
Base Radio User Guide

900 MHz ISM Band



**XYR 5000 Line
34-XY-25-05
Rev. 4
08/06**

Base Radio

Models: WBR-AK

Versions 1.70 or later

Important Information for the User

- Changes or modifications not expressly approved by the manufacturer 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.
- If the WMT (RF Server) software is shutdown, the RS-485 network **MUST** be physically disconnected from the PC as the serial port is no longer being controlled by the software and may disrupt communications between multiple Base Radios.
- 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 900 MHz 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 user.

This document cannot be changed without prior FM approval

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Revision Notes

The following list provides notes concerning all revisions of this document.

| <u>Doc ID</u> | <u>Rel ID</u> | <u>Date</u> | <u>Notes</u> |
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1 Introduction

1.1 Using this Manual

This manual is designed to assist in installing, operating, and maintaining Honeywell Model WBR-AK Base Radios. 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 or how-to information to perform the tasks outlined.

3 Installation

This section explains mechanical installation and correct wiring for power and communications. Also covered in this section are instructions for “daisy-chaining” multiple Base Radios together on the same power and communications supplies. Proper termination of the communications is also covered.

4 General Configuration

In this section the general configuration options such as password protecting, and selecting a user password are discussed. Also covered is the importance of the Number of Wireless Instruments (HI RFID) setting, as well as the configuring of this setting.

5 Configuring the RF Communications

This section covers the setup of the Base Radio RF Communications that allow the Base Radio to communicate with Transmitters that have been placed in service.

6 Configuring the MODBUS Communications

This section covers the various Base Radio settings that must be configured for Modbus communication such as baud rate, parity, device ID's, and register mapping modes. Also covered in this section is a brief discussion of the Modbus communications protocol and Modbus commands that are used with this device.

Modbus register locations are also discussed within this section.

7 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

The Honeywell Base Radio is a reliable Radio Frequency (RF) transceiver with a variety of available outputs contained in an explosion proof housing useable in many hazardous and hard-to-reach areas. 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 Base Radio allows you to quickly and accurately monitor those devices at a fraction of the cost, giving you bigger and faster returns on your instrumentation investments.

The Base Radio communicates in a secure, frequency digital protocol over a band of frequencies from 902 MHz to 928 MHz. These devices do not require permits or licenses and are easily setup and installed right out of the box.

The Honeywell Base Radio may be used to communicate with many Transmitters in various applications. You can use this device for long-term monitoring in remote locations, for short-term data gathering on process conditions, or to quickly test the economic viability of a new installation.

The purpose of this guide is to help you install, configure and maintain your Honeywell 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 Honeywell Representative. Upon receipt of 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.

Please note that 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 Honeywell is revised periodically. Internal device software may contain portions that are not compatible with previous versions of WMT (Wireless Management Toolkit software)

To ensure software compatibility, WMT version 1.70.138 or later must be used. If you believe you are experiencing software compatibility issues please call Honeywell Technical Support at 800-423-9883 or email ACE@Honeywell.com.

2 Quick Start

This section summarizes what must be done in order to get the device installed, configured and in operation quickly. Additional detailed information is found throughout this guide. Steps 1-3 refer to the following diagram:

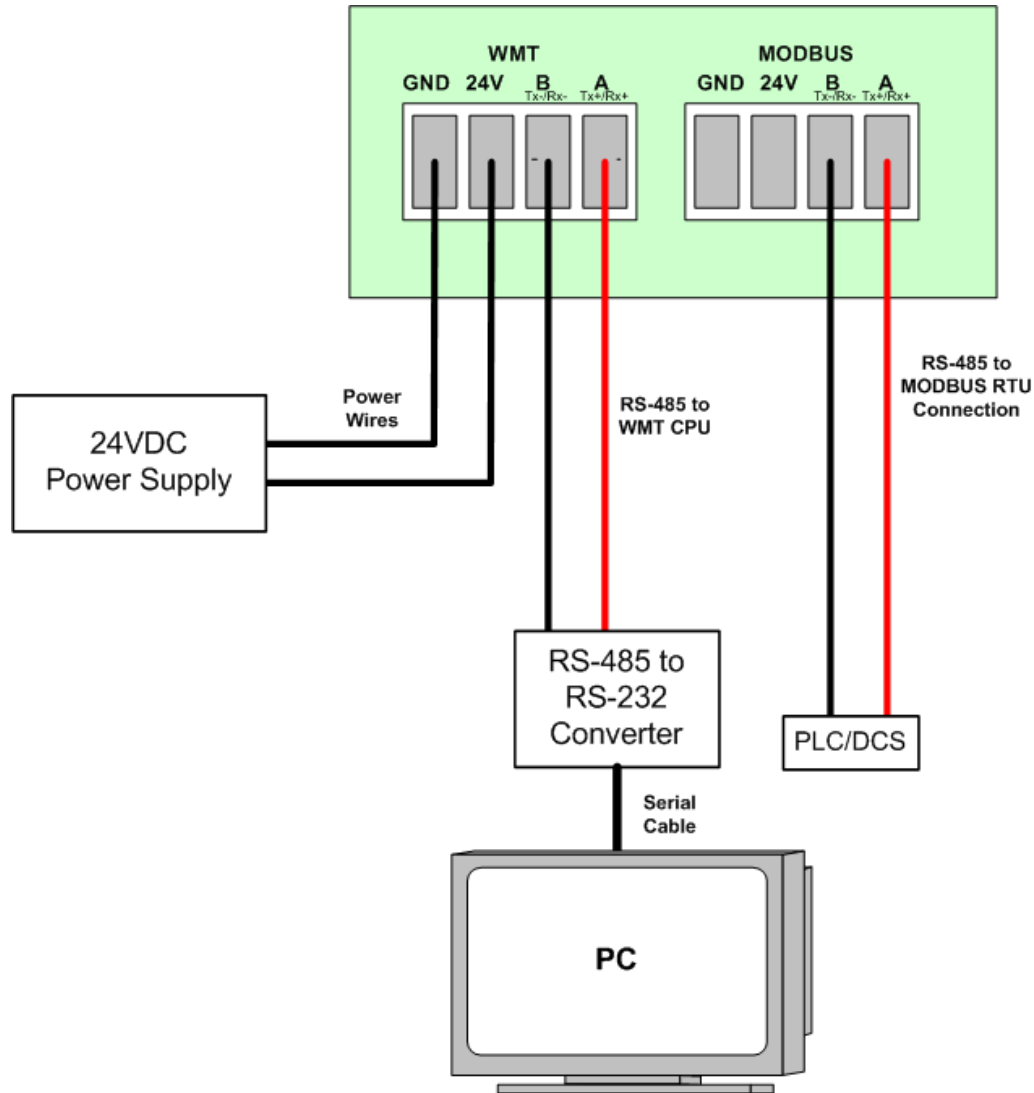


Figure 2-1 Overall Wiring Schematic

1. Wire 24VDC power to the Base Radio using the power terminals on either the WMT or the Modbus connection. Do not apply power to both sets of terminals.
2. Wire WMT RS-485 communications to the left terminal of the Base Radio.
3. Wire Modbus RS-485 communications to the right terminal of the Base Radio.
4. Place the terminating resistor between terminals A and B if the Base Radio will be used as an End Unit (See Section 3.2.7).

5. The Base Radio RF settings should be configured as follows:
 - Set the RF Channel to any available RF CHAN that matches the one used by the Transmitters you wish to communicate with (other than RF OFF).
 - Set the Baud Rate to 76.8 K or to the Baud Rate used by the Transmitters with which you wish to communicate.
 - HI RF ID = the highest transmitter RF ID you assign to this network.
6. Configure the Modbus settings
7. Verify "COMM OK" message on Base Radio LCD screen

If you are not receiving a "COMM OK" message on the Base Radio check the following:

- Is the Base Radio set to the above listed configurations?
- Are all the Transmitters on?
- Are the Transmitters set to the matching RF configurations (see Section 5 of Transmitter and Base Radio User Manuals)?
- Are the Base Radio and Transmitters unable to communicate due to obstructions or distance (see Transmitter Manual: Transmitter Placement section)?



Warning! If the Transmitters 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 Transmitters will only search for the Base Radio every one hour or so. Turning the Transmitters off and back on will cause them to begin searching immediately.

3 Installation

This section discusses both the mechanical and electrical aspects of installation. It is divided into the following sections:

- 3.1: Mechanical Installation
- 3.2: Electrical Installation

3.1 Mechanical Installation

In this section, the mechanical installation instructions are discussed for the various setup capabilities of the Base Radio. The subsections are as follows:

3.1.1 Base Radio Positioning

The Honeywell Base Radio is a rugged device, which provides optimal performance when installed with careful consideration. Installation practices greatly affect the life that you can expect from your Honeywell Base Radio. The main considerations for installation are covered below.

Give careful consideration to the environment where you will be installing the devices. Avoid installations that expose the device to excess temperature, high vibration, considerable shock, or exposure 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 guidelines and cannot cover all possible variations.

