



IntelliStick™



Model AS230 – Operation Manual

OPERATING INSTRUCTIONS

Before installing or operating this unit, please read this operating manual thoroughly so that you can obtain the maximum use from it. This manual should be retained for future reference and used to answer your operational questions as they arise.

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For technical assistance, visit the Customer Support section of www.intellistick.com or contact Customer Support at **1-888-812-5988**
Mon - Fri: 8 am – 6 pm PDT
Sat - Sun: 10 am – 6 pm PDT

Patent Protection

This product is covered by U.S. Pat. No. 5,933,016 and its foreign counterparts. Additional coverage from pending U.S. and/or foreign patent applications may apply. Patent No. 092216 (DE, FR, UK)

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OVERVIEW OF THE INTELLISTICK SYSTEM

The IntelliStick system consists of two parts: the analyzer and the sensor.



Figure 1.0 IntelliStick Threaded Sensor



Figure 2.0 IntelliStick Analyzer

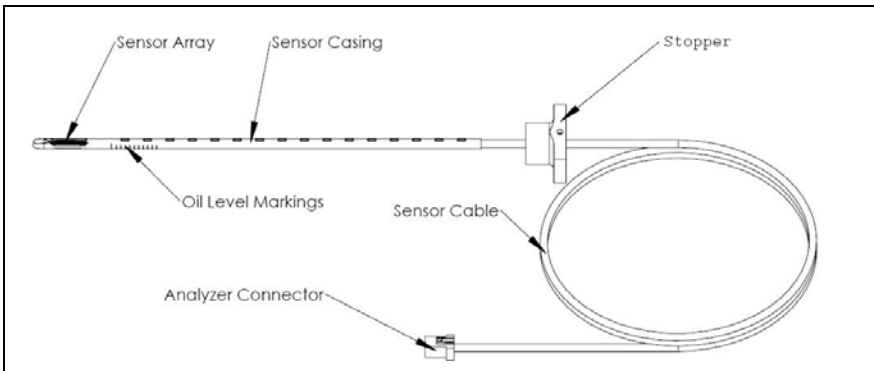


Figure 3. IntelliStick Dipstick Sensor

1. The IntelliStick-TS (Threaded Sensor) – (Figure 1) consists of a sensor that can be threaded into a ½" port, with a cable and a connector.
2. The Analyzer Box – (Figure 2) can be mounted anywhere clear of obstructions. It reads the oil condition from the sensor and communicates using RS-232 or RS-485 and (optionally) 4-20mA.
3. The IntelliStick-DS (Dipstick Sensor) – (Figure 3) is a probe that will go down a dip-tube, and a stopper with a cable and a connector.

WARNING

During installation:

- ! DO NOT INSTALL THE INTELLISTICK WITH THE MACHINE ON OR HOT.**
- ! DO NOT USE THE INTELLISTICK FOR ANYTHING OTHER THAN ITS INTENDED PURPOSE.**
- ! DO NOT INSTALL THE ELECTRONICS ASSEMBLY CLOSE TO ANY DIRECT HEAT SOURCE SUCH AS EXHAUST COMPONENTS.**
- ! DO NOT CUT THE INTELLISTICK CABLE AND RE-ATTACH THE CABLE CONNECTOR.**
- ! CAUTION: THIS PRODUCT IS NOT INTENDED FOR USE AS AN OIL LEVEL SENSOR. PLEASE BE SURE TO RETAIN THE MECHANICAL DIPSTICK OR OTHER OIL LEVEL SENSOR PROVIDED BY THE VEHICLE OR EQUIPMENT MANUFACTURER IN ORDER TO CONTINUE TO MONITOR AND MAINTAIN OIL LEVELS IN ACCORDANCE WITH THE MANUFACTURER SPECIFICATIONS AND INSTRUCTIONS.**

THREADED SENSOR INSTALLATION

The Intellistick Threaded Sensor is intended to be fitted into a threaded port on an oil reservoir or a threaded fitting on an oil line.

Directions:

1. Sensor is ½-inch NPT threaded.
2. A suitable installation location gets oil flow and allows the sensor to be approximately 0.75" into the oil flow.
3. Coat the threads in either thread sealant or thread tape.
4. Shut down flow of oil to the location before installing.

