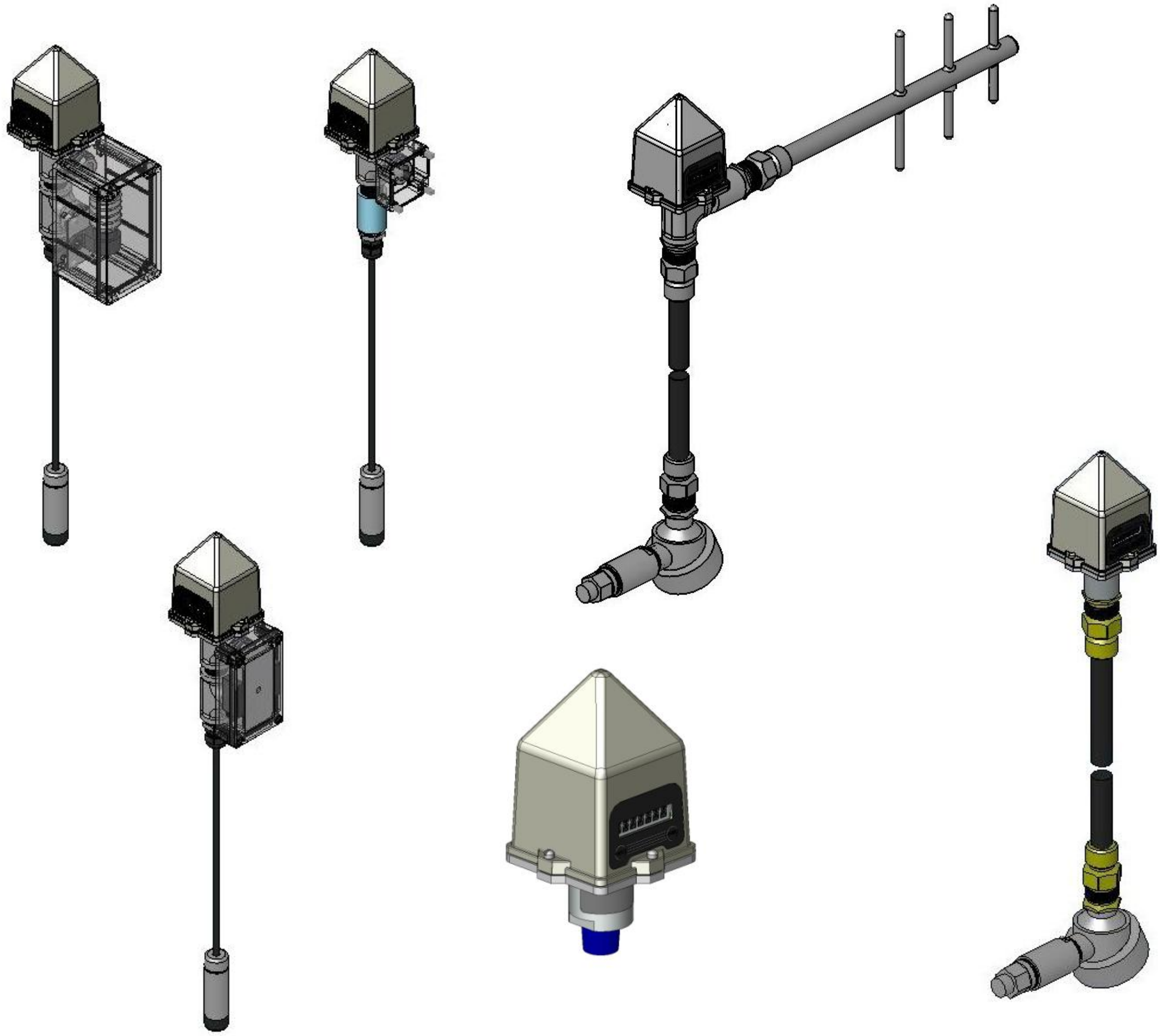
Level Products User Manual



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Level Field Units

Models: WI-SL-xx WI-GL-I-xx WI-GL-E-xx
WI-GL-E-Y6-XX

Versions 1.70 or later

Important Information for the User

- Changes or modifications not expressly approved by Adaptive Wireless Solutions may void the user's authority to operate the equipment.

- This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

    1 This device may not cause harmful interference.

    2 This device must accept any interference received, including interference that may cause undesired operation.

- This device is for mobile and fixed use only (not portable or body-worn). A separation distance of 20cm must be maintained at all times between the antenna and the body of the user and bodies of nearby persons.

- This device has been designed to operate with an antenna having a maximum gain of 9 dBd. Antenna having a higher gain is strictly prohibited per regulations of Industry Canada. The required antenna impedance is 50 ohms.

- To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the EIRP (Equivalent Isotropically Radiated Power) is not more than that required for successful communication.

- The installer of this radio equipment must ensure that the antenna is located or pointed such that it does not emit RF field in excess of Health Canada limits for the general population; consult Safety Code 6, obtainable from Health Canada's website www.hc-sc.gc.ca/rpb.

FCC Certification

- This product is a frequency hopping RF transceiver module for the 900MHz ISM band, designed to meet FCC 15.247, and is used in industrial control and monitoring applications.

- The antenna is factory installed and **MUST NOT** be removed or modified by the user.

Adaptive Wireless Solutions reserves the right to update or change this user guide at anytime. For the most recent version of the user guide, please check our website: www.adaptive-wireless.com

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1 Introduction

1.1 USING THIS MANUAL

This manual is designed to assist in installing, operating, and maintaining AWS Level Field Units. The manual is broken into sections as follows:

2 Quick Start
This section summarizes what must be done in order to get the device installed, configured, and in operation quickly. However, it does not provide detailed information or step-by-step instructions explaining how to perform the tasks outlined.

3 Installation
This section covers general considerations regarding correctly commissioning the Field Unit as well as unique applications such as flow service commissioning. Also covered in this section are mechanical installation considerations, such as Field Unit placement.

4 General Configuration
In this section, general configuration options such as password protection and selecting a user password are discussed. Also covered is the setting of a Field Unit tag name, resetting of all Field Unit settings, and a discussion of the various messages that are displayed on the Field Unit LCD.

5 Configuring the RF Communications
This section covers the setup of the Field Unit RF Communications that allow the Field Unit to achieve communication with the Base Radio. Parameters discussed are the Field Unit RF ID, the RF channel setting, and Baud Rate.

6 Configuring the Sampling and Transmission Rates
This section aids you in selecting the amount of time between each sample of the process, and the time between each transmission of this sample to the Base Radio. Also discussed, is the use of setting an abnormal threshold in which sampling and transmission times may change during a period when the process variable is within the abnormal region.

7 Configuring the Process Variable
This section helps you to zero the sensor and discusses setting a measurement offset and trimming the process measurement.

8 Selecting and Configuring Operation Modes
In this section, the two operation modes (Pressure and Gauge Level) of the Level Field Units are discussed in order to aid you in selecting the right mode for your application.

9 Maintaining the Field Unit
This section explains how the Field Unit should be cared for once it has been placed into service and how to change the battery.

10 Technical Specifications
This section explains the technical specifications that are associated with this device, such as power characteristics, accuracy, and operating characteristics.

1.2 ABOUT THE DEVICE

Each AWS Level Field Unit is a reliable RF (Radio Frequency) transceiver coupled with a Gauge Level sensor that can be used in two different modes: to monitor submerged pressure or tank level. Tank level calculations can be performed using any of the following methodologies: height, volume, or mass.

The time and expense of running wires often makes it difficult to measure parameters that have an economic impact on your plant operation, but the Level Field Units allow you to quickly and accurately monitor those devices at a fraction of the cost. This gives you bigger and faster returns on your instrumentation investments.

The Field Units communicate in a secure, digital protocol over a band of frequencies from 902MHz to 928MHz. This data communication technique has been the backbone of the military's secure communications protocols for many years. These devices require no wires, permits, or licenses, and they are easily set up and installed right out of the box.

You can use this device for long term monitoring in remote locations, for short-term data gathering on process conditions, or for quickly testing the economic viability of a new installation.

The purpose of this manual is to help you install and maintain your AWS Level Field Unit. BEFORE setting up and installing the Field Unit please setup and configure the Base Radio.

1.3 UNPACKING

Remove the Packing List and check off the actual equipment received. If you have any questions about your shipment, please call your Adaptive Wireless Solutions Representative. Upon receipt of the shipment, inspect the container for any signs of damage in transit. Especially take note of any evidence of rough handling. Report any apparent damage immediately to the shipping agent.

Please note that sometimes units are assembled with accessories when shipped. Inspect the shipment carefully if you think that something is missing. This is rare, as we take considerable care to pack units for shipment, but it does sometimes happen. Please give us a call and we may be able to resolve this matter quickly over the phone.

Note *The carrier will not honor any claims for damage unless all shipping materials are saved for their examination. If you find any damage while you are examining and removing the contents, save the packing material and the carton.*

1.4 SOFTWARE COMPATIBILITY

Software for AWS is revised periodically. Internal device software may contain portions that are not compatible with previous versions of WIM (Wireless Instrumentation Manager software.)

To ensure software compatibility, WIM version 1.70.138 or later must be used. If you believe you are experiencing software compatibility issues please call Adaptive Wireless Solutions Technical Support at (978) 875-6000 or email techsupport@adaptive-wireless.com .

2 Quick Start

This section summarizes what must be done in order to get the device installed, configured, and in operation quickly. However, it does not provide detailed or step-by-step instructions explaining how to perform the tasks outlined.

1. Install the Field Unit in the desired location of operation.
2. Turn on the Field Unit by simultaneously pressing and holding the ENTER and NEXT buttons until the unit powers up.
3. Hit the NEXT button until the CONFIG message appears then hit ENTER.
4. Enter the default password 0000 to enter the CONFIG menu.
5. Enter the SET RF menu.
6. Set the RF CHAN setting equal to the Base Radio's RF Channel.
7. Set the BAUD RT setting equal to the Base Radio's RF Baud Rate.
8. Set the RF ID number to be a unique value between 1 and 100.
9. Zero the sensor.
10. Trim and Offset the measurement (if appropriate).

Perform the following via WIM:

11. Select a mode of operation.
12. Select the appropriate engineering units.
13. Enter the appropriate calculation parameters.
14. Select the normal transmission rate.
15. Select the normal sampling rate.
16. Select the abnormal transmission rate.
17. Select the abnormal sampling rate.
18. Set the normal upper and lower values.

If the "RF OFF" message is being displayed on the Field Unit LCD, perform the following:

- Set the RF CHAN setting equal to the Base Radio's RF Channel.

If "NO RF" is being displayed on the Field Unit LCD, check the following:

- Is the Field Unit set to the above listed settings?

- Is the Base Radio on?
- Do the Field Unit and Base Radio settings match? (See Section 5 of the Field Unit and Base Radio User Manuals)
- Are the Base Radio and Field Units unable to communicate due to obstructions or distance? (See Section 3.1.1 Field Unit Positioning).
- Have you run the RSSI Diagnostics? (See Section 3.2.1 Field Unit RSSI Diagnostic)

Warning! If the Field Units have been running for an extended period of time with no signal from the Base Radio (the Base Radio is off or not present), the Field Units will only search for the Base Radio every one hour or so. Turning the Field Units off and back on will cause them to begin searching immediately.

3 Installation

- **WI-GL-I-XX** is a Gauge Level Field Unit with an integrated sensor.
- **WI-GL-E-XX** is a Gauge Level Field Unit with an extended sensor. This Field Unit is for locations where the sensor is too close to the ground, a dike, or additional obstructions. It allows you to position the Field Unit transmitter in a location for optimal communication with the Base Radio.
- **WI-GL-E-Y6-XX** is a Gauge Level Field Unit with an extended sensor and a high gain directional Yagi antenna. This Field Unit has all of the benefits of the WI-GL-E-XX plus the high gain antenna to increase the transmission distance between the Field Unit and Base Radio.
- **WI-SL-XX** is a Submersible Level Field Unit with a cable-mounted sensor.

3.1 Mechanical Installation

In this section, mechanical installation instructions are discussed for the various setup capabilities of the Level Field Units.

Each AWS Level Field Unit is a rugged device, but it provides much better performance if installed with careful consideration, as noted in this manual. It may be utilized in any Level measurement application so long as care is exercised to prevent exposing the sensing elements to excess stress or temperature. Installation practices greatly impact these service parameters and the life that you can expect from your AWS Level Field Units.

Carefully consider the environment in which you will install your instrument. Avoid installations that expose the device to excess temperature, high vibration, considerable shock, or to dripping condensate or corrosive materials. Also avoid installing the device in an unserviceable location.

Most often these problems can be avoided with some thought at the time of installation. The practices noted below are generally recommended, but they can only act as a guideline and cannot cover all possible variations. The final installation must be made at the discretion and approval of the user. The user must be the judge of the actual installation.

Dimensioned mechanical drawings for aid in mechanical installation are located in Section 10 Technical Specifications.

3.1.1 Field Unit Positioning

Correct positioning of the Field Unit will ensure the best performance of the device. When planning the positioning of the Field Units, there are a few parameters that must be paid attention to:

- The top of the Field Unit should point in an upward fashion. The bottom of the Field Unit should NOT point directly at the Base Radio and the Field Unit LCD should point away from the Base Radio.

- All Field Units should maintain an approximate spacing of at least six feet apart from one another. Should you need to put Field Units closer than six feet, please see Section 3.1.1.1 entitled “Technique for Close Positioning of Field Units”.

- The line of sight range between a Field Unit and Base Radio is 2000 feet at the 19.2K baud rate setting. Note that this range is reduced by the amount of RF Noise present, obstructions, and the material properties of the obstructions.

- Only place the Field Unit in ambient operating temperatures of -40°F to 185°F (-40°C to 85°C).

Figure 3-1, shown below, gives examples of incorrect setups according to the previously mentioned parameters.

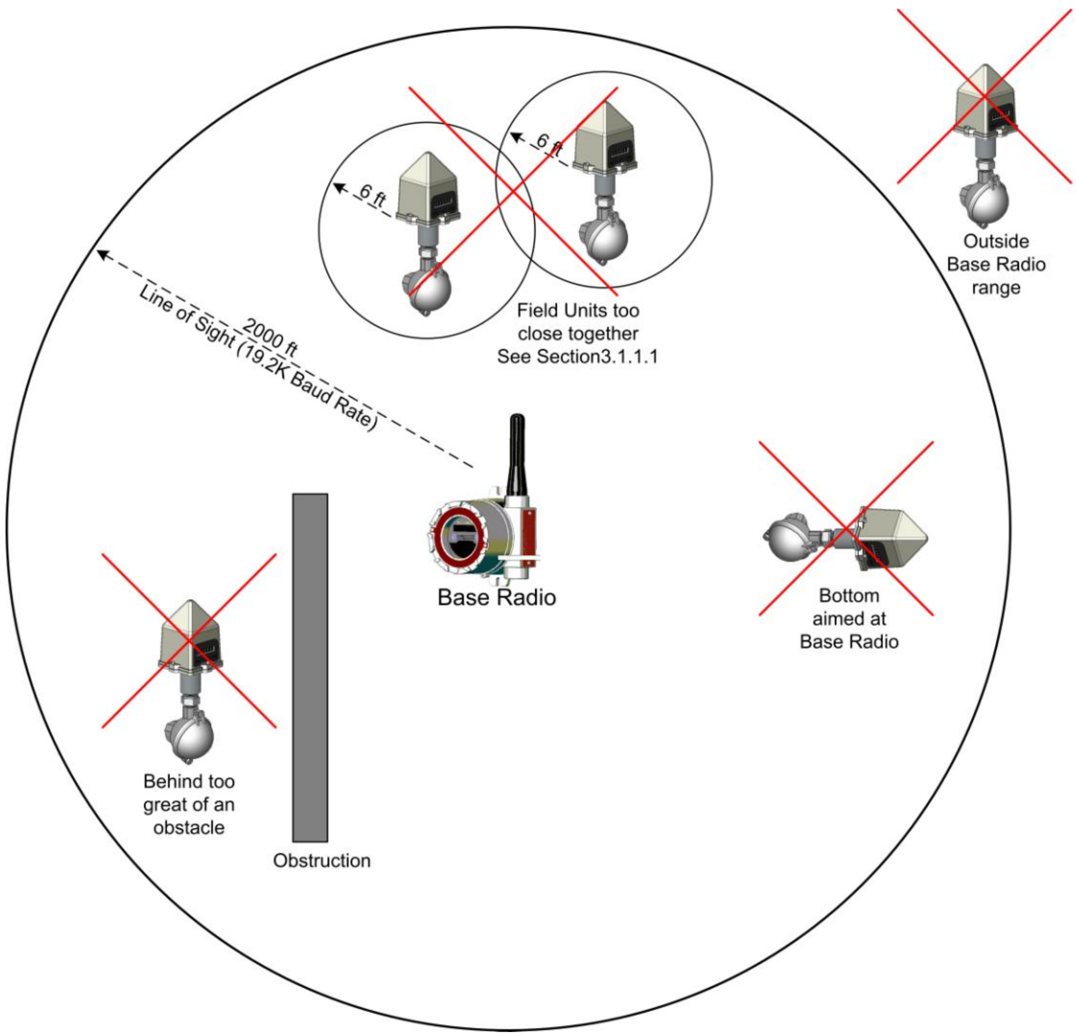


Figure 3-1 Examples of Incorrect Field Unit Positioning

Because there are so many setup possibilities, we cannot cover them all. A correct setup would make sure that the above warnings are heeded, and that the Field Unit and Base Radio are capable of communicating. The Testing Communications section will help you to determine if you have selected the correct installation points and orientations for your application.

Warning! During installation, do not apply force to the instrument housing or antenna. Use a proper wrench for all installations. Failure to use correct installation procedures can cause damage to the Field Unit.

3.1.1.1 Technique for Close Positioning of Field Units

Field Units may be placed closely together by carefully following this procedure. If this procedure is not followed, the communication range of the Field Units will be significantly reduced and the Field Units may eventually lose communication with the Base Radio entirely. This procedure is easy to implement, but please read carefully for a full understanding.

The AWS Base Radio synchronizes with the Field Units in Synch Groups of seven, organized by their RFID numbers. If you want to place two Field Units closer than six feet, make sure that you have set them in different groups. Note that this only applies to Field Units that are communicating with the same Base Radio. The groups are defined in the following table:

Group	RFID Range
1	1-7
2	8-14
3	15-21
4	22-28
5	29-35
6	36-42
7	43-49
8	50-56
9	57-63
10	64-70
11	71-77
12	78-84
13	85-91
14	92-98
15	99-100

For example, if two Field Units are placed one foot apart and the first Field Unit has an RFID number of 027, it is in the 4th group (22-28). The second Field Unit must have an RFID number that is in another group (less than 22 or greater than 28). Setting the RFIDs of two closely spaced Field Units so that the RFID numbers are greater than seven apart ensures that the Field Units are in different Base Radio sync groups. This allows the closely spaced Field Units to properly receive their synchronization signal from the Base Radio and maintain their proper communication and range.

You can also ensure that closely spaced Field Units maintain their synchronization with their Base Radio by simply assigning each of the two Field Units to talk to a different Base Radio.

Either way, following this process will keep the Base Radio and Field Units properly synchronized for long-term communication.

3.2 Testing Communications

Remember that proper placement of the Field Unit will optimize your RF communication range and capabilities. Perhaps the best test to perform before mechanically mounting the unit is a quick hand-held test. There are two types of tests you can conduct: the RSSI (Received Signal Strength Indicator) Diagnostic and the Link Test. The RSSI Diagnostic measures the strength of the signal at the Field Unit. The Link Test measures the throughput of data sent to and from the Field Unit. The Link Test may be conducted from the Field Unit, Base Radio, or through WIM.

The RSSI Diagnostic should be conducted first to determine if the Base Radio is communicating with the Field Unit. Then the Link Test may be performed to test the validity of the installation.

To perform these tests, you should have a good idea of where the Base Radio will be placed (for more information, see Section 3 of the Base Radio User Manual). Place the Base Radio in the desired area and power on. Make sure that the Base Radio and Field Unit are on the same RF Channel and Baud Rate (See Section 5). You may also have to increment the number of Field Units with which the Base Radio is communicating (See the Base Radio User Manual Section 4.3).

Once both the Base Radio and Field Unit are set up to be on the same network, make sure communication is established by looking at the Field Unit LCD for the 'RF OK' message in the Read-Only Sequence (see Section 4.2.1).

After communications have been established, go to Section 3.2.1 for the RSSI Diagnostic or Section 3.2.2 for the Link Test.

3.2.1 Field Unit RSSI Diagnostic

The Field Unit should be placed in RSSI Diagnostic mode to determine the signal strength at the location of the equipment to be monitored.

The RSSI Diagnostic, located in the Field Unit's diagnostic menu, displays the RF signal strength in one of seven ranges. The signal strength is displayed on the LCD using a combination of '>' and '_' characters. Full signal strength is displayed as "> > > > > > >", while minimum signal strength is displayed as "> _ _ _ _ _ _". If the field unit is not communicating with the Base Radio (i.e. NO RF), all underscore characters will be displayed ("_ _ _ _ _ _ _").

The RSSI is measured every time the Field Unit receives a message from the Base Radio. The signal strength of the received message from the Base Radio is calculated during this time. The actual signal strength in dBm for each range is shown below:

>	>	>	>	>	>	>
Less than	Between	Between	Between	Between	Between	Greater than
-105 dBm	-105 dBm & -100 dBm	-100 dBm & -95 dBm	-95 dBm & -90 dBm	-90 dBm & -85 dBm	-85 dBm & -80 dBm	-80 dBm

To place the Field Unit in RSSI Diagnostic mode, follow the menu map shown in Figure 3-2. Note that the RSSI menu is under the DIAGNSE menu and not the CONFIG menu.

