MODEL 2000CE
PROCESS ANALYZER

MODEL 10
OPTICAL DISSOLVED OXYGEN SENSOR

MODEL 15/15L
OPTICAL SUSPENDED SOLIDS SENSOR

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Product Description

The Model 2000 Process Analyzer is a two channel analyzer designed for the continuous measurement of dissolved oxygen and/or suspended solids in mixed liquor aeration basins. The microprocessor-based electronics of the Model 2000 analyzer provide a high degree of flexibility and ease of use. The instrument is designed to operate with any combination of InsiteIG sensors in a variety of applications. The DO sensor to be used with this analyzer 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 SS sensor operates on the principle of single gap light absorption as a means of detecting the presence of suspended solids.

The Model 10 Dissolved Oxygen sensor is designed for the continuous monitoring of dissolved oxygen in water and wastewater where parts per million accuracy is required. The unit will display dissolved oxygen content in either 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 20.0. 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 400%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. It incorporates self-cleaning optics via air or water jet.

The Model 15 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 Model 15L sensor has been designed for low ranges (0 to 1500 mg/l) as commonly found in effluent streams. Both sensors utilize an infrared emitter to minimize color effects and compensates for emitter variations due to temperature by measuring source brightness. They incorporate self-cleaning optics via air or water jet.

Packaging

The analyzer 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

1. The Model 2000 analyzer should be located convenient for an operator to read and technician to install and maintain. A rear rail mounting kit is available for the standard enclosure (see Drawing IIG01N110). This mounting kit is design for a standard 2" handrail but can be adapted to square or angle handrails as well.

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

2. Mount the sensor in the desired location. InsiteIG can supply a sensor handrail mounting kit that easily mounts to most handrails and slide locks the sensor into place with out the use of tools. (See drawings IIG02N004, IIG02N005, IIG03N004 and IIG03N005). Again, this sensor mounting kit is design for a standard 2" handrail but can be adapted to square or angle handrails as well.

    **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 Process Analyzer. 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 blocks TB5 (labeled SENSOR 1) and TB7 (labeled SENSOR 2) (see drawing IIG04R111). 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 unit is turned on, the unit will initialize and then jump into the "RUN" mode and begin displaying Channel 1 "CH 1" content on the upper portion of the display and Channel 2 "CH 2" content on the lower portion of the display.

Note: The Model 10 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.

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 IIG04R111 for details. The analog #1 output, for channel #1, is labeled "I 1" and the analog #2 output, for channel #2, 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 plus (labeled X+), a transmit minus (labeled X-), and a transmit ground or common (labeled X COM). See drawing IIG04R111 for details. The RS-485 interface is electrically isolated from the measurement and microprocessor circuitry of the Model 2000. The communications protocol for the Digital Output is fully described in Appendix A.

Relay Outputs

There is one independent programmable set point control relay for each channel. These relays are Form-C with contacts rated 10/6 amps resistive load at 125/250 VAC. Two Form-A relays with contacts rated 10/6 amps resistive load at 125/250 VAC are used for the jet clean function. The connections for the relay outputs are available from TB6. See drawing IIG04R111 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.

Run Mode

The RUN mode is the normal operating mode of the analyzer and is entered upon power-up. When the Run mode is entered the analyzer will determine what types of sensors are attached to each channel. The supplied sensors have 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 information for the Model 10 D.O. sensor is stored in non-volatile memory of the sensor. Sensor information for the Model 15/15L TSS sensor is stored in non-volatile memory of the analyzer. If a Model 15/15L is connected to the analyzer and the sensor information does not match the information stored in the analyzer, the analyzer will display a configuration message. The configuration message for the Model 15/15L TSS sensor is "**Zero sensor**". These messages will appear whenever the sensor is changed.

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 available from the main menu. Use the arrow keys to switch between RUN, SETUP & 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 five 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 six options will be displayed. The options are;

RELAYS
ANALOG OUTPUT
MODBUS
SENSOR 1 SETUP
SENSOR 2 SETUP
CH 2 MODE

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 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 11 menu options for configuring the relays.

RELAY 1 OP MODE –	defines operation mode of relay 1
RELAY 1 ON SETPOINT –	defines when relay 1 will energize
RELAY 1 OFF SETPOINT –	defines when relay 1 will de-energize
RELAY 1 FAIL MODE –	defines the relay 1 state during an alarm condition
RELAY 2 OP MODE –	defines operation mode of relay 2
RELAY 2 ON SETPOINT –	defines when relay 2 will energize
RELAY 2 OFF SETPOINT –	defines when relay 2 will de-energize
RELAY 2 FAIL MODE –	defines the relay 2 state during an alarm condition
RELAY 3 OP MODE –	defines operation mode of relay 3.
CLEAN SCHEDULE –	defines how often relay four will energize cleaning
CLEAN JET TIME –	defines duration of time the clean relays will be energized
CLEAN RECOVERY TIME –	defines how many long the reading holds.

