FIC-4000™

Digital (FSK) Gauge Interface Controller

OPERATIONS MANUAL

GRC
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Any questions concerning the content of this manual, equipment operation, field maintenance, maintenance assistance, and operation or maintenance training courses should be directed to Sercel-GRC.

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1.0 FIC-1500 Overview

The FIC-1500 surface controller is a system designed to read all Sercel-GRC FSK gauges including the QTIEG-4000 and the C-4000/4500/5000/5500 line of gauges. The FIC-1500 can read up to 6 channels at the same time using FSK technology. Each gauge has a different number of channels depending on the number of gauge sensors. A single channel can contain multiple sensors. The FIC-1500 has an LCD screen that displays data from each sensor and also has a USB port for computer connection and a configurable Modbus that can be connected to a VSD or SCADA system (Figure 1).

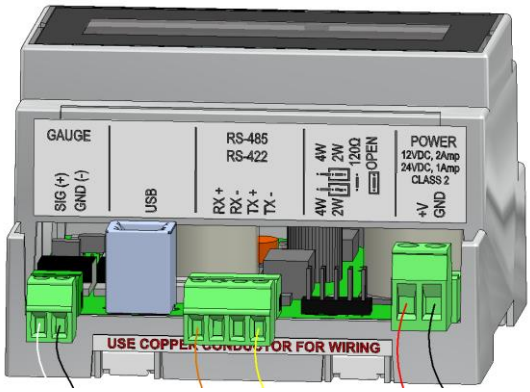


Figure 1: FIC-1500.

2.0 FIC-1500 Wiring Connections

The FIC-1500 has four connectors for gauge, Modbus, USB and power (Figure 2). The FIC-1500 is powered with a Class 2 DC power supply. The operating voltage range is from 12VDC to 24VDC. The maximum current rating is 2Amp which includes the inrush current during power-up. The nominal current consumption with a full load (six channels) is 0.5Amp. The Modbus connections can be RS-485 (2-wire) or RS-422 (4-wire) with the configuration of 120Ω load termination or open termination.

Note: Optional DC Power Supply, p/n#062-0049-00, can be bought from GRC.

Wire terminal screws should be torqued properly as shown below:

a) FSK gauge and Modbus connection terminal screws: between 2 inch-pounds and 2.2 inch-pounds (0.22Nm – 0.25Nm)

b) Power connection terminal screws: between 4.4 inch-pounds and 5.3 inch-pounds (0.5Nm – 0.6Nm)

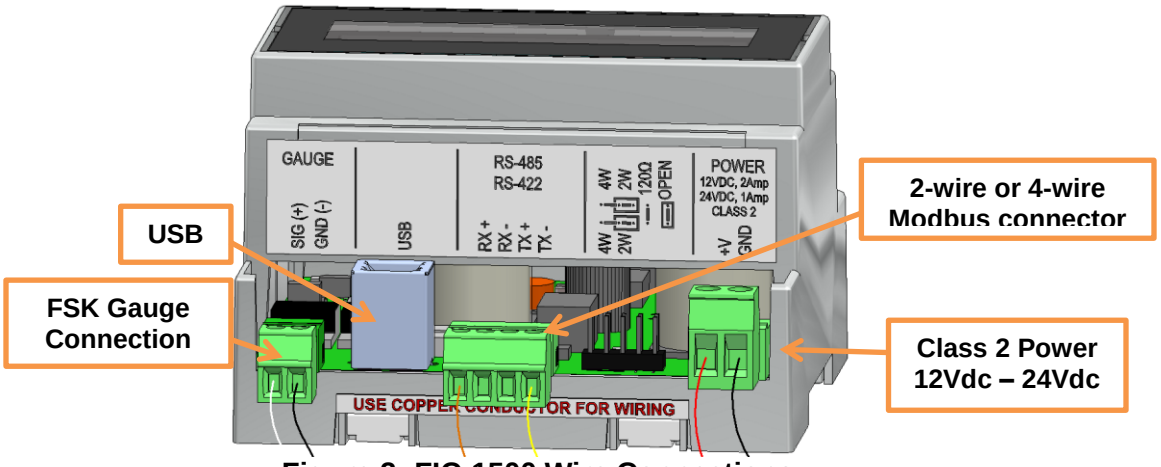


Figure 2: FIC-1500 Wire Connections.

3.0 FIC-1500 Modbus Connection

The FSK Surface Board relays data from several downhole tools via Modbus to a VSD or SCADA system. The FIC-1500 makes a connection to Modbus equipment simple and flexible. The Modbus data is transmitted using RS-485 protocol and has been pre-wired as a factory default. RS-485 wiring (Figure 3) is made to connector J3 (R+) and (T-). Some SCADA systems use RS-422 protocol for Modbus communication. The FIC-1500 allows you to change the communication protocol with some minor modifications to the FIC-1500 as described in the following section.

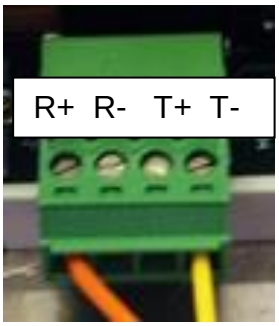


Figure 3: Modbus connector J3.

3.1 RS-485/RS-422 Modbus Connections

The FIC-1500 is shipped with default Modbus configuration of 2-wire with open termination (Figure 4). To change the RS-485 (2-wire) to RS-422 (4-wire), turn the power off to the FIC-1500 and unplug the connector to J3. Then move the two jumpers located next to the socket (Figure 5) to the left one pin. Once the jumpers are moved to RS-422, connect the 4 wires from your SCADA system (RX+, RX- and TX+, TX-) to the J3 connector as shown on the label above connector J3. The transmit port on the FIC-1500 (TX+ and TX-) will need to connect to the receive port on the external SCADA system. The receive port on the FIC-1500 (RX+ and RX-) will need to connect to the transmit ports on the external SCADA system.

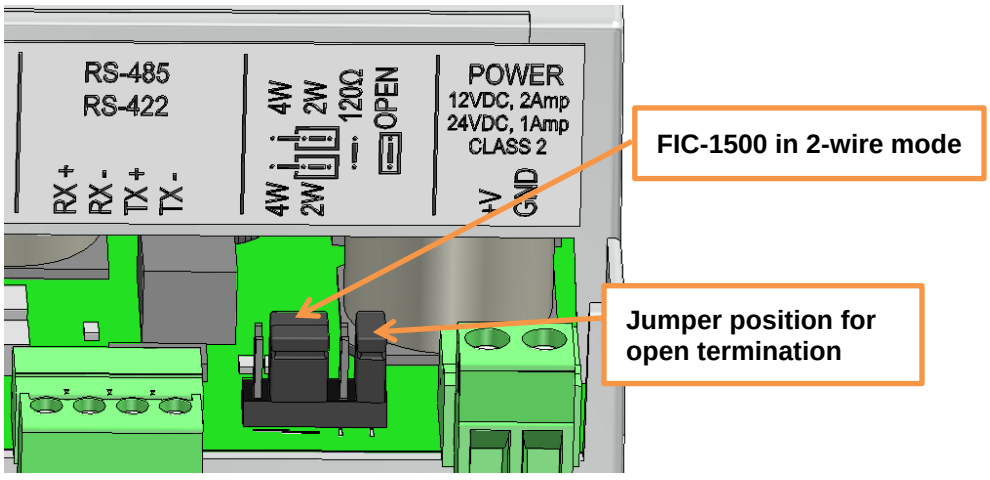


Figure 4: FIC-1500 with default Modbus Configuration.

3.2 120Ω Wire Termination

The FIC-1500 also has the option of terminating with 120Ω resistors. The default mode from Sercel-GRC is open termination. If 120Ω termination is desired simply move the jumper block to pins 7 and 8 (Figure 5).

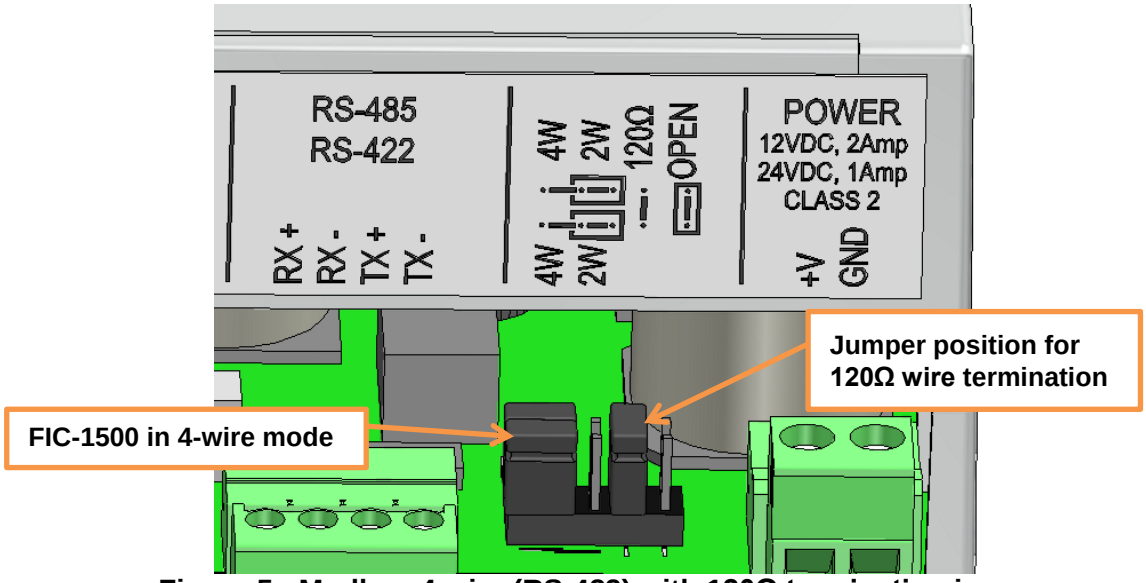


Figure 5: Modbus 4-wire (RS-422) with 120Ω termination jumper.

