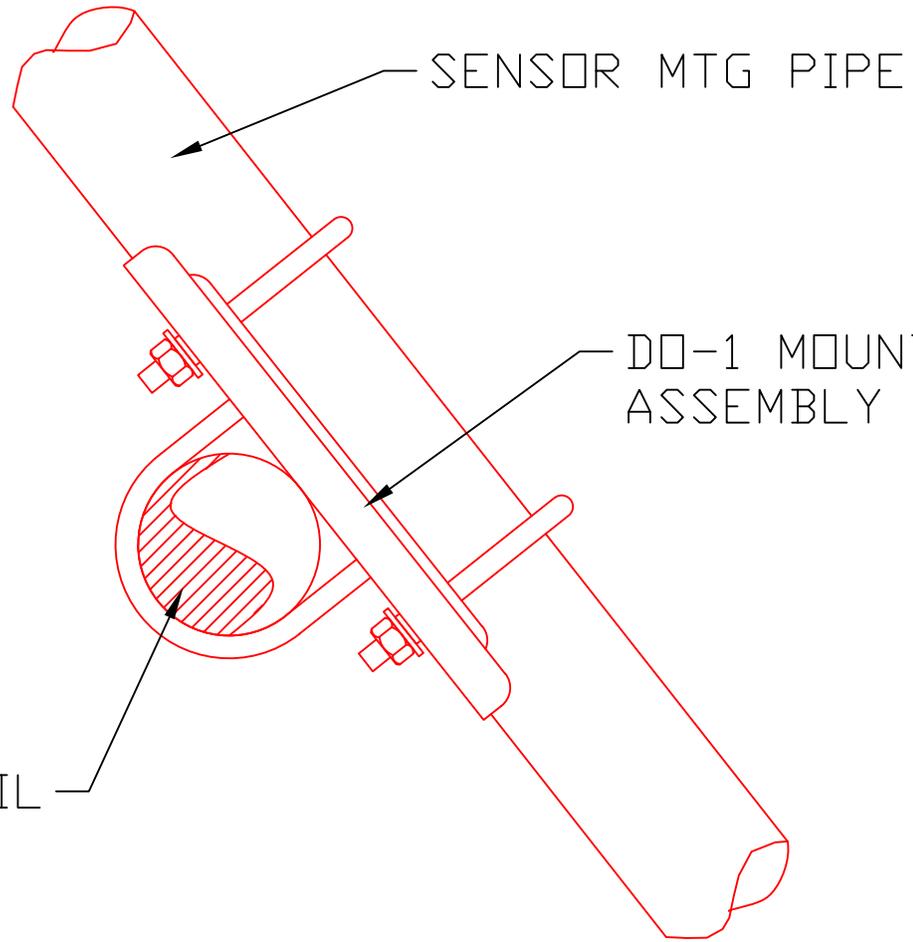
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REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED



SENSOR MTG PIPE

DO-1 MOUNTING BRKT ASSEMBLY

2" HANDRAIL

SIZE	DWG NO.	REV
C	IIG01N005	-
SCALE NTS	SHEET 2 OF 2	

DWG. No IIG01N005 REV. -

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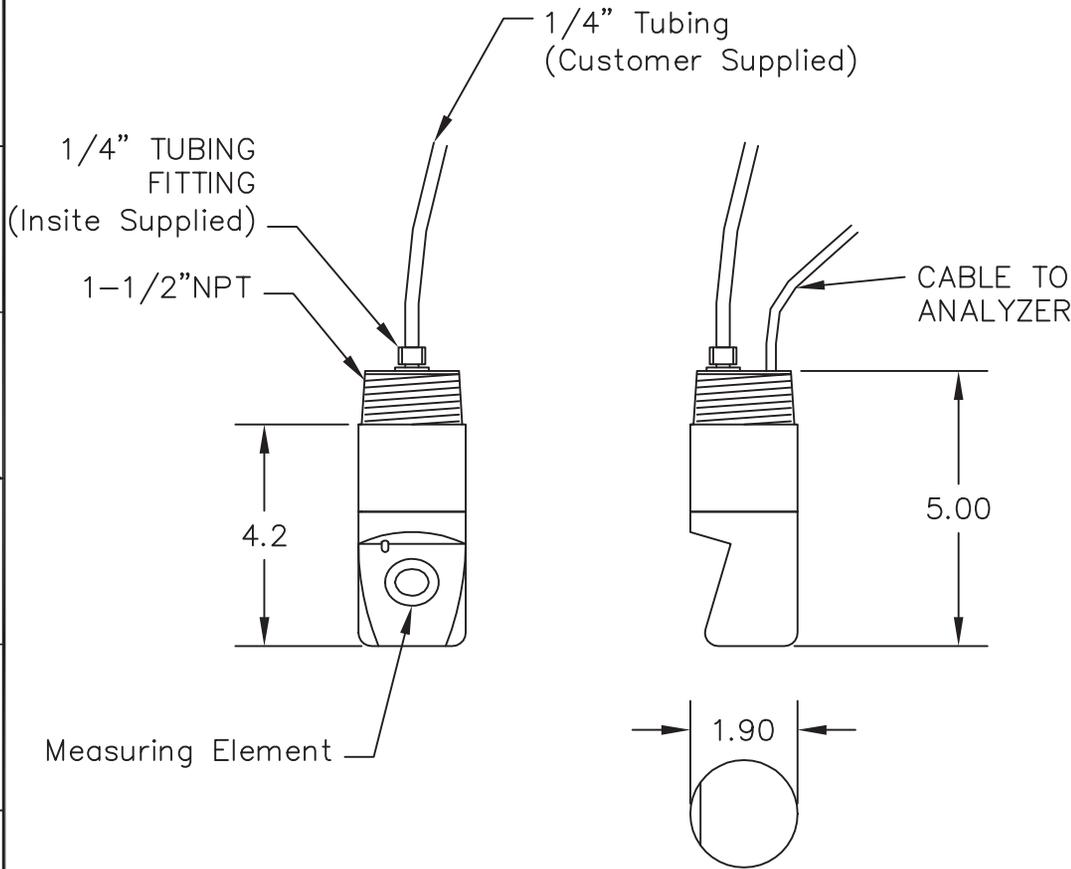
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IIG02N004 C