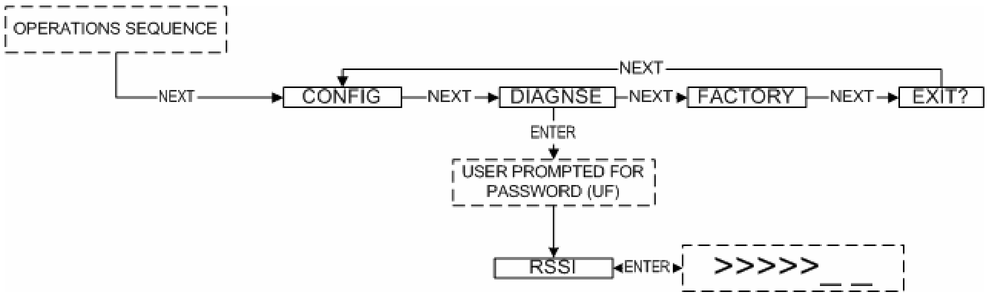


Figure 3-2 Menu Map to RSSI Mode

Now that the Field Unit is in the RSSI mode, bring the Field Unit close to the equipment you wish to monitor. Look at the LCD; notice the '>' will constantly fluctuate. One should estimate an average value based on these fluctuations. The ideal signal integrity is seven arrows.

Once you have verified that you are receiving a signal, you should check to make sure the Field Unit is communicating properly with the Base Radio. To do so, exit the RSSI by pressing ENTER, and then navigate to EXIT? of the diagnostic menu and return to the Operations Sequence shown in Figure 4-1 in Section 4.2.

If you see a NO RF message, then you do not have satisfactory RF communication with the Base Radio. If your application allows, move the Field Unit to a different position and check again for communications. If your application only allows you to mount at this particular point, you may want to try a slower baud rate setting for an increased range.

Note *While using a slower baud rate increases communication distance, it also increases the minimum transmit time. See Section 5.2 for a list of the fastest transmit rates for each baud rate. This may not be suitable for your application.*

One final solution is to reposition the AWS Base Radio. However, this may affect communications with previously installed Field Units, and if so, may require the use of a second Base Radio for your application. To select a better spot for the Base Radio, see Section 3.1.1 of the Base Radio User Manual.

3.2.2 Link Test

The Link Test measures the wireless link performance of a Field Unit running in its normal operating mode. Messages are sent from the Field Unit to the Base Radio at a predefined interval called the Transmit Rate (see Section 6.1). Each message contains data for the previous time period (since the last transmit). The Link Test looks at the wireless performance going in both directions, from the Field Unit to the Base Radio and vice versa, and comes up with a rating. The result that appears on the display shows the determined link strength.

In order to perform this test, the Field Unit must be communicating on the same channel and baud rate as the Base Radio. See Section 5 to configure communications.

The Link Test may be conducted from the Field Unit, Base Radio, or through WIM. Running the Link Test from WIM is ideal for testing communications for an installation with remote Field Units or those that are hard to reach. To conduct the Link Test from a Base Radio, see Section 3.2.2.2. To conduct the Link Test from WIM, see Section 3.2.2.3.

3.2.2.1 Conducting a Link Test from the Field Unit

The Link Test is located in the Field Unit's diagnostic menu (see Figure 3-3).

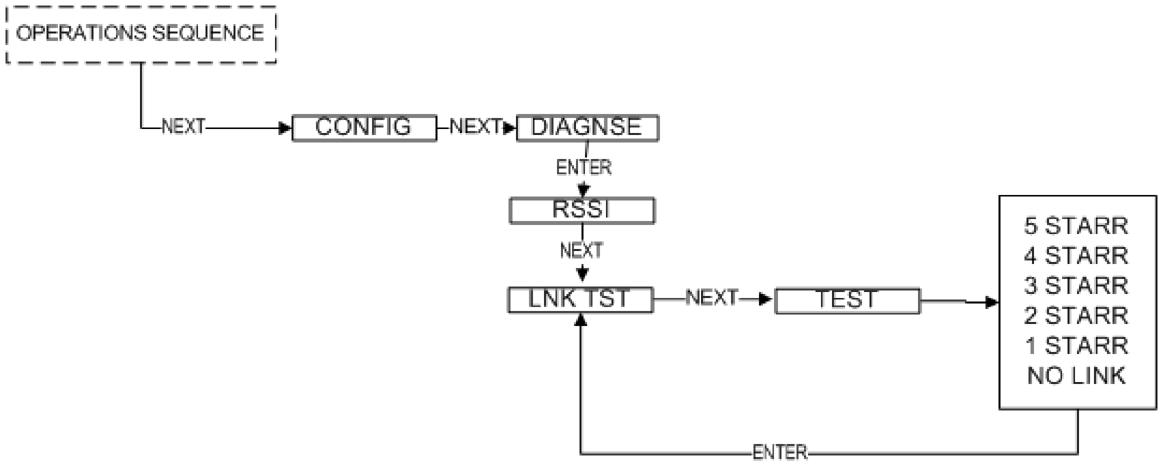


Figure 3-3 Field Unit Link Test

Using the NEXT and ENTER buttons, navigate to Link Test and press the ENTER button to begin the test. The Field Unit will begin to test the link in both directions (to and from the Base Radio). During this time, the word TEST will appear on the LCD display. When the test is complete, the Field Unit will display the quality of the link. Be aware that the Field Unit uses the configured Baud Rate and transmission rate to perform this test. The length of time it will take to perform this test depends on the device's normal transmitting rate.

When enough messages have been observed, link strength will be shown on the display. 5 STARR indicates the strongest link, while 1 STARR indicates the weakest link. The Link Test will continue to be evaluated and the rating on the screen may adjust itself. Keep in mind that the longer the Link Test runs, the more data the Field Unit will have to evaluate.

The Field Unit installation site should strive to place the Field Unit in a location where it receives the highest number possible. A stronger link means less data re-transmits and longer battery life.

3.2.2.2 Conducting a Link Test from the Base Radio

When the Link Test is conducted from a Base Radio, it measures the link strength between a selected Field Unit and the Base Radio. The Link Test data must be configured to match the communication parameters of the Field Unit from which you want to test. The Link Test is located in the Base Radio's diagnostic menu (see Figure 3-4).

To conduct a Link Test from the Base Radio, Navigate to Link Test and press the Enter button. Next, enter the RF ID for the Field Unit that you want to test. Then select the Normal Transmit rate that matches that of the Field Unit. If the Field Unit is transmitting at a different rate than the one you select in this menu, your results will be invalid.

Once the Normal Transmit Rate is selected, the Link Test will immediately start. The Base Radio will begin to test the link from the Field Unit. During this time, the word TEST will appear on the LCD display. When the test is complete, the Base Radio will display the quality of the link. Be aware that the length of time it takes to perform this test depends on the device's normal transmitting rate.

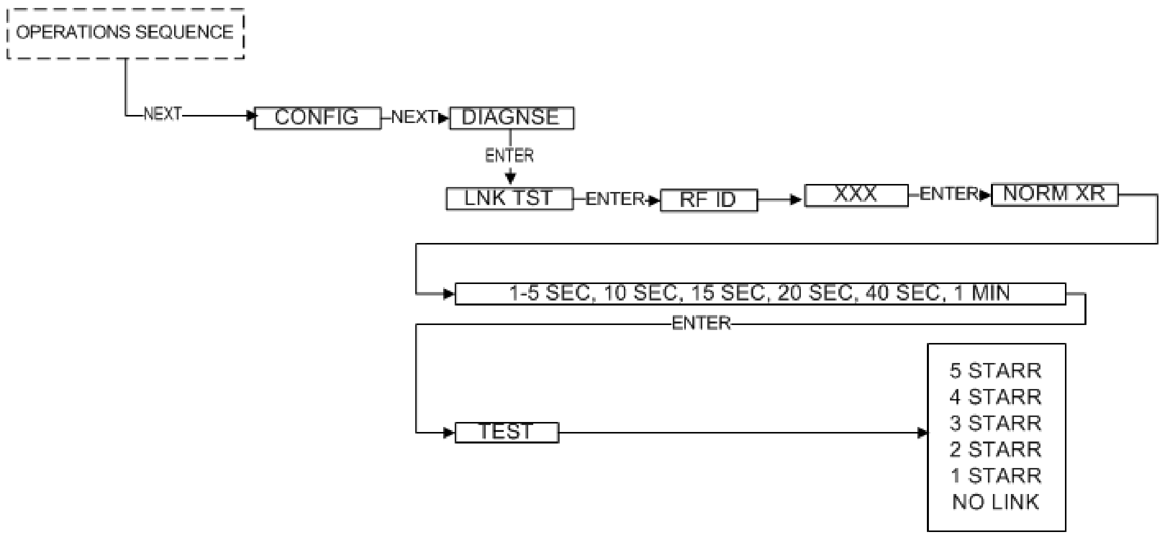


Figure 3-4 Base Radio Link Test

When enough messages have been observed, link strength will be shown on the display. 5 STARR indicates the strongest link, while 1 STARR indicates the weakest link. The Link Test will continue to be evaluated and the rating on the screen may adjust itself. Keep in mind that the longer the Link Test runs the more data the Field Unit will have to evaluate.

The Field Unit installation site should strive to place the Field Unit in a location where it receives the highest number possible. A stronger link means less data re-transmits and longer battery life.

3.2.2.3 Conducting a Link Test from WIM

To conduct a Link Test from WIM, make sure that WIM is running on the PC attached to the Base Radio. Then go to the Field Unit view and right-click on the Field Unit you want to test Received data transmission from (Figure 3-5).

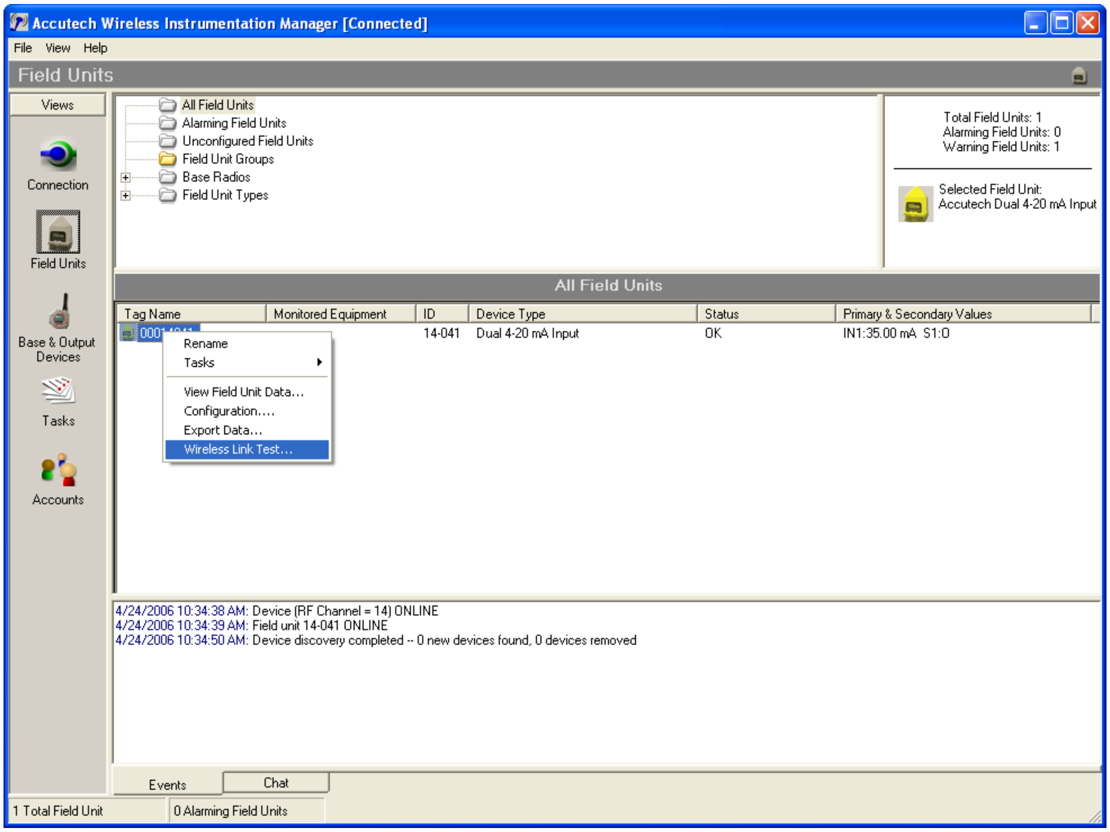


Figure 3-5 WIM Field Unit View

Select **Wireless Link Test…** from the popup menu.

The Wireless Data Loss Test window appears (Figure 3-6). The name of the Field Unit being tested appears in the title bar in parentheses.

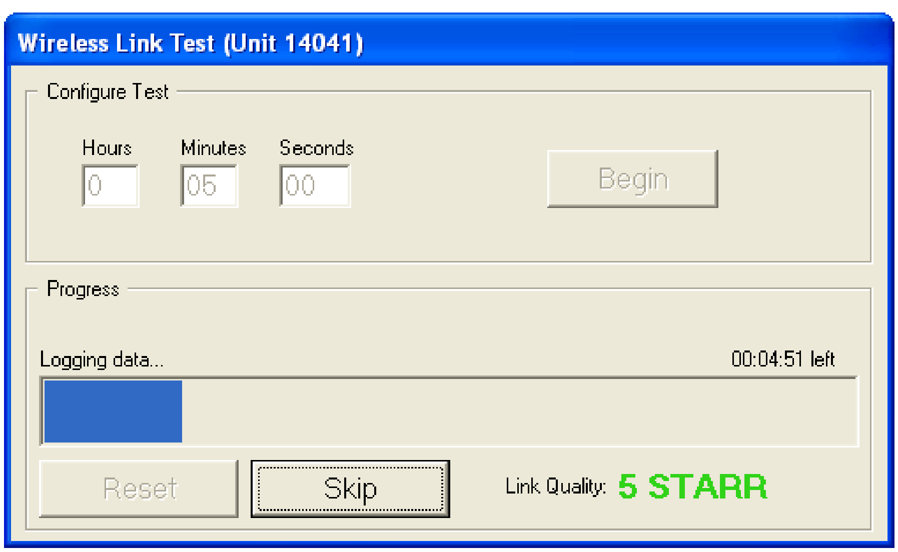


Figure 3-6 Wireless Data Loss Test

In the top of the window, you can configure the test to run for a specified amount of time. The longer the test, the more data the test will have to do an evaluation. Type the length of time that you want to run the test and click Begin to start. Once the test starts, WIM will reconfigure the Field Unit's Transmit Rate to the fastest possible for the selected Baud Rate. These rates are listed in Section 5.2. After the test has completed, it will restore the previously configured Transmit Rate.

During the test, the communications reliability is evaluated while the Field Unit is running under normal operating conditions. As the test runs, link strength is shown in the lower right hand corner of the window. 5 STARR indicates the strongest link, while 1 STARR indicates the weakest link. The Link Test continues to be evaluated and the rating on the screen adjusts itself for the specified amount of time.

4 General Configuration

This section discusses general configuration of the Field Unit via the NEXT and ENTER buttons. The subsections are as follows:

4.1 Navigating User Menus
4.2 Field Unit Displayed Messages
4.3 Overall Configuration Menu Map
4.4 Setting the Field Unit Tag Name
4.5 Setting a User Password
4.6 Resetting All Field Unit Settings

4.1 Navigating User Menus

Pressing either the NEXT or ENTER buttons located on the front of the Field Unit or Base Radio just below the LCD screen is all that is needed to navigate the respective menus. Pressing both of these buttons simultaneously for one second will turn the unit on.

Pressing the NEXT button at any time while the Field Unit is cycling through the normal messages causes the Field Unit to enter the setup mode. The NEXT button is then used to step through menu options, and the ENTER button is used to enter a sub menu of what is displayed on the LCD at that time. If no button is pressed within a 30-second period, the unit goes back to the normal display mode.

If you enter a sub menu that requires a numerical input, such as 001, the leftmost zero will be blinking. This indicates that pressing the NEXT button will increment this value with each press from 0 to 9. Pressing the NEXT button when the value is at 9 causes it to reset back to 0. Pressing the ENTER button will move to the next available value. If the last value is blinking, pressing ENTER will save the entered values and return from the sub menu.

If both the NEXT and ENTER buttons are depressed at the same time while the unit is turned on, a message on the LCD displaying OFF? will appear. If both buttons are released upon appearance of this message, you will be returned to the scrolling main screen. If both buttons are not released for the duration of the OFF? message, you will be prompted for the password. Upon entering the correct password, the unit will power down and turn off.

Note *If the unit is turned off while entering values in a sub menu, those values will NOT be saved.*

Note *There are several menu options that will automatically turn off if you are using WIM. All changes to these Field Unit menu options should then be made through WIM instead. This is to prevent simultaneous changes from taking place. If you wish to discontinue use of the software and want these menus re-instated, you must contact your Adaptive Wireless Solutions Sales Representative.*

4.2 Field Unit Displayed Messages

To turn the Field Unit on, press and hold both the NEXT and ENTER buttons simultaneously for a few seconds. Upon power up, the Field Unit will display the Power-

Up Sequence, and then go into the Operations Sequence. These sequences are shown in Figure 4-1.

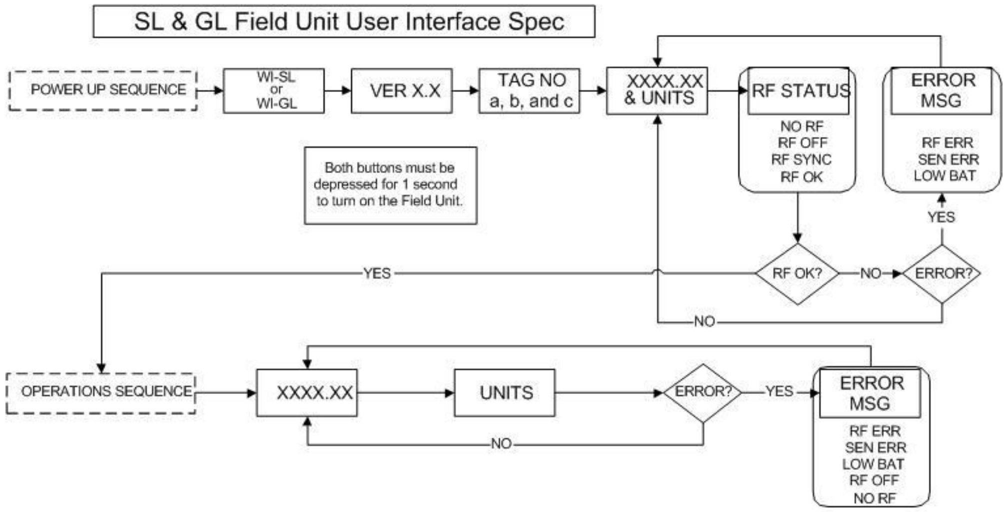


Figure 4-1 Field Unit Power-Up and Operations LCD Sequences

Note *During configuration and testing, keep Field Units at least six feet from the Base Radio and other Field Units.*

4.2.1 The Read-Only Sequence

Once the Field Unit is in the Operations Sequence, you may access the Read-Only Sequence without a password by simply pressing the ENTER button at any time. The Read-Only Sequence, as shown in Figure 4-2, displays extra information about the current settings of the Field Unit that is not seen during the Operations Sequence, but does not allow any changes to be made to these settings.

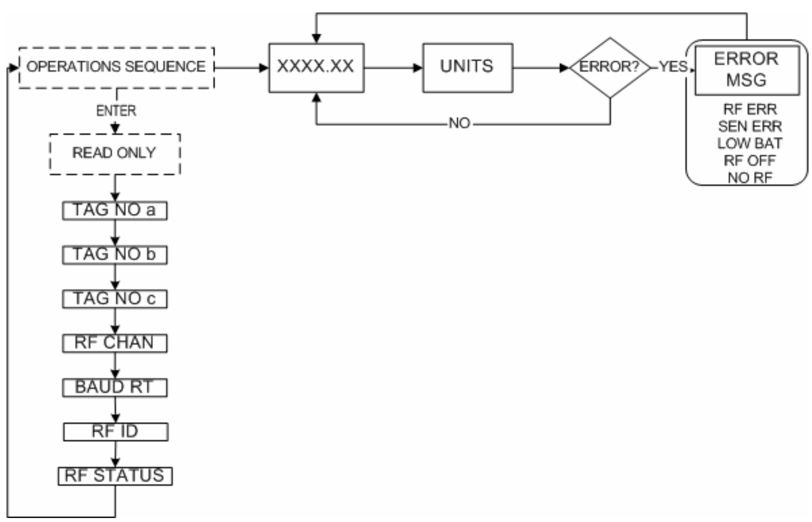


Figure 4-2 The Read-Only Sequence

4.3 Overall Configuration Menu Map

A complete Field Unit Menu Map is shown in Appendix C. Below is an overall view of the configuration menu to aid you in setting up the Field Unit for proper operation.

Figure 4-3 Overall Configuration Menu Map

Note *You must enter a four-digit password to enter the CONFIG and DIAGNSE menus. The FACTORY menu is for factory use only. The default user password is 0000. For more information about the password, see Section 4.5.*

4.4 Setting the Field Unit Tag Name

Note *Once WIM has been used to configure the Field Unit, this menu option will be disabled on the Field Unit LCD menu. See Section 4.1 for more details.*

Each Field Unit has a user-settable Field Unit Tag Name. This Tag Name is displayed upon Field Unit power up, and when the Read-Only Sequence is selected. The Tag Name is a 21-character string that is displayed in three separate 7-character flashes on the Field Unit LCD.

You may choose from A-Z, 0-9, a dash (“-“), and an underscore (“_”). The underscore has a special meaning to the software inside the Field Unit. For example, if you have a Tag Name that is only five characters long, then you may not want to wait for the remaining 16 characters to be displayed on the LCD. So if your Tag Name was “TANK1”, you would want to enter the Tag Name like this: “TANK1_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _”.