Note: Sensor ***MUST*** be in oil flow. It will not read correctly if oil is stagnant in the sensor region.

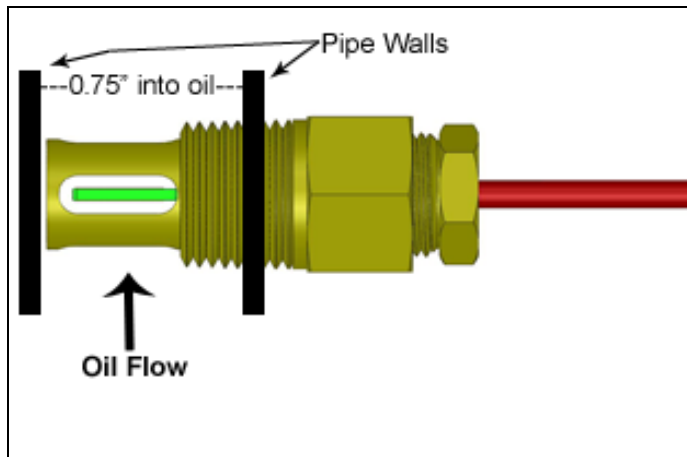


Figure 4.0 Sensor Installation into Oil Flow

DIPSTICK SENSOR INSTALLATION

The IntelliStick Dipstick Sensor is intended to be inserted into the oil pan or oil reservoir down a narrow dip tube. It can be removed and reinserted easily. The installation procedure must ensure the sensor is inserted far enough down the tube to be entirely in the oil during operation.

Directions:

1. Carefully line up the LOW mark of the IntelliStick probe with the LOW mark of the original OEM dipstick (Figure 5). Straighten the IntelliStick wire and move the stopper along the cable to line it up with the same stop on the original dipstick (Figure 6). Secure the stopper to the cable by tightening the set screw to maintain the alignment. DO NOT over-tighten the set screw to avoid damaging the cable.
2. You can use a permanent marker to make a mark on the probe that lines up with the Full mark on the OEM dipstick.

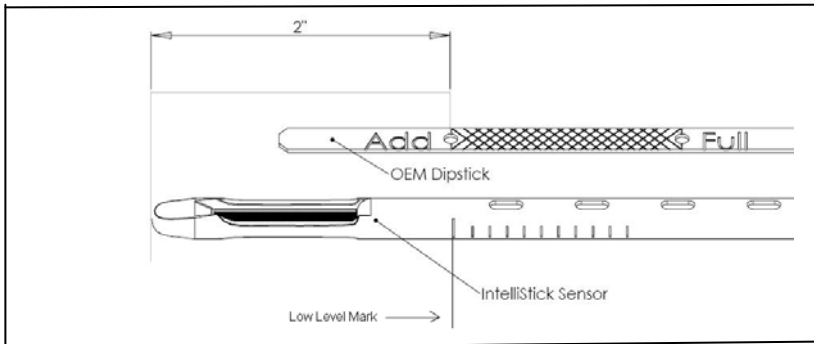


Figure 5 Low Mark Alignment

Note: The *LOW* mark on the IntelliStick probe is located 2 inches from the tip of the probe. This is to ensure that the sensor is always immersed in oil.