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED



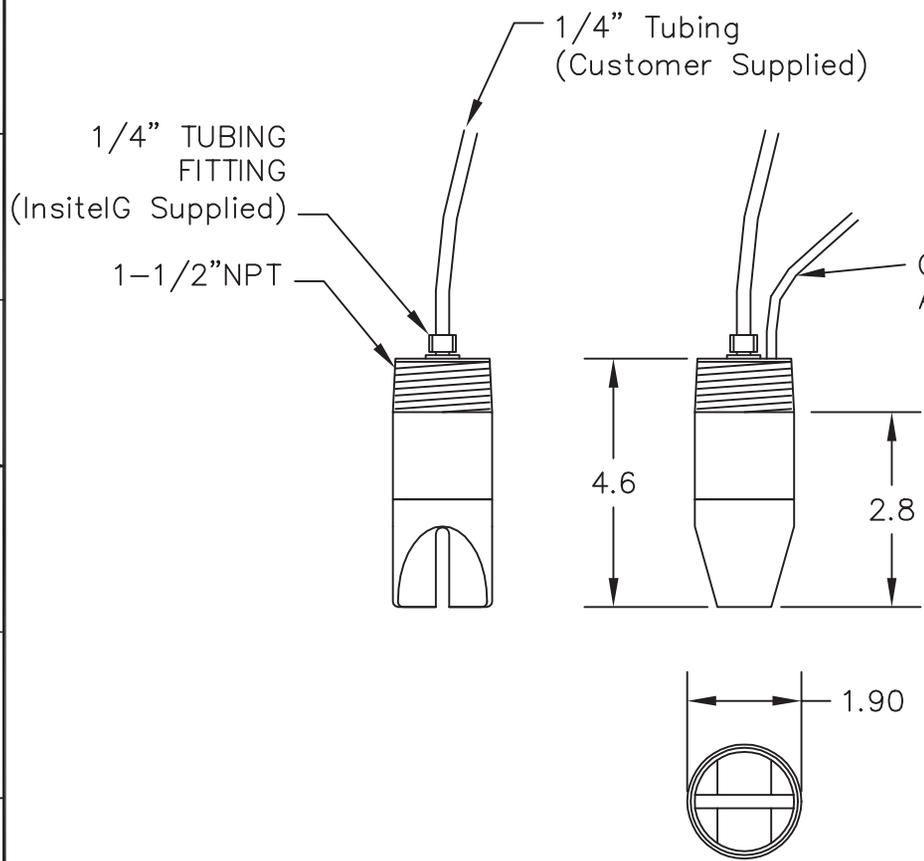
Notes:

- 1) Sensor Material: Epoxy, Polyurethane, PVC, 316 SS
- 2) Oxygen measurements should be take 2ft. below the surface and 3ft. from the wall.
- 3) Measurement element surface should not be facing downward in order to avoid collecting air bubbles.

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES TOLERANCES ON: FRACTIONS DECIMALS ANGLES	CONTRACT NO.			80 Whisperwood Blvd. Suite 107 Slidell, LA 70458				
	SIGNATURES	DATES		DO SENSOR OUTLINE & MOUNTING				
	DRAFTSMAN		SIZE			FSCM NO.	DRAWING NO.	REV
	CHECKER		B				IIG02N004	C
	DESIGNER		SCALE			NTS	SHEET 1 OF 1	
MATERIAL	-	PROJ. ENGR.						
SPEC		RELEASED						
FINISH	-	APPROVAL						

IIG03N004 A

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED



Notes:

