MODEL 1500CE
SUSPENDED SOLIDS ANALYZER

MODEL 15/15L
OPTICAL SUSPENDED SOLIDS SENSOR

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Insite Instrumentation Group, Inc
80 Whisperwood Blvd.
Suite 107
Slidell, LA 70458
Phone: (985) 639-0006
Fax: (985) 639-0014
E-mail: info@insiteig.com
www.insiteig.com

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GENERAL INFORMATION

Product Description

The Model 1500 Suspended Solids Analyzer is a multi-range analyzer designed for the continuous measurement of suspended solids in aqueous solutions. The microprocessor-based electronics of the Model 1500 analyzer provide a high degree of flexibility and ease of use. The instrument is designed to operate in a variety of applications. The sensor operates on the principle of single gap light absorption as a means of detecting the presence of suspended solids.

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 TSS 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 compensate for emitter variations due to temperature by measuring source brightness. The sensor incorporate self-cleaning optics via air or water jet.

Packaging

The analyzer is housed in a UL Listed, NEMA 4X enclosure (see Drawing IIG01N111 for Outline and Mounting) and is designed for outdoor mounting.

INSTALLATION

1. 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 IIG03N004 & 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 switch 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. Input/ Output Connections: Open the enclosure of the Suspended Solids Analyzer. Pass all connection cables through conduit or glands in the bottom of the enclosure (conduit and glands not supplied). The sensor input connections are made to the terminal block labeled TB5 (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 can 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 to "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 the Dissolved Oxygen content and the temperature.

Note: In order for the Model 15 sensor to operate properly, the frequency select parameter must be set to the power line frequency (50/60 Hz). See setup mode section for details.

7. The first time the unit is powered up with the sensor in the process, 1 or 2 minutes are required for the sensor to stabilize. The reading will drift slightly during this period.

Analog Output

An optically isolated 4-20 or 0-20 milliamp signal capable of driving 600 ohms is available from the terminal block labeled TB1. See drawing IIG01R111 for details. The analog output is labeled "I 1". The common or ground for this signal is labeled "ICOM". This is an “active” output and does not require an external voltage.

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 IIG01R111 for details. The communications protocol for the Digital Output is fully described in Appendix A. This output is optically isolated.

Relay Outputs

There are three independently programmable set point control relays and one jet clean relay. Relay 1 & 2 are Form-C with contacts rated 10/6 amps resistive load at 125/250 VAC and relay 3 & 4 are Form-A with contacts rated 10/6 amps resistive load at 125/250 VAC. The output for these is 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.

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. If no keys are pressed within a 30 second period, the analyzer will return to the RUN mode.

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 begin displaying the TSS value (however it will be approximately one minute before the TSS value is stabilized). This is a function of the response time setting. The display is continuously updated with the current TSS value. 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.

The analyzer and sensor have been zero calibrated at the factory. If the analyzer does not identify the sensor, the display will read "**Zero sensor**" beneath the TSS reading. This will happen anytime the sensor is changed. If the sensor and analyzer are kept together, the factory zero will be recognized and a snapshot/span is all that is needed. In most cases the factory default will be adequate until the lab results of a TSS sample are available.

While in the RUN Mode, the relay status and 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.

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 options are;

1. Sensor Calibration
2. Relays

3. Analog Outputs
4. 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 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, and then press the “ENTER” key.

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 1500 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 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 sensor 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.

1: Sensor Zero

Each TSS sensor will have a unique zero reference. This calibration mode will calculate and store the zero reference for the current sensor.

Select the "Sensor Zero" option from the calibrate menu using the up and down arrow keys. Press the "ENTER" key. 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. With the sensor submerged in clean water, wait about 15 minutes for complete temperature stability. Finally, dislodge any air bubbles that may have collected on the sensor face, then press the ENTER key on the analyzer. 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" key to exit or use the up and down arrow keys to select another calibration mode.

2: Snapshot

This mode is the first step in calibrating the span of the system. The snapshot mode does not immediately effect calibration. Instead, it is used to memorize process conditions while a physical sample is

being pulled for lab analysis. When the lab analysis is complete, the “sensor span” mode is used to complete the calibration process to the memorized conditions.

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 keys. Press the "ENTER" key. Pressing the "ENTER" key 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, the calibration of the analyzer has NOT been altered; only the conditions of the process water have been stored in memory for future use. Press the "MENU" key to exit or use the up and down arrow keys to select another calibration function.

3: 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 keys and press the "ENTER" key. The value that was previously saved in the snapshot mode will be displayed. Use the up and down arrow keys to adjust the analyzer reading to the value of the laboratory analysis. Press the "ENTER" key when done. The system is now calibrated and ready for normal operation. Press the "MENU" key to exit or use the up and down arrow keys to select another calibration mode.

4: 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.

Select the "Default Span" option from the calibrate menu using the up and down arrow keys and press the "ENTER" key. Pressing the "ENTER" key again will cause the analyzer to use the factory default span calibration value. Press the "MENU" key to exit or use the up and down arrow keys to select another calibration mode.

5: Response Time

The response time mode 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.

6: Sensor Curve

The sensor curve mode 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.

7: Freq. Select

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

8: 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.

Relays

From the setup menu, use the arrow keys to move the cursor to the “1-Relays” option, press the “ENTER” key. There are 14 menu options for configuring the relays.