The Tag Name can also be entered via WIM. To do so, when the software is in the Field Unit view (See Appendix A), right-click the Field Unit icon, select **Rename**, and then enter the Tag Name you wish the Field Unit to have.

This Tag Name will then be uploaded to the Field Unit and can be displayed by pressing the ENTER button when the unit is in the Operations Sequence (See Section 4.2.1 of this manual).

4.5 Setting a User Password

Note *Once WIM has been used to configure the Field Unit, this menu option will be disabled on the Field Unit LCD menu. See Section 4.1 for more details.*

Each Field Unit has a password that will lock out undesired users from making changes to the Field Unit. Any user may still view some of the Field Unit settings by pressing the ENTER key during the Operations Sequence and viewing the Read-Only Sequence.

The password consists of four digits. The factory default is 0000. If you wish to select a different password, one may be entered via WIM. To do so, enter the configuration dialog box (See Appendix A). From the configuration dialog box, click on the **General** tab to bring up the general information as shown in Figure 4-4.

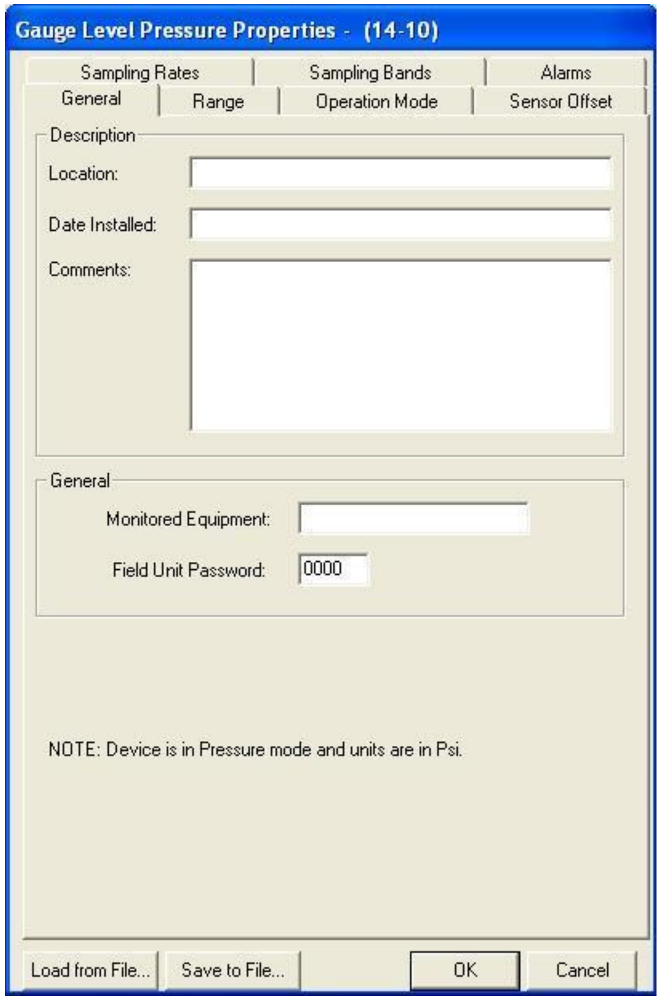


Figure 4-4 Setting a User Password

You can set the Field Unit password for this device by entering a four-digit number in the **Field Unit Password** field. Once a password is entered, click **OK** to save and download the password to the Field Unit.

Please note that the password only protects the Field Unit from unauthorized configuration via the NEXT and ENTER buttons. WIM requires a user login password to gain access to all configuration parameters. However, user accounts are available and can be set with different access levels and restrictions (For more information on user accounts see the WIM User Manual Section 8.4).

4.6 Resetting All Field Unit Settings

To reset all Field Unit settings to their default state, you must navigate to the DEFAULT menu option in the CONFIG menu via the keypad.

Note *Once at the default menu option, pressing the ENTER button will display 'RESET?' on the LCD, which asks you to confirm the reset operation. You will then be prompted with 'NO' on the LCD. Pressing the ENTER button while 'NO' is being displayed will NOT reset the device. Pressing the NEXT button will display 'YES' on the LCD. If you press the ENTER button while 'YES' is being displayed, the device will be reset.*

Note *Resetting the Field Unit by using the DEFAULT menu option will not reset the TRIM or OFFSET values.*

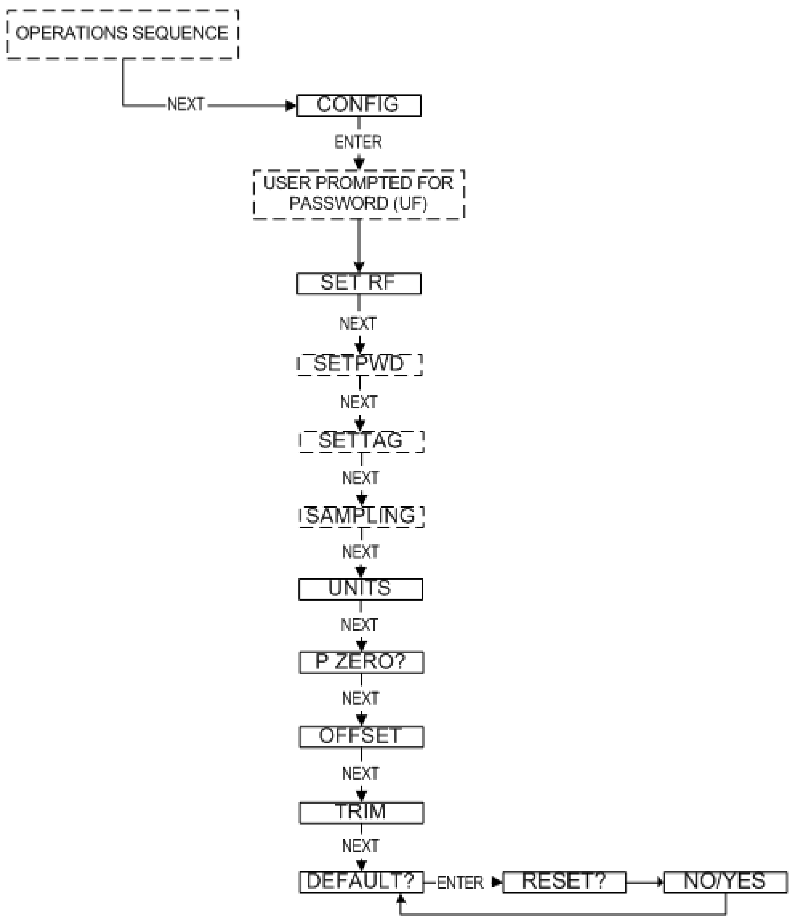


Figure 4-5 Menu Map to Reset All Field Unit Settings

5 Configuring the RF Communications

In order for the Field Unit and the Base Radio to communicate, they must be on the same RF Channel and must be transmitting at the same Baud Rate. While all Field Units and Base Radios are set to default configurations at the factory, if any configuration differences are present, the Base Radio will not be able to communicate with the Field Units. The subsections are as follows:

5.1 RF Channel Selection
5.2 RF Baud Rate Selection
5.3 RF Identification (RF ID) Selection

Warning: If the Field Units have been running for an extended period of time with no signal from the Base Radio (the Base Radio is off or not present), the Field Units will only search for the Base Radio every one hour or so. Turning the Field Units off and back on will cause them to begin searching immediately.

5.1 RF Channel Selection

The RF Channel defines a set of frequencies on which communication takes place between the Base Radio and the Field Unit. Each RF Channel has a different set of frequencies, thus allowing you to have multiple different wireless networks co-existing throughout the same facility.

All Base Radios and Field Units can be set to one of 16 different RF channels. The only Field Units recognized by a particular Base Radio are the units that are on the same RF Channel as that Base Radio. This allows you to decide which Field Units communicate with each Base Radio.

The RF Channel idea is analogous to a set of walkie-talkies. If both walkie-talkies are on channel one, they can communicate. If a walkie-talkie is on channel one and the other is on channel two, they cannot communicate. Likewise, if two walkie-talkies are on channel one, and two other walkie-talkies are on channel two, the walkie-talkies on channel one cannot hear what is being transmitted by the walkie-talkies on channel two.

Each Field Unit comes from the factory with the RF Channel set to OFF. This means the Field Unit will not communicate with any Base Radio. To set the Field Unit for communication, first determine the channel that you want to use. Then follow the Field Unit menu map shown in Figure 5-1 to configure the RF Channel.

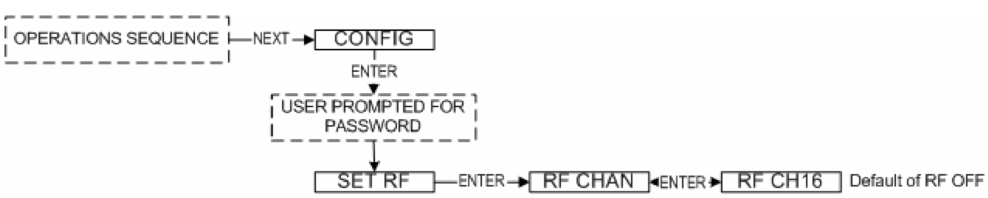


Figure 5-1 Menu Map to RF Channel Setting

Once in the RF Channel menu, increment it by pressing the NEXT button. When selecting this value, do not choose an RF Channel that is currently being used by other AWS Wireless Systems as this can cause communication problems.

5.2 RF Baud Rate Selection

The RF Baud Rate refers to the speed at which the Base Radio and Field Units communicate. The RF baud rate for the Base Radio and the Field Unit must be the same in order for them to communicate successfully. There are three selectable settings with the fastest update times and ranges listed below:

- 4.8K — Rate of 4.8K baud (Update every 20 seconds)
  — Range of 3000ft (Line of Sight)
- 19.2K — Rate of 19.2K baud (Update every 5 seconds)
  — Range of 2000ft to 2500ft (Line of Sight)
- 76.8K — Rate of 76.8K baud (Update every 1 second)
  — Range of 500ft to 750ft (Line of Sight)

A faster RF Baud Rate allows you to transmit more information in a given period of time, but it will also limit the Field Unit's range. If you need more distance out of your Field Units or are encountering difficulties by frequently losing communications, then select a slower baud rate.

Follow the Base Radio menu map shown in Figure 5-2 to configure the RF Baud Rate. The factory default is the 19.2K Baud Rate.

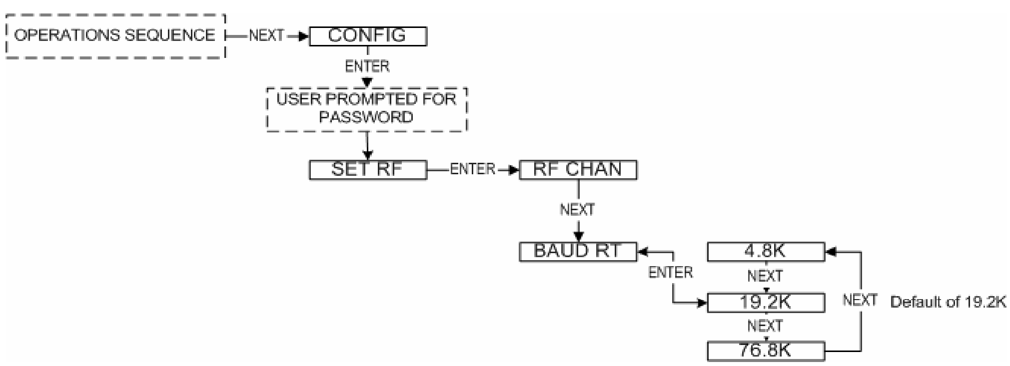


Figure 5-2 Menu Map to Baud Rate Setting

Note *If you change the baud rate of a Field Unit, you must also change the baud rate of the Base Radio and all other Field Units that are communicating with that Base Radio.*

5.3 RF Identification (RF ID) Selection

Each Field Unit is identified by the Base Radio and WIM according to the RF ID given to that particular unit. Two Field Units on the same RF Channel CANNOT have the same RF ID (if you do not know the RF Channel, see section 5.1). When the Field Unit is in the Operations Sequence, pressing the ENTER button displays the Read-Only Sequence on the LCD. The RF of that unit will be displayed in the format: ID 3.

All Field Units in your system are set to a default RF ID number upon shipment. For example, if you have ordered a Base Radio and three Field Units, the Field Units will be configured to ID's 0, 0, and 0. You must set these units to three different RF IDs between 1 and 100. The Field Units in this example could be set to RF IDs 1, 2, and 3.

First determine the RF ID's you'd like to give each unit. Then follow the menu map shown in Figure 5-3 to configure the RF ID. The factory default is RF ID 0, which disables the RF communication of the unit.

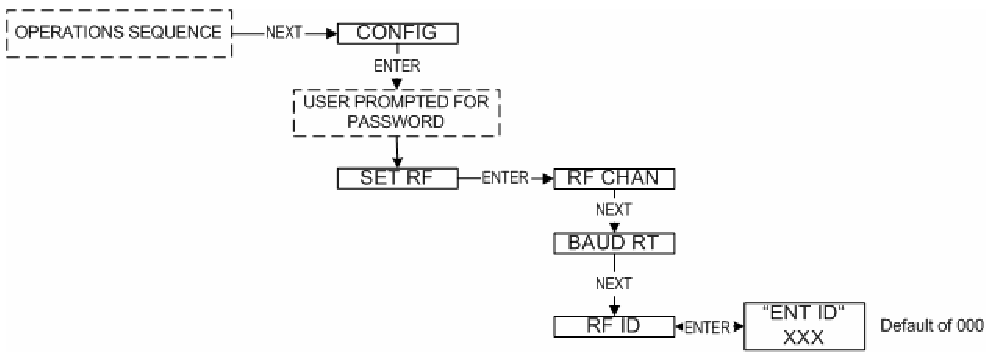


Figure 5-3 Menu Map to RF ID Setting

Once you have selected the RF ID you wish to use for this particular Field Unit, exit the menus and return to the Operations Sequence.

The Field Unit should now be successfully configured to the Base Radio. To check this, press ENTER while the Field Unit is in the Operations Sequence for the Read-Only Sequence to be displayed. You may see an RF SYNC message displayed on the Field Unit LCD. This means that the Field Unit and Base Radio are attempting to synchronize communications. If this is successful, the RF Status will display an RF OK message. If this is unsuccessful, the RF Status will display a NO RF message.

Also notice the two small arrows on either side of the LCD; if they are fluctuating up and down, that indicates the Field Unit and Base Radio are successfully communicating. If only one or none of the arrows are moving, then they are not communicating successfully.

6 Configuring the Sampling and Transmission Rates

The Level Field Units are very versatile with many programmable features and can be used in numerous different applications. Because no two applications are the same, some configuration is required for each unit. This section will walk you through the initial configuration of the Sample and Transmit settings. Each section includes instructions for configuring the rates from the Field Unit and with WIM. The subsections are as follows:

6.1 Selecting the Normal Transmission Rate
6.2 Selecting the Normal Sampling Rate
6.3 Selecting the Abnormal Transmission Rate
6.4 Selecting the Abnormal Sampling Rate
6.5 Setting the Smart Rate Threshold
6.6 Selecting the Normal Upper and Lower Values

6.1 Selecting the Normal Transmission Rate

The **Normal Transmission Rate** is the interval in which the Field Unit transmits data to the Base Radio. The Field Unit is in a “sleep” mode to save power during the operations sequence. This mode turns off most of the electronics on the unit, with the exception of the LCD, in order to preserve battery life. The Field Unit will then ‘wake up’ every **Normal Sampling Period** and take the necessary process value readings. The Field Unit will then transmit these readings to the Base Radio on an interval determined by the **Normal Transmission Rate.**

Notice that the fastest update rate of the **Normal Transmission Rate** is dependent on the baud rate setting you selected earlier (see Section 5.2). The transmission rates cannot update data faster than their communication speed allows. Thus, if you selected the 19.2K Baud Rate setting, your fastest transmission rate will be five seconds. The Field Unit automatically determines these settings and adjusts the menu options accordingly. A complete table of these parameters is shown in Section 6.2.

In order to properly set the **Normal Transmission Rate**, you must first determine how often you need updates from the Field Unit. You have a selectable range of 1-5, 10, 15, 20, 40 seconds, and 1 minute. The factory default is 10 seconds.

If all of the data does not get through, the data is resent the following second. This prevents data from being lost. However, if the Transmission Rate is set to the maximum (one second; 76.8K baud), then the data cannot be resent the following second because the next set of data must be sent in order to meet the Transmission Rate.

6.1.1 Configure the Normal Transmission Rate from the Field Unit

To configure the normal transmission rate, follow the menu map below.

***Note** Once WIM has been used to configure the Field Unit, this menu option will be disabled on the Field Unit LCD Menu.*

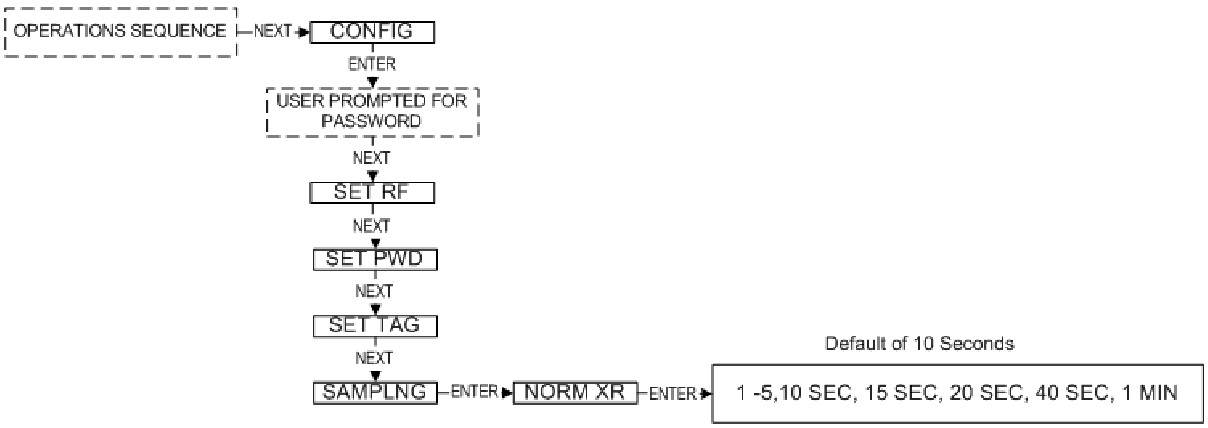


Figure 6-1 Menu Map to Normal Transmission Rate Setting

6.1.2 Configure the Normal Transmission Rate Using WIM

1. Open the configuration dialog box (See Appendix A).

2. In the configuration dialog box, click the **Sampling Rates** tab to display the sampling rate information as shown below.

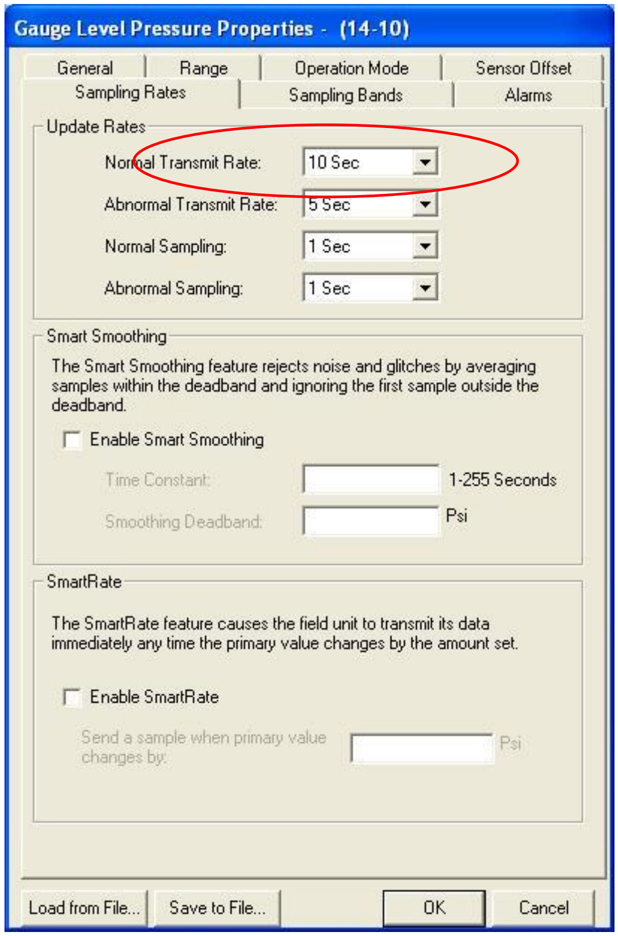


Figure 6-2 Sampling Rates Tab

3. Select one of the time periods from the Normal Transmit Rate drop-down list box.

4. Click **OK** to save and download the configuration changes to the Field Unit.

6.2 Selecting the Normal Sampling Rate

The **Normal Sampling Rate** is the interval in which the Field Unit reads the monitored process value. As previously mentioned, the Field Unit is in “sleep” mode to save power during the operations sequence. This mode turns off most of the electronics on the unit (with the exception of the LCD) in order to preserve battery life. The Field Unit will then ‘wake up’ for every **Normal Sampling Period** and take the necessary process value readings.

Notice that the minimum speed of the Normal Sampling Rate depends on the Normal Transmission Rate setting selected (see Section 6.1). The Sampling Rate cannot be slower than the **Normal Sampling Rate**. Thus, if you selected the Normal Transmit Rate setting to be 10 Seconds, the Normal Sampling Rate must be set to 10 Seconds or faster. A complete table of these parameters is shown below.