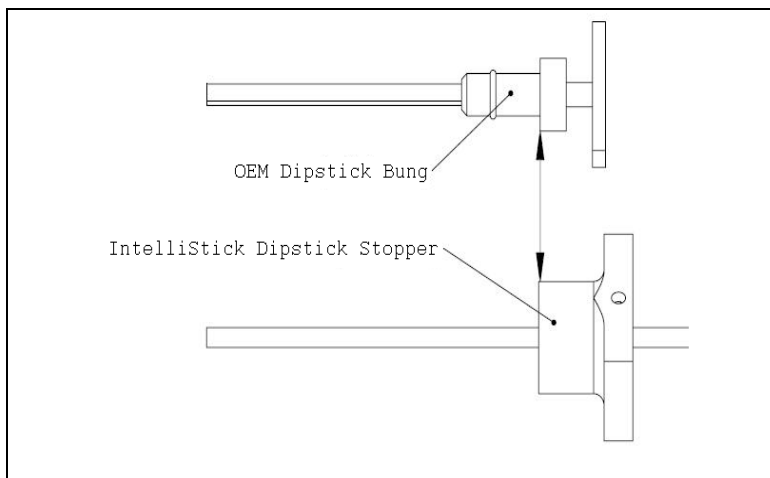


Figure 6 Stopper Alignment

3. Insert the IntelliStick probe into the dipstick tube and make sure the stopper is secure on top of the dipstick tube.

Note: *In some cases, the dipstick tube will be too narrow or too curved for the probe to reach the oil pan. Do not try to force it into the dip tube. In such cases, please call IntelliStick Customer Service for additional assistance and advice. Upgrading the Intellistick Dipstick Sensor to the Threaded Sensor is possible.*

Note: Store the original dipstick in a safe place. The original dipstick will need to be used for setting the oil level when new oil is put into the equipment.

ANALYZER BOX INSTALLATION

Directions:

1. Find a suitable location for the analyzer box. It should be easily accessible and away from any direct heat sources or moving components. Take into account the length of the sensor cables available. The standard lengths are 6 ft and they have a maximum run of 30 ft.
2. Use the existing holes in the analyzer box to determine the location of mounting holes to be drilled and securely mount the analyzer box.
3. Open the analyzer box using #2 Philips head screw driver. When placing the cover to one side, take care not to damage the light-pipes on the inside.
4. Feed 9-30 volt DC power and ground lines through the cable gland and strip off ¼" of wire.
5. Connect to the terminal block and tighten the screw down.
6. Verify that the green LED on the analyzer box is flashing.

Note: *Continuous power is preferable – the Intellistick reading takes many minutes to stabilize after a power loss.*

4-20mA and ALARM OUTPUT INSTALLATION

There are three outputs from the Intellistick. These are described in more detail in the Reading Description section. Each output has a 4-20mA loop associated with it.

Temp	Emul	Read
Oil temperature. Range 100-350F	Emulsion / contamination measurement. Range: 0-30000	Temperature- compensated conductance (TCC). Range: 0-16000

Table 1. *4-20mA output table*

The outputs are not electrically isolated from each other. The negative (-) and SH terminals are common and connected to the negative power supply. Each wire's shield should be connected to ground at only one end. At the Intellistick Analyzer end, the SH terminal is provided for this purpose.

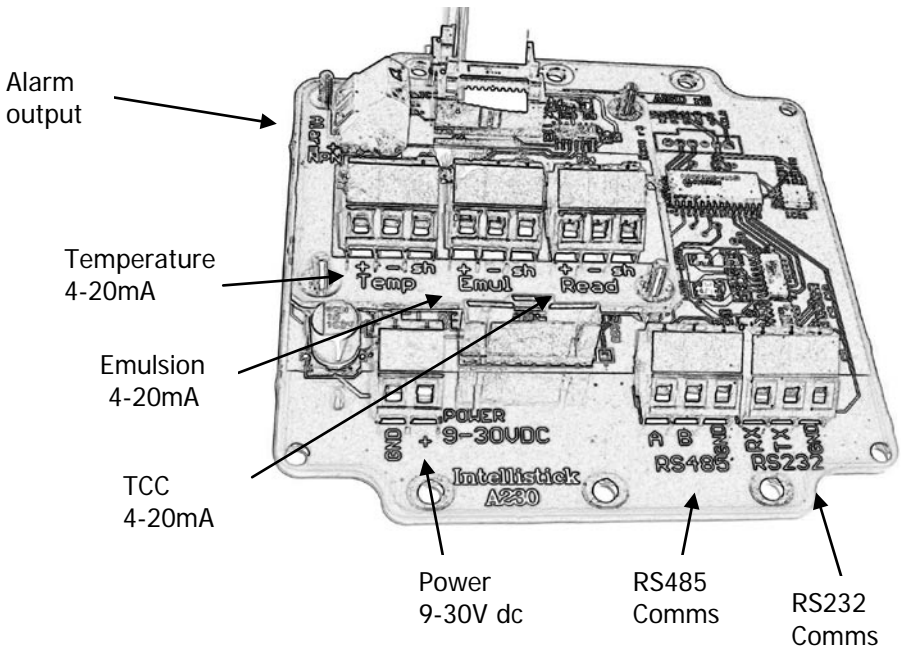


Figure 7. *Intellistick Analyzer Wiring Locations. (Shown with optional 4-20mA board fitted.)*