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

Note: Do not attempt to adjust relay set points values until a working sensor has been connected to the channel. Otherwise, the analyzer may not display the correct units (TSS or D.O.) for the channel.

Low Setpoint

If a relay “OP MODE” has been set as a LOW setpoint, then the corresponding relay will energize if the reading falls below the value set in the “ON SETPOINT” parameter. Once the relay has been energized by a low reading, it will not be deenergized until the reading rises above the value set in the “OFF SETPOINT” parameter. The relay “OFF SETPOINT” value MUST be greater than or equal to the “ON SETPOINT” value in this mode.

High Setpoint

If a relay “OP MODE” has been set as a HIGH setpoint, then the corresponding relay will energize if the reading rises above the value set in the “ON SETPOINT” parameter. Once the relay has been energized by a high reading, it will not be deenergized until the reading falls below the value set in the “OFF SETPOINT” parameter. The relay “OFF SETPOINT” value MUST be less than or equal to the “ON SETPOINT” value in this mode.

Relay #3:

Relay 3 has three modes, ALARM, CA2 CLEAN, and SPECIAL.

ALARM MODE: In this mode, the relay is energized for normal operation and will become deenergized if an error condition occurs. Consequently, loss of power can be sensed remotely as an alarm condition.

CA2 CLEAN: This mode must be chosen if a model CA2 compressor cleaning assembly is used. Both relays 3 and 4 are needed to operate this compressor.

SPECIAL: This mode is set if customer supplied air or water is being used with one or two solenoid valves (see drawing IIG04R113) Or, if a CA1 compressor is being used to clean both sensors. In this mode the analyzer will energize relay #4 for a clean duration and then de-energize #4 and energize relay #3 for a clean duration.

Clean Mode

The jet clean system is intended to be connected to relays 4 and/or 3. The relays are connected to the InsiteIG compressor, CA-2, or a customer supplied air or water source and a shut-off valve. See drawing IIG04R113 and IIG04R112 for details.

The CLEAN 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. If this is set to “0” then cleaning is turned off.

The CLEAN JET TIME program parameter determines how long the jet clean cycle will last. The CLEAN PULSE can be set to values of 1-second to 90-seconds with a 1-second resolution. Typically, a clean pulse of 30-seconds works well for aeration basins. A clean cycle will consist of the channel 1 sensor being cleaned for the programmed clean jet time immediately followed by the channel 2 sensor being cleaned for the programmed clean jet time. The analyzer will hold the measurement reading during the clean cycle and the recovery period which is equal to the programmed clean jet time.

The CLEAN RECOVERY parameter determines how long the analyzer will hold the DO reading after the cleaning 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 pressing the "ENTER" button will cause a clean cycle to begin. Performing demand clean doesn’t affect the normal clean schedule.

Analog Output

From the SETUP menu, use the ARROW keys to select the “ANALOG OUTPUT” option, then press the ENTER key. The ANALOG OUTPUT SETUP menu has 8 parameters for configuring these outputs.

ANALOG 1 TYPE – select either 4-20mA or 0-20mA operation for the Analog 1 output.
ANALOG 1 FULL SCALE – defines the value that will cause the Analog 1 output to go to 20mA.
ANALOG 1 MIN SCALE – defines the value that will cause the Analog 1 output to go to 0/4mA.
ANALOG 1 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 4-20mA operation, 0-20mA operation, or 4-20mA output of channel 1's temperature (only available if channel 1 is a DO sensor) for the Analog 2 output.
ANALOG 2 FULL SCALE – defines the value that will cause the Analog 2 output to go to 20mA.
ANALOG 2 MIN SCALE – defines the value that will cause the Analog 2 output to go to 0/4mA.
ANALOG 2 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.

Modbus Setup Mode

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

Comm Address – defines the address of the analyzer
Comm Baud Rate – defines the baud rate of the digital output

Appendix A describes the Modbus protocol implementation in the Model 2000.

SENSOR SETUP

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

DO Sensor

General

The Model 10 sensor has been designed to require very infrequent calibration. Unlike polaragraphic 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 Model 10 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 Model 2000 analyzer allows the user to select from two different calibration procedures. The procedure can be selected by choosing SETUP from the main menu. Once the SETUP menu appears, use the arrow keys to choose the "SENSOR x SETUP" option where x is the channel number of the desired sensor.

Sensor Calibration to a Reference

Calibration to a known reference is the easiest, simplest, and also the preferred method of calibration when calibration is required. Calibration option number 1 "Sensor Ref Cal" allows the operator to make adjustments to the D.O. reading to agree with any other source of D.O. information. 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 "Sensor 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.