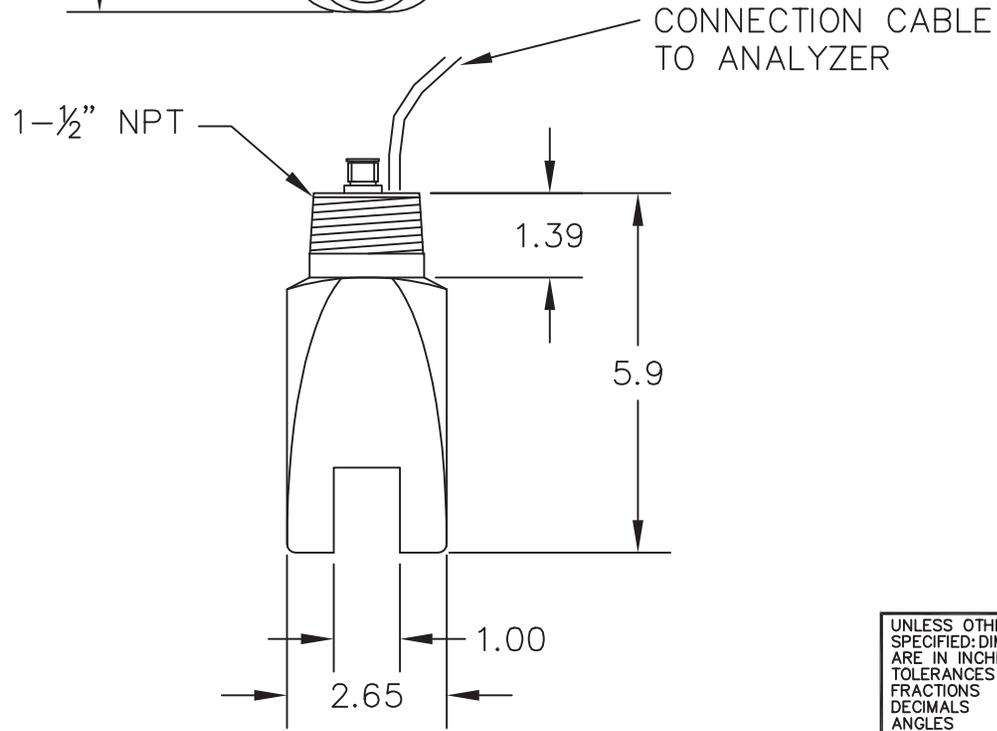
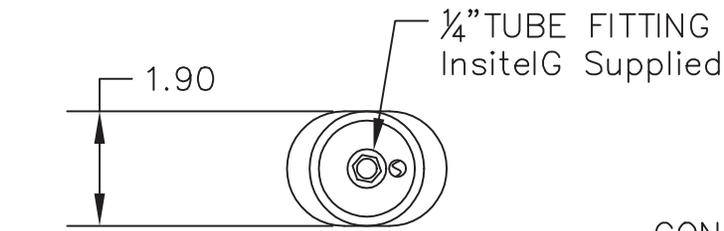
- 1) Material: Epoxy, Polyurethane, & PVC
- 2) For best accuracy, Suspended Solids measurements should be taken 2ft. below the surface and 3ft. from the wall.

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES TOLERANCES ON: FRACTIONS DECIMALS ANGLES MATERIAL - SPEC FINISH -	CONTRACT NO.		 80 Whisperwood Blvd. Suite 107 Slidell, LA 70458	TSS SENSOR OUTLINE & MOUNTING	
	SIGNATURES	DATES			
	DRAFTSMAN	CHECKER	SIZE B SCALE NTS	FSCM NO. DRAWING NO. IIG03N004	REV A
	DESIGNER	PROJ. ENGR.			
	RELEASED	APPROVAL	SHEET 1 OF 1		

IIG03N010

REVISIONS

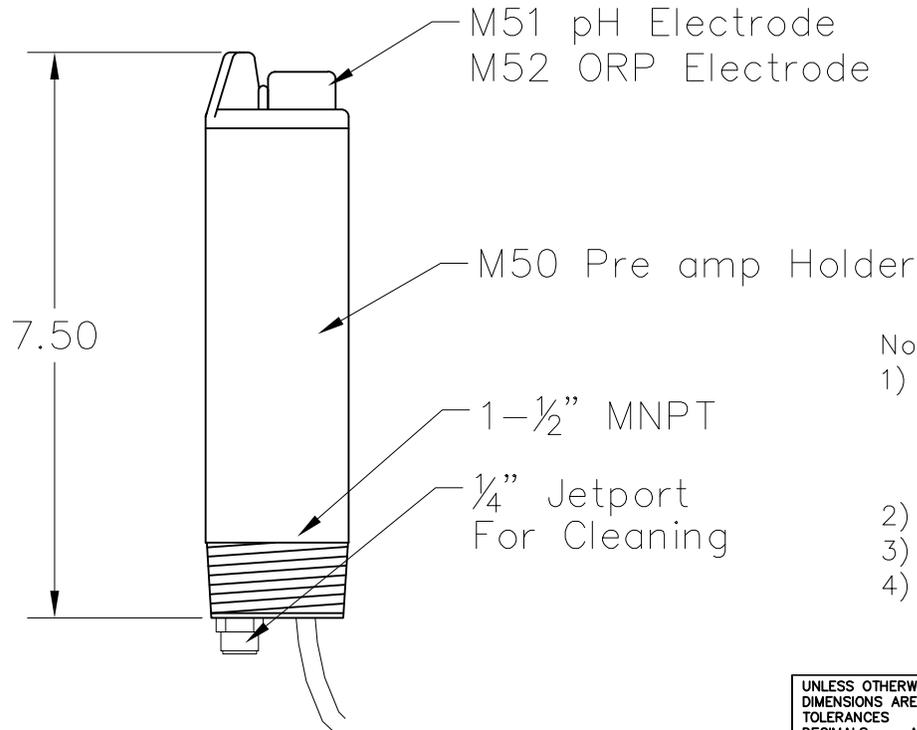
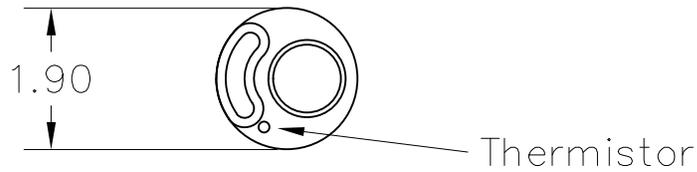
ZONE	REV	DESCRIPTION	DATE	APPROVED



Notes:

- 1) Material: Epoxy, Polyurethane, & PVC
- 2) For best accuracy, Suspended Solids measurements should be taken 2ft. below the surface and 3ft. from the wall.