The alarm output is a NPN transistor output. It comes on when an alarm condition is present. The maximum current rating of the transistor switch is 1Amp. It functions the equivalent to a switch to ground. Figures 8 and 9 show the wiring for two typical alarm configurations.

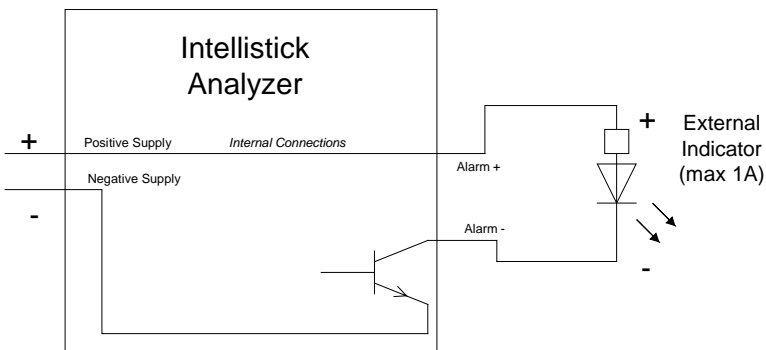


Figure 8. *Wiring for an external alarm indicator.*

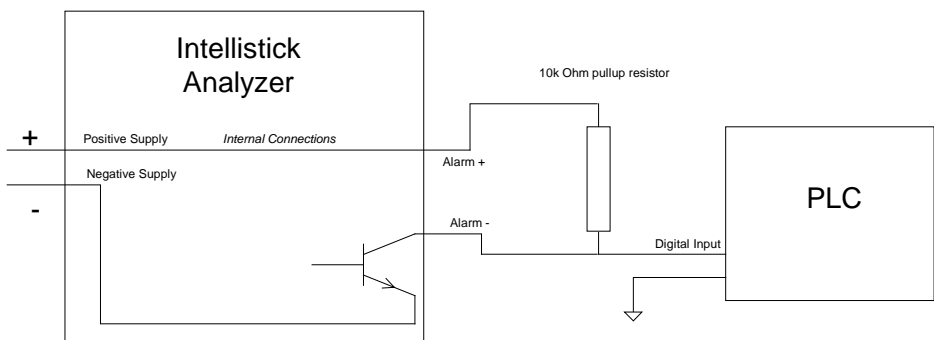


Figure 9. Wiring for digital alarm input to a PLC.

COMMUNICATION INSTALLATION

The Intellistick Analyzer can use either RS232 or RS485 data communications – but not both at once. Only **ONE** of these communications methods should be connected at any one time.

If you are only using the 4-20mA output and are satisfied with the default internal alarm set points, it is not necessary to use the communications.

The positive power connection should be removed when connecting or disconnecting communications or output wiring.

Figure 7 in the previous section shows the location of the connection terminal blocks.

RS232 Connection

1. Connect the ground line from your PC or control board to the IntelliStick – this is labeled GND.
2. Connect the receive/transmit line from your PC or control board to the IntelliStick. The IntelliStick receives data on the connection labeled RX – this must be connected to the transmit line of the PC or control board. This is pin 3 of a standard DB9 connector (Figure 10).
3. Connect the transmit line from your PC or control board to the IntelliStick. The IntelliStick transmits data on the connection labeled TX – this must be connected to the receive line of the PC or control board. This is pin 2 of a standard DB9 connector.