4.0 DataWorks Software

This section will describe how to use DataWorks software to view real-time tool data, change configuration settings for the FIC-1500 and change gauge settings.

4.1 FIC-1500 Connections

To connect the FIC-1500 to a computer simply plug in the provided USB cable to the USB port (Figure 6) on the FIC-1500 and plug the other end into the USB port on the computer. Your computer should automatically install the proper driver for communicating to the FIC-1500.

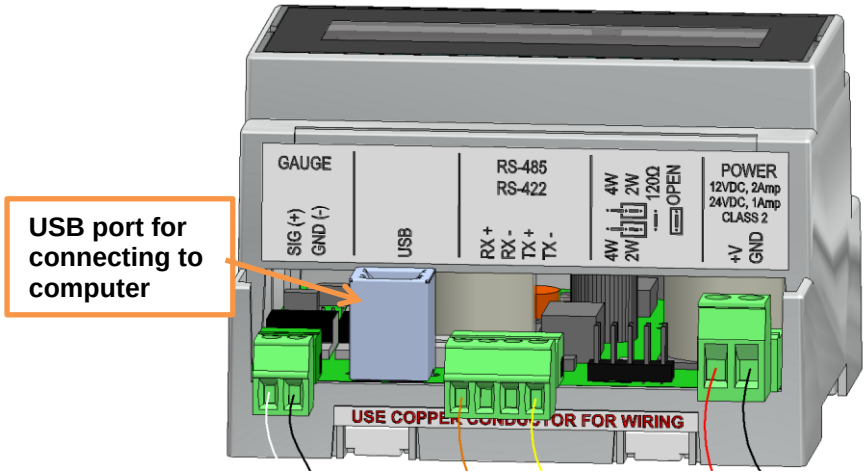


Figure 6: FIC-1500 USB connection.

4.2 DataWorks Configuration for FIC-1500

After connecting the FIC-1500 to the computer you can open DataWorks and configure the com port settings. The DataWorks home screen allows you to select FIC from the drop-down menu at the top of the screen. Now that you have selected FIC (Figure 7), click the Com Port tab from the top of the screen. A pop-up form (Figure 8) will appear and you can choose the com port, baud, and Modbus Slave ID options.

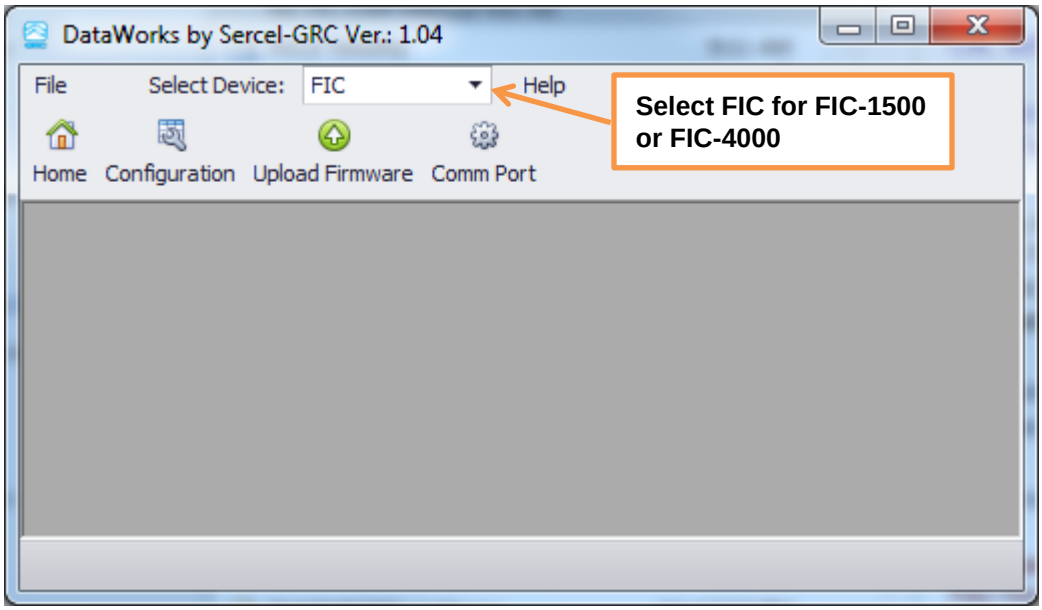


Figure 7: DataWorks home screen.

Select the FIC-1500 Modbus Slave ID (factory default is 1). Select the com port your PC has assigned to the FIC-1500. If you are not sure what port to use you can check the port assignments in the Control Panel of your PC or simply with trial and error. The Baud Rate defaults at 9600, Parity is set to none, Data Bits set to 8 and 1 Stop Bit. To save the interface properties click Save and the DataWorks home screen will return.

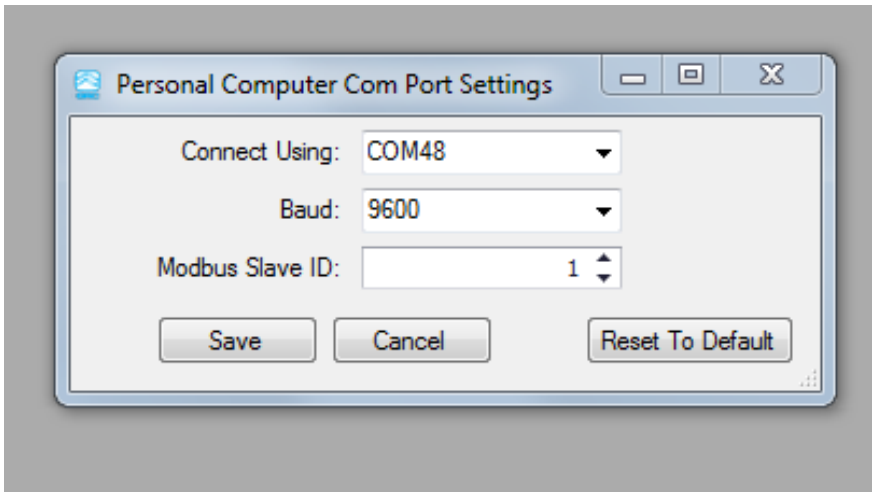


Figure 8: FIC interface properties.

4.3 Real-Time Gauge Data

Now that the FIC-1500 interface properties have been configured, you can view real-time data. Click the Configuration tab at the top of the screen (Figure 9).

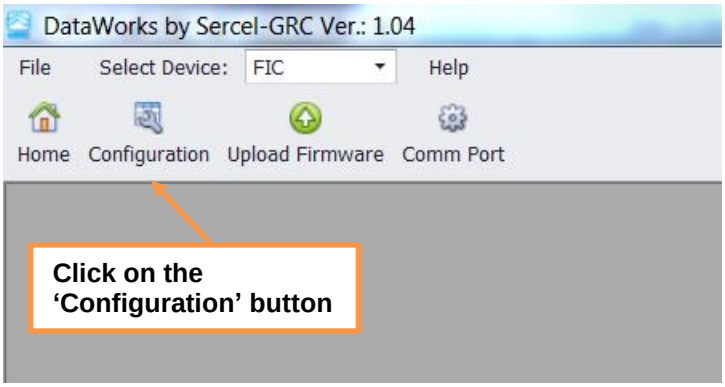


Figure 9: DataWorks home screen with different options.

After clicking on Configuration, the window (Figure 10) opens up with five tabs, which are FIC Configuration, Sensor Control, Sensor Configuration, OEM Map, and Real-Time. Initially, the Real-time tab appears with green color, which indicates that DataWorks is in the process of collecting data in order to display on data grid and graph. After few seconds, that Real-Time tab appears with gauge serial number. In this example, gauge serial number is 'FSKQrt' and the tab name appears on DataWorks screen is 'FSKQrt-Real-Time'.

Note: The green color of 'Gauge Serial Number-Real-Time' tab implies the wait time before Real-Time data is valid in DataWorks.

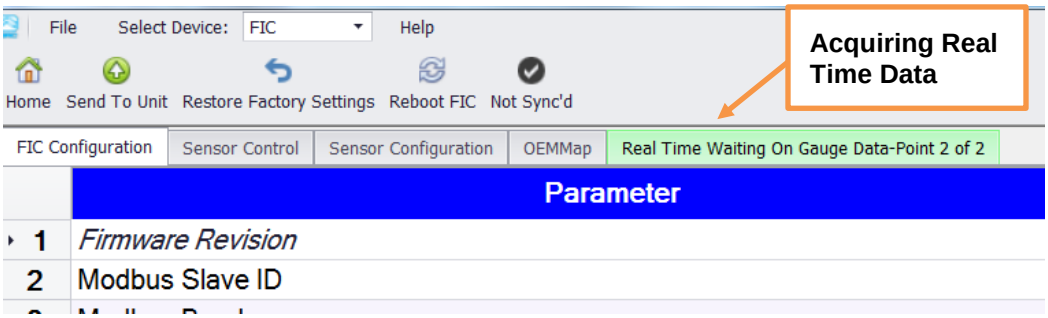


Figure 10: DataWorks Configuration screen.

The Tool Data screen will display real-time data from all tools communicating with the FIC-1500. Once the FIC-1500 and gauges have been detected, the software will display real-time data on the bottom of the screen the charted data on the top. The FIC-1500 streams data constantly but you can change the rate at which the software displays a sample by changing the software sample rate at the bottom of the screen (Figure 11). This is helpful when saving a data file if you don't need to collect a lot of data points (see Section 4.4 for saving real time data files). To exit the real time screen simply click the home tab on the menu bar at the top left of the data screen.