Sensor Slope Adjustment (NOT RECOMMENDED)

If performed correctly, the previously described "Sensor Calibration to a Reference" should be all that is required by the user. "Sensor slope adjustment" should only be attempted upon recommendation from the factory.

Sensor calibration option 2 "Sensor Slope Adj" allows the user to adjust the span of the sensor, but this procedure must only be used immediately AFTER the sensor has been "zeroed" using calibration option 1 with the sensor submerged in a zero oxygen solution. This zero solution may be prepared by adding two tablespoons of sodium sulfite salt to a gallon of tap water in an open container (bucket). The sodium sulfite salt will remove all oxygen from the water as it dissolves. Stir the water for about one

minute to dissolve the salt. Submerge the Model 10 sensor in this water and allow it to rest for at least 30 minutes. For best accuracy, the sensor should be resting face down in the bottom of the container. (The solution stratifies over time at rest, and the dissolved oxygen content will be closest to zero at the bottom of the container, while slightly above zero nearer the surface.) Also 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 0.00 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 0.10 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. Place the sensor in a solution of known D.O. concentration, and allow about 15 minutes to fully stabilize. 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.

FACTORY 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.

DISPLAY MODE

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

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 CALIBRATION

To do a complete calibration, three steps are required. The analyzer must first be zeroed, and then a sample/snapshot is taken. After the sample has been analyzed, the span of the analyzer 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 Model 2000 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 analyzer's SPAN function will recall the stored value and allow the user to adjust the span value accordingly.

The range of operation of the Model 15 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 Model 15L 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

Submerge the sensor in clean water. It is important that the water used to zero the sensor be clean. At the very least use potable water for this, and distilled water is even better. Do not use plant process water of any type.

Select the "ZERO" option from the calibrate menu using the up and down arrow buttons. Press the "ENTER" button. With the sensor submerged in clean water, wait about 15 minutes and then press "ENTER". The analyzer 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

With the sensor submerged in the process to be measured and stable, select the "SNAPSHOT" option from the calibrate menu using the up and down arrow buttons. Press the "ENTER" button. Pressing the "ENTER" button again will cause the analyzer to take a snapshot of the conditions. The analyzer will take about sixty seconds to obtain a sample value. The display will return to the calibrate menu automatically when it is finished. At this point, you have NOT altered the calibration of the analyzer at all; you have only stored the conditions of the process water in memory for future use. Press the "MENU" button to exit or use the up and down arrow buttons to select another calibration function.

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 calibrate

menu using the up and down arrow buttons and press the "ENTER" button. The value that was previously saved snapshot will be displayed. Use the up and down arrow buttons to adjust the analyzer reading to the value of 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 analyzer has been properly zeroed in clean water, the analyzer 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.

CH 2 MODE

If the Model 2000 has only one senor connected, you may use this setup option to disable channel 2 completely. This eliminates all channel 2 information from the normal RUN mode display. The options are ENABLED and DISABLED

Test Mode

This mode of operation allows the user to perform basic test functions to aid in troubleshooting. 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 Sensor 1 Data

This test is intended primarily to aid the InsiteIG technical support engineers in troubleshooting. The following channel 1 sensor data is displayed: sensor type, sensor serial number, sensor reporting mode, and sensor raw data. Press the MENU key to exit.

View Sensor 2 Data

This test is intended primarily to aid the InsiteIG technical support engineers in troubleshooting. The following channel 2 sensor data is displayed: sensor type, sensor serial number, sensor reporting mode, and sensor raw data. Press the MENU key to exit.

View Sensor Clk

View Sensor Clk displays the power line frequency which is used to filter the sensor data. Press the MENU key to exit.

Cal Analog 1

Cal analog 1 will cause the analyzer 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 analyzer 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.

Clean Relay (Relay #4)

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 analyzer. To exit, press the "MENU" button.

View Sensor 1 Char

This test is intended primarily to aid the InsiteIG technical support engineers in troubleshooting. The characteristics for the channel 1 sensor are displayed.

View Sensor 2 Char

This test is intended primarily to aid the InsiteIG technical support engineers in troubleshooting. The characteristics for the channel 2 sensor are displayed.

ERROR MESSAGES

During operation, the Model 2000 analyzer 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 analyzer is not receiving any data from the sensor. This could be caused by either the sensor is not properly connected to the analyzer or a faulty sensor or analyzer electronics.

***SENSOR ERROR* (Model 10 only)**

This error message will be displayed if the sensor's electronics become faulty. Call the factory for assistance.

****Zero Sensor** (Model 15/15L only)**

The analyzer is indicating that a zero cal operation is required for proper operation. This can occur if a new or different sensor has been connected to the analyzer. This would be indicated if the current counts are greater than 5% of the pervious stored zero value.

***Ambient Error* (Model 15/15L 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. Call the factory for assistance.

MAINTENANCE

The analyzer does not require any periodic maintenance. However, it may be necessary to periodically clean the exterior of the analyzer. 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 analyzer. 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.