TX	RX	GND
RS232 Analyzer Transmit (to pin 2 on PC)	RS232 Analyzer Receive (to pin 3 on PC)	Communications Ground (to pin 5 on PC)

Table 2 RS232 wiring table

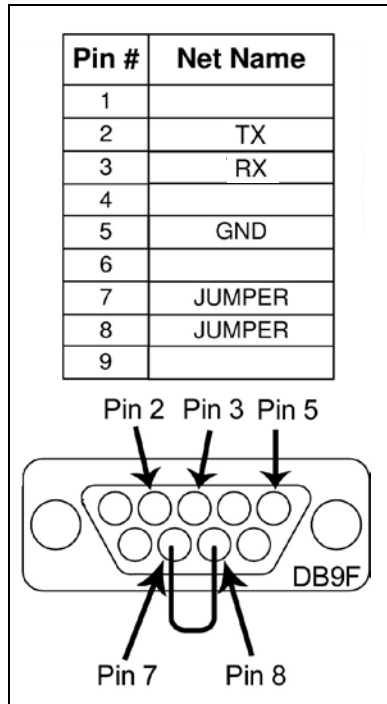


Figure 10 Example RS232 wiring on a DB9 female connector for connection to a PC

RS485 Connection

Each end of the RS485 bus should have a terminating resistor – the Intellistick Analyzer does not include one.

A	B	GND
RS485 Bus A (+)	RS485 Bus B (-)	Communications Ground

Table 3 RS485 wiring table

Digital Data Format

There are three measurements made by the IntelliStick oil condition sensor.

1. **Temperature-compensated conductance:** This is a voltammetric measurement that responds to additives and oxidation by-products. This is a positive integer in the range of 0-16000. A reading of 19000 is returned if the sensor is saturated at its maximum output.
2. **Emulsion ratio:** This responds to the presence of water, glycol or other conductive emulsions in the oil. It also reads higher if there is sludge formation on the sensor. This is a positive integer in the range of 0-30000.
3. **Fluid temperature** reading: Ranges from 1000 – 3500. This is always returned in units of 0.1 F. e.g. 250 degrees F is returned as 2500.

Several auxiliary data values are also returned.

- **Oil loss alarm:** This alarm occurs when there is a possible oil loss or the probe is out of the oil. This alarm also occurs when erratic or anomalous readings are detected.
- **Emulsion alarm:** This alarm occurs when the user-specified emulsion alarm threshold is reached (e.g. possible contamination with water or coolant).
- **Oil temperature alarm:** This alarm occurs when the user-specified oil temperature alarm threshold is reached.
- **Fault alarm:** This alarm occurs when an internal fault has occurred with the analyzer. If this alarm occurs the analyzer may need to be serviced.

STATUS LIGHTS

The analyzer box has two lights:

1. The green **Comm Status Light** indicates power and communications. Short flashes indicate it is operational. Long flashes will occur when it is communicating.
2. The **Alarm Light** causes include:
 - Orange light:**
 - Water or coolant intrusion into the oil.
 - Any other sort of contamination of the oil that causes an unusual response.

Red Light:

- Sensor disconnected.
- Oil level loss. This includes removal of the sensor from the oil pan. (Dipstick sensor only).
- Internal fault with the sensor or analyzer.

The alarm output transistor will activate at the same time. The alarm turns off when its cause is gone.

SOFTWARE

There are two software applications that can be used with the A230 Analyzer. The Configure Intellistick program and the Intellistick Monitor program.

The A230 Intellistick Analyzer stores its most recent 4 weeks of readings – the Intellistick Monitor program can download this data and display it in a user-friendly way.

The Configure Intellistick program allows setting of the baud rate, communication method, alarm points and some reading parameters.

Both of these programs can be installed from the Intellistick website.

Updates to the IntelliStick software will be made available on the IntelliStick website as necessary at www.intellistick.com.

EVALUATING DATA

How the IntelliStick Works

The IntelliStick oil condition monitoring system uses a patented sensor design originally developed for the U.S. Army. It electrically stimulates the oil at a particular low voltage and frequency that is designed to obtain the greatest response from both additives and oxidation by-products in the oil. The oil itself does not react electrically. The reading is obtained by measuring the overall conductivity of the oil and compensating for changes due to variations in the temperature of the oil.

Interpreting the Results

The oil condition takes a long time to change, so the graph will not change rapidly.