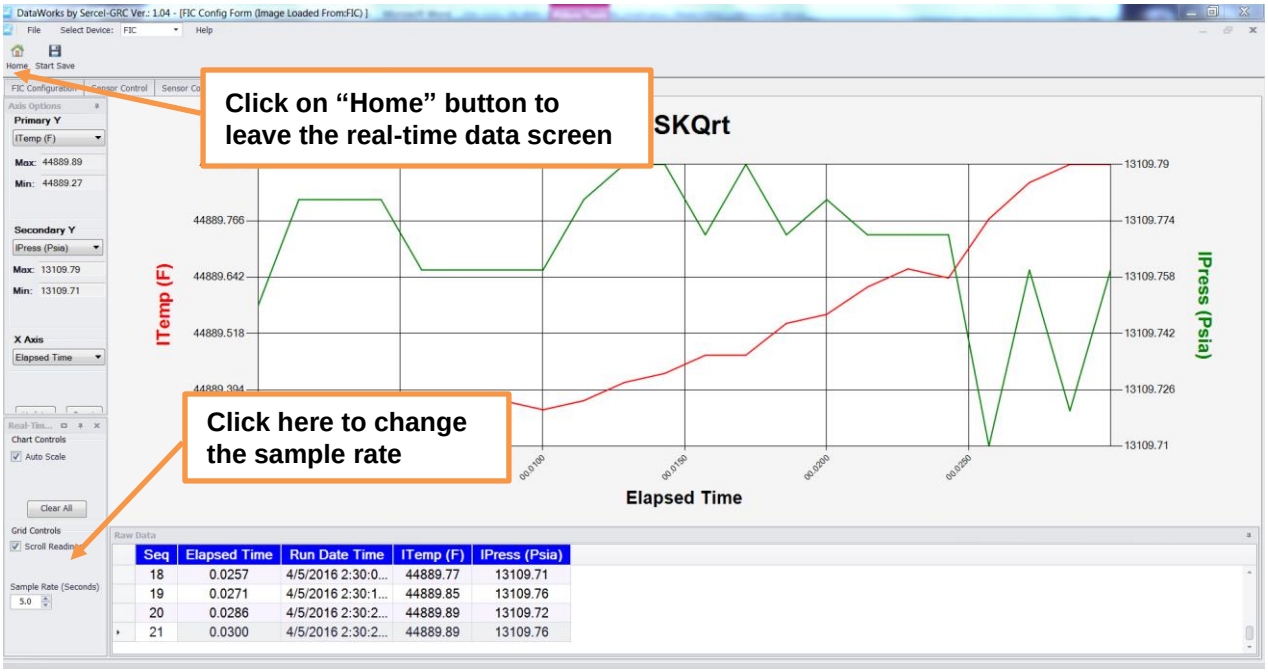


Figure 11: Real-Time Gauge Data screen.

4.4 Real-Time Data Save

DataWorks has the ability to save real time data files to your PC. To save data simply click the “Start Save” tab on the menu bar (Figure 12). A “Browse For Folder” form will appear so you can select where you want to save the data (Figure 13). After selecting the folder or creating the folder you want to save the data to click “OK” and the data will start to be saved.

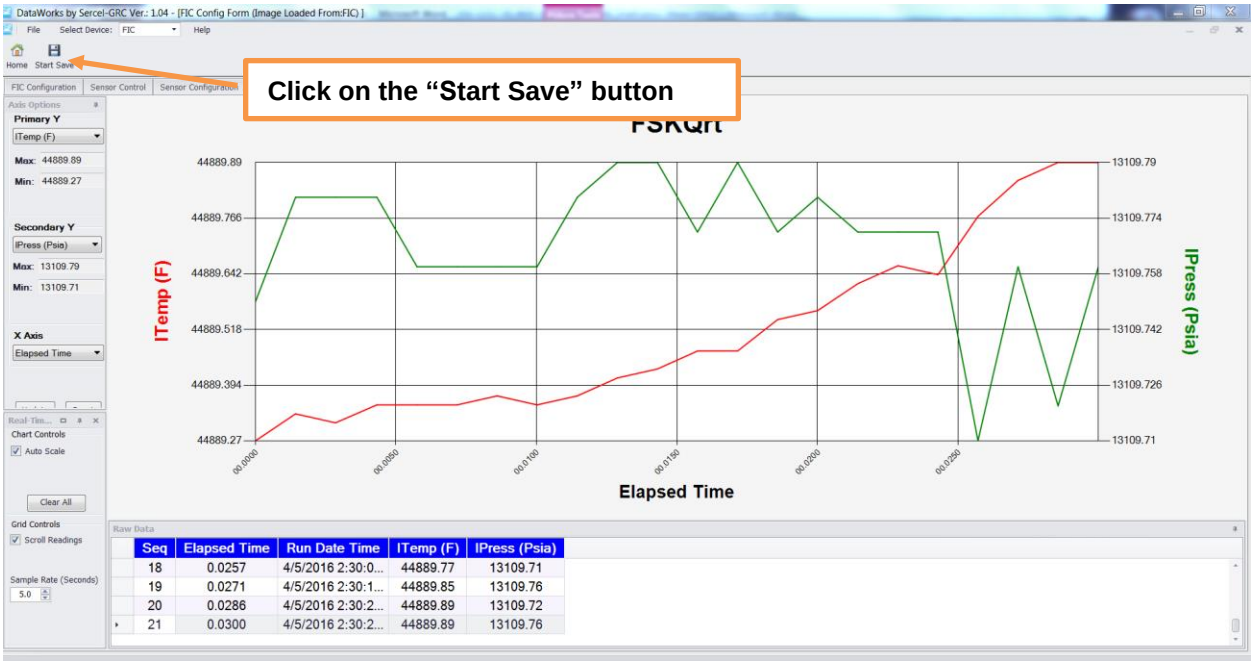


Figure 12: Gauge Real-Time data options.

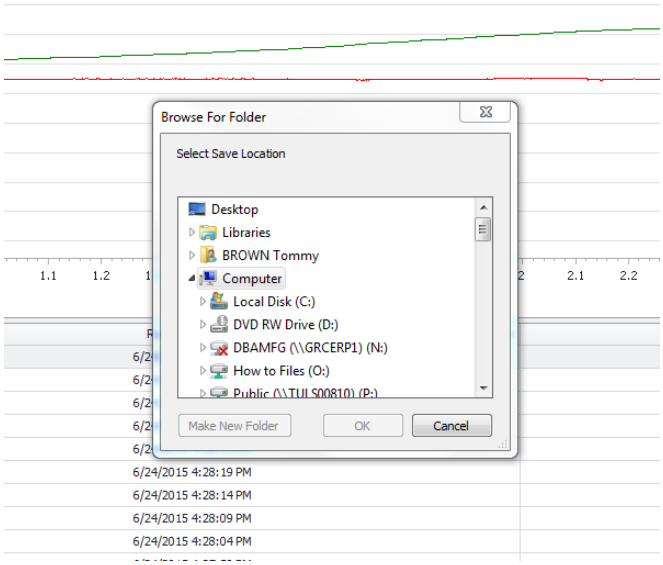


Figure 13: Browse directory for Real-Time data storage.

To open the real-time data that was saved, simply click on file at the top left side of the screen, click on open, and navigate to where you saved the data. Open the desired file and it will then be displayed. The file is saved in a CSV format which can also be opened in Excel.

4.5 FIC-1500 Configuration

To change any of the configuration settings of the FSK surface controller, click on "Configuration" on the menu bar of the home screen and then 'FIC Configuration'. The FIC Configuration screen (Figure 14) will now appear. To change any of the settings simply click on the setting you desire to change in the setting column. If the setting is shaded out it cannot be changed. After making desired changes click on 'Send To Unit' to save the changes to the FIC-1500.

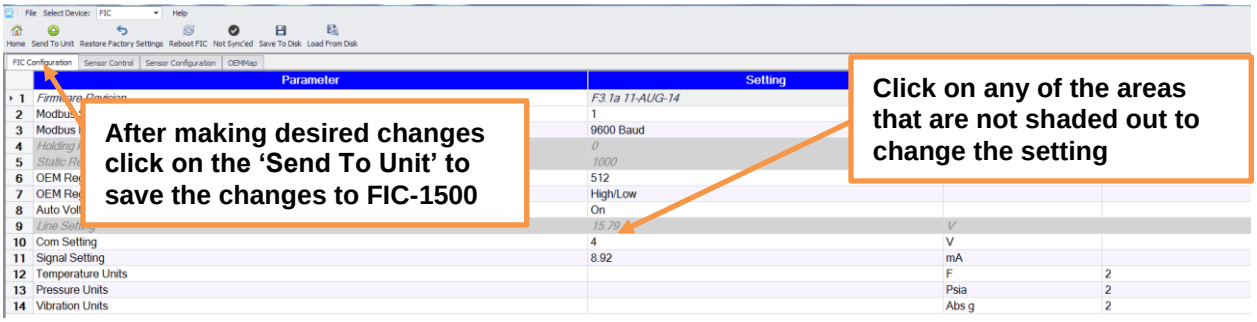


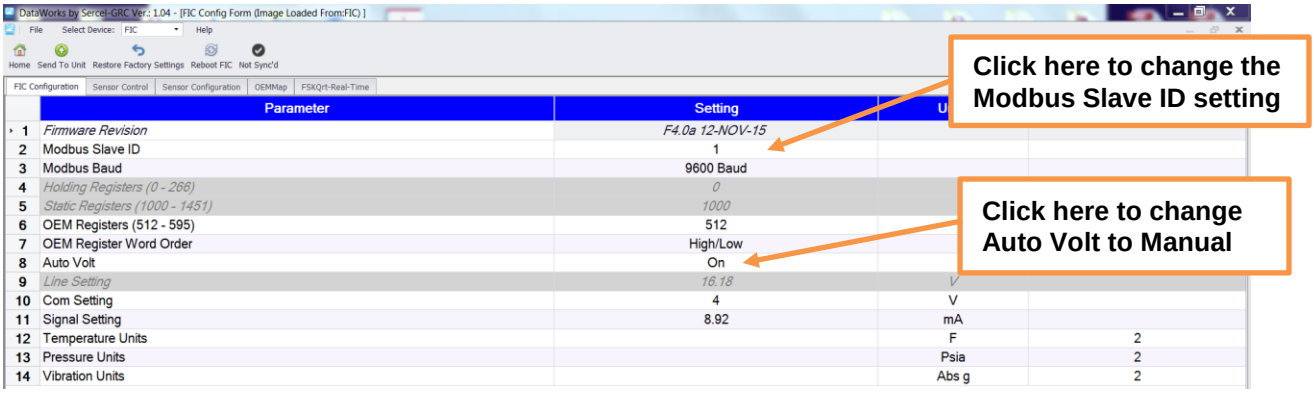
Figure 14: Configuration window.