Baud Rate	76.8K	19.2K	4.8K
(communication range)	500-750 feet	2000-2500 feet	3000 feet
(speed of updates)	1 Second	5 Seconds	20 Seconds
Normal and Abnormal Transmit Rates	1 Second or Greater	5 Seconds or Greater	20 Seconds or Greater
Normal and Abnormal Sampling Rates	Equal to Transmit Rate or Less	Equal to Transmit Rate or Less	Equal to Transmit Rate or Less

In order to properly set the **Normal Sampling Rate,** determine how often updates are needed from the Field Unit when the process being monitored is operating under normal conditions. The Field Unit has a selectable range of 1-5, 10, 15, 20, 30, and 60 seconds depending on the **Normal Transmission Rate**. The factory default is one second. However, the more frequently the Field Unit wakes up to check the monitored device, the less battery life you can expect from the Field Unit.

Figure 6-3 is an example of what happens when the Normal Sampling Rate is too slow for the process being monitored. Notice how the rise in the voltage level falls between two normal samples, and thus goes completely undetected.

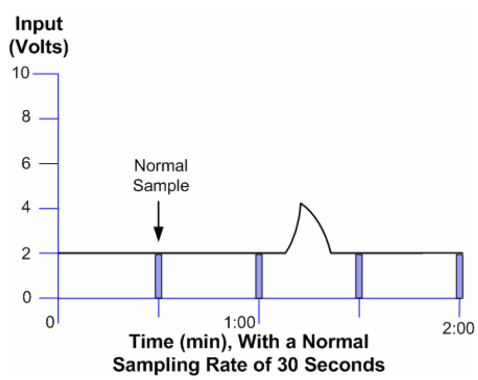


Figure 6-3 Incorrect Sampling Rate

Figure 6-4 is an example of what happens when the **Normal Sampling Rate** is correctly set for the device that is being monitored. Notice how this setting makes it possible to sample the rise in the voltage level.

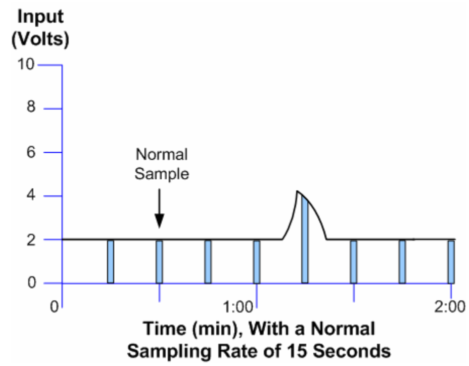


Figure 6-4 Correct Sampling Rate

Once you have decided on the proper **Normal Sampling Rate,** select this setting from the Field Unit or through WIM.

6.2.1 Configure the Normal Sampling Rate from the Field Unit

To configure the normal sampling rate from the field unit, follow the menu map below.

Note *Once the WIM has been used to configure the Field Unit, this menu option will be disabled on the Field Unit LCD Menu.*

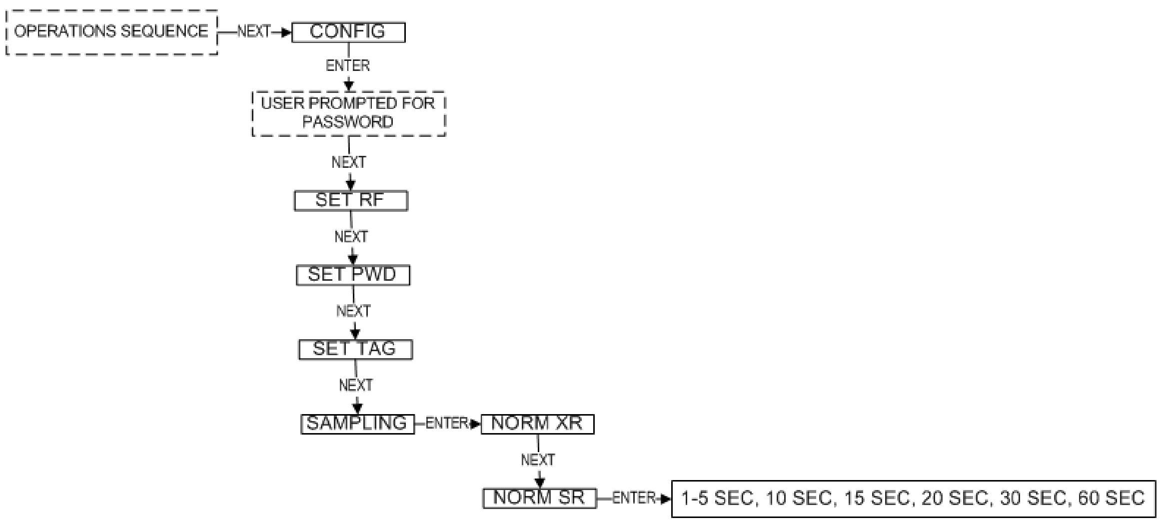


Figure 6-5 Menu Map to Normal Sampling Rate Setting

6.2.2 Configure the Normal Sampling Rate with WIM

1. Open the configuration dialog box (See Appendix A).

2. In the configuration dialog box, click the **Sampling Rates** tab to display the sampling rate information as shown below.

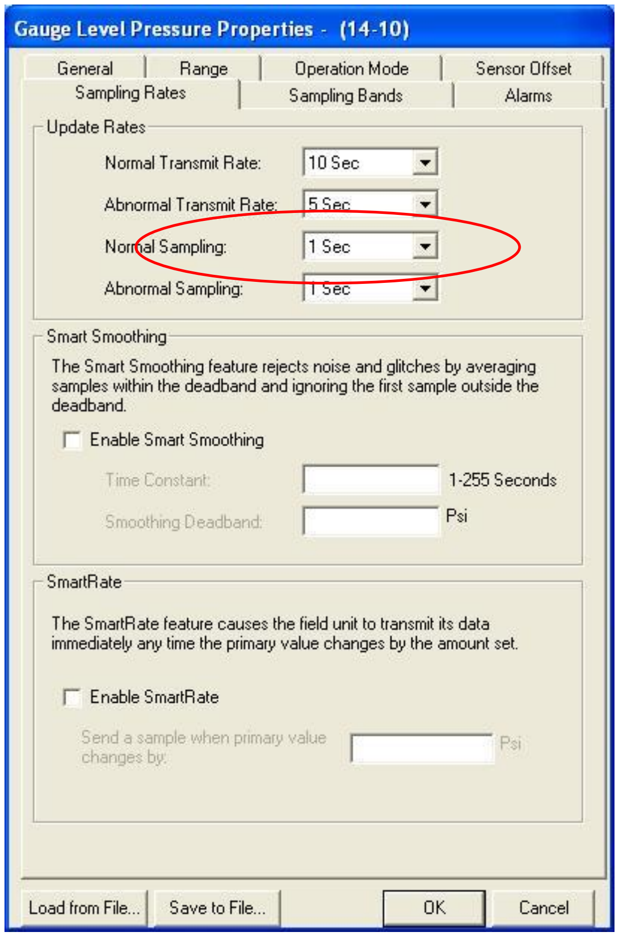


Figure 6-6 Sampling Rates Tab

3. Select one of the time periods from the Normal Sampling drop-down list box.

4. Click **OK** to save and download the configuration changes to the Field Unit.

6.3 Selecting the Abnormal Transmission Rate

Note *If the device is not configured to check for abnormal process conditions using the Sampling Bands (section 6.6.2), the* ***Abnormal Transmission Rate*** *is not used and this section can be ignored.*

The **Abnormal Transmission Rate** is identical to the Normal Transmission Rate with one exception. The **Abnormal Transmission Rate** only applies while the Field Unit is in an abnormal condition (see Section 6.6 Selecting the Normal Upper and Lower Values). This allows an increase or decrease in the frequency of information you receive depending on the operating conditions of the process being monitored.

In order to properly set the **Abnormal Transmission Rate**, determine how often updates are needed from the Field Unit when the process being monitored is operating under normal conditions. The Field Unit has a selectable range of 1-5, 10, 15, 20, 40 seconds, and 1 minute. Figure 6-7 is an example of how the device switches transmission rates from Normal Transmission Rate to **Abnormal Transmission Rate**. Note how the first abnormal transmission is sent immediately when the Normal Upper Value set point is exceeded. The next transmission will then follow this immediate transmission by 10 seconds (or whatever the Abnormal Transmission Rate is set to). The transmissions will continue at this interval until the process value drops below the Normal Upper Value set point.

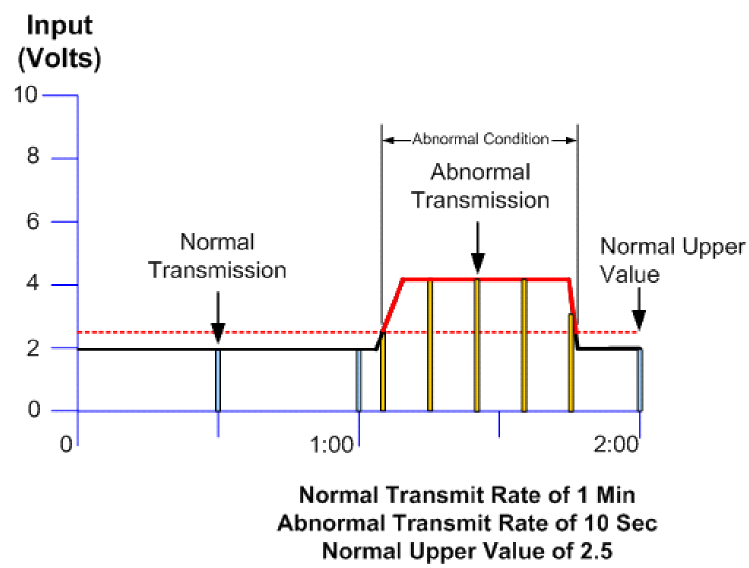


Figure 6-7 Example of Abnormal Transmission Rate Setting

Once the process value drops below this set point, another transmission is sent to the Base Radio. The transmissions will then be sent at the Normal Transmission Rate of one minute (the current setting for the Normal Transmission Rate) from the time of the last abnormal transmission.

You should also note that the transmission time depends on the sampling rate, and when the process value is sampled. If the Normal Sampling Rate is 30 seconds, then the process value may be above the Normal Upper Value for up to 29 seconds before an abnormal condition is detected. This means that the transmission could be as late as 29 seconds after the process value exceeded the Normal Upper Value.

Once you have decided the proper time for the **Abnormal Transmission Rate**, select this setting from the Field Unit or through WIM.

6.3.1 Configure the Abnormal Transmission Rate from the Field Unit

To configure the abnormal transmission rate from the field unit, follow the menu map below.

Note *Once WIM has been used to configure the Field Unit, this menu option will be disabled on the Field Unit LCD menu. See Section 4.1 for more details.*

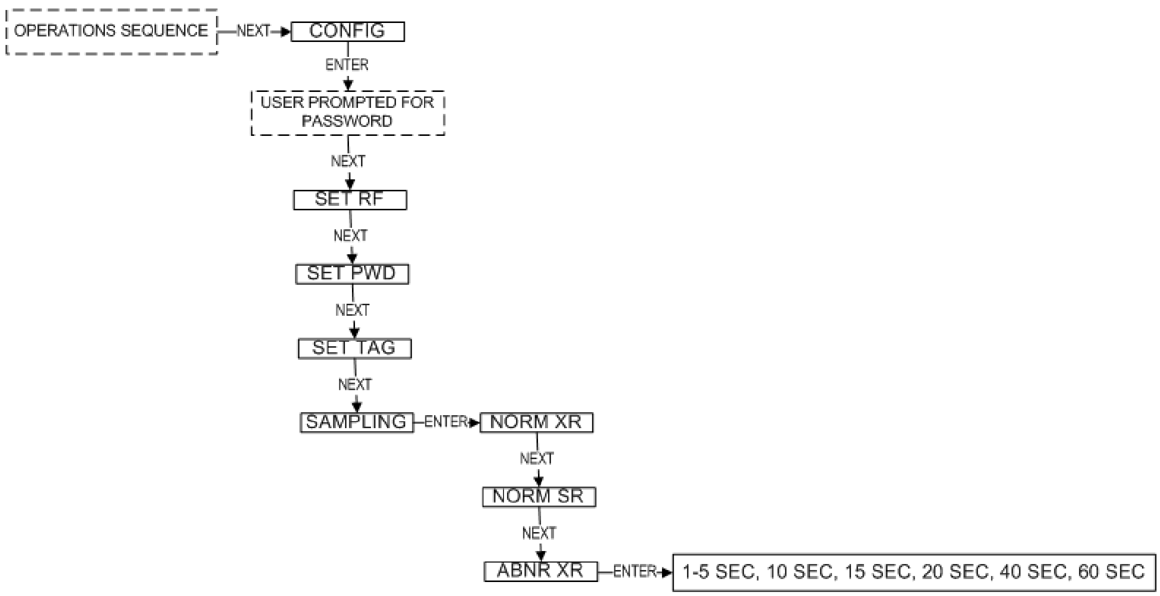


Figure 6-8 Menu Map to Abnormal Transmission Rate Setting

6.3.2 Configure the Abnormal Transmission Rate Using WIM

1. Open the configuration dialog box (See Appendix A).

2. In the configuration dialog box, click the **Sampling Rates** tab to display the sampling rate information as shown below.

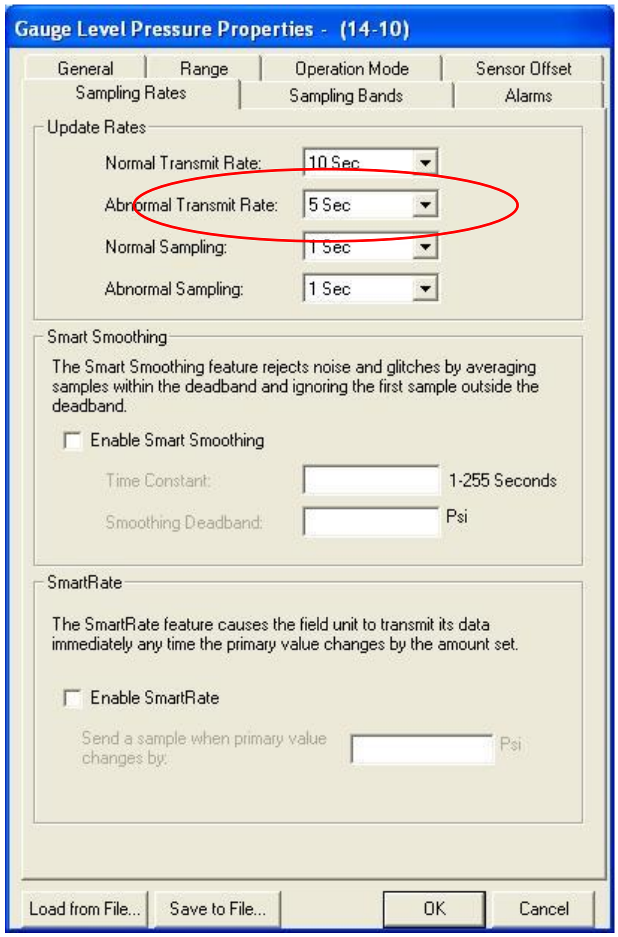


Figure 6-9 Sampling Rates Tab

3. Select one of the time periods from the Abnormal Transmit Rate drop-down list box.

4. Click **OK** to save and download the configuration changes to the Field Unit.

6.4 Selecting the Abnormal Sampling Rate

***Note** If the device is not configured to check for abnormal process conditions using the Sampling Bands (section 6.6.2), the Abnormal Sampling rate is not used and this section can be ignored.*

The **Abnormal Sampling Rate** is identical to the Normal Sampling Rate with one exception. The Abnormal Sampling Rate only applies while the Field Unit is in an abnormal condition (see 6.6 Selecting the Normal Upper and Lower Values). This allows an increase or decrease of the frequency of information you receive depending on the operating conditions of the process being monitored.

In order to properly set the **Abnormal Sampling Rate**, determine how often updates are needed from the Field Unit when the process being monitored is operating under normal conditions. The Field Unit has a selectable range of 1-5, 10, 15, 20, 40 seconds. and 1 minute. Figure 6-10 is an example of how the device switches sampling methods from Normal Sampling Rates to **Abnormal Sampling Rates**. Note how the first abnormal sample is taken a few seconds after the Normal Upper Value set point is exceeded. The next sample will then follow this sample by five seconds (or whatever the Abnormal Sampling Rate is set to). These samples will continue at this interval until the process value drops below the Normal Upper Value set point.

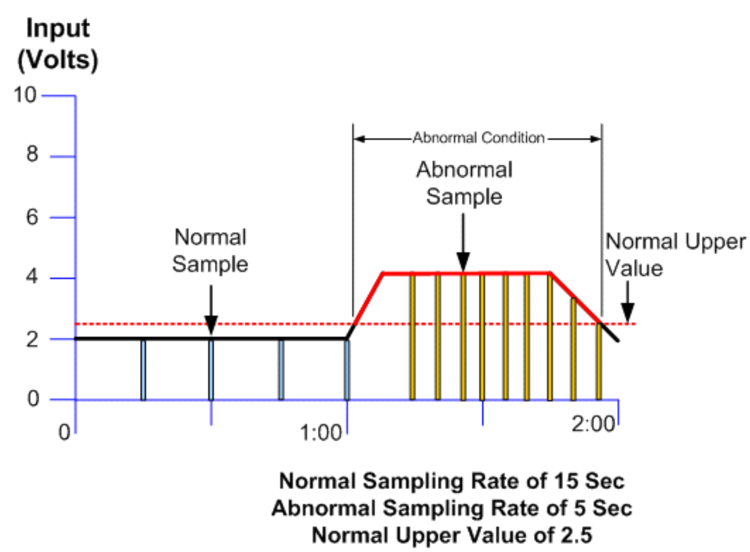


Figure 6-10 Example of Abnormal Sampling Rate Setting

Once the process value drops below this set point, the sampling rate will return to the **Normal Sampling Rate**. Also, the Abnormal Sampling must be equal to or faster than the Abnormal Transmission Rate.

You should also note that the transmission time depends on the sample rate, and when the process variable is sampled. If the Normal Sampling Rate is 30 seconds, then the process variable may be above the Normal Upper Value for up to 29 seconds before abnormal condition is detected. This means that the transmission could be as late as 29 seconds after the process variable exceeded the Normal Upper Value.

Once you have decided the proper time for the **Abnormal Sampling Rate**, select this setting from the Field Unit or through WIM.

6.4.1 Configure the Abnormal Sampling Rate from the Field Unit

To configure the abnormal sampling rate from the field unit, follow the menu map below.

***Note** Once WIM has been used to configure the Field Unit, this menu option will be disabled on the Field Unit LCD Menu.*

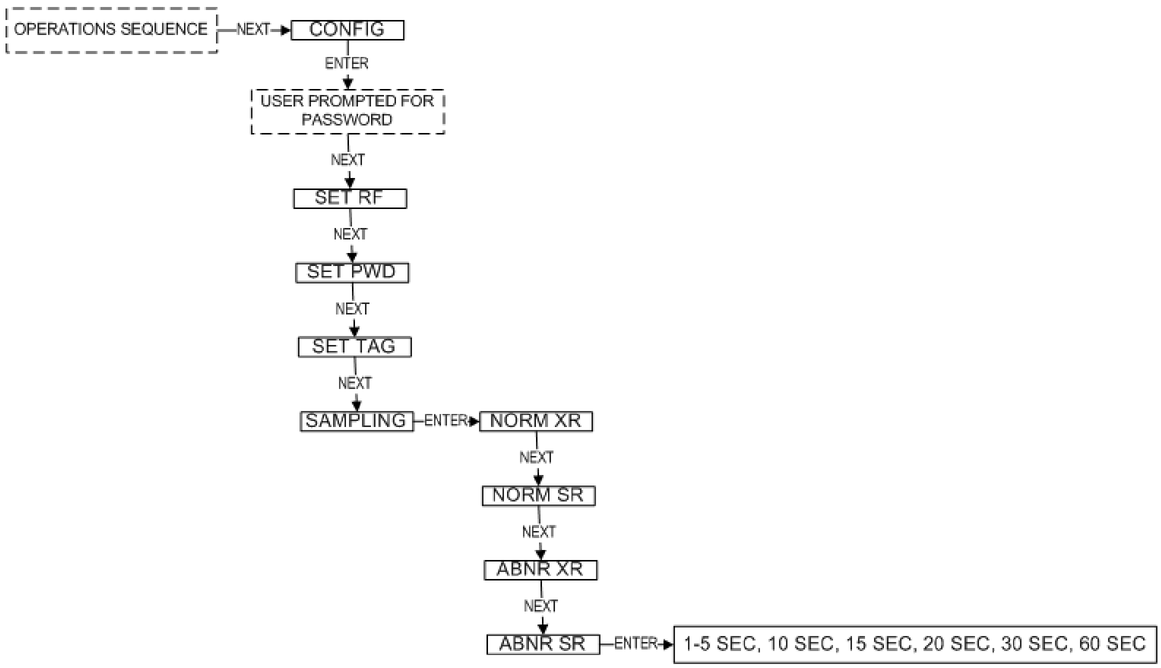


Figure 6-11 Menu Map to Abnormal Sampling Rate Setting

6.4.2 Configure the Abnormal Sampling Rate Using WIM

1. Open the configuration dialog box (See Appendix A).

2. In the configuration dialog box, click the **Sampling Rates** tab to display the sampling rate information as shown below.