The 'Kauffman Conductance Curve' is created by graphing the reading vs. engine run time. The different stages of oil life cause distinct changes in the curve.

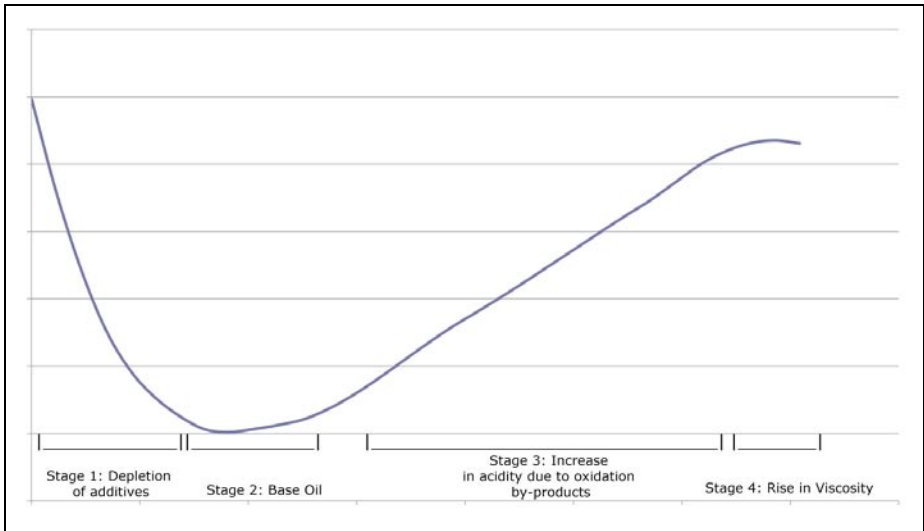


Figure 11 Kauffman Conductance Curve

During the **first** stage the conductance reading is declining. This is because of the depletion of the lubricity, antioxidant and detergent package in the oil. All modern motor oils must contain these additives, without them the oil does not adequately protect the engine. A gradual decrease in conductance indicates that the additives are present and that they are being used up as they work. This is normal.

In the **second** stage the conductance will stay steady. This means that the lubricity additive package is almost entirely depleted and the oil lubricity is strongly dependent on the base oil. A small amount of polishing wear may be occurring on the engine. This second stage may have a gradual rise, because the antioxidant package is starting to lose its capability to stop basestock oxidation.

In the **third** stage the conductance is increasing. This is a result of the buildup of oxidation by-products. This means that the oil is oxidizing, breaking down and further losing its ability to lubricate. Engine polishing wear is accelerating. If this stage goes on for long enough the reading will start to level out again – this means that the viscosity of the oil is increasing and severity of engine wear is increasing.

Every Kauffman Curve will be unique based on the oil type, the brand, and the operating conditions of the engine. Although each curve is unique, the characteristic turning points of the curve will be present with all oils because all oils degrade in the same way. The difference between curves will be in the value and duration of each of the stages. For example, premium oils such as synthetic oils contain more additives and resist oxidation longer.

Interpreting a given curve to determine an optimal oil change interval requires a certain amount of understanding of each of the stages, through which a compromise can be made between the oil efficiency and the life of the engine.

For example, if protecting the engine is the primary concern, the oil should be changed at the end of stage one just as the lubricity additives in the oil have been depleted. On the other hand, if it is acceptable to incur some polishing wear, the oil change can be postponed until stage three is well underway.

Contamination and Oil Loss

In addition to indicating the life stage of the oil, IntelliStick can also detect several types of oil contamination as well as major oil loss.

A relatively sharp increase of the conductance reading indicates **fuel contamination of the oil**. This is because the fuel decreases the viscosity of the oil and tends to oxidize rapidly. Seeing a relatively sharp increase in conductance reading at an unexpected point on the curve may mean there is fuel leaking into the oil.

The IntelliStick's sensor has two measurement arrays. Using the two of them together, harmful amounts of water and coolant can be detected. This is because the fine array has a particular spacing that makes it extra sensitive to water or coolant droplets suspended in the oil. An increase in the ratio between the two array outputs signals the **presence of water**. When this occurs the red alarm light comes on and the software will display a message box alerting the user the next time the software is connected.