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES TOLERANCES ON: FRACTIONS DECIMALS ANGLES MATERIAL Listed SPEC FINISH -	CONTRACT NO.		 80 Whisperwood Blvd. Suite 107 Slidell, LA 70458	Outline & Mounting Low Range 15L/25L Sensor		
	SIGNATURES	DATES		SIZE	FSCM NO.	DRAWING NO.
	DRAFTSMAN		B		IIG03N010	-
	CHECKER		SCALE	NTS	SHEET 1 OF 1	
	DESIGNER					
PROJ. ENGR.						
RELEASED						
APPROVAL						



Notes:

- 1) Material:
  - M50 - PVC, Polyurethane and Viton O-rings
  - M51 - Flat Glass Double Junction w/Viton O-rings
  - M52 - Flat Glass Double Junction w/Viton O-rings
- 2) Temperature Range: 10 to 60°C
- 3) Cable length 33'
- 4) Operating Range:
  - M51 - 2 to 12pH
  - M52 - ±2000mV

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES TOLERANCES DECIMALS    ANGULAR .XX ±.010    X° ±1' .XXX ±.005 DO NOT SCALE DRAWING	CONTRACT NO.		 80 Whisperwood Blvd. Suite 107 Slidell, LA 70458
	DRAWN	DATE	
	CHECK		TITLE
	DESIGN		OUTLINE & MOUNTING 28 & 50 SERIES pH/ORP
	MATERIAL	-	DESIGN
FINISH	-	APPROVED	
SPEC.		CUSTOMER	
SCALE NTS		SIZE	DWG NO.
		C	IIG07N201
			REV B
			SHEET 1 OF 1

REV. B  
 DWG. No. IIG07N201

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REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED

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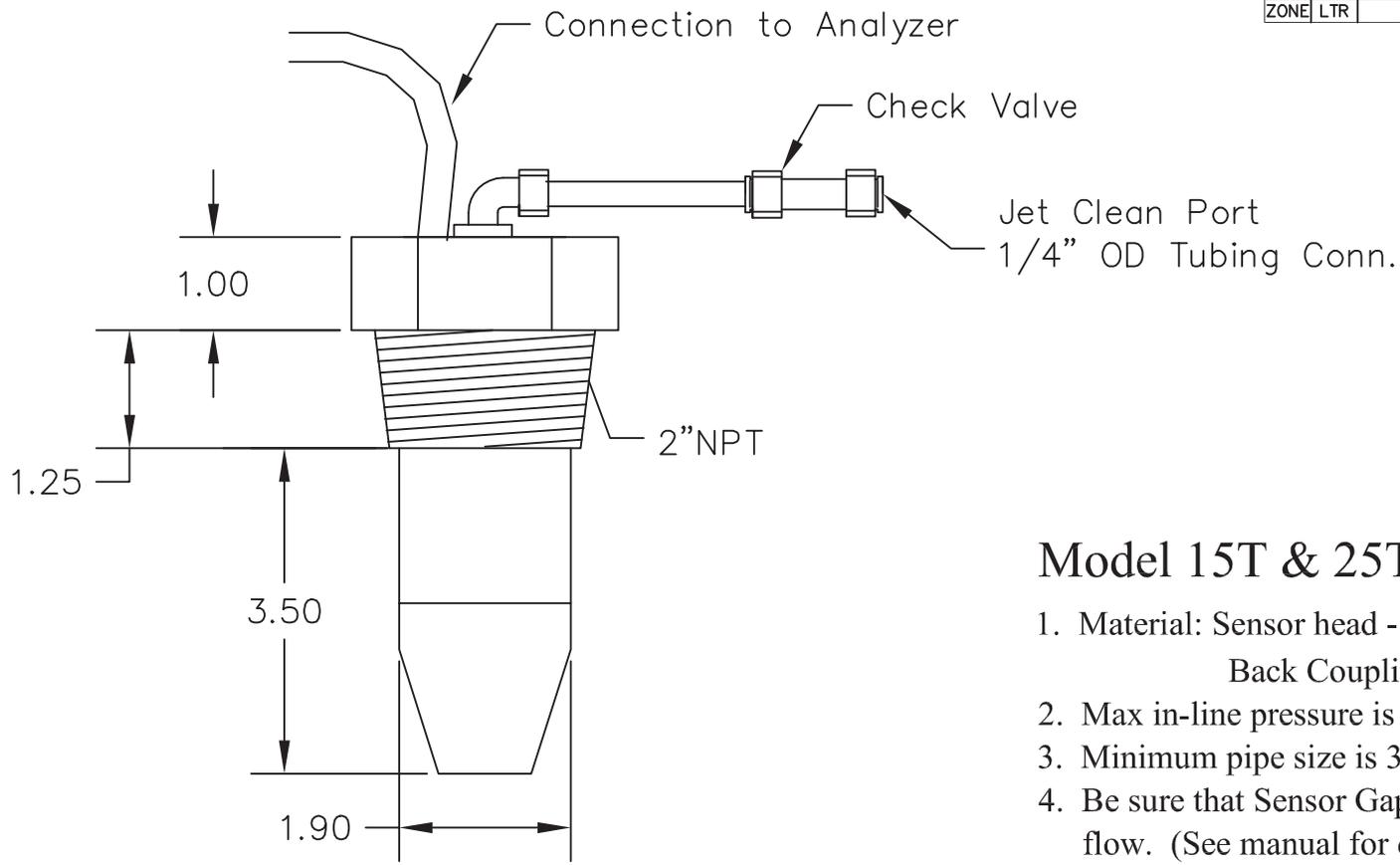
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### Model 15T & 25T Notes:

1. Material: Sensor head - Epoxy and Polyurethane  
Back Coupling - Gray PVC
2. Max in-line pressure is 20psi
3. Minimum pipe size is 3" nominal dia.
4. Be sure that Sensor Gap is in-line with sample flow. (See manual for details.)
5. Sensor must penetrate ID of the pipe by 1.5".

## Model 15T & 25T

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES TOLERANCES DECIMALS    ANGULAR .XX ±.010    X' ±1" .XXX ±.005 DO NOT SCALE DRAWING	CONTRACT NO.		 80 Whisperwood Blvd. Suite 107 Slidell, LA 70458		
	DRAWN	DATE			
	CHECK		TITLE	OUTLINE & MOUNTING MODEL 15T/PI & 25T/PI	
	MATERIAL	DESIGN	SIZE	DWG NO.	REV
	FINISH	APPROVED	C	IIG03N006	B
SPEC.	CUSTOMER	SCALE    NTS		SHEET 1 OF 3	

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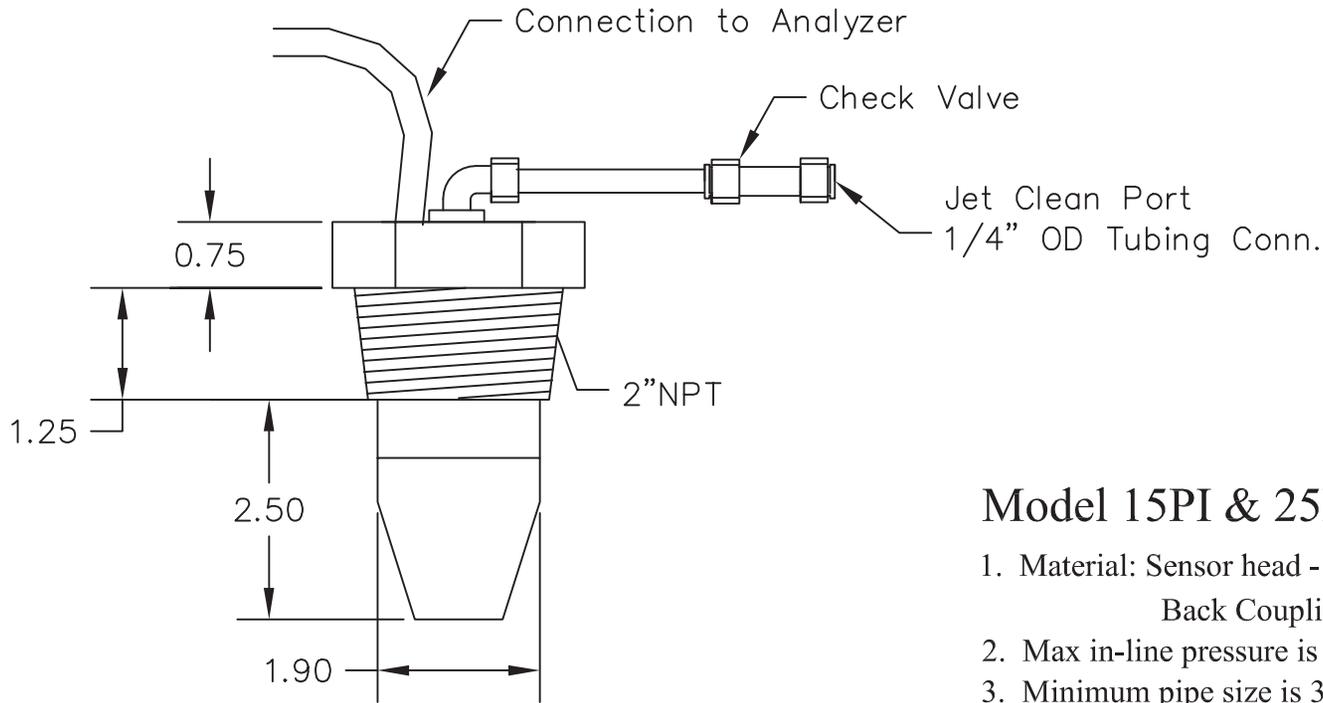
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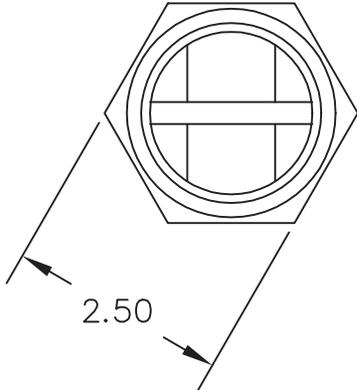
REV. B  
 DWG. No IIG03N006

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED



**Model 15PI & 25PI Notes:**

1. Material: Sensor head - Epoxy and Polyurethane  
Back Coupling - 316 Stainless Steel, Passivated
2. Max in-line pressure is 20psi
3. Minimum pipe size is 3" nominal dia.
4. Be sure that Sensor Gap is in-line with sample flow. (See manual for details.)
5. Sensor must penetrate ID of the pipe by 1.5".