4.6 FIC-1500 Modbus Slave ID Configuration

To change the Modbus Salve ID for the FIC-1500 open the configuration window (Figure 15) in DataWorks and click on the Modbus Slave ID setting and change the ID to the desired number. After making desired changes click on 'Send To Unit' to save the changes to the FIC-1500.

4.7 Auto Volt Configuration

The FIC-1500 is set up from the factory to use Auto Volt detection (Figure 15). Auto Volt continuously analyzes gauge communication and determines where to set the line and com voltages for optimum gauge performance. If Auto Volt is OFF, line and com voltage are left at their initial settings. If you are having trouble, communicating with the gauges you can increase the line setting to increase the voltage at the gauge downhole. If you change the line voltage you should also change the com voltage. The com voltage is the level at which the gauge communicates with the surface controller. A general rule is to set the com voltage at ¼ the line voltage (for example, if line voltage is set to 20V then set com voltage to 5V). The signal setting represents the target signal level to maintain from the gauges when Auto Volt is switched ON. Set it to ½ the desired voltage at the tool. For example, a Target Signal of 9mA corresponds to a target of 18V at the tool.



	Parameter	Setting	U	
1	*Firmware Revision*	*F4.0a 12-NOV-15*		
2	Modbus Slave ID	1		
3	Modbus Baud	9600 Baud		
4	*Holding Registers (0 - 266)*	*0*		
5	*Static Registers (1000 - 1451)*	*1000*		
6	OEM Registers (512 - 595)	512		
7	OEM Register Word Order	High/Low		
8	Auto Volt	On		
9	*Line Setting*	*16.18*	*V*	
10	Com Setting	4	V	
11	Signal Setting	8.92	mA	
12	Temperature Units		F	2
13	Pressure Units		Psia	2
14	Vibration Units		Abs g	2

Figure 15: Modbus Slave ID and Auto Volt configuration.

4.8 Gauge Modbus Address Configuration

The communication protocol for FSK allows multiple gauges to communicate using a single conductor. To achieve this, each gauge sensor is assigned a Modbus address. Connect the gauges to the FIC-1500 and apply power. Each sensor should reply to the FIC-1500 when its address is detected. The PCP-5500, for example, has 3 channels. One channel will read intake pressure and intake temperature; another channel will read discharge pressure and discharge temperature; the last channel will read vibration X/Y and temperature. Since the FSK 1500 can only read 6 channels it can only be connected to two PCP-5500s. When the surface controller detects the gauges it will show two gauges have been found and will then display real time data scrolling through each sensor on the LCD. The QTIEG-4000 gauge has 1 channel representing two sensors (pressure and temperature), so it will have one Modbus address. In some applications the modbus address of the gauge sensors may need to be changed. The modbus addresses are limited between 32 and 48 as shown in appendix B.

WARNING

- **WHEN COMMUNICATING WITH MULTIPLE GAUGES TO THE SAME SURFACE CONTROLLER, MAKE SURE NOT TO DUPLICATE MODBUS ADDRESSES.**

- **DO NOT ATTEMPT TO CHANGE A GAUGE MODBUS ADDRESS WHILE THE GAUGE IS AT TEMPERATURE ABOVE 80C (176F). THIS CAN CAUSE GAUGE FLASH MEMORY TO BE CORRUPTED.**

To change the Modbus address verify that the tool temp is below 80C (176F) then connect the gauge to the FIC-1500. Power the system and verify tool communication in DataWorks. Click on the configuration tab. After the configuration window opens click on the “Sensor Configuration” tab. The Sensor Configuration window (Figure 16a) shows all the sensors with their serial numbers, address, and sensor type. To change gauge address, click on up or down arrows of that particular gauge address. Each click will shift the gauge address by one with respect to its old address. The gauge with serial number ‘3062P’ has gone through three clicks to move to address 35 (Figure 16b). Once new gauge address is determined, click on “Send Sensor Configuration” to save the changes made. DataWorks keep the record of old address and new Modbus gauge address.

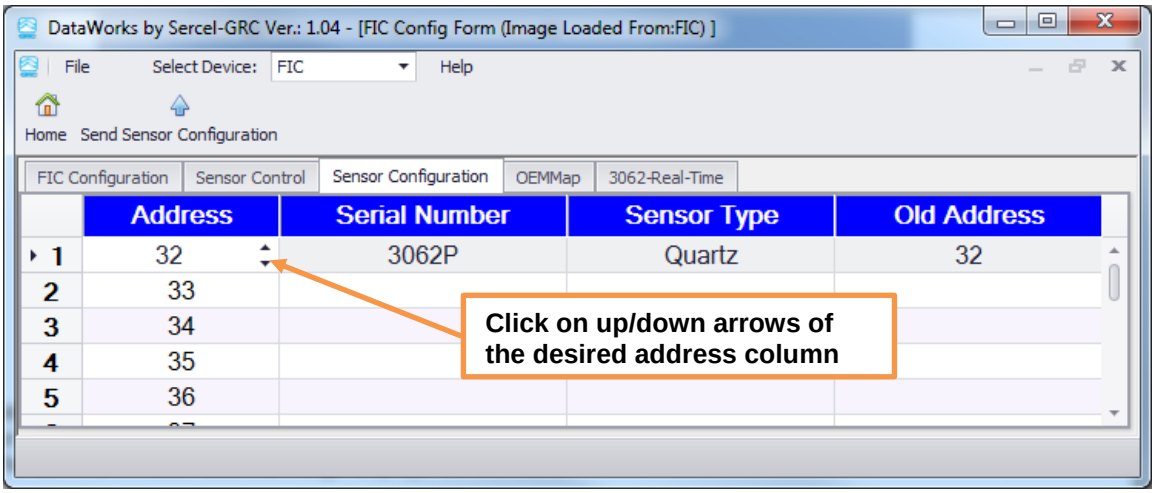


Figure 16a: Gauge Modbus address change.

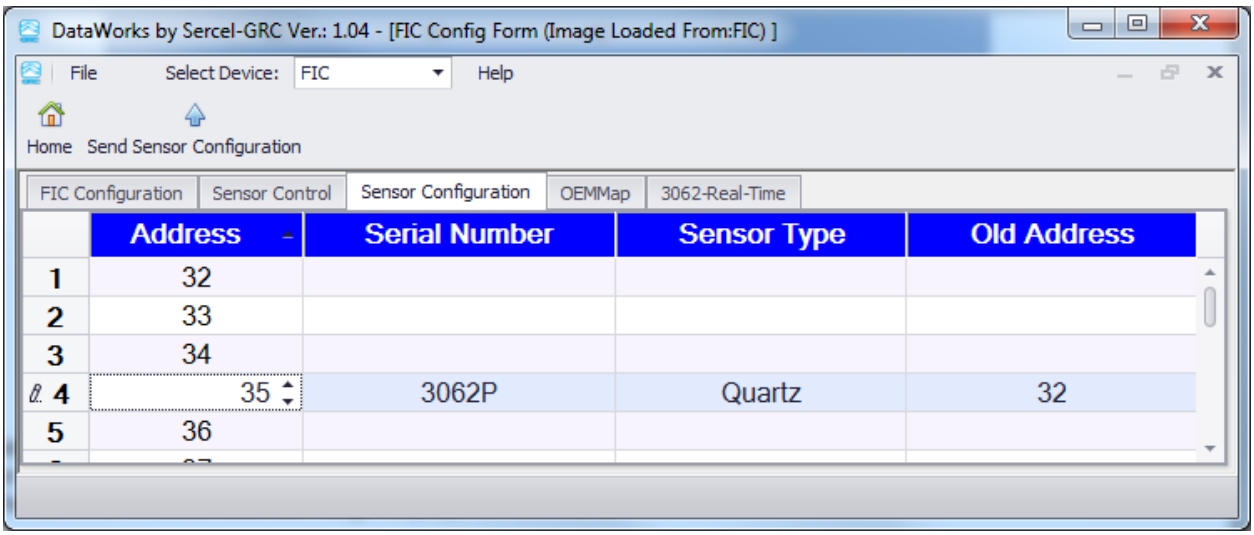


Figure 16b: Gauge Modbus address change.

4.9 Modbus Configuration

DataWorks allows users to change the Modbus ***‘Word Order’*** to accommodate Modbus master devices that require their data packets in a reversed word order. The default Modbus order is set to ***‘High/Low’***. The Modbus word order governs the order of grouping different registers in the Modbus Master to interpret the temperature and pressure gauge readings correctly.

DataWorks enables the user to select the Modbus data format between ***IEEE Float*** and ***Integer*** type. The decimal places can be set using the pull-down menu (Figure 17).