An **oil loss** is also detected by a comparing the two array outputs to determine that the sensor is only partially immersed. Likewise, when this occurs the alarm light comes on and the software will display a message box.

UNIT CONFIGURATION

The IntelliStick configuration software can be downloaded from the IntelliStick website. This allows the unit's configuration settings to be changed.

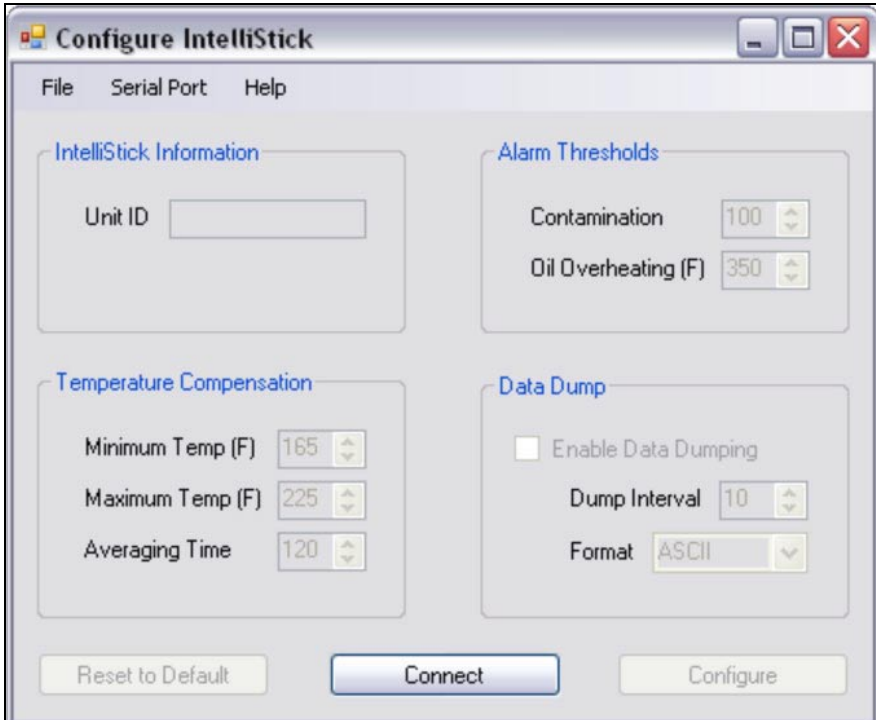


Figure 12 IntelliStick Configuration Interface

This is a list of the configurable settings for the IntelliStick Analyzer A220. These settings are adjustable using the IntelliStick Configuration Program – the changes are stored in the IntelliStick analyzer's non-volatile memory.

Temperature Compensation High and Low Temperature Thresholds

This is the temperature range over which normal readings are expected. This should be kept reasonably narrow, such as a range of 50 F. This is because conductance varies significantly with temperature and the temperature compensation method used is able to correct for temperatures significantly different from the normal range.

Outside of this range, the Temperature Compensated Conductance will hold its previous value.

Enable Data Dump Function

In this mode data is continuously sent out on the RS-232 port at a user-selected time interval. This mode is disabled by default.

Note that the standard IntelliStick communications method can be used whether Data Dump is disabled or enabled. Command messages sent to the IntelliStick analyzer initiate a response from the IntelliStick dependent on the command type. The full IntelliStick communications is described in the document "IntelliStick Communications Protocol Version 120."

Data Dump Interval

This is the number of seconds between each data output. Ten seconds is the fastest this can be set to.

Data Dump Mode

There are two options for the format of the Data Dump.

1. Dump Data in ASCII Format

In this mode the output is a human-readable ASCII comma separated value file. After every defined interval one line is output.