**Model 15PI & 25PI**

SIZE	DWG. NO.	REV
C	IIG03N006	B
SCALE NTS	SHEET 2 OF 3	

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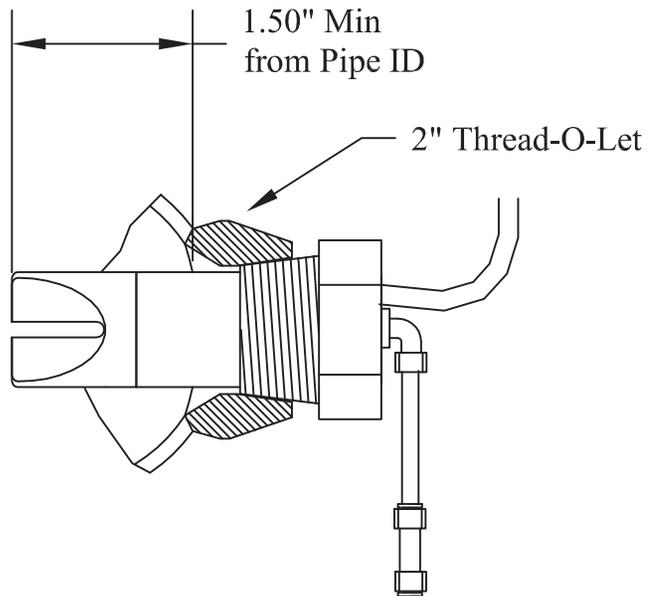
REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED

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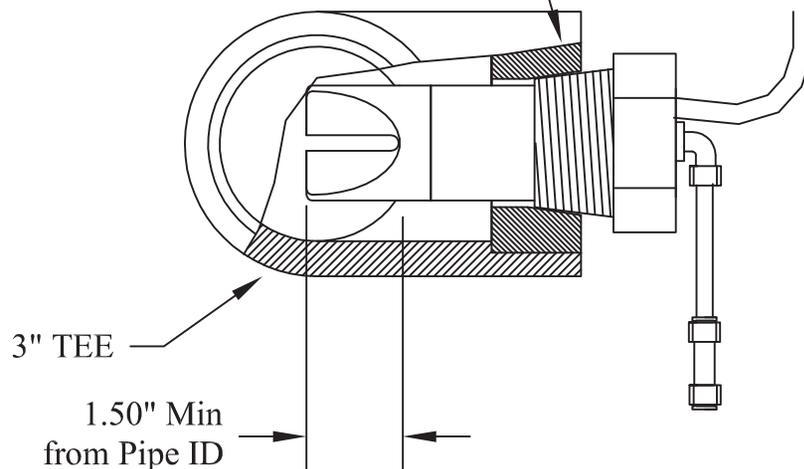
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Thread-O-Let Installation

2" FNPT x 3" ADAPTER



PVC TEE Installation

REV. B

DWG. No. 11G03N006

SIZE	DWG. NO.	REV
C	11G03N006	B
SCALE NTS	SHEET 3 OF 3	

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REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED

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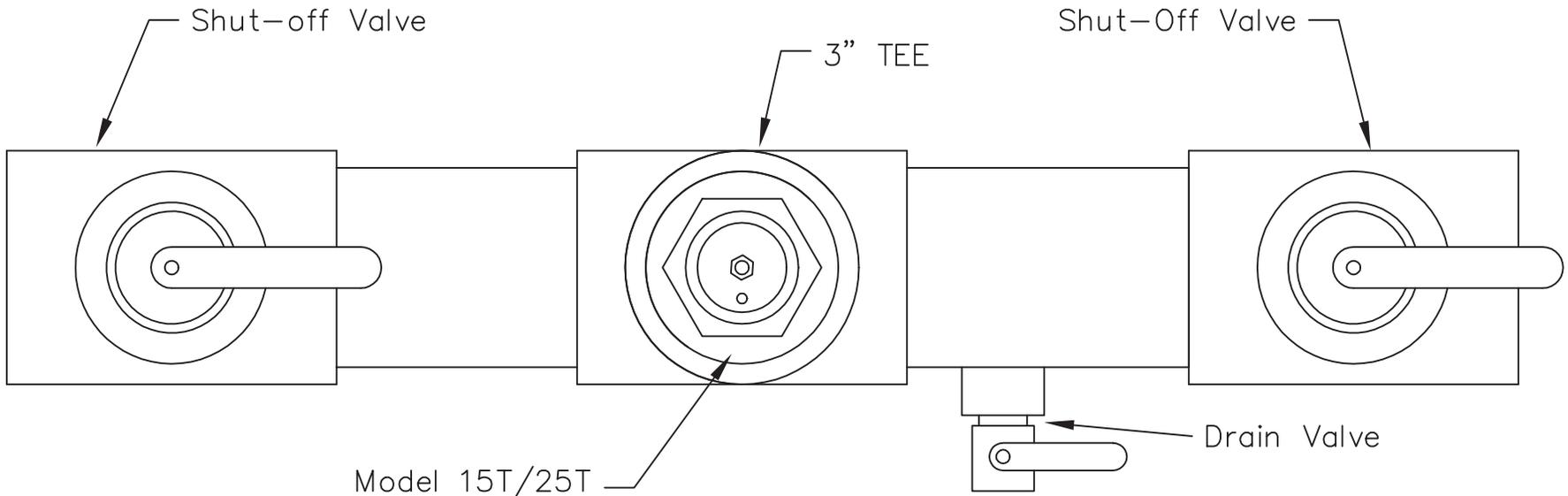
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Model 15T/25T