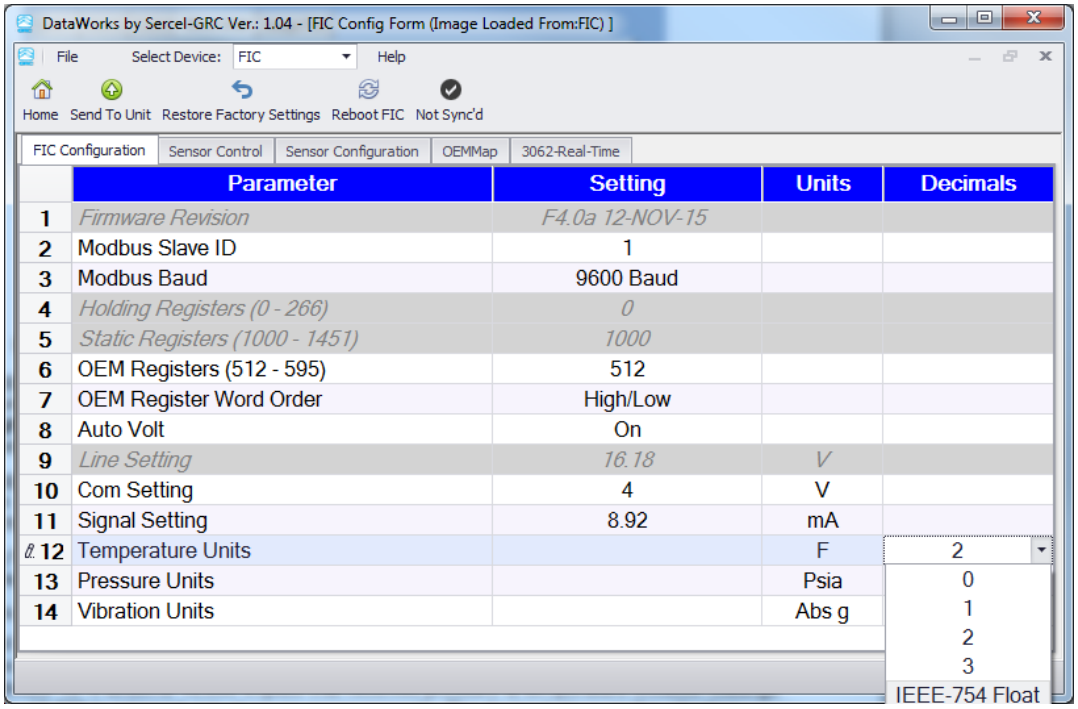


Figure 17: FIC Modbus Configuration.

The selected decimal places set the divisor for the Modbus readings to correctly interpret temperature and pressure readings. For example, if the temperature and pressure decimal place values are set to 2, the divisor will be 10^2, which means the received pressure & temperature Modbus readings are divided by 100 to interpret actual gauge measurements.

The Modbus data can be presented in a ***Float*** format by selecting ***'IEEE-754 Float Format'***. The ***Float*** format automatically presents the data with the selected number of decimal places; there is no need of a divisor.
Tables 1 and 2 show the commonly used gauge registers and their data type for GRC gauges.

Registers Count	Data Reading	Data Format	Data Interpretation
2	Serial Number	32-bit Integer	The numerical value of gauge Serial Number displayed
	Pressure		Divide by 10, 100, or 1000 depending upon selected decimal places
	Temperature		
	Vibration		

Table 1 – Gauge Registers with 'Integer' format

Registers Count	Data Reading	Data Format
2	Serial Number	32-bit Integer
	Pressure	32-bit IEEE-754 Float
	Temperature	
	Vibration	

Table 2 – Gauge Registers with 'Float' format

The detailed holding register mapping of the GRC gauges from Modbus address 32 to 48 is shown in Appendix B.

4.10 Gauge Syncing Configuration

Upon power-up, the FIC-1500 will check its internal memory to see if any gauge information is stored. If no gauges are saved, it will automatically scan FSK addresses 32 through 48 for gauges and begin polling any gauges it finds (the status is reflected on the LCD display). Once it is confirmed that all connected gauge channels have been detected successfully, it is important to issue the Sync'd command to the surface board. To save the gauges click the "Not Sync'd" tab in the configuration window (Figure 18) of DataWorks and the FIC-1500 will automatically load the saved gauges at boot up.

It is important to save your attached gauges because if the line voltage is not high enough, a gauge may not respond to the initial scan, causing the FIC-1500 to unable to poll it again until the next power cycle. If the gauges have been saved, the FIC-1500 will continue to poll the gauge even if it does not respond to the initial poll. Saving your gauges ensures that your specific configuration of gauges will always be polled the same, even between power cycles.

If a gauge is removed or added to the FIC-1500, or a gauge configuration is changed, you may clear the saved gauges, rescan, and re-save via the software interface at any time. To clear the gauges click the "Sync'd" tab (Figure 19) and the tab will now show "Not Sync'd". A command will be issued to the FIC-1500 to clear the gauges.

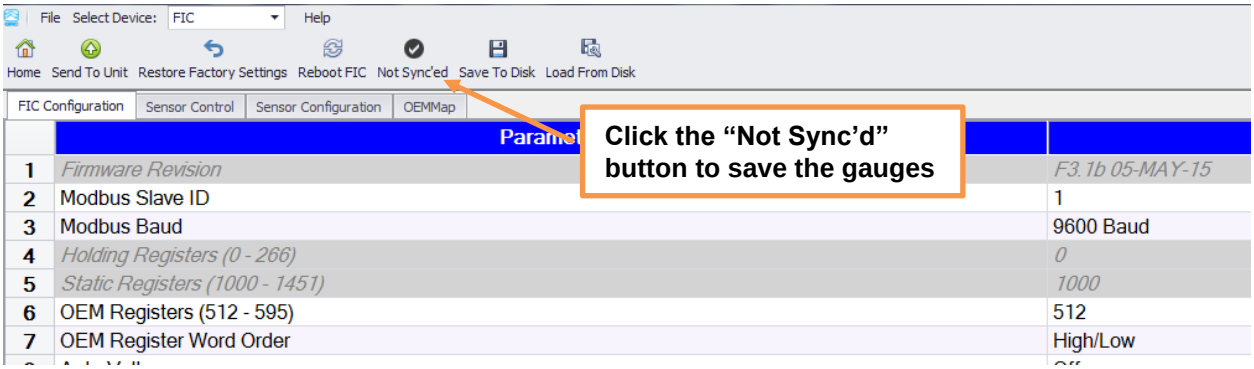


Figure 18: Not Sync'd.

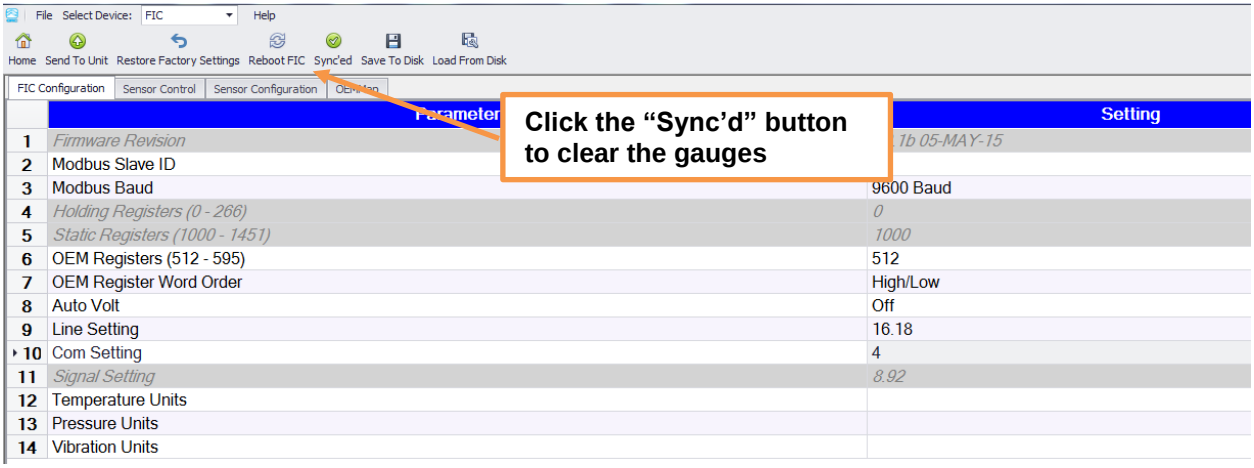


Figure 19: Sync'd.

4.11 Firmware Upload

Items Needed:

1. USB Cable, A-B (Sercel-GRC P/N 136-0076-01)
2. DataWorks software
3. Current released version of FIC-1500 firmware

Procedure

1. Plug the USB cable into the FIC-1500.
2. Plug the USB cable into the computer.
3. Open DataWorks.
4. Set up FSK interface as described in section 4.2.
5. Click the “Upload Firmware” tab at the top of the DataWorks home screen (Figure 20).

Figure 20: Firmware upload to FIC-1500.

6. After clicking the upload firmware tab the device upload form will appear. Click on the browse button (Figure 21) and navigate to the stored firmware file location.

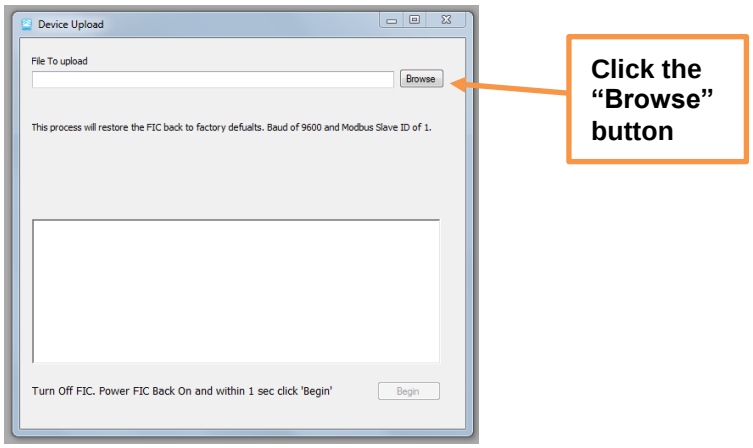


Figure 21: Browse file for firmware upload.