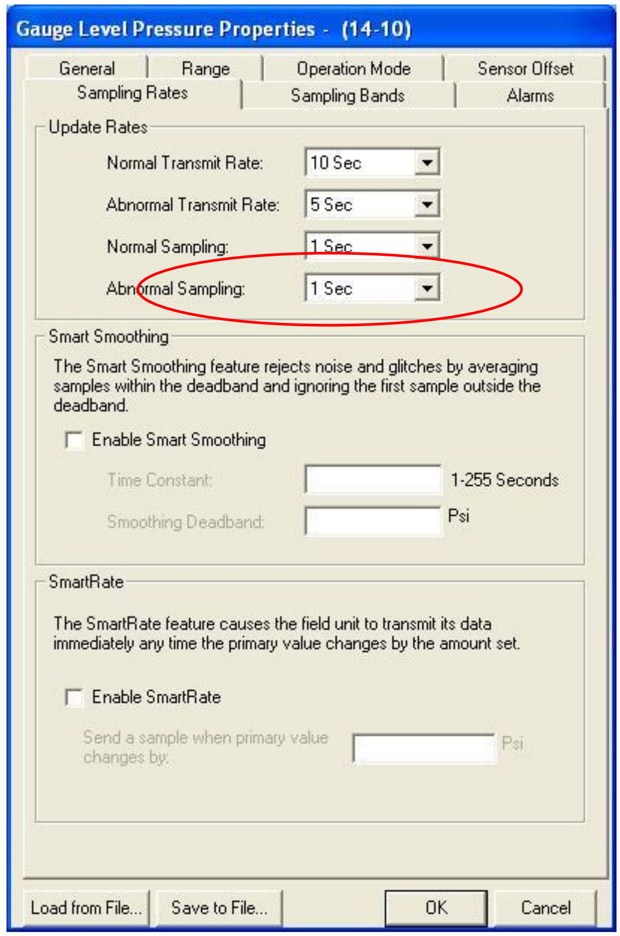


Figure 6-12 Sampling Rates Tab

3. Select one of the time periods from the Abnormal Sampling drop-down list box.

4. Click **OK** to save and download the configuration changes to the Field Unit.

6.5 Setting the Smart Rate Threshold

The Smart Rate is a feature used to trigger radio transmission of the measured data sooner than the normal or abnormal rate that you specify. This feature is used to construct a more accurate graph of the measured process value vs. time than is possible with the fixed transmission rates, while using less battery power.

If the process value changes by more than the entered Smart Rate amount within the normal or abnormal sampling rate (whichever is active), then the process variable is transmitted immediately. The normal/abnormal transmit clock is then reset upon this transmission. If the Smart Rate amount is not exceeded in the next normal/abnormal sample, then the next transmission will be the normal/abnormal transmit rate period.

The amount entered is in the same units as you selected to be displayed on the Field Unit. If the measured process value does not change by more than the entered Smart Rate amount within the time between the sampling rates (whichever is active), then the process value is transmitted on the next transmit rate.

If changes in the process value, which exceed the Smart Rate Amount, continue to occur, the process value is transmitted repeatedly.

6.5.1 Configure the Smart Rate from the Field Unit

The Smart Rate cannot be configured on Level Field Units. The Smart Rate can only be enabled using WIM.

6.5.2 Configure the Smart Rate Using WIM

1. Open the configuration dialog box (See Appendix A).

2. Click on the **Sampling Rates** tab to display the sampling rate information as shown below.

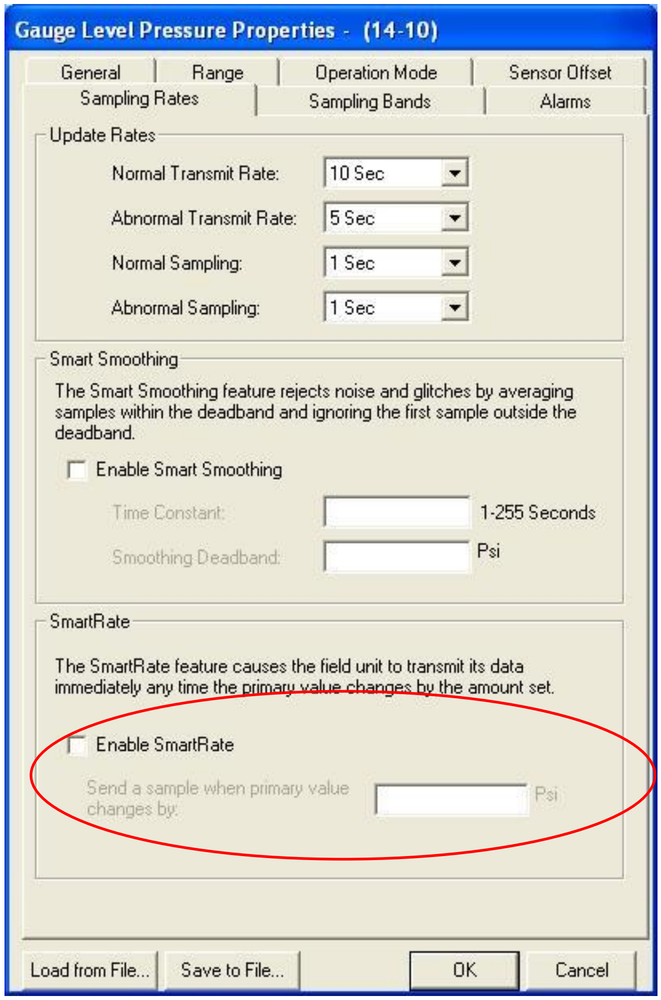


Figure 6-13 Smart Rate Configuration Using WIM

3. Select the Enable SmartRate check box.

4. Enter the amount the process value needs to change, in order to trigger a transmission to be sent.

5. Click OK to save and download the configuration changes to the Field Unit.

6.6 Selecting the Normal Upper and Lower Values

Each Field Unit is equipped with an upper and lower value for the analog input level. As the analog input is measured, it is compared to a set threshold value. Depending upon the setting of that value, whether it is enabled or not, and what the Time Deadband is, the Field Unit will enter an Abnormal condition as seen in Figure 6-14.

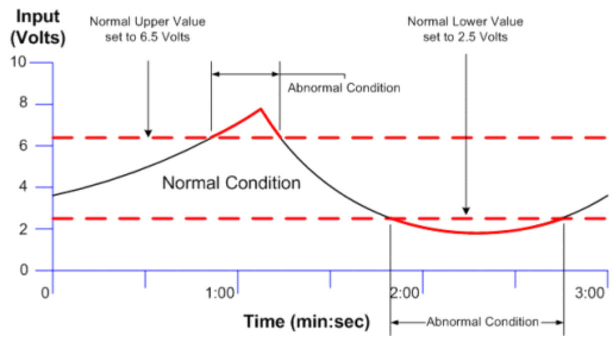


Figure 6-14 Normal Upper and Lower Value Example

The Normal Upper Value would be an indication that the analog input is 'high' and the Normal Lower Value would be an indication that analog input is 'low'. Thus, the normal operating condition for the analog input application would be found in between the two Normal Values.

The Time Deadband refers to the number of seconds that the measured reading must stay in a certain condition before the Field Unit will actually switch to that condition. To select a proper Time Deadband, consider the example in Figure 6-15.

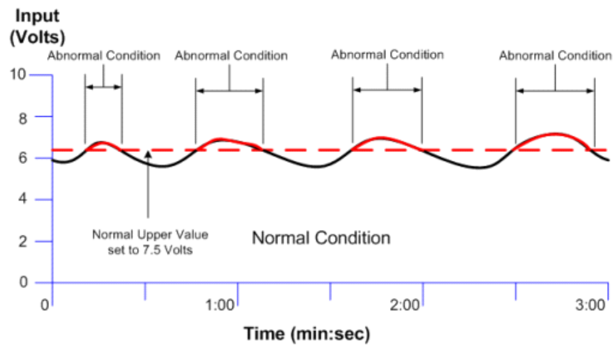


Figure 6-15 Condition "Chatter" Without Time Deadband

Notice that the Field Unit continues to cycle from Normal to Abnormal Conditions due to the fact that the input value is fluctuating around the 7.5 Volt Normal Upper Value. This is undesired. Adding a delay of several seconds before the Field Unit switches conditions eliminates this “chatter”, as seen in Figure 6-16.

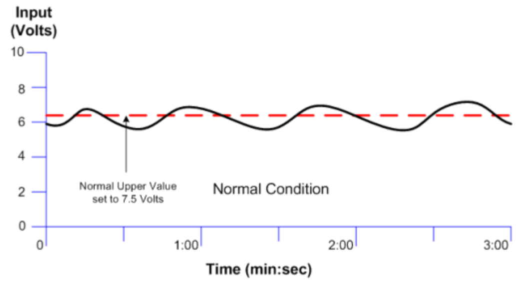


Figure 6-16 Condition “Chatter” Elimination Due to Time Deadband

6.6.1 Configure the Upper and Lower Limits from the Field Unit

The Upper and Lower Limits cannot be configured on Level Field Units. The Upper and Lower Limits can only be enabled using WIM.

6.6.2 Configure the Upper and Lower Limits Using WIM

1. Open the configuration dialog box (See Appendix A).

2. Click the **Sampling Bands** tab to display the sampling bands information as shown below.

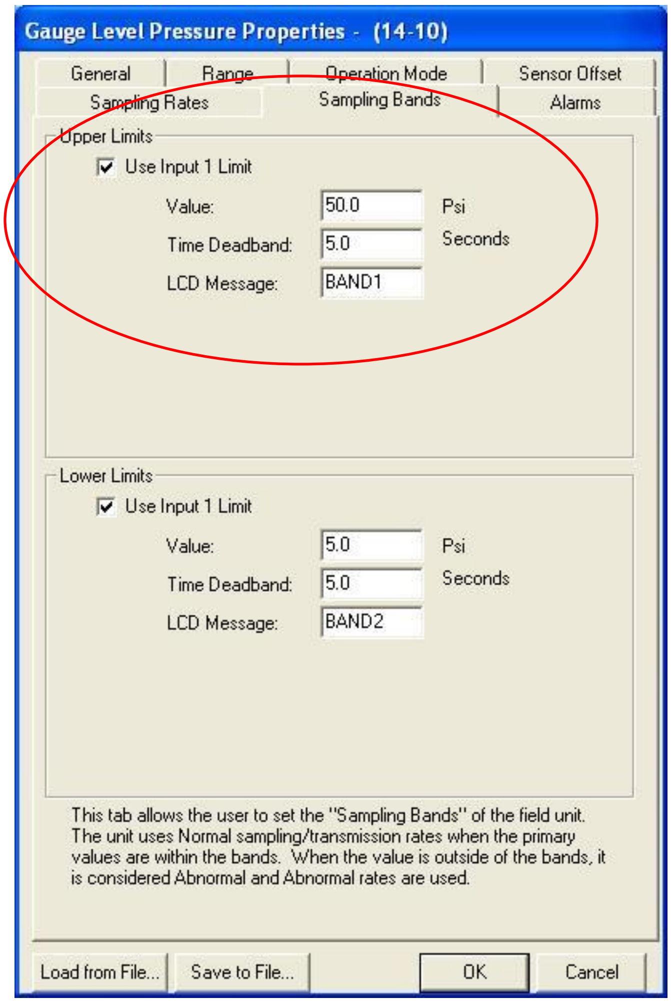


Figure 6-17 Normal Upper and Lower Value

3. Enable the Upper Limit by selecting the **Use Input 1 Limit** check box.

4. Enter the Value and Time Deadband for the limit.

5. Type a message in the **LCD Message** box to be displayed on the Field Unit when the value is beyond your set limit.

6. Repeat steps 3-5 for the Lower Limit.

7. Click **OK** to save and download the configuration changes to the Field Unit.

7 Configuring the Process Variable

This section helps you to select the engineering units and discusses the setting of a measurement offset and the trimming of the process measurement. The subsections are as follows:

7.1 Zeroing the Sensor
7.2 Setting a Measurement Offset
7.3 Trimming the Measurement
7.4 Entering a 22- Point Curve

7.1 Zeroing the Sensor

Zeroing the sensor can only be performed from the Field Unit. You will need to check the “position zero” (P ZERO) reading on the transmitter. The Level Field Unit is a sensitive device. Its elevation and its orientation in the field may be different from the orientation in the factory where it received its last configuration. To compensate for position changes, you may need to perform a sensor position adjustment once the unit is installed.

If you have a Field Unit pressure reading of “zero”, (that is, the Field Unit reading is within the specified accuracy of ±0.1% of the full scale value when zero pressure is applied), there is no need to zero the sensor. If your “zero” reading is outside of this value, you will need to execute the position zero adjustment.

When P ZERO is selected, the sensor is zeroed; however, the displayed value is calculated relative to the offset point. The unit will display an amount equal to the keypad-configured offset added to the WIM-configured level offset, if applicable. If the intent is to have the unit display “0,” the offsets must be zero before applying P ZERO.

For example, if 3 PSI of pressure is applied to a sensor, an offset of 5 PSI is entered into the keypad, and P ZERO is applied, the unit will display 5 PSI. If the pressure is then raised by 1 PSI to 4 PSI, the unit will display 6 PSI.

To set position zero, power on the unit and apply zero pressure. Be sure that the unit is installed in its final location or that it is oriented exactly as it will be in its final installation. Then follow the menu map shown in Figure 7-1.

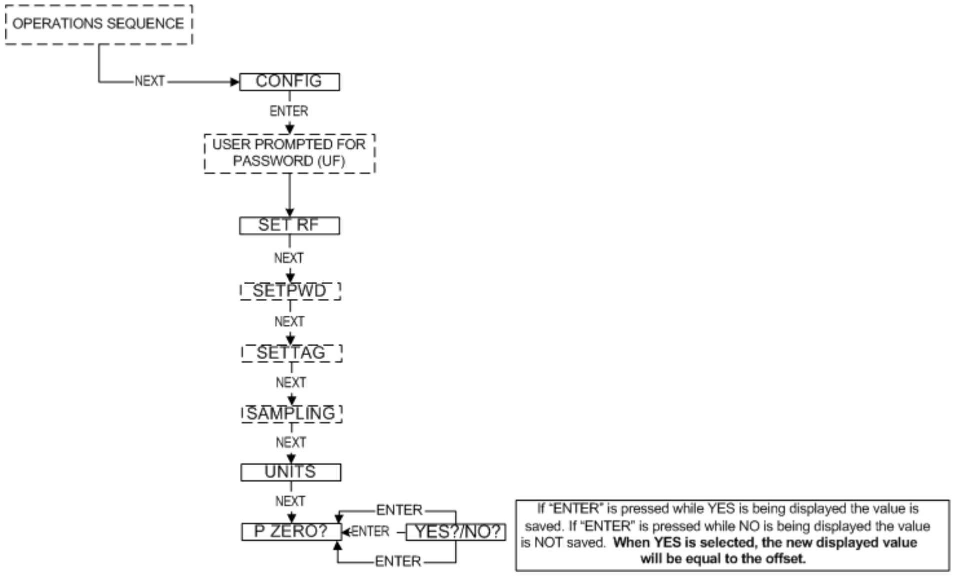


Figure 7-1 Menu Map to Pressure Zero Setting

7.2 Setting a Measurement Offset

For various applications, you may wish to display an offset value rather than the actual value. To enter an offset, navigate to the OFFSET command, as shown in Figure 7-2. Then enter the offset to be added or subtracted from the actual measured value.

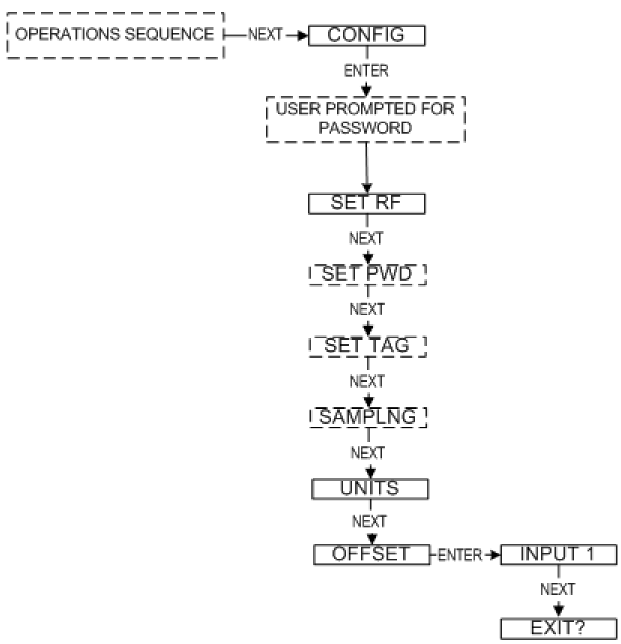


Figure 7-2 Menu Map to Offset Setting

7.3 Trimming the Measurement

The Field Unit interface allows you to set a two-point correction curve for the sensor. This process is often called “trimming” because the displayed value is trimmed up or down to reflect the actual value being applied.

To set a trim point, take the Field Unit offline, navigate to the TRIM menu as shown in Figure 7-3, select the input to be trimmed, and then select the point you wish to enter. After selecting the point, you will have the option to trim the device or reset the trim. If NEW TRIM is selected, you will be prompted to enter the lower point first. Type the value and press ENTER. The Field Unit will prompt you to apply the indicated process value to the Field Unit. Apply the process value and press ENTER. Repeat the process for the higher point. After both points have been trimmed, you can choose to save or discard the new trim.

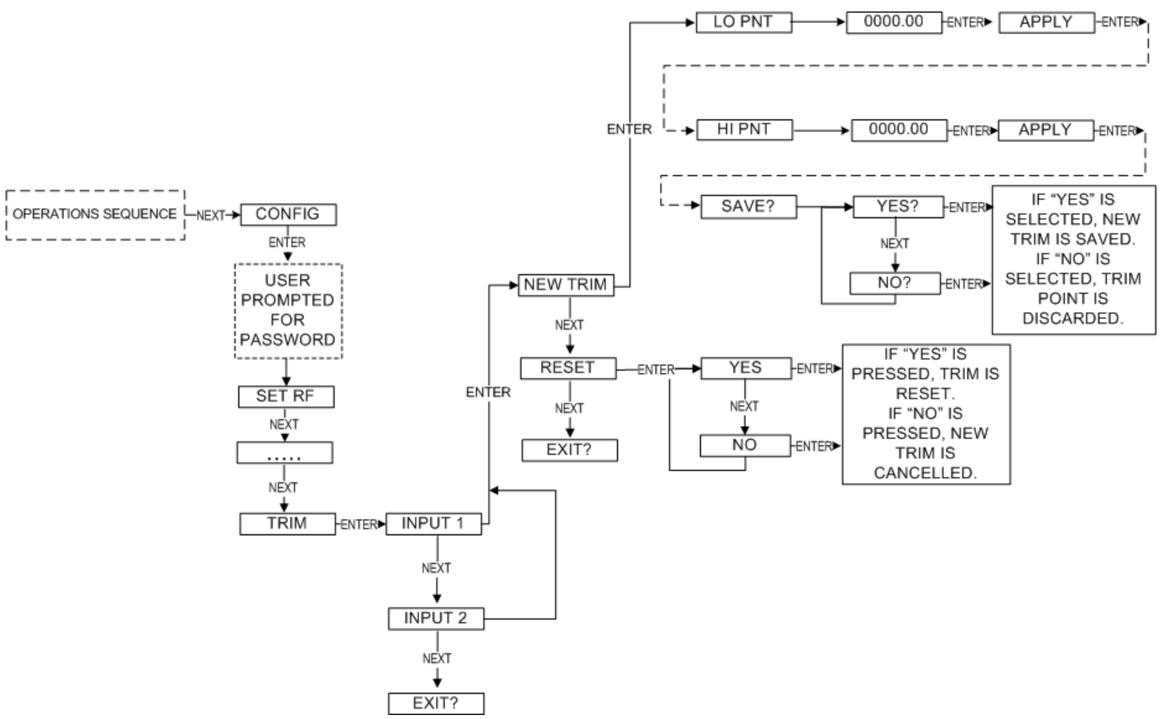


Figure 7-3 Menu Map to Trim Setting

7.4 Entering a 22- Point Curve

If you are running WIM, a 22-point sensor offset curve may be entered for the Field Unit. To do so, open the configuration dialog box (See Appendix A). Once in the configuration dialog box, click the **Sensor Offset** tab to bring up the offset information as shown for Level in Figure 7-4 and for Pressure in Figure 7-5.

Note *For Gauge Level, a 22-point curve table must be filled out for correct operation.*

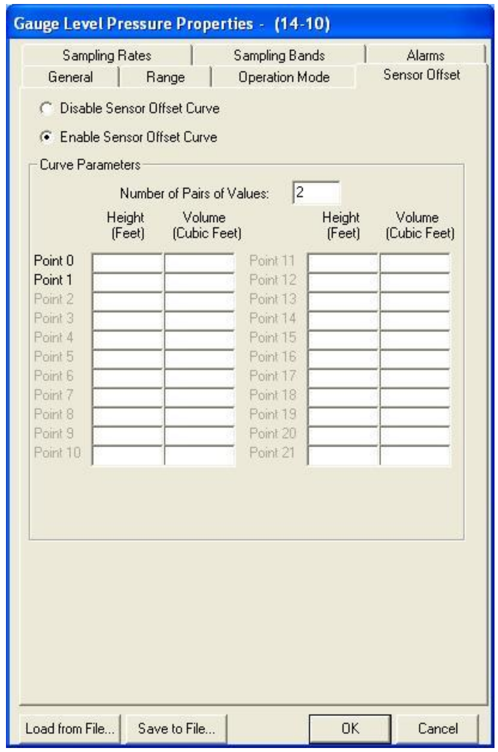


Figure 7-4 Setting a 22-Point Curve for Level Using WIM

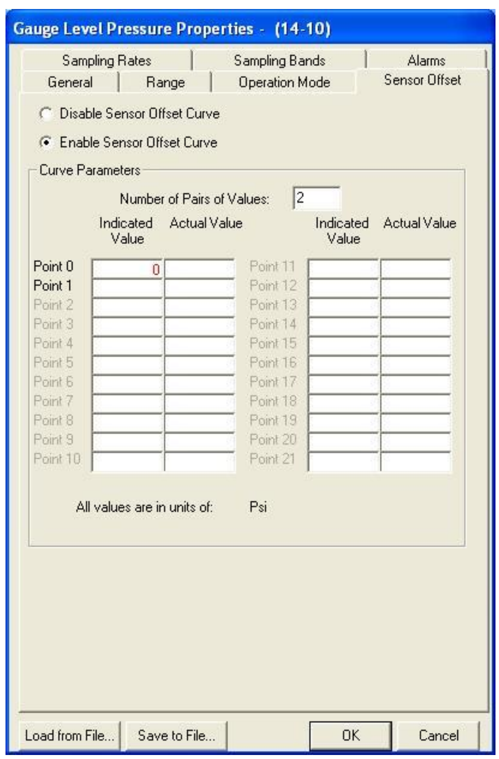


Figure 7-5 Setting a 22-Point Curve for Pressure Using WIM

8 Selecting and Configuring Operation Modes

In this section, the two operation modes, Pressure and Gauge Level, are discussed in order to aid you in selecting the right mode for your application and properly configuring the Field Unit. The subsections are as follows:

8.1 Pressure
8.2 Gauge Level

8.1 Pressure

This mode simply calculates and displays the Pressure value from the Gauge Level sensor. To set the Field Unit to this operation mode, you must go to the configuration dialog box in WIM. For further instructions on opening the configuration dialog box, see Appendix A.