The comma separated values on one line are as follows:

Cond, emulsion, temp, ambient, alarm 1, alarm 2, alarm 3, alarm 4

A line is terminated with a CR (0x0D) and a LF (0x0A). Each value is a positive integer. The meaning is as follows:

- Cond: Temperature compensated conductance reading
- Emulsion: Emulsion ratio reading
- Temp: Fluid temperature reading (This is in units of 0.1 F.)
- Ambient: Temperature inside the analyzer box (This is in units of 0.1 F.)
- Alarm 1: This can be either 0 or 1.
1 means a possible oil loss or probe out of oil. This occurs when anomalous readings are detected.
- Alarm 2: This can be either 0 or 1.
1 means the emulsion alarm threshold reached (e.g. possible contamination with water or coolant).
- Alarm 3: This can be either 0 or 1.
1 means the temperature alarm threshold reached.

- Alarm 4: This can be either 0 or 1.
1 means an internal fault has occurred with the analyzer.

2. Dump Data in Binary Format

In this mode the same data as above is transmitted, but it is formatted in binary. The format is described fully in the document "IntelliStick Communications Protocol Version 120".

Emulsion Contamination Alarm Threshold

Alarm values can range from 100-10000. When the emulsion reading exceeds this threshold, the alarm is output in the next RS-232 data communication and the orange alarm light is lit.

Oil Overheating Alarm Threshold

The temperature at which the oil temperature alarm is activated. When the temperature exceeds this threshold, the alarm is output in the next RS-232 data and the orange alarm light is lit.

Conductance Averaging Time

This value is in minutes. The unit will accept values in the range of ten minutes to two hours.

TECHNICAL SUPPORT

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Sat - Sun: 10 am – 6 pm PDT

PRODUCT SPECIFICATIONS

A230 Analyzer	
Power requirements	
Voltage	9-30 V dc
Current	Max 100mA (typical 20mA)
Environmental	
Temperature	-20C to 85C (-4F to 185F)
Environmental sealing	NEMA4X
4-20mA	
Non-isolated: All three loops share the common ground	
Maximum load: 450 Ohms (when powered by 12V or greater)	

P200 Threaded Sensor	
½" NPT Male Thread – brass	
Extends 0.75" into the oil space	
Maximum oil pressure	80 psi
Oil temperature range	-20C to 150C (-4F to 302F)
External environmental sealing	IP68
Standard sensor cable length	6 ft
Maximum sensor cable run	30 ft

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IntelliStick, Inc.
2961 W. MacArthur Blvd.
Santa Ana, CA 92704

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8. Governing Law. This EULA will be governed by the laws of the State of California, United States of America, excluding its conflict of law provisions.

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10. No Waiver. No waiver of any breach of any provision of this EULA shall constitute a waiver of any prior, concurrent or subsequent breach of the same or any other provisions hereof, and no waiver shall be effective unless made in writing and signed by an authorized representative of the waiving party.

LIMITED WARRANTY

IntelliStick warrants to the original purchaser that the product will be free from defects in materials and workmanship under normal and proper use for one year from the original date of purchase. IntelliStick, at its option, shall repair or replace the product or parts determined by IntelliStick to be defective in materials or workmanship.

To obtain warranty service, the customer must return the product or the defective part(s) to the company at the following address, appropriately packed, along with a dated proof of purchase, before the end of the warranty period:

IntelliStick, Inc.
2961 W. MacArthur Blvd.
Santa Ana, CA 92704

Prior to shipping the product or defective part(s), the customer must call 1-888-812-5988 to request a Return Material Authorization (RMA) and must include the RMA number and a description of the problem along with the returned product or part.

IntelliStick will use commercially reasonable efforts to repair or replace within 30 days of receipt.

If the product or part has been updated or superseded, a replacement maybe made with a different model or part of comparable or better quality and function. Warranty of the repaired or replacement product or part is limited to 90 days or the unexpired portion of the original warranty period for the product, whichever is longer.

This warranty does not cover any defects or damages caused by: (1) modification, alteration, repair or service of this product by any persons or company other than IntelliStick; (2) physical abuse to, or misuse of, the product or operation thereof in a manner inconsistent with the use indicated in the instructions; (3) any use of the product other than that for which it was intended; or (4) shipment of the product to IntelliStick for service.

This warranty does not cover the labor costs associated with the installation or removal of the product or part(s) or the costs of shipping product or parts to IntelliStick. For your protection, IntelliStick recommends that you use a traceable and insurable form of mail for shipment. IntelliStick is not responsible for any items lost or damaged in transit.

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