7. Choose the firmware you want to install and click on open (Figure 22).

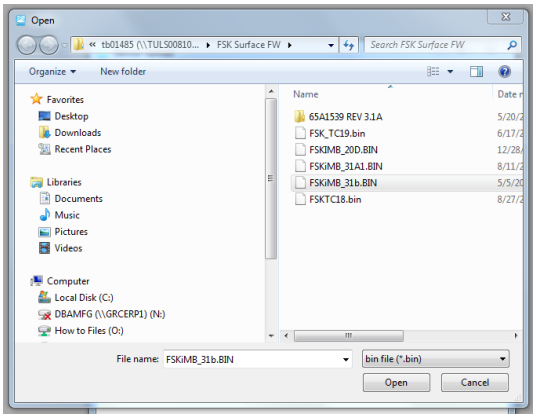


Figure 22: Select Firmware File.

8. To upload the firmware to the FIC-1500, cycle power to the FIC-1500 wait 1 second and click the “Begin” button. The firmware will now begin to install as shown by the progress bar (Figure 23 and Figure 24). After the firmware is uploaded simply close the device upload screen.

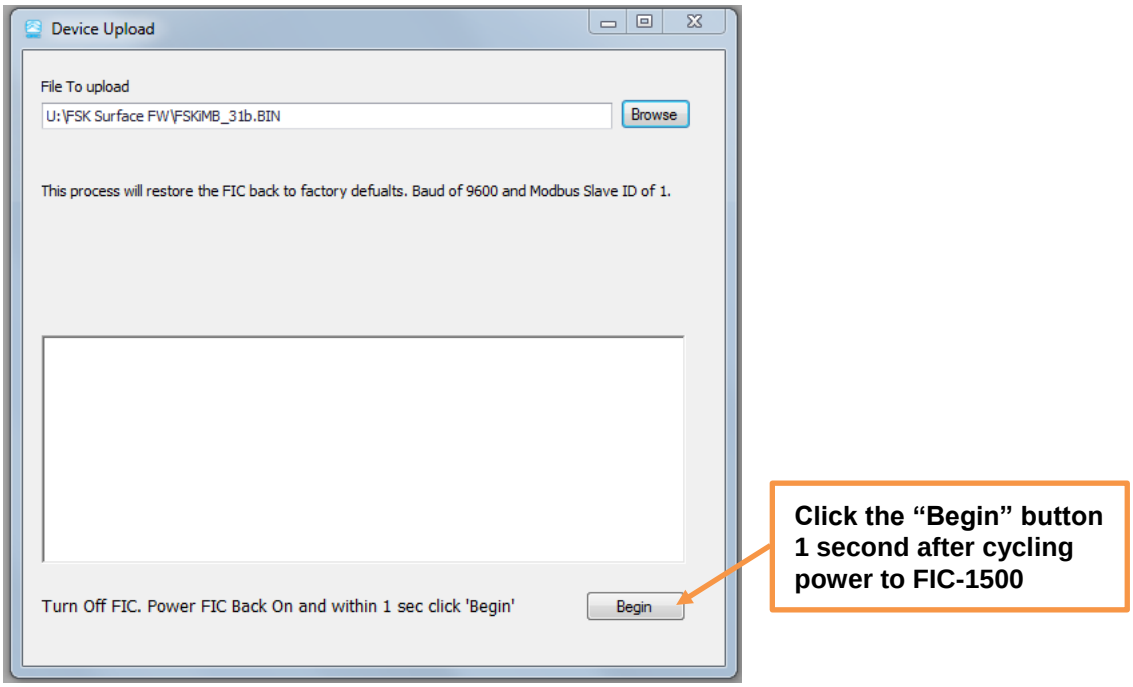


Figure 23: Uploading the firmware.

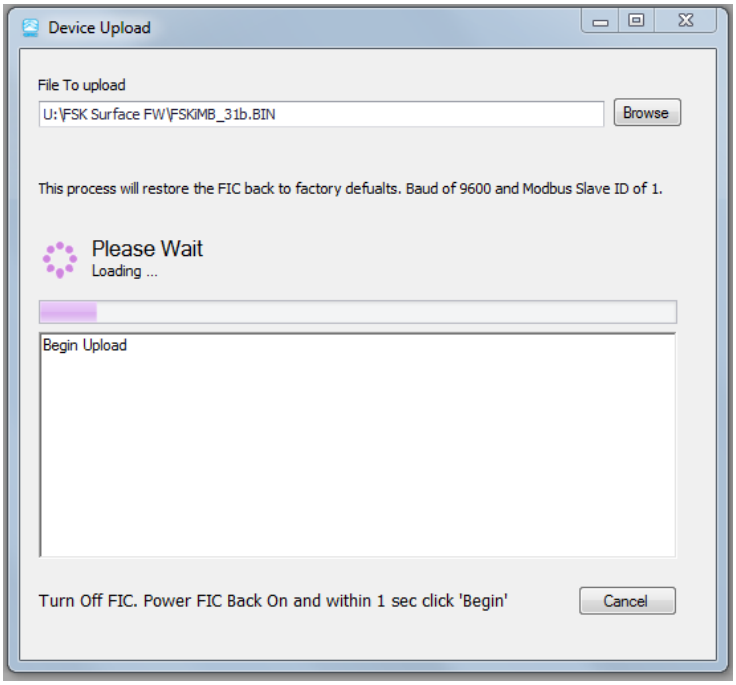


Figure 24: Firmware upload progress.

5.0 QTIEG-4000 Streaming Mode

The QTIEG-4000 now offers the option of a data fast streaming mode with data rates up to 1/10th of a second. Due to the fast sample speed, you can only get the fast sample speed for pressure only or temperature only. In other words, if you choose pressure for a 1/10th sample rate you will get 10 pressure samples a second and no temperature samples. The gauge will sample temperature once every 10 seconds, but will only use this for internal compensation and will not report it to the surface. In temperature only mode you will receive temperature samples, but no pressure samples. This option only works if you purchase the gauge with the fast mode option.

To place the gauge in the fast sample mode simply use DataWorks (Figure 25) and follow the steps below.

1. After connecting the FIC-1500 to the gauge and to your computer, open DataWorks and choose the correct com port.
2. Click on “Configuration” and then “Sensor Control”.
3. Change the “Select Mode” to “Fast Mode”.
4. Select whether you want pressure only or temperature only in fast mode.
5. Change to the desired sample rate.
6. Click on the “Send To Unit” tab on the menu bar.

Note: Fast sample mode uses a large amount of data on the Modbus line. Therefore, it should only be used when the Modbus line can be dedicated to communicating with the FIC-1500. Any other devices sharing the Modbus line may have difficulty communicating due to a large amount of traffic.

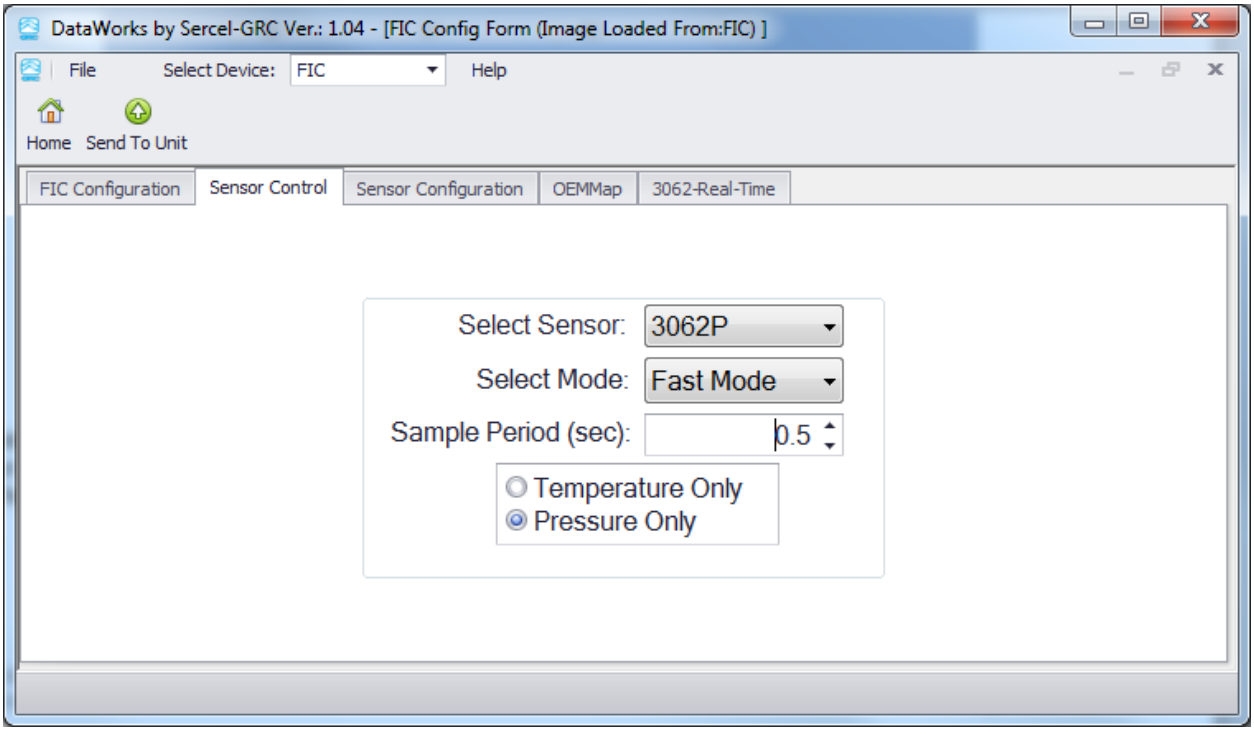


Figure 25: Fast mode configuration.