Once you have opened the configuration dialog box, select the **Operation Mode** tab at the top of the dialog box. You should then see a dialog box like the one shown below.

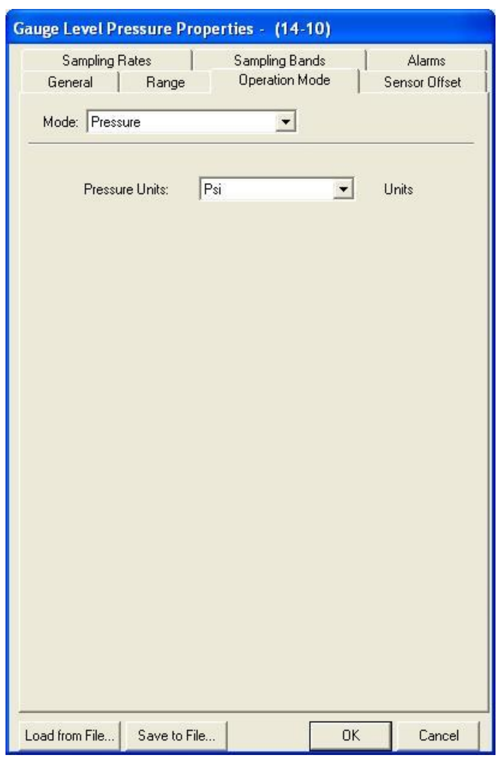


Figure 8-1 Pressure Setting Using WIM

To select the Pressure mode, select **Pressure** in the **Mode** drop-down list box. This will display the Pressure Units drop-down list box, which will allow the selection of Pressure engineering units. You should select the units that are appropriate for your application. All possible units are listed on the next page:

Pressure Units	Display Characters
Atmospheres	ATMS
Bar	BAR
Feet of Water	FT H2O
Grams / cm2	GM/SQCM
Inches of Mercury	IN HG
Inches of Water	IN H2O
Inches water @ 4°C	INH2O4C
Kilograms / cm2	KG/SQCM
Kilopascal	KPASCAL
Megapascal	MPASCAL
Millibar	MBAR
Millimeters of Mercury	MM HG
Millimeters of Water	MM H20
Mm water @ 4°C	MMH2O4C
Pascals	PASCALS
Percent (%)	PER FS
Pounds per in2 (PSI)	PSI
Special	SPECIAL
Torr	TORR

Once you select the engineering units, you have the option of enabling a 22-point sensor offset curve (it is disabled upon delivery from the factory). For additional information on a 22-point sensor curve, see Section 7.4.

8.2 Gauge Level

This mode will calculate the level and display it in the units of your choice. In this mode, you have the option of entering the density of the material or the full tank pressure. Also, you must enter tank height and tank volume. Finally, you must select level units, which can be in units of height, volume, or mass. The entered information is used to make level calculations in the units you selected. For non-uniform tanks, you must also fill out the 22-point curve table indicating the relationship between height and volume.

To set the Field Unit to this operation mode, you must go to the configuration dialog box in WIM. For further instructions on opening the configuration dialog box, see Appendix A.

Once you have opened the configuration dialog box, select the **Operation Mode** tab at the top of the dialog box and then select **Fluid Level** in the **Mode** drop-down list box. You will then see a dialog box like the one shown in Figure 8-2.

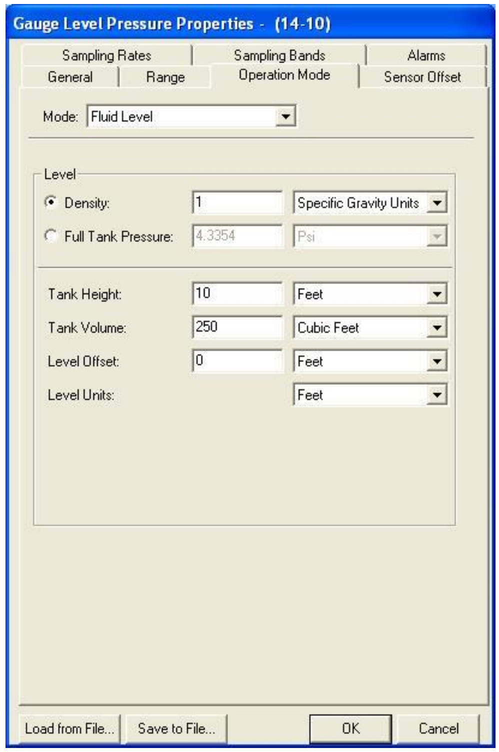


Figure 8-2 Gauge Level Mode

You should select the units that are appropriate for your application. Note that the units differ based on calculations by density and by Full Tank Pressure. For pressure units, see Section 8.1. Density and Height units are listed below and on the next page:

Density Units	Display Characters
Degrees API	degAPI
Degrees Baume heavy	degBaum hv
Degrees Baume light	degBaum lt
Degrees Twaddell	degTwad
Grams / liter	G/L
Grams / cubic centimeter	GM/CUCM
Grams / milliliter	GM/ML
Kilograms / cubic meter	KG/CM
Kilograms / liter	KG/L
Pounds / cubic foot	LB/CUFT
Pounds / cubic inch	LB/CUIN
Pounds / gallon	LB/GAL
Specific Gravity Units	SGU
Short tons / cubic yard	STON/CUYD

Level Height Units	Display Characters
Centimeters	CM
Feet	FEET
Inches	INCHES
Meters	METERS
Millimeters	MM
Percent (%)	PER FS

Once you select the engineering, you MUST enable a 22-point sensor offset curve (it is disabled upon delivery from the factory). Enable the offset curve by selecting the **Sensor Offset** tab within the configuration dialog box. For additional information on a 22-point sensor curve, see Section 7.4.

9 Maintaining the Field Unit

The Level Field Units are extremely easy to maintain in that they require no periodic calibration or system checks. Each Level Field Unit has a self-diagnostic that is constantly checking the internal system. If the field unit finds any errors, they are reported via the LCD or in the WIM software. A simple yearly visual inspection for the following is all that is needed:

- Is the Field Unit still securely fastened to the equipment being monitored?
- Are there any visible corrosions, cracks, or residue build-ups on the unit?
- Has anything about the application changed from the original intended use?

9.1 Changing the Battery

The battery will need to be changed within one month of seeing a 'LOW BAT' message on either the Field Unit or in the Wireless Instrumentation Manager. Changing the battery is a simple process, but you need to carefully follow the guidelines as the battery is a safety component of the Wireless Field Unit and needs to be changed in accordance with this procedure to maintain the safety of the device.

1. Make sure you have the correct replacement battery:
   There are two types of batteries depending on the date of manufacture of the field unit. The type of battery can be identified from the battery label on the field unit.

   Be certain that you replace the battery with the battery specified on the battery label as the battery contains protective components and must be replaced with an identical kind to maintain the safety features of the product.

   To identify the type of battery in the individual field unit, first find the battery label on the outside housing. If you see the note "Contains Battery Pack WI-BATTERY KIT – 01" on the battery label, then you must replace the field unit battery with AWS Battery Pack Part Number WI-BATTERY KIT - 01. These battery packs, with AWS Part Number "WI-Battery Kit -01", are available directly from AWS and may be ordered by calling 800-879-6576.

   The AWS Battery Pack WI-BATTERY KIT - 01 is a battery replacement kit. The kit contains a battery encapsulated with electronic safety components along with two battery tie-down clips.

2. If you do not see the battery pack identification labels noted in item 1 above, your field unit contains the following battery:

   TADIRAN™ Lithium Inorganic Battery (non-rechargeable) size 'C" – 3.6Volts #TL 2200/S.

   These replacement batteries, with AWS Part Number "WI-BAT", are available directly from AWS and may be ordered by calling 800-879-6576.

3. To replace the battery or the battery pack, first power down the Field Unit by pressing and holding the NEXT and ENTER buttons simultaneously for a few moments. You should see the display ask for the PASSWORD. Enter the

correct password to power down the unit. The factory default password is "0000".

4. Next, remove the four cover screws on the sides of the Field Unit housing with a standard screwdriver. Remove the housing cover. It may be a bit difficult to separate the housing cover from the gasket. Be very careful, if you need to pry the cover off the gasket, not to damage the gasket. When removing the cover, you will notice a flexible cable that connects the instrument cover to the electronic circuit boards. Note the position of this cable as well as the tether which restrains the movement of the cover. The ribbon cable is easily damaged and must be carefully folded back into place when you replace the cover.

5. Locate the battery or the battery pack and identify which type of battery you have. The battery pack, AWS Part Number "WI-BATTERY KIT – 01," is shown in Figure 9-1 on the following page. To replace this battery pack, follow steps 5a through 5d and then proceed to Step 7. Otherwise follow steps 6a through 6b and then proceed to Step 7

Caution! The positive end of the battery clip is the end with the red wire. Putting the battery in backwards will blow a fuse!

a) If your unit contains the battery pack AWS Part Number WI-BATTERY KIT - 01, carefully unplug the connector that connects the battery pack to the circuit board. There is a small detent in the connector which must be fully depressed to remove the battery wiring connector. Once the detent is sufficiently depressed, the connector sections are easily disengaged. If the connector sections do not disengage easily, you have not depressed the detent sufficiently. Do not apply a large amount of force to separate the connection sections and do not pry the connector apart.

b) Cut the plastic tie wraps that hold the battery pack in place.

c) Remove the battery pack and the plastic tie wraps.

d) Slide the new plastic tie wraps included in the replacement kit through the mounting holders on the circuit board.

e) Place the new battery pack on the mounting holders and fasten the two tie wraps.

f) Plug the connector into the battery connector on the circuit board. Note that the connector has a specific mating orientation and is intended to only engage in one orientation. Do not force the connectors together. If it does not fit easily, check to see if the battery connector is backwards and try to plug the connector in again.

6. If the battery looks like that shown in Figure 9-2 on page 51, then replace it by following steps 6 a through 6b and then proceed to Step 7

Figure 9-1 WI-Battery Kit—01

a) Look carefully at the battery in the unit and identify the positive (+) end and the Negative (-) end. The positive and negative terminals are marked on the battery and on the circuit board.

b) Remove the old battery and replace it with AWS Part Number "WI-BAT". Be extremely careful to put the positive (+) end of the battery in the proper location. Plugging the battery in backwards will cause a safety component on the circuit board to trip and the unit will need to be returned to the factory for safety component replacement.

7. Now you are ready to replace the cover. You will note that the cover gasket has a thin coating of gasket lubrication. Use a cotton swab to wipe around the gasket to spread the lubrication, and then replace the housing. When replacing the housing, make sure that the flexible ribbon cable folds properly. If the ribbon cable seats next to the antenna, the RF operating distance can be reduced. Also check to be certain that the cover tether is not sandwiched between the cover and the cover gasket.

8. Tighten the four cover screws and torque them to 18 inch pounds (1.5 ft-lbs).

9. Dispose of the old battery properly in accordance with your local regulations.

Figure 9-2 AWS WI-BAT Field Unit Battery

Warning! When removing the housing, do not twist or bend the green flex cable! Doing so may cause the tether to improperly seat next to the antenna and greatly reduce operable RF distances. Do not allow the housing to flop around while hanging by the tether.

9.2 Debugging the Field Unit

The field unit records recent errors that have occurred in a log. Using the following debugging tools, you will be able to keep track of all errors and RF communication problems that have occurred. There is also the option to clear the logs of these records for debugging purposes.

9.2.1 Error Log

9.2.2 Error Counts

9.2.3 RF Statistics

9.2.4 Clear Logs

To use the above tools, follow the Field Unit menu map shown in Figure 9-3 on the following page.

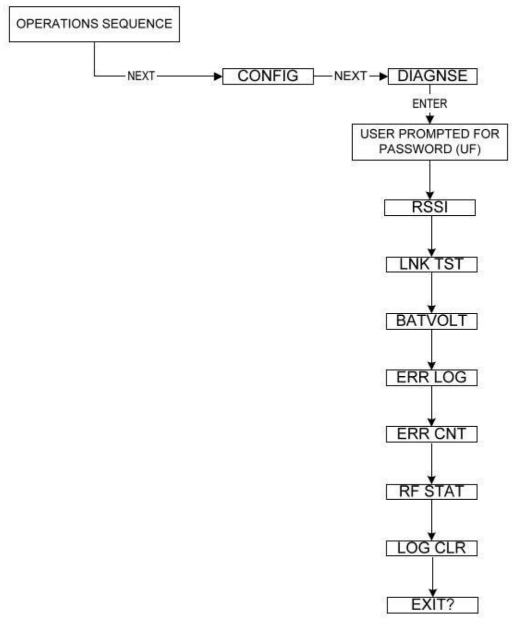


Figure 9-3 Menu Map to Error Log, Error Counter, RF Statistics, and Log Clearing

9.2.1 Error Log

The error log holds information about the six most recent errors that have occurred within the firmware of the Field Unit. Some errors are not fatal, and can occur automatically as a result of the field unit's design. However, other errors indicate a potentially fatal condition and should be dealt with accordingly by using the table of errors in Figure 9-4.

Navigate to the Error Log using the NEXT and ENTER buttons and Figure 9-3 as a guide. When the display shows ERR LOG, press Enter to enter the Error Log. An error number and an error code will then be displayed in the format "Error# Error Code#". After three seconds, the display will flash and show a number followed by the letter "H"; this represents the register location in the Field Unit's firmware where the error occurred. The display will continue to flash, alternating between the error number and code and the register location until you press enter to return to the diagnostic menu.

For example, the display may show "E5 23" and then "10H" after flashing. The number after the letter "E" indicates that the error is the fifth most recent. In the example, the code of the error is 23. Use Figure 9-4 to determine the meaning of the error codes.

Pressing the NEXT button while the Field Unit is displaying a logged error will show the next available entry. After the Field Unit has cycled through all six error messages, E1-E6, E1 will be displayed the next time you press the NEXT button.

The table in Figure 9-4 on the following page shows the possible error codes and their definitions.

Code	Description
1	generic or unspecified error
2	watchdog timeout (causes automatic reset through hardware)
3	oscillator fault error (causes automatic reset)
4	internal RAM error
5	undefined interrupt vector error
6	false/spurious interrupt trigger error
20	any of several possible errors that should never happen in the kernel but are checked just in case
21	kernel configuration error - number of defined tasks does not match what is actually in the task data table
22	maximum number of preemptive scheduler instances has exceeded the allowed limit
23	kernel interrupt occurred without the appropriate status flags being set
24	task is in an error state
25	runaway task timer - i.e. the current timeout value is greater than the beginning periodic value
26	a preemptive task that is already active has been attempted to be executed a second time
30	semaphore is already owned by another task
40	stack overflow or underflow error
41	checksum error for calibration data
42	checksum error for program Flash
43	invalid value for one of the Chiplet's nonvolatile memory configuration parameters - i.e. update rate, contrast etc.
50	external A/D converter error
51	broken sensor lead(s) error
60	ALL parameters were reloaded to their defaults
100	the SmartWatch module is not responding to sample and/or communications wakeup attempts
101	the Xemics transceiver failed at least one write/readback test
102	the Xemics' clock output should be enabled
103	problem with EEPROM communication, no sensor board or bad EEPROM
104	problem initializing or communicating with the Aic Sensor ADC or no sensor board

Figure 9-4 Definitions of error codes

9.2.2 Error Counts

The Error Counts menu contains a list of six counters that keep track of the number of times each particular error has occurred. Each counter is associated with a different error type, all of which are outlined in Figure 9-5.

Navigate to the Error Counts using the NEXT and ENTER buttons and Figure 9-3 as a guide. When the display shows ERR CNT, press Enter to enter the Error Counts menu. C1 is displayed on the Field Unit followed by a number that shows the value of the counter. For example, “C1 5” indicates that the error specified by C1 has occurred five times since the last time the log was cleared (for the Clear Logs tool, see section 9.2.4.)

Pressing the NEXT button while the Field Unit is displaying an error count will show the NEXT logged entry. Once the unit has cycled through all error counts, C1-C6, the unit will return to C1 the next time you press the NEXT button.

Counter	Definition
C1	*Cold Resets* - Indicates the number of times the device has been restarted cold. This means that a source of power, such as a battery, was removed.
C2	*Warm Resets* - Indicates the number of times the firmware of the device has reset itself.
C3	*Watchdog Resets* - Indicates the number of times the embedded CPU has crashed. The watchdog module physically resets the CPU if it crashes.
C4	*Oscillator Faults* - Indicates the number of times the onboard oscillator has failed to run properly.
C5	*Stack Overflows* - Indicates the number of times the stack, a temporary storage area the CPU uses in the RAM of the unit, has run out of space.
C6	*Minimum Free Stack* - Number of bytes free in stack

Figure 9-5 Error counter definitions

9.2.3 RF Statistics

The RF Statistics menu contains a list of 19 counters, each of which indicates the number of times a particular condition has occurred. These conditions and their definitions are listed in Figure 9-6. This menu allows for simplifying the task of solving communications problems.

Navigate to the RF Statistics using the NEXT and ENTER buttons and Figure 9-3 as a guide. When the display shows RF STAT, press Enter to enter the RF Statistics menu.

Field Unit RF Statistics		
Code	Name	Description
A	Rx Frame Start Msgs	Number of start-of-frame messages received from the Base Radio. The start of frame message is sent by the Base Radio at the beginning of each set synchronous messages. If the Field Unit does not receive this message, it cannot send its synch data.
B	Rx In-Frame Msgs	Number of asynchronous messages received from the Base Radio.
C	Rx Errors	This increments when a bit error is detected by the Field Unit during the start of frame message it is receiving from the Base Radio, after the pattern match.
D	Rx USART Errors	Not implemented
E	Rx Recover Errors	Not implemented
F	Rx Wrong Slot Error	Incremented if Field Unit ever wakes up in the wrong timeslot.
G	Missing Frame Start Msgs	This increments when it wakes up and doesn't receive the start of frame message from the Base Radio at all. If a pattern match is received and then the error occurs, C is incremented instead.
H	Missing In-Frame Msg	This increments if the Field Unit is told to receive an Async message, but does not receive the message for whatever reason (it becomes corrupt, the base radio fails to send it, etc).
I	Rx Buffer Overflow	Debug
J	Tx Msgs	Number of synchronous messages sent from the Field Unit to the Base Radio.
K	Tx Failed	After three failed attempts to receive a start of frame message from the Base Radio, the message buffer flushes, the field unit tries to re-synchronize its clock with the Base Radio, and this number gets incremented.
L	Tx Lost Acks	Not implemented
M	Tx Retransmits	Not implemented
N	Sync Success	Number of times the Field Unit successfully re-synchronized itself with the Base Radio.
O	Sync Attempts	Number of times the Field Unit attempted to re-synchronize itself with the Base Radio.
P	RF Driver Restarts	Debug
Q	2nd Sync Attempts	Number of times the RF driver has attempted the 2nd synchronous data re-transmission
R	3rd Sync Attempts	Number of times the RF driver has attempted the 3rd synchronous data re-transmission
S	Sync Failure	Number of times the RF driver has failed to transmit a synchronous message and has stopped trying to send the message

Figure 9-6 RF Statistics code descriptions

9.2.4 Clear Logs

For debugging purposes, you may wish to reset the values of all error or condition counters to determine how many errors or conditions will occur within a given time period. In order to do this, the Clear Logs feature can be utilized. This tool will clear all logs, including the Error Log, the Error Counts, and the RF Statistics counters.

Navigate to the Clear Logs menu using the NEXT and ENTER buttons and Figure 9-3 as a guide. When the display shows LOG CLR, press Enter to enter the Clear Logs menu.

The Field Unit will display “NO?” on the screen and wait for your input. Pressing the ENTER button while “NO?” is displayed will cause the Field Unit to return to the diagnostic menu and no changes will be made to the logs. Pressing the NEXT button while “NO?” is displayed will cause the Field Unit to display “YES?”. Pressing the ENTER button while “YES?” is displayed will cause the Error Log, the Error Counts, and the RF Statistics counters to be reset to zero. To ensure that the operation is complete, make sure “OK” is displayed on the screen after clearing the logs.