1:	#1 Op Mode –	defines operation mode of relay number one
2:	#1 ON Setpt –	defines when relay one will energize
3:	#1 OFF Setpt –	defines when relay one will de-energize
4:	#1 FAIL MODE –	defines the relay one state during an alarm condition
5:	#2 Op Mode –	defines operation mode of relay number two
6:	#2 ON Setpt –	defines when relay two will energize
7:	#2 OFF Setpt –	defines when relay two will de-energize
8:	#2 FAIL MODE –	defines the relay two state during an alarm condition
9:	#3 Op Mode –	defines operation mode of relay number three
10:	#3 ON Setpt –	defines when relay three will energize
11:	#3 OFF Setpt –	defines when relay three will de-energize
12:	#3 FAIL MODE –	defines the relay three state during an alarm condition
13:	Cln Schedule –	defines how often relay four will energize cleaning
14:	Cln Jet Time –	defines duration of time relay four will be energized

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

Low Setpoint

If a relay “Op Mode” has been set as a LOW setpoint, then the corresponding relay will energize if the TSS reading falls below the value set in the “ON Setpt” parameter. Once the relay has been energized by a low TSS reading, it will not be deenergized until the TSS 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 setpoint, then the corresponding relay will energize if the TSS reading rises above the value set in the “ON Setpt” parameter. Once the relay has been energized by a high TSS reading, it will not be deenergized until the TSS 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 the relay “Op Mode” is set to alarm mode, then the relay will function to indicate alarm or error conditions. 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. In this mode, the relay can also indicate low TSS conditions as an alarm. The relay will deenergize if the TSS level drops below the value set in the “ON Setpt” parameter. Once the relay has been deenergized by a low TSS reading, it will not be reenergized until the TSS 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.

Clean Mode

The jet clean system is intended to be connected to relay 4.

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.

The CLN 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.

Demand Clean

When the analyzer is in the RUN mode pressing the "ENTER" key 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 4 parameters for configuring these outputs.

1: Analog Type – choose either 4-20 milliAmp or 0-20 milliAmp operation for the Analog output.
2: TSS Full Scale – defines the TSS value that will cause the output to go to 20 milliAmps.
3: TSS Min Scale – defines the TSS value that will cause the output to go to 0 or 4 milliAmps.
4: Ana Fail Mode – defines the value of the TSS output during an alarm or error condition. Choose between holding the last good reading, or dropping to 0 or 4 milliAmps.

Modbus Setup Mode

From the setup menu, use the arrow keys to select the "3-Modbus" option, then press the "ENTER" key. There are 2 menu options for configuring the serial digital output.

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

Appendix A describes the Modbus protocol implementation in the Model 1500.

TEST MODE

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

1: View Sensor Data

This test is intended primarily to aid the InsiteIG technical support engineers in troubleshooting. The raw counts for the reference and gap detectors are displayed in HEX. Press the MENU key to exit.

2: View Sensor Serial Number

View Sens S/N# displays the serial number of the sensor currently connected to the analyzer. Sensor reports its serial number once per minute. Press the MENU key to exit.

3: View Sensor Clock

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

4: View Zero Cal

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

5: View Span Cal

View span cal displays the span factor ratio. Press the MENU key to exit.

6: Cal Analog Output

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

7: Test Relay 1

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

8: Test Relay 2

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

9: Test Relay 3

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

10: Test Clean Relay

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

11: Test Modbus

Test Modbus will test the RS-485 communication port.

12: Software Version

Software Ver displays the current version of software in the analyzer. To exit, press the "MENU" key.

ERROR MESSAGES

During operation, the Model 1500 analyzer may determine that an error condition exists. If this happens, the display will contain an error message. The 3 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.

****Zero Sensor****

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

This error message will be displayed if the sensor is exposed to too much ambient light. Or the sensor has a LED of detector fault.

MAINTENANCE

The analyzer does not require any periodic maintenance. 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 1500 Suspended Solids Analyzer & Model 15/15L suspended solids sensors and related items are guaranteed for two years against defective materials and workmanship. It 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 R/A 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

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.

Function codes supported by the Model 1500

01 Read Coil Status

Description
Reads the ON/OFF status of the relays in the Model 1500 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 1500 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 1500 analyzer.

Query

The query message specifies the starting register address and the quantity of registers to be read. The Model 1500 input registers are as follows:

Address	Register
0000	Sensor status
0001	TSS measurement

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

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

The units for TSS are mg/l.

Below is an example of a request to read the sensor status and TSS 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	02
CRC	--

Below is an example of a response to the previous query where the sensor is a Model 15 TSS sensor measuring 3740 mg/l.

Field Name	Example
Slave Address	01
Function	04
Byte Count	04
Data Hi (Reg 0)	00
Data Lo (Reg 0)	00
Data Hi (Reg 1)	0E
Data Lo (Reg 1)	9C
CRC	--

06 **Preset Single Register**

Presets a value into a single register of the Model 1500 analyzer.

Query

The query message specifies the register to be preset. The demand clean cycle register is the only register in the Model 1500 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 1500 is shown below.

Field Name	Example
Slave Address	01
Function	11
Byte Count	02
Slave ID	01
Run status	00=Off, FF = On
CRC	--

Exception Responses

If the Model 1500 analyzer receives a query without a communication error, but cannot handle it, an exception response will be returned.

In a normal response, the Model 1500 echoes the function code of the original query in the function code field of the response. In an exception response, the Model 1500 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 1500 are:

Exception code	Description
01	Illegal function code
02	Illegal data address

Appendix B – CA-1 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 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. A ¼" OD flexible tube with a 70 psi rating (customer supplied) connects the sensor to the compressor assembly. Quick disconnect fitting are supplied on both the sensor head and compressor. The tubing length should be as short and 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 analyzer need only open the valve to provide the cleaning blast. A ¼" quick disconnect fitting is supplied with the sensor. There are no changes required in the sensor head for use with water or shop air. See drawing IIG01R113 for wire details.

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.