6.0 Troubleshooting Problems/Solutions

All the gauges aren't found:

- Are the gauges stored (sync'd) and don't include the new gauge? If so, clear saved gauges and reboot to run auto find.
- Is there enough voltage on the line? Gradually increase line voltage setting and the com voltage setting and retry auto find. A general rule is com set voltage should be ¼ the line set voltage.
- Is there an FSK Address collision between the gauges? Plug them in one by one and check their FSK Address, every gauge requires a unique address between 32 and 48.

Communication Errors (Note: less than 1% error rate is normal)

- If the gauge is having trouble receiving messages from the surface board, try increasing the com voltage setting. This will provide more communication voltage for the gauge to see.
- If the surface board is having trouble receiving messages from a gauge, try increasing the line set (or target Signal if Auto volt is used). Don't forget to increase com set proportionately.

7.0 Appendix A – FIC-4000 Installation Manual

The FIC-4000 (Figure 26) is an enclosure with the FIC-1500 as well as an AC power supply and a wire terminal block. This gives the customer the ability to install the FIC-1500 where a standalone or a weatherproof NEMA-4 enclosure is required and DC power may not be available.

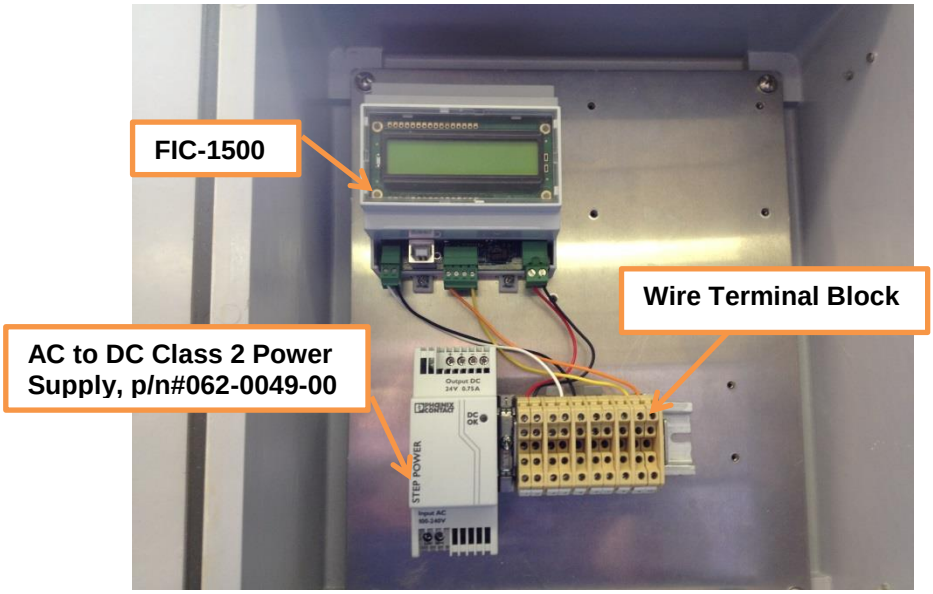


Figure 26: FIC-4000.

7.1 FIC-4000 Power Connections

To power the FIC-4000 you will need to determine the power requirements for the installation. The FIC-4000 is equipped with a standard 100-240VAC power supply. Connect the AC power cable (Figure 27) to the AC-DC power supply with its black wire to 'Line+' and its white wire to 'Neutral-'.

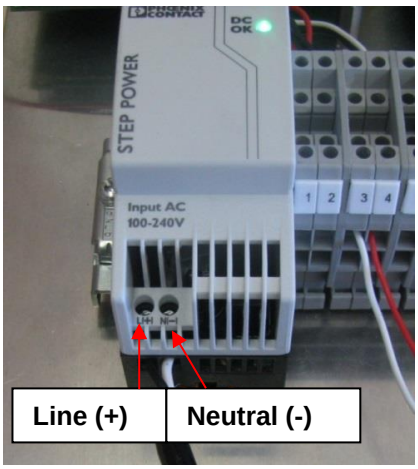


Figure 27: AC power supply connections.

The FIC-4000 is available without the AC power supply for installations with access to a DC power source. The FIC-4000 will operate on voltages from 12VDC to 24VDC with a maximum

nominal current rating of 0.5Amps. The DC connections (Figure 28) are made to terminal blocks 1 DC Positive and 2 DC Negative.

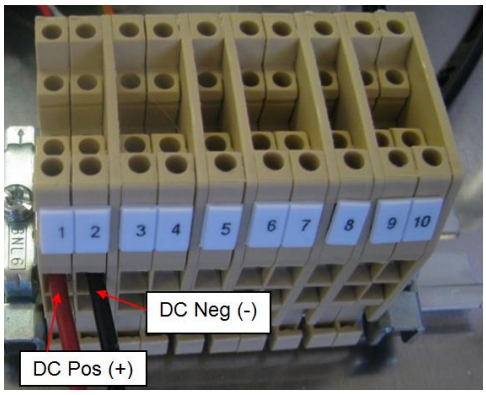


Figure 28: DC Power Connections.

7.2 FIC-4000 Gauge Connections

The FIC-4000 can communicate with up to 6 FSK channels (1 channel = 1 pressure/ temperature sensor or 1 vibration/ temperature sensor) for 1 FIC-1500. The FIC-4000 is standard equipped with 1 FIC-1500 but can support 2 if equipped. To connect the gauges (Figure 29) run the signal and ground wires into the enclosure and connect the signal wire to terminal blocks 3 or 4 (the terminals are internally bridged) and connect the gauge ground wire to terminal block 5. If you have the optional 2nd FIC-1500 the connections for the gauge signal wire are terminal blocks 6 or 7 and the gauge ground wire is terminal block 8.

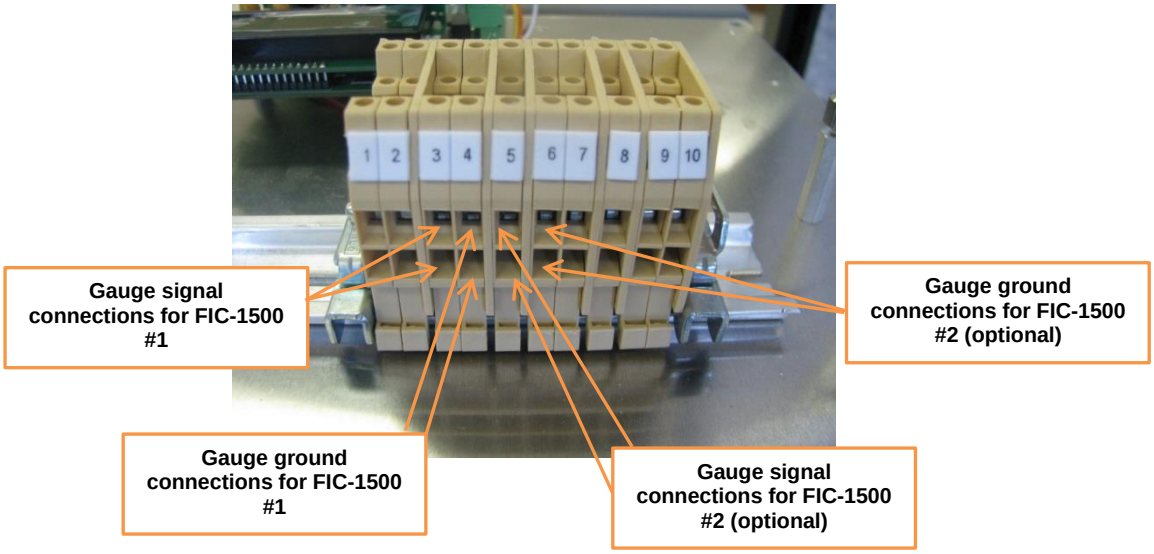


Figure 29: Gauge connections.

7.3 FIC-4000 Modbus Connections

Modbus connections for the FIC-4000 are the same as the FIC-1500. See the FIC-1500 sections 3.0, 3.1 and 3.2 in this manual for this procedure.

8.0 Appendix B – Modbus Gauge Data Register Map

# Of Regs	Register	FSK Address	Sensor	Units Applied
1	41001	32	Hi Byte: Gauge Type (1=Qz, 2=Cap, 3=Vibe) Lo Byte: Gauge Revision	
2	41002		Serial Number (int)	
1	41004		Serial Number First Two Non-Numeric Chars (I/D/V)	
2	41005		Packet Count	
2	41007		Error Count	
1	41009		Hi Byte: Signal Current Low (mA) Lo Byte: Signal Current High (mA)	
2	41010		Last Packet Time (Seconds x10)	
2	41012		Pressure	Pressure
2	41014		Temperature	Temperature
2	41016		Vibration X	Vibration
2	41018		Vibration Y	Vibration

# Of Regs	Register	FSK Address	Sensor	Units Applied
1	41028	33	Hi Byte: Gauge Type (1=Qz, 2=Cap, 3=Vibe) Lo Byte: Gauge Revision	
2	41029		Serial Number (int)	
1	41031		Serial Number First Two Non-Numeric Chars (I/D/V)	
2	41032		Packet Count	
2	41034		Error Count	
1	41036		Hi Byte: Signal Current Low (mA) Lo Byte: Signal Current High (mA)	
2	41037		Last Packet Time (Seconds x10)	
2	41039		Pressure	Pressure
2	41041		Temperature	Temperature
2	41043		Vibration X	Vibration
2	41045		Vibration Y	Vibration

# Of Regs	Register	FSK Address	Sensor	Units Applied
1	41055	34	Hi Byte: Gauge Type (1=Qz, 2=Cap, 3=Vibe) Lo Byte: Gauge Revision	
2	41056		Serial Number (int)	
1	41058		Serial Number First Two Non-Numeric Chars (I/D/V)	
2	41059		Packet Count	
2	41061		Error Count	
1	41063		Hi Byte: Signal Current Low (mA) Lo Byte: Signal Current High (mA)	
2	41064		Last Packet Time (Seconds x10)	
2	41066		Pressure	Pressure
2	41068		Temperature	Temperature
2	41070		Vibration X	Vibration
2	41072		Vibration Y	Vibration