10 Technical Specifications

10.1 WI-SL-XX

Accuracy

- ± 0.1 % of sensor URL over temperature

Stability

- Combined zero and span stability: Less than ± 0.1% of sensor URL per year at 60°F

RF Characteristics

- 902 MHz – 928 MHz Frequency Hopping Spread Spectrum, FCC certified ISM license-free band
- Up to 3000' range from Base Radio with clear line of sight; 500' to 1000' range with obstructions
- The RF module in each field unit is individually tested and calibrated over the full temperature range to ensure reliable wireless operation

Operating Temperature Range

- -4°F to +140°F (-20°C to +60°C) process temperature, steady state
- -4°F to +140°F (-20°C to +60°C) electronics
- -4°F to +140°F (-20°C to +60°C) display (full visibility)

Physical Characteristics

- Type titanium base and diaphragm
- GE Lexan® cover. V-0 rating and UV stable

Operating Vibration and Shock Characteristics

- Certified per IEC EN00068 2 -6 (vibration) and 2-27 (shock)

Random Vibration Characteristics

- Certified to withstand 6 g's, 15 minutes per Axis from 9 – 500 Hz

Electromagnetic Compatibility (CE Compliance)

- Operates within specification in fields from 80 to 1,000 MHz with Field strengths to 30 V/m. Meets EN 50082-1 general immunity standard and EN 55011 compatibility emissions standard

Industrial Certification

- **For ordinary locations only**

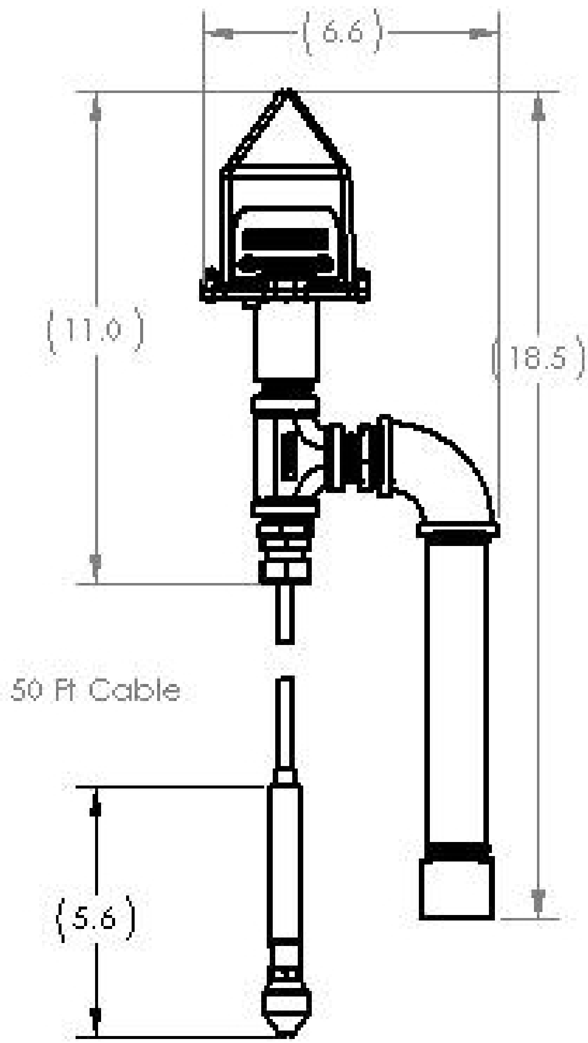


Figure 10-1 WI-SL-XX Dimensioned Mechanical Drawing

10.2 WI-GL-I-XX

Accuracy

- ± 0.1 % of sensor URL over temperature

Stability

- Combined zero and span stability: Less than ± 0.1% of sensor URL per year at 70°F

RF Characteristics

- 902 MHz – 928 MHz Frequency Hopping Spread Spectrum, FCC certified ISM license-free band
- Up to 3000' range from Base Radio with clear line of sight
- The RF module in each field unit is individually tested and calibrated over the full temperature range to ensure reliable wireless operation

Operating Temperature Range

- -40°F to +185°F (-40°C to +85°C) electronics
- -4°F to +158°F (-20°C to +70°C) display (full visibility)
- -40°F to +185°F (-40°C to +85°C) display (with reduced visibility)

Physical Characteristics

- Type 316 Stainless Steel Base and Diaphragm
- Standard ½" MNPT (Other Options Available)
- GE Lexan® cover. V-0 rating and UV stable

Operating Vibration and Shock Characteristics

- Certified per IEC EN00068 2 -6 (vibration) and 2-27 (shock)

Random Vibration Characteristics

- Certified to withstand 6 g's, 15 minutes per Axis from 9 – 500 Hz

Electromagnetic Compatibility (CE Compliance)

- Operates within specification in fields from 80 to 1,000 MHz with Field strengths to 30 V/m. Meets EN 50082-1 general immunity standard and EN 55011 compatibility emissions standard

Industrial Certification

- Rated for industrial use -40°F to 185°F (-40°C to 85°C)
- FM NEMA 4 weather-proof housing
- FM rated intrinsically safe for Class I/II/III, Division 1, Groups A,B,C,D,E,F&G; Class I/II/III, Division 2, Groups A,B,C,D,F&G

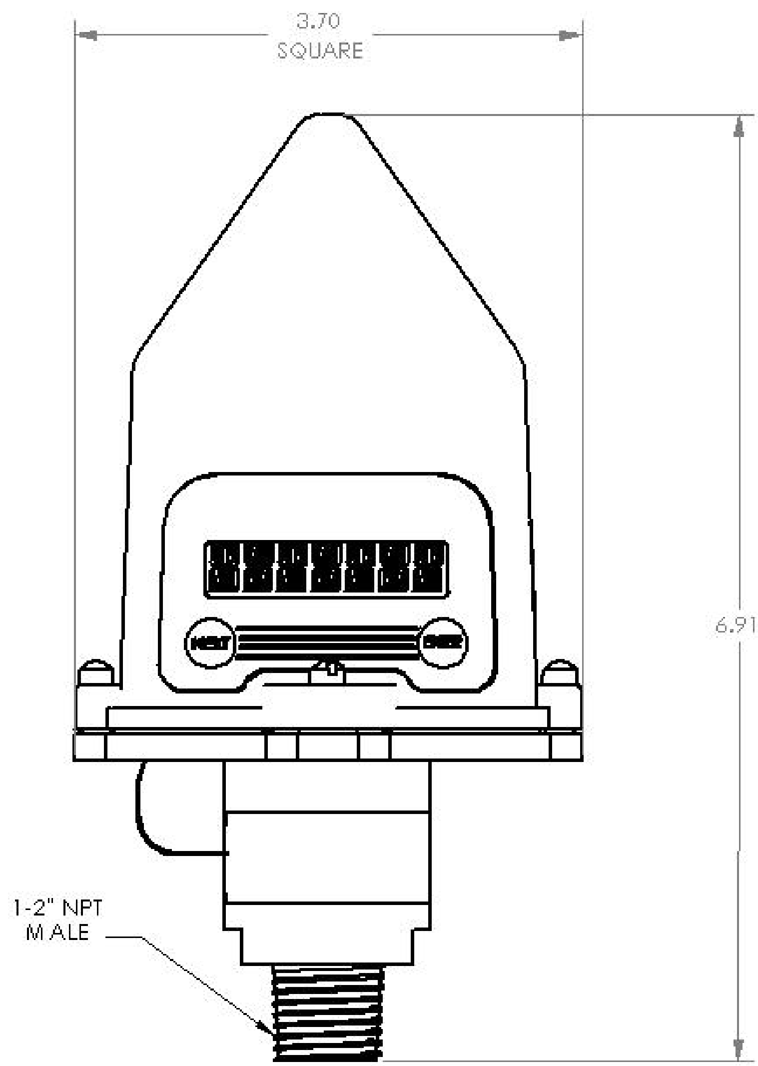


Figure 10-2 WI-GL-I-XX Dimensioned Mechanical Drawing

10.3 WI-GL-E-XX

Accuracy

- ± 0.1 % of sensor URL over temperature

Stability

- Combined zero and span stability: Less than ± 0.1% of sensor URL per year at 70°F

RF Characteristics

- 902 MHz – 928 MHz Frequency Hopping Spread Spectrum, FCC certified ISM license-free band
- Up to 3000' range from Base Radio with clear line of sight; 500' to 1000' range with obstructions
- The RF module in each field unit is individually tested and calibrated over the full temperature range to ensure reliable wireless operation

Operating Temperature Range

- -40°F to +250°F (-40°C to +121°C) process temperature, steady state
- -40°F to +185°F (-40°C to +85°C) ambient temperature sensor
- -40°F to +185°F (-40°C to +85°C) electronics
- -4°F to +158°F (-20°C to +70°C) display (full visibility)
- -40°F to +185°F (-40°C to +85°C) display (with reduced visibility)

Physical Characteristics

- Type 316 Stainless Steel Base and Diaphragm
- Standard ½" MNPT (Other Options Available)
- GE Lexan® cover. V-0 rating and UV stable

Operating Vibration and Shock Characteristics

- Certified per IEC EN00068 2 -6 (vibration) and 2-27 (shock)

Random Vibration Characteristics

- Certified to withstand 6 g's, 15 minutes per Axis from 9 – 500 Hz

Electromagnetic Compatibility (CE Compliance)

- Operates within specification in fields from 80 to 1,000 MHz with Field strengths to 30 V/m. Meets EN 50082-1 general immunity standard and EN 55011 compatibility emissions standard

Industrial Certification

- Rated for industrial use -40°F to 185°F (-40°C to 85°C)
- FM NEMA 4 weather-proof housing
- FM rated intrinsically safe for Class I/II/III, Division 1, Groups A,B,C,D,E,F&G; Class I/II/III, Division 2, Groups A,B,C,D,F&G

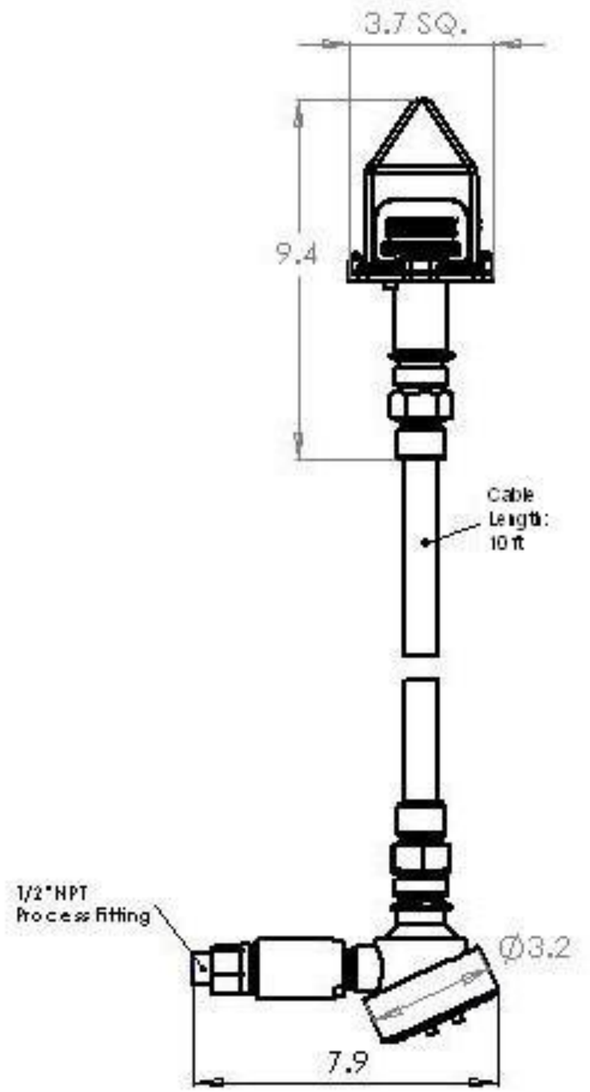


Figure 10-3 WI-GL-E-XX Dimensioned Mechanical Drawing

10.4 WI-GL-E-Y6-XX

Accuracy

- ± 0.1 % of sensor URL over temperature

Stability

- Combined zero and span stability: Less than ± 0.1% of sensor URL per year at 70°F

RF Characteristics

- 902 MHz – 928 MHz Frequency Hopping Spread Spectrum, FCC certified ISM license-free band
- Up to 3000’ range from Base Radio with clear line of sight
- The RF module in each field unit is individually tested and calibrated over the full temperature range to ensure reliable wireless operation

Operating Temperature Range

- -40°F to +250°F (-40°C to +121°C) process temperature, steady state
- -40°F to +185°F (-40°C to +85°C) ambient temperature sensor
- -40°F to +185°F (-40°C to +85°C) electronics
- -4°F to +158°F (-20°C to +70°C) display (full visibility)
- -40°F to +185°F (-40°C to +85°C) display (with reduced visibility)

Physical Characteristics

- Type 316 Stainless Steel Base and Diaphragm
- Standard ½” MNPT (Other Options Available)
- GE Lexan® cover. V-0 rating and UV stable

Operating Vibration and Shock Characteristics

- Certified per IEC EN00068 2 -6 (vibration) and 2-27 (shock)

Random Vibration Characteristics

- Certified to withstand 6 g’s, 15 minutes per Axis from 9 – 500 Hz

Electromagnetic Compatibility (CE Compliance)

- Operates within specification in fields from 80 to 1,000 MHz with Field strengths to 30 V/m. Meets EN 50082-1 general immunity standard and EN 55011 compatibility emissions standard

Industrial Certification

- Rated for industrial use -40°F to 185°F (-40°C to 85°C)
- FM NEMA 4 weather-proof housing
- FM rated intrinsically safe for Class I/II/III, Division 1, Groups A,B,C,D,E,F&G; Class I/II/III, Division 2, Groups A,B,C,D,F&G

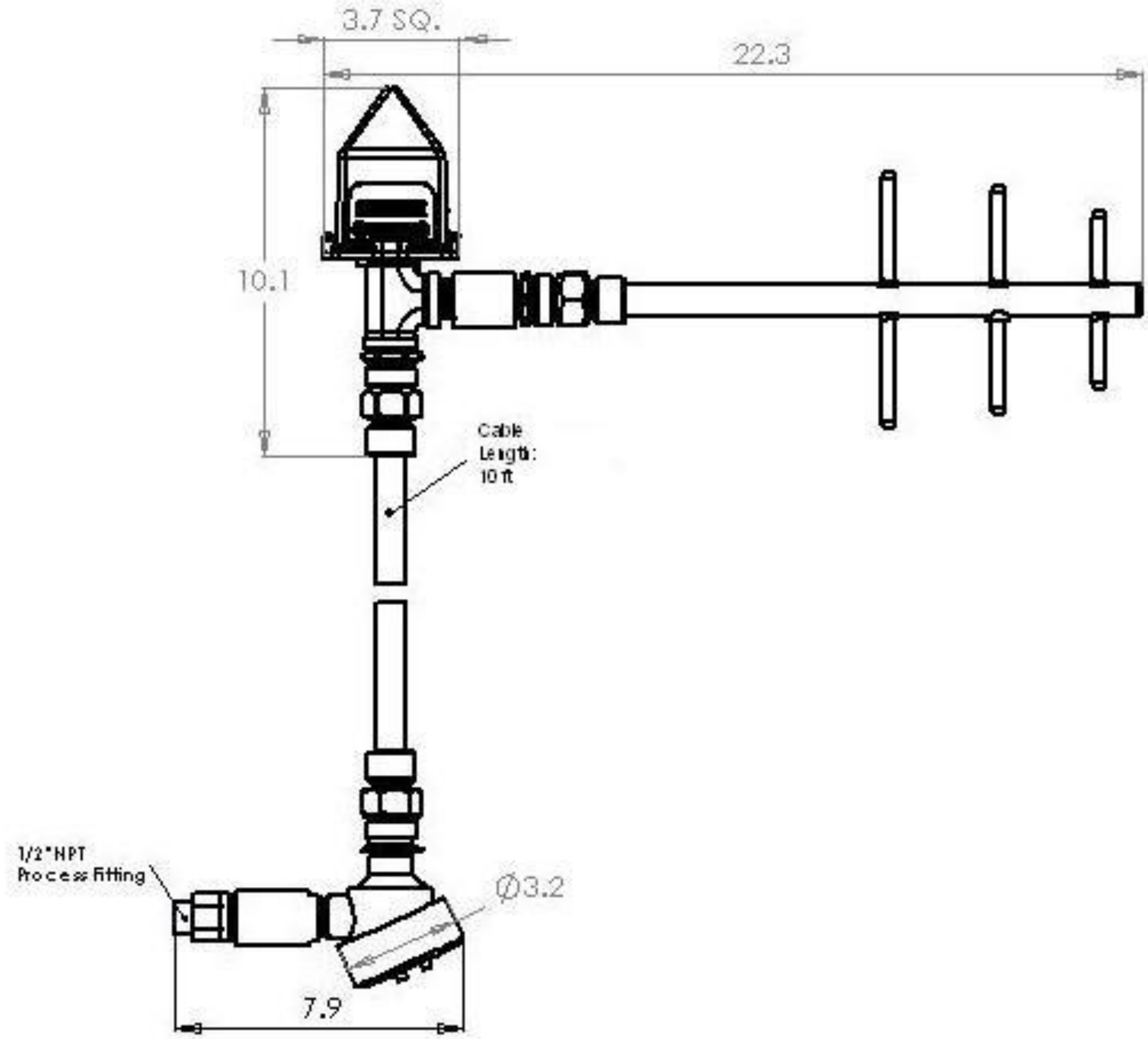


Figure 10-4 WI-GL-E-Y6-XX Dimensioned Mechanical Drawing

Appendix A Opening the Configuration box in WIM

In WIM, go to the Field Unit View. This view shows the Field Unit information and allows you to configure and view individual Field Unit data. This view can be accessed at any time by clicking on the Field Units icon in the Views pane. The Field Unit View is shown below. More information is found in Sections 8 and 9 of the WIM User Guide.

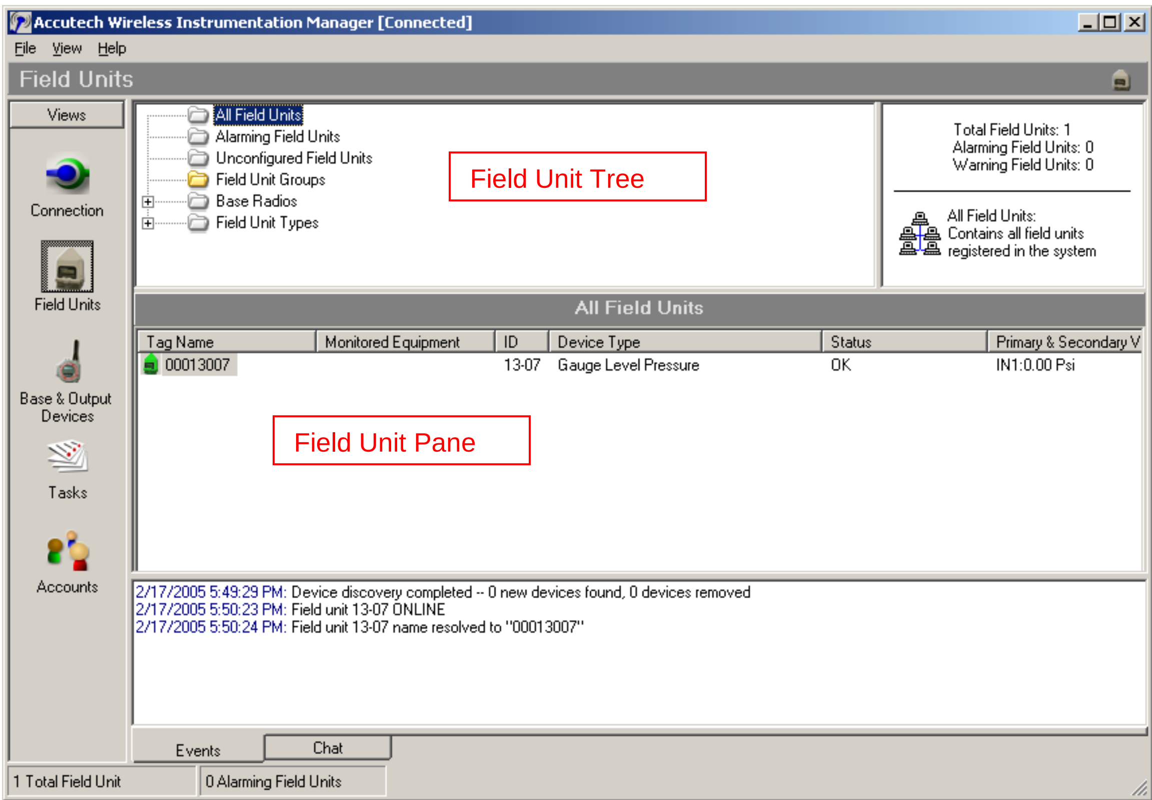
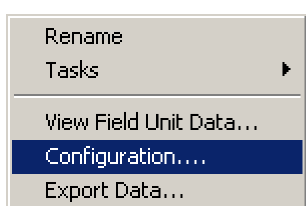


Figure A- 1 WIM with All Field Units view

The Field Units are displayed in the Field Unit Pane based on the selection in the Field Unit Tree.

To open the Configuration dialog box, right mouse click a Field Unit and select Configuration from the Right Mouse Button menu:



Appendix B Field Unit Displayed Message Definitions

This section covers the various messages, displayed on the Field Unit LCD, that occur during operation of the device.