Sample By-Pass Line

DWG. No IIG03N007 REV. I

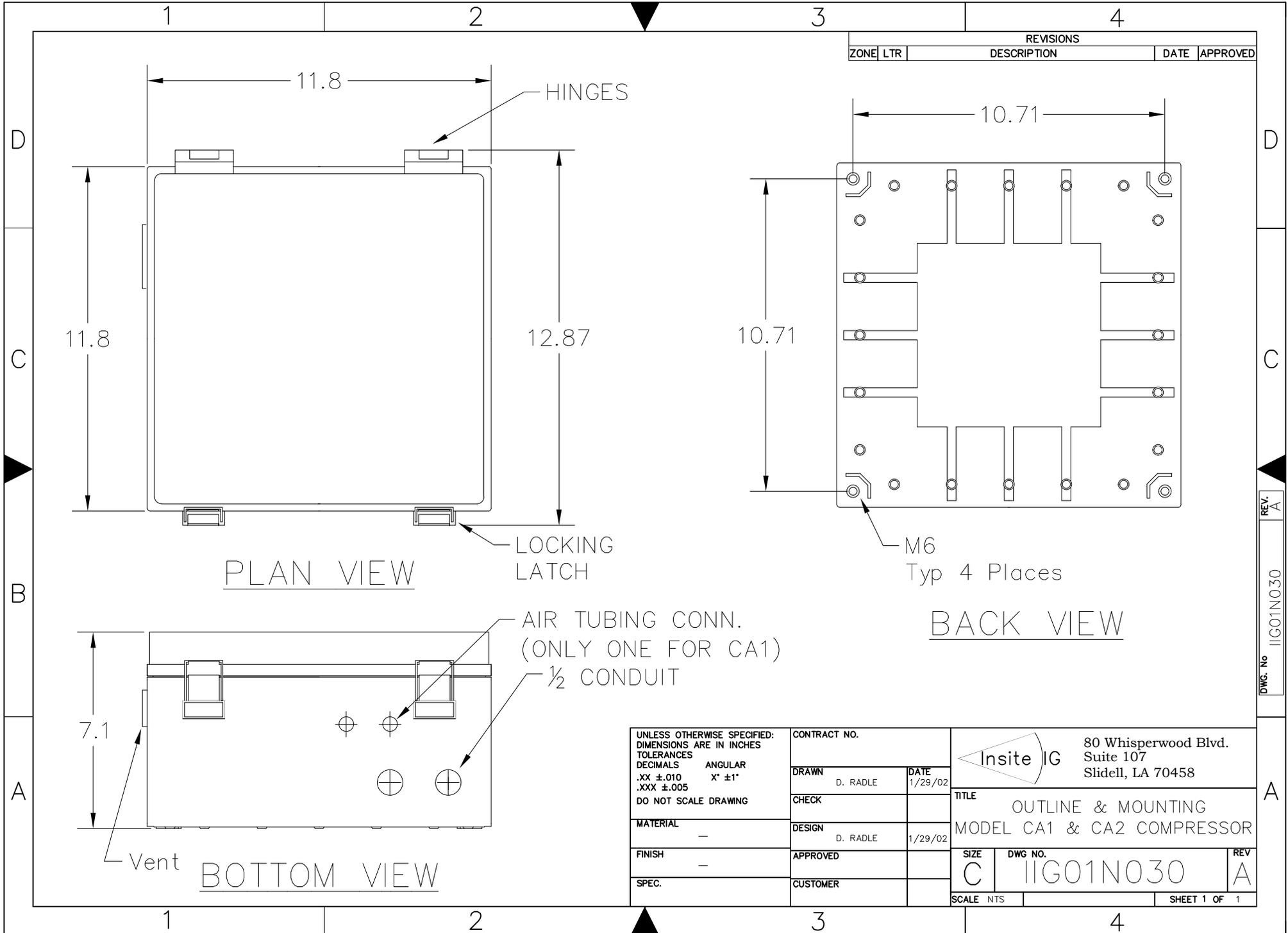
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES TOLERANCES DECIMALS    ANGULAR .XX ±.010    X' ±1" .XXX ±.005 DO NOT SCALE DRAWING	CONTRACT NO.		 80 Whisperwood Blvd. Suite 107 Slidell, LA 70458	
	DRAWN	DATE		
	MATERIAL	DESIGN	TITLE	INSTALLATION DIAGRAM
	FINISH	APPROVED	SIZE	DWG NO.
	SPEC.	CUSTOMER	C	IIG03N007
		SCALE	NTS	SHEET 1 OF 1