# Of Regs	Register	FSK Address	Sensor	Units Applied
1	41082	35	Hi Byte: Gauge Type (1=Qz, 2=Cap, 3=Vibe) Lo Byte: Gauge Revision	
2	41083		Serial Number (int)	
1	41085		Serial Number First Two Non-Numeric Chars (I/D/V)	
2	41086		Packet Count	
2	41088		Error Count	
1	41090		Hi Byte: Signal Current Low (mA) Lo Byte: Signal Current High (mA)	
2	41091		Last Packet Time (Seconds x10)	
2	41093		Pressure	Pressure
2	41095		Temperature	Temperature
2	41097		Vibration X	Vibration
2	41099		Vibration Y	Vibration

# Of Regs	Register	FSK Address	Sensor	Units Applied
1	41109	36	Hi Byte: Gauge Type (1=Qz, 2=Cap, 3=Vibe) Lo Byte: Gauge Revision	
2	41110		Serial Number (int)	
1	41112		Serial Number First Two Non-Numeric Chars (I/D/V)	
2	41113		Packet Count	
2	41115		Error Count	
1	41117		Hi Byte: Signal Current Low (mA) Lo Byte: Signal Current High (mA)	
2	41118		Last Packet Time (Seconds x10)	
2	41120		Pressure	Pressure
2	41122		Temperature	Temperature
2	41124		Vibration X	Vibration
2	41126		Vibration Y	Vibration
# Of Regs	**Register**	**FSK Address**	**Sensor**	**Units Applied**
1	41136	37	Hi Byte: Gauge Type (1=Qz, 2=Cap, 3=Vibe) Lo Byte: Gauge Revision	
2	41137		Serial Number (int)	
1	41139		Serial Number First Two Non-Numeric Chars (I/D/V)	
2	41140		Packet Count	
2	41142		Error Count	
1	41144		Hi Byte: Signal Current Low (mA) Lo Byte: Signal Current High (mA)	
2	41145		Last Packet Time (Seconds x10)	
2	41147		Pressure	Pressure
2	41149		Temperature	Temperature
2	41151		Vibration X	Vibration
2	41153		Vibration Y	Vibration

# Of Regs	Register	FSK Address	Sensor	Units Applied
1	41163	38	Hi Byte: Gauge Type (1=Qz, 2=Cap, 3=Vibe) Lo Byte: Gauge Revision	
2	41164		Serial Number (int)	
1	41166		Serial Number First Two Non-Numeric Chars (I/D/V)	
2	41167		Packet Count	
2	41169		Error Count	
1	41171		Hi Byte: Signal Current Low (mA) Lo Byte: Signal Current High (mA)	
2	41172		Last Packet Time (Seconds x10)	
2	41174		Pressure	Pressure
2	41176		Temperature	Temperature
2	41178		Vibration X	Vibration
2	41180		Vibration Y	Vibration

# Of Regs	Register	FSK Address	Sensor	Units Applied
1	41190	39	Hi Byte: Gauge Type (1=Qz, 2=Cap, 3=Vibe) Lo Byte: Gauge Revision	
2	41191		Serial Number (int)	
1	41193		Serial Number First Two Non-Numeric Chars (I/D/V)	
2	41194		Packet Count	
2	41196		Error Count	
1	41198		Hi Byte: Signal Current Low (mA) Lo Byte: Signal Current High (mA)	
2	41199		Last Packet Time (Seconds x10)	
2	41201		Pressure	Pressure
2	41203		Temperature	Temperature
2	41205		Vibration X	Vibration
2	41207		Vibration Y	Vibration

# Of Regs	Register	FSK Address	Sensor	Units Applied
1	41217	40	Hi Byte: Gauge Type (1=Qz, 2=Cap, 3=Vibe) Lo Byte: Gauge Revision	
2	41218		Serial Number (int)	
1	41220		Serial Number First Two Non-Numeric Chars (I/D/V)	
2	41221		Packet Count	
2	41223		Error Count	
1	41225		Hi Byte: Signal Current Low (mA) Lo Byte: Signal Current High (mA)	
2	41226		Last Packet Time (Seconds x10)	
2	41228		Pressure	Pressure
2	41230		Temperature	Temperature
2	41232		Vibration X	Vibration
2	41234		Vibration Y	Vibration

# Of Regs	Register	FSK Address	Sensor	Units Applied
1	41244	41	Hi Byte: Gauge Type (1=Qz, 2=Cap, 3=Vibe) Lo Byte: Gauge Revision	
2	41245		Serial Number (int)	
1	41247		Serial Number First Two Non-Numeric Chars (I/D/V)	
2	41248		Packet Count	
2	41250		Error Count	
1	41252		Hi Byte: Signal Current Low (mA) Lo Byte: Signal Current High (mA)	
2	41253		Last Packet Time (Seconds x10)	
2	41255		Pressure	Pressure
2	41257		Temperature	Temperature
2	41259		Vibration X	Vibration
2	41261		Vibration Y	Vibration

# Of Regs	Register	FSK Address	Sensor	Units Applied
1	41271	42	Hi Byte: Gauge Type (1=Qz, 2=Cap, 3=Vibe) Lo Byte: Gauge Revision	
2	41272		Serial Number (int)	
1	41274		Serial Number First Two Non-Numeric Chars (I/D/V)	
2	41275		Packet Count	
2	41277		Error Count	
1	41279		Hi Byte: Signal Current Low (mA) Lo Byte: Signal Current High (mA)	
2	41280		Last Packet Time (Seconds x10)	
2	41282		Pressure	Pressure
2	41284		Temperature	Temperature
2	41286		Vibration X	Vibration
2	41288		Vibration Y	Vibration
# Of Regs	**Register**	**FSK Address**	**Sensor**	**Units Applied**
1	41298	43	Hi Byte: Gauge Type (1=Qz, 2=Cap, 3=Vibe) Lo Byte: Gauge Revision	
2	41299		Serial Number (int)	
1	41301		Serial Number First Two Non-Numeric Chars (I/D/V)	
2	41302		Packet Count	
2	41304		Error Count	
1	41306		Hi Byte: Signal Current Low (mA) Lo Byte: Signal Current High (mA)	
2	41307		Last Packet Time (Seconds x10)	
2	41309		Pressure	Pressure
2	41311		Temperature	Temperature
2	41313		Vibration X	Vibration
2	41315		Vibration Y	Vibration

# Of Regs	Register	FSK Address	Sensor	Units Applied
1	41325	44	Hi Byte: Gauge Type (1=Qz, 2=Cap, 3=Vibe) Lo Byte: Gauge Revision	
2	41326		Serial Number (int)	
1	41328		Serial Number First Two Non-Numeric Chars (I/D/V)	
2	41329		Packet Count	
2	41331		Error Count	
1	41333		Hi Byte: Signal Current Low (mA) Lo Byte: Signal Current High (mA)	
2	41334		Last Packet Time (Seconds x10)	
2	41336		Pressure	Pressure
2	41338		Temperature	Temperature
2	41340		Vibration X	Vibration
2	41342		Vibration Y	Vibration

# Of Regs	Register	FSK Address	Sensor	Units Applied
1	41352	45	Hi Byte: Gauge Type (1=Qz, 2=Cap, 3=Vibe) Lo Byte: Gauge Revision	
2	41353		Serial Number (int)	
1	41355		Serial Number First Two Non-Numeric Chars (I/D/V)	
2	41356		Packet Count	
2	41358		Error Count	
1	41360		Hi Byte: Signal Current Low (mA) Lo Byte: Signal Current High (mA)	
2	41361		Last Packet Time (Seconds x10)	
2	41363		Pressure	Pressure
2	41365		Temperature	Temperature
2	41367		Vibration X	Vibration
2	41369		Vibration Y	Vibration

# Of Regs	Register	FSK Address	Sensor	Units Applied
1	41379	46	Hi Byte: Gauge Type (1=Qz, 2=Cap, 3=Vibe) Lo Byte: Gauge Revision	
2	41380		Serial Number (int)	
1	41382		Serial Number First Two Non-Numeric Chars (I/D/V)	
2	41383		Packet Count	
2	41385		Error Count	
1	41387		Hi Byte: Signal Current Low (mA) Lo Byte: Signal Current High (mA)	
2	41388		Last Packet Time (Seconds x10)	
2	41390		Pressure	Pressure
2	41392		Temperature	Temperature
2	41394		Vibration X	Vibration
2	41396		Vibration Y	Vibration

# Of Regs	Register	FSK Address	Sensor	Units Applied
1	41406	47	Hi Byte: Gauge Type (1=Qz, 2=Cap, 3=Vibe) Lo Byte: Gauge Revision	
2	41407		Serial Number (int)	
1	41409		Serial Number First Two Non-Numeric Chars (I/D/V)	
2	41410		Packet Count	
2	41412		Error Count	
1	41414		Hi Byte: Signal Current Low (mA) Lo Byte: Signal Current High (mA)	
2	41415		Last Packet Time (Seconds x10)	
2	41417		Pressure	Pressure
2	41419		Temperature	Temperature
2	41421		Vibration X	Vibration
2	41423		Vibration Y	Vibration

# Of Regs	Register	FSK Address	Sensor	Units Applied
1	41433	48	Hi Byte: Gauge Type (1=Qz, 2=Cap, 3=Vibe) Lo Byte: Gauge Revision	
2	41434		Serial Number (int)	
1	41436		Serial Number First Two Non-Numeric Chars (I/D/V)	
2	41437		Packet Count	
2	41439		Error Count	
1	41441		Hi Byte: Signal Current Low (mA) Lo Byte: Signal Current High (mA)	
2	41442		Last Packet Time (Seconds x10)	
2	41444		Pressure	Pressure
2	41446		Temperature	Temperature
2	41448		Vibration X	Vibration
2	41450		Vibration Y	Vibration

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