Operations Sequence

RF Link Status
RF OK—–Field Unit and Base Radio are communicating properly
RF SYNC–Field Unit and Base Radio are attempting to synchronize communications
RF OFF–Field Unit's RF Channel is set to RF OFF
NO RF–Field Unit and Base Radio are not communicating

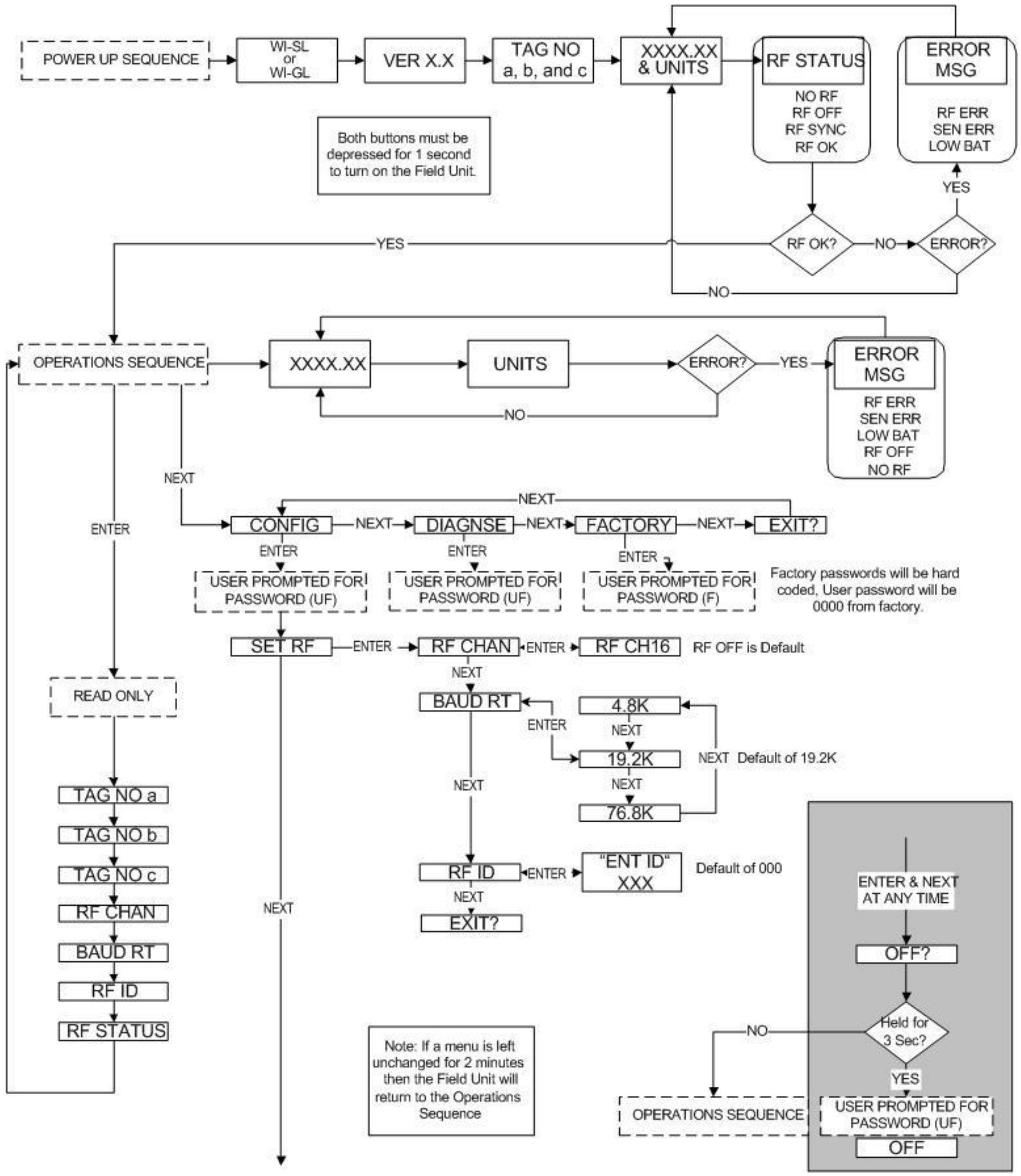
Gauge Level Input Level
–XX.XX–Currently measured differential input level

Error Messages
If an error is detected with the operation of the Field Unit, a message will be displayed on the Field Unit LCD (a corresponding message may also appear on the Base Radio LCD).

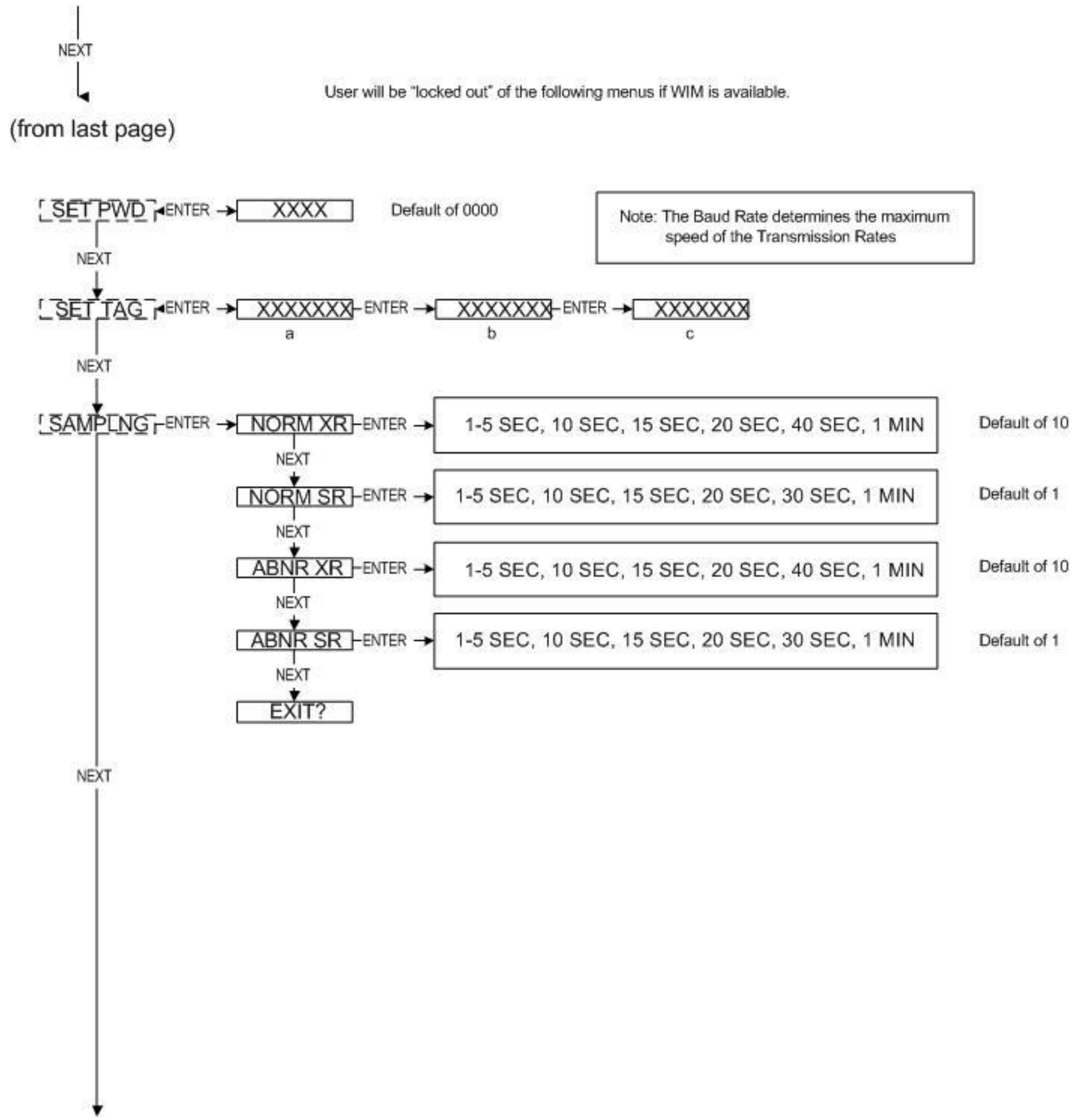
There are several types of error messages, both warnings and fatal errors. Warning messages are displayed as part of the normal cycling message sequence. These are:
LOW BAT–battery should be replaced as soon as possible
NO RF–can not detect Base Radio
S FAULT–there is an open sensor or excitation wire detected. Also displayed if a sensor value goes above/below logical limits. The unit will display 9999.99 for measurement (sensor fault mode), but will continue sampling and recover if the problem desists.
OVERRNG - the device is measuring a value above/below sensor dependent bound values. For example, the Analog Input device will report over-range if measurement is above 105% of the range of the Analog Input sensor. If the measurement goes above 150% of the full range, the unit will go into Sensor Fault mode. In over-range mode, the measurement is continually displayed, with the "OVERRNG" message to remind you that the specified range of the sensor and the calibrated range of the device are being exceeded.

Fatal error messages will replace the normal cycling message sequence and will flash. A fatal message indicates the Field Unit is no longer operating normally and requires repair. These are:
RF ERR - fatal error within RF communications
SEN ERR–fatal error within the sensor electronics
SYS ERR–fatal error within the microprocessor system
RF CAL–fatal error within the RF calibration system

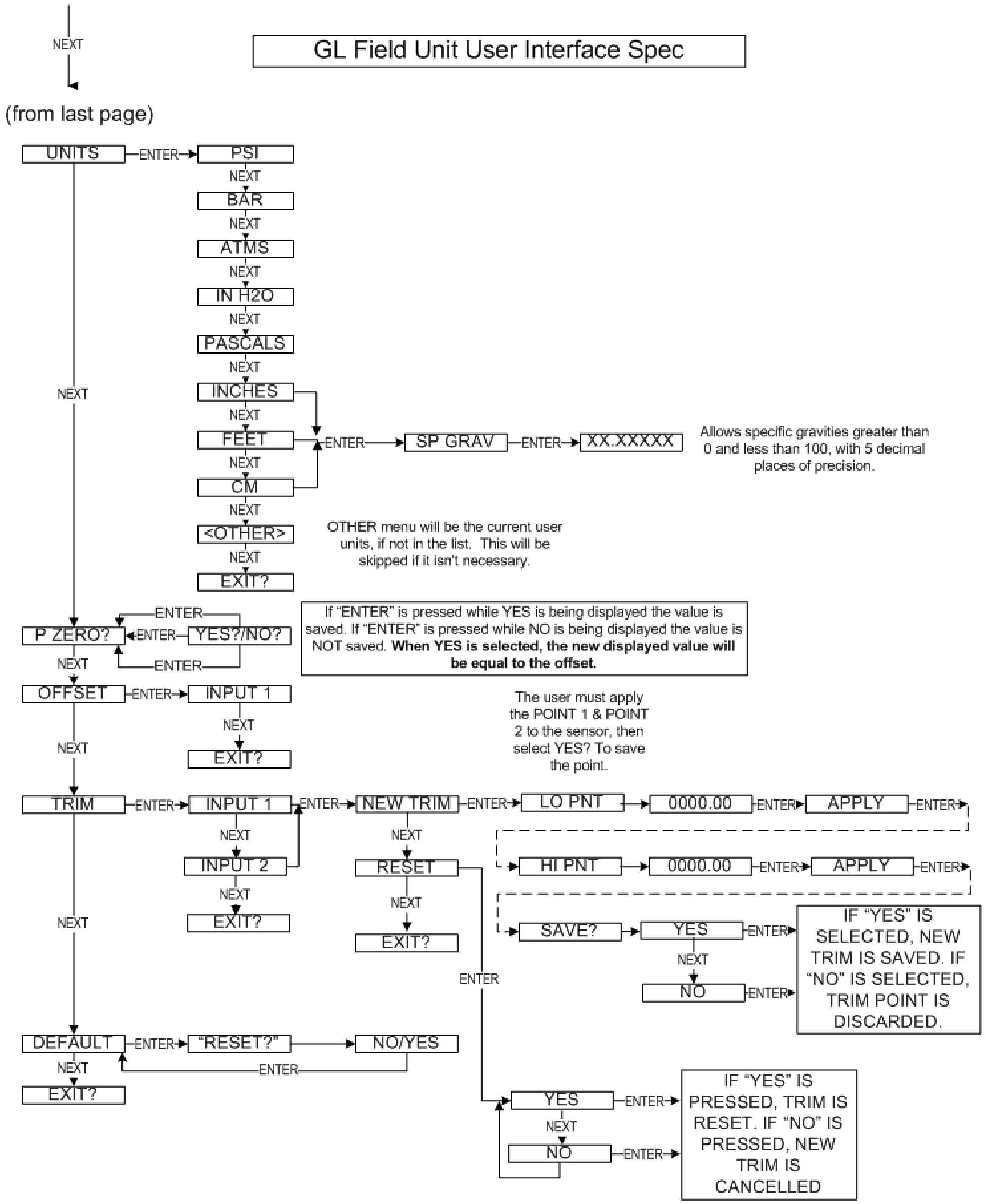
Appendix C Field Unit Menu Map



Field Unit Menu Map (page 1)



Field Unit Menu Map (page 2)



Field Unit Menu Map (page 3)

Appendix D Modbus Register Definitions

```
/* Temperature Units */
DegC = 32, /* Degrees Celcius */
DegF = 33, /* Degrees Fahrenheit */
DegR = 34, /* Degrees Rankine */
DegK = 35, /* Kelvin */

/* Pressure Units */
InH2OAt68F = 1, /* inches of water at 68 degF */
InHgAt0C = 2, /* inches of mercury at 0 degC */
FtH2OAt68F = 3, /* feet of water at 68 degF */
MMH2OAt68F = 4, /* millimeters of water at 68 degF */
MMHgAt0C = 5, /* millimeters of mercury at 0 degF */
PSI = 6, /* pounds per square inch */
BAR = 7, /* bars */
MilliBAR = 8, /* millibars */
GMPerSqCm = 9, /* grams per square centimeter */
KGPerSqCm = 10 /* kilograms per square centimeter */
Pascals = 11, /* pascals */
KiloPascals = 12, /* kilopascals */
Torr = 13, /* torricellis */
Atmospheres = 14, /* atmospheres */
InH2OAt60F = 145, /* inches of water at 60 degF */
CmH2OAt4C = 170, /* centimeters of water at 4 degC */
MetH2OAt4C = 171, /* meters of water at 4 degC */
CmHgAt0C = 172, /* centimeters of mercury at 0 degC */
PSF = 173, /* pounds per square foot */
HectoPascals = 174, /* hectopascals */
PSIA = 175, /* pounds per square inch absolute */
KGPerSqMeter = 176, /* kilograms per square meter */
FtH2OAt4C = 177, /* feet of water at 4 degC */
FtH2OAt60F = 178, /* feet of water at 60 degF */
MetHgAt0C = 179, /* meters of mercury at 0 degC */
MegaPascals = 237, /* megapascals */
InH2OAt4C = 238, /* inches of water at 4 degC */
MMH2OAt4C = 239, /* millimeters of water at 4 degC */

/* Volumetric Flow Units */
CuFtPerMin = 15, /* cubic feet per minute */
GalPerMin = 16, /* gallons per minute */
LiterPerMin = 17, /* liters per minute */
ImpGalPerMin = 18, /* imperial gallons per minute */
CuMeterPerHr = 19, /* cubic meter per hour */
GalPerSec = 22, /* gallons per second */
MillionGalPerDay = 23, /* million gallons per day */
LiterPerSec = 24, /* liters per second */
MillionLiterPerDay = 25,/* million liters per day */
CuFeetPerSec = 26, /* cubic feet per second */
CuFeetPerDay = 27, /* cubic feet per day */
CuMeterPerSec = 28, /* cubic meters per second */
CuMeterPerDay = 29, /* cubic meters per day */
ImpGalPerHr = 30, /* imperial gallons per hour */
ImpGalPerDay = 31, /* imperial gallons per day */
NormCuMeterPerHr = 121,/* normal cubic meter per hour - MKS System */
NormLiterPerHr = 122, /* normal liter per hour - MKS System */
StdCuFtPerMin = 123, /* standard cubic feet per minute - US System */
CuFeetPerHour = 130, /* cubic feet per hour */
CuMeterPerMin = 131, /* cubic meters per minute */
BarrelPerSec = 132, /* barrels per second - 1 Barrel = 42 US gallons */
BarrelPerMin = 133, /* barrels per minute */
BarrelPerHr = 134, /* barrels per hour */
BarrelPerDay = 135, /* barrels per day */
GalPerHr = 136, /* gallons per hour */
ImpGalPerSec = 137, /* imperial gallons per hour */
LiterPerHr = 138, /* liters per hour */

/* Velocity Units */
```

```
FtPerSec = 20, /* feet per second */
MetersPerSec = 21, /* meters per second */
InPerSec = 114, /* inches per second */
InPerMin = 115, /* inches per minute */
FtPerMin = 116, /* feet per minute */
MetersPerHr = 120, /* meters per hour */

/* Volume Units */
Gallons = 40, /* gallons */
Liters = 41, /* liters */
ImpGallons = 42, /* imperial gallons */
CuMeters = 43, /* cubic meters */
Barrels = 46, /* barrels */
Bushels = 110, /* bushels */
CuYard = 111, /* cubic yards */
CuFeet = 112, /* cubic feet */
CuInch = 113, /* cubic inches */
BarrelsLiquid = 124, /* liquid barrels - 1 bbl liq = 31.5 US gallons */
NormalCuMeter = 166, /* normal cubic meter - MKS System */
NormalLiter = 167, /* normal liter - MKS System */
StdCuFeet = 168, /* standard cubic feet - US System */
HectoLiter = 236, /* hectoliters */

/* Length Units */
Feet = 44, /* feet */
Meters = 45, /* meters */
Inches = 47, /* inches */
CM = 48, /* centimeters */
MM = 49, /* millimeters */
FtInSixteenths = 151, /* see Note 1 in HART document HCF_SPEC-183 */

/* Time Units */
Min = 50, /* minutes */
Sec = 51, /* seconds */
Hr = 52, /* hours */
Day = 53, /* days */

/* Mass Units */
Gram = 60, /* grams */
KG = 61, /* kilograms */
MetricTon = 62, /* metric tons */
Pound = 63, /* pounds */
ShortTon = 64, /* short tons */
LongTon = 65, /* long tons */
Ounce = 125, /* ounce */

/* Mass Flow Units */
GramPerSec = 70, /* grams per second */
GramPerMin = 71, /* grams per minute */
GramPerHr = 72, /* grams per hour */
KGPerSec = 73, /* kilograms per second */
KGPerMin = 74, /* kilograms per minute */
KGPerHr = 75, /* kilograms per hour */
KGPerDay = 76, /* kilograms per day */
MetTonPerMin = 77, /* metric tons per minute */
MetTonPerHr = 78, /* metric tons per hour */
MetTonPerDay = 79, /* metric tons per day */
PoundsPerSec = 80, /* pounds per second */
PoundsPerMin = 81, /* pounds per minute */
PoundsPerHr = 82, /* pounds per hour */
PoundsPerDay = 83, /* pounds per day */
ShTonPerMin = 84, /* short tons per minute */
ShTonPerHr = 85, /* short tons per hour */
ShTonPerDay = 86, /* short tons per day */
LongTonPerHr = 87, /* long tons per hour */
LongTonPerDay = 88, /* long tons per day */

/* Density Units */
SGU = 90, /* specific gravity units */
GramPerCuCm = 91, /* grams per cubic centimeter */
```

```
KGPerCuMeter = 92, /* kilograms per cubic meter */
PoundsPerGal = 93, /* pounds per gallon */
PoundsPerCuFt = 94, /* pounds per cubic foot */
GramsPerML = 95, /* grams per milliliter */
KGPerLiter = 96, /* kilograms per liter */
GramsPerLiter = 97, /* grams per liter */
PoundsPerCuIn = 98, /* pounds per cubic inch */
ShTonPerCuYard = 99, /* short tons per cubic yard */
DegTwad = 100, /* degrees twaddell */
DegBaumHeavy = 102, /* degrees baume heavy */
DegBaumLight = 103, /* degrees baume light */
DegAPI = 104, /* degrees API */
MicroGMPerLiter= 146, /* micrograms per liter */
MicroGMPerCuMeter= 147,/* micrograms per cubic meter */
PercentConsistency = 148,/* percent consistency */

/* Viscosity Units */
Centistokes = 54, /* centistokes */
Centipoise = 55, /* centipoise */

/* Angular Velocity Units */
DegPerSec = 117, /* degrees per second */
RPS = 118, /* revolutions per second */
RPM = 119, /* revolutions per minute */

/* Energy (Work) Units */
NM = 69, /* newton meter */
DekaTherm = 89, /* deka therm */
FtLbForce = 126, /* foot pound force */
KWHr = 128, /* kilo watt hour */
MCal = 162, /* mega calorie */
MJ = 164, /* mega joule */
BTU = 165, /* british thermal unit */

/* Force Units */
Newton = 68, /* newton */

/* Power Units */
KW = 127, /* kilo watt */
HP = 129, /* horsepower */
MCalPerHr = 140, /* mega calorie per hour */
MJPerHr = 141, /* mega joule per hour */
BTUPerHr = 142, /* british thermal unit per hour */

/* Frequency Units */
Hertz = 38, /* hertz */

/* Analytical Units */
Percent = 57, /* percent */
PH = 59, /* pH */
PerSteamQuality= 150, /* percent steam quality */
PercentPlato = 160, /* percent plato */
PerLowExpLevel = 161, /* percent lower explosion level */

/* Capacitance Units */
PF = 153, /* picofarads */

/* EMF Units */
MilliVolts = 36, /* millivolts */
Volts = 58, /* volts */

/* Current Units */
MA = 39, /* milliamperes */

/* Resistance Units */
Ohms = 37, /* ohms */
KOhms = 163, /* kilo ohms */

/* Angle Units */
Deg = 143, /* degrees */
```

```
Rad = 144, /* radians */

/* Conductance Units */
MicroSiemens = 56, /* micro siemens */
MilliSiemensPerCM= 66, /* milli siemens per centimeter */
MicroSiemensPerCM= 67, /* micro siemens per centimeter */

/* Volume per Volume Units */
VolumePercent = 149, /* volume percent */
MilliLitersPerLiter= 154,/* milli liters per liter */
MicroLitersPerLiter= 155,/* micro liters per liter */

/* Volume per Mass Units */
DegBalling = 107, /* degrees balling */
CuFtPerLb = 152, /* cubic feet per pound */

/* Concentration Units */
DegBrix = 101, /* degrees brix */
PerSolidsPerWt = 105, /* percent solids per weight */
PerSolidsPerVol= 106, /* percent solids per volume */
PfPerVol = 108, /* proof per volume */
PfPerMass = 109, /* proof per mass */
PPM = 139, /* parts per million */
PPB = 169, /* parts per billion */

/* Special Units */
SpecialUnits = 253
```

A B O U T U S

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