Model 10 D.O. Sensor: In normal wastewater aeration basins the Model 10 Sensor will 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-slim and scaling, the integrated jet clean system is recommended to be used to prevent the slim 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.

Model 15/15L 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.

GUARANTEE AND REPAIR POLICY

Model 2000 Process Analyzer, Model 10, and Model 15/15L sensors and related items are guaranteed for two years against defective materials and workmanship. They will be replaced or repaired at InsiteIG's discretion free of charge during the guarantee period. Freight to our factory is to be paid by the customer.

All shipments are insured. If you receive a damaged unit, please notify InsiteIG so that we may authorize return of the equipment. Shipments to InsiteIG should be protected and insured by the customer.

Repairs to the equipment not covered by the guarantee will be billed per standard service charges. Please request service price sheet and/or spare parts price list.

Appendix A - Modbus Protocol

Insite IG analyzers support communication with other devices via the Modbus protocol using RTU 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.

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.

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 Model 2000.

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.

01 Read Coil Status

Description
Reads the ON/OFF status of the relays in the Model 2000 analyzer.

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 Model 2000 with slave address 1.

Field Name	Example
Slave Address	01
Function	01
Starting Address Hi	00
Starting Address Lo	00
No. of Relays Hi	00
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 Model 2000 analyzer.

Query

The query message specifies the starting register address and the quantity of registers to be read. The Model 2000 input registers are as follows:

Address	Register
0000	Channel 1 status
0001	Channel 1 primary measurement
0002	Channel 1 secondary measurement
0003	Channel 2 status
0004	Channel 2 primary measurement
0005	Channel 2 secondary measurement
000A	Last 4 digits of the channel 1 sensor serial number
000F	Last 4 digits of the channel 2 sensor serial number

The Model 10 sensor will report the channel status as follows:

Status	Description
0000	Normal
0001	Sensor not responding
0002	Sensor error
0003	New sensor codes needed

The Model 10 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 Model 15/15L sensor will report the channel status as follows:

Status	Description
0000	Normal
0001	Sensor not responding
0002	Sensor error
0003	Sensor requires a zero calibration

The Model 15/15L sensor will report TSS as the primary measurement and the secondary measurement is undefined. The units for TSS are mg/l.

Input Registers 6, 7, 8, 9, B, C, D and E are internal calculation values used by the factory for testing.

Below is an example of a request to read the channel 2 status and channel 2 primary 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		03
No. of Regs. Hi		00
No. of Regs. Lo		03
CRC		--

Below is an example of a response to the previous query where channel 2 is connected to a Model 10 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 3)		00
Data Lo (Reg 3)		00
Data Hi (Reg 4)		03
Data Lo (Reg 4)		3E
Data Hi (Reg 5)		00
Data Lo (Reg 5)		FA
CRC		--

06 Preset Single Register

Presets a value into a single register of the Model 2000 analyzer.

Query

The query message specifies the register to be preset. The demand clean cycle register is the only register in the Model 2000 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 Model 2000 is shown below.

Field Name	Example
Slave Address	01
Function	11
Byte Count	04
Slave ID	02
Run status	00=Off, FF = On
Ch 1 sensor type	00=Model 10, 10=Model 15, 20=Model 15L
Ch 2 sensor type	00=Model 10, 10=Model 15, 20=Model 15L
CRC	--

Exception Responses

If the Model 2000 analyzer receives a query without a communication error, but cannot handle it, an exception response will be returned.

In a normal response, the Model 2000 echoes the function code of the original query in the function code field of the response. In an exception response, the Model 2000 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 Model 2000 are:

Exception code	Description
01	Illegal function code
02	Illegal data address

Appendix B – CA-2 Jet Clean System

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 relays #3 and #4. (see drawing IIG04R112 & IIG04113) This relays are programmable through the setup menu, see Relays section of this manual for more detail.

The InsiteIG Model CA-2 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 and a directional solenoid valve to blast the sensors on channel 1 and channel 2 independently. 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. 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 and possible. (If over 100' please consult the factory) In this case Relay #3 mode should be set to CA2 CLEAN.

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 IIG04R112.

If plant water is being used, or shop air, the customer must supply clean water at 35 to 50 psig or air at 40 to 60 psig. A 2-way solenoid valve (customer supplied) may be used to turn on and off the water to both sensor heads. A ¼" quick disconnect fitting is supplied with the sensor. See drawing IIG04R113 for wire details. There are no changes required in the sensor head for use with water or shop air. In this case Relay #3 mode should be set to ALARM.

Two solenoid valves may be used (one for each sensor) so that the cleaning blast is not divided. In this case Relay #3 & Relay #4 are energized separately and Relay #3 mode should be set to SPECIAL.

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 optics of the sensor, removing any debris that may cause fouling.