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UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES TOLERANCES DECIMALS    ANGULAR .XX ±.010    X° ±1' .XXX ±.005 DO NOT SCALE DRAWING	CONTRACT NO.		 80 Whisperwood Blvd. Suite 107 Slidell, LA 70458	
	DRAWN D. RADLE	DATE 1/29/02		
	CHECK		TITLE	
	DESIGN	D. RADLE    1/29/02	OUTLINE & MOUNTING MODEL CA1 & CA2 COMPRESSOR	
MATERIAL		SIZE	DWG NO.	REV
FINISH		C	IIG01N030	A
SPEC.	CUSTOMER	SCALE NTS		SHEET 1 OF 1

DWG. No IIG01N030  
 REV. A

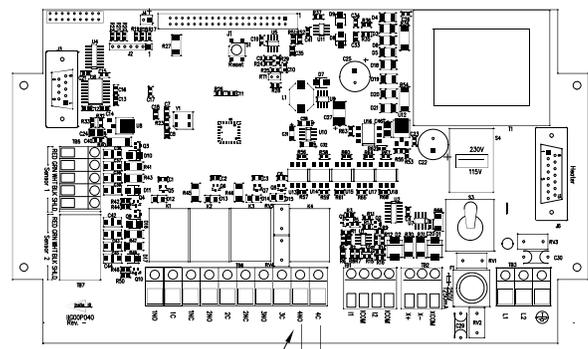
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REVISIONS				
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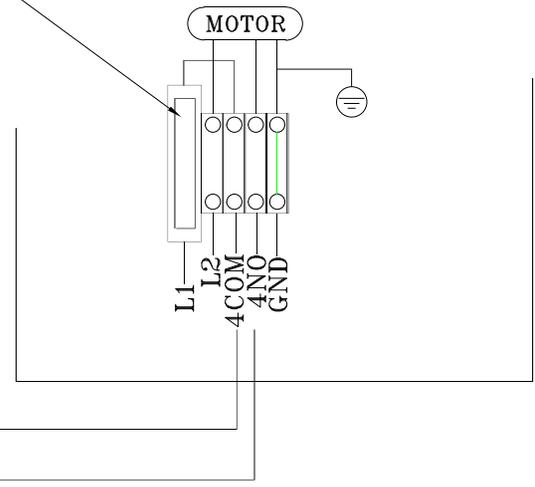


RELAY #4  
CLEANING RELAY

ANALYZER CONNECTIONS

1-1/4" x 1/4"  
3 AMP FUSE  
MAX WITH  
TIME DELAY  
(GDC TYPE)

CUSTOMER SUPPLIED  
2 CONDUCTOR CONNECTION  
18 AWG OR LARGER (3AMP)  
RATED FOR 115/230 VAC



COMPRESSOR CONNECTIONS  
INSITE IG - MODEL CA1

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES TOLERANCES DECIMALS    ANGULAR .XX ±.010    X° ±1' .XXX ±.005 DO NOT SCALE DRAWING	CONTRACT NO.		 80 Whisperwood Blvd. Suite 107 Slidell, LA 70458		
	DRAWN	DATE			
	CHECK		TITLE COMPRESSOR CONNECTION INSITE IG ANALYZER		
	DESIGN				
	MATERIAL		SIZE	DWG NO.	REV
	FINISH		C	IIG01R112	A
SPEC.	CUSTOMER	SCALE NTS		SHEET 1 OF 1	

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REV. A  
 DWG. No IIG01R112

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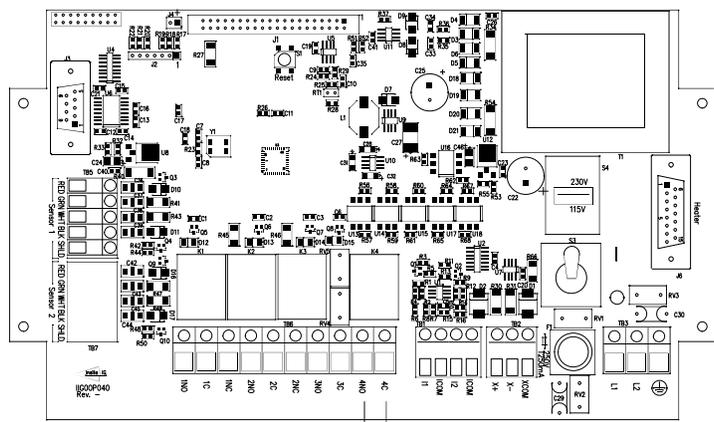
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REV. A

DWG. No IIG01R113

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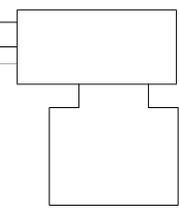
REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED



Rely 4C TO L1

Solenoid L1 to 4N0

L2



2-Way Shutoff Valve  
 ASCO P/N 8262G220-115VAC  
 OR EQUIVALENT  
 1/4" FNPT Connection

### ANALYZER CONNECTIONS

FOR SENSOR JET CLEAN

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES TOLERANCES DECIMALS      ANGULAR .XX ±.010      X° ±1' .XXX ±.005 DO NOT SCALE DRAWING	CONTRACT NO.		 80 Whisperwood Blvd. Suite 107 Slidell, LA 70458
	DRAWN D. RADLE	DATE	
	MATERIAL	CHECK	TITLE SOLENOID JET CONNECTION INSITE IG ANALYZER
	FINISH	DESIGN D. RADLE	SIZE      DWG NO.      REV C      IIG01R113      A
	SPEC.	APPROVED	SCALE      NTS      SHEET 1 OF 1
CUSTOMER			

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