The final installation must be made at the discretion and approval of the user. You must be the judge of the actual installation.



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 Base Radio.

3.1.1 Base Radio Positioning

Correct positioning of the Base Radio will ensure the best performance of the device. Because the Base Radio is the central communication device of all Transmitters that are assigned to it, the Base Radio should be located in an area that is somewhat central to all of the Transmitters.

Figure 3-1 is a picture of a general Base Radio layout. The maximum distance is determined by a number of factors, including the Baud Rate Setting. When planning the positioning of the Base Radio, try to place the Base Radio in a location with an unobstructed view to the most Transmitters possible.

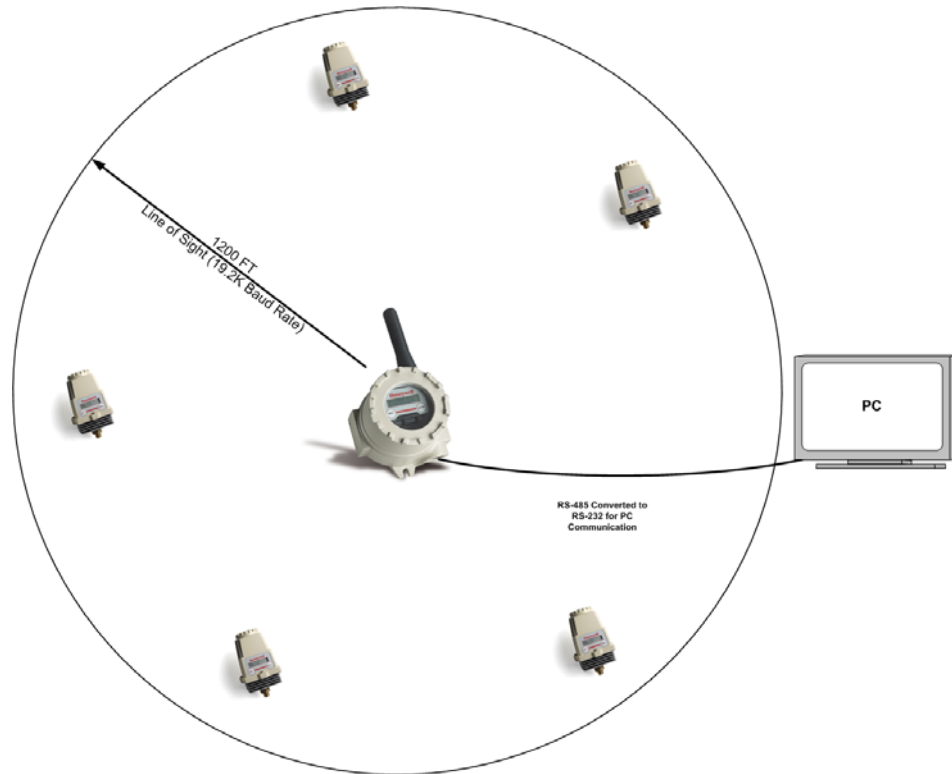


Figure 3-1 General Layout

Remember, the approximate line of sight range between a Transmitter and Base Radio is determined by the Baud Rate as listed below:

- 76.8K - 76.8 Kbaud, Range of 500 to 750 ft
- 19.2K - 19.2 Kbaud, Range of 2,000 to 2,500 ft
- 4.8K - 4.8 Kbaud, Range of 3,000 ft



Note This range is reduced by the amount of RF Noise present, obstructions, and the material properties of those obstructions.

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

Make sure you have power and communication to the Base Radio available (see 3.2 Electrical Installation).

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 Transmitter and Base Radio are capable of communication. The RF Placement Procedure section of the Transmitter Guide will help you to determine if you have a selected the correct installation points and orientations for your application.

3.2 Electrical Installation

In this section wiring instructions are discussed for the various setup capabilities of the Base Radio. The subsections are as follows:

- 3.2.1 Electrical Specifications
- 3.2.2: Wiring Power to the Base Radio
- 3.2.3 Wiring RS-485 to the Base Radio
- 3.2.4 Wiring the RS-485/232 Converter to the Base Radio
- 3.2.5 Wiring the RS-485/USB Converter to the Base Radio
- 3.2.6 Daisy-Chaining Multiple Base Radios to Single RS-485/Power
- 3.2.7 Terminating Communications Wiring to the Base Radio
- 3.2.8 Grounding the Base Radio
- 3.2.9 High Gain Antenna



Warning! Remember to turn off all power BEFORE attaching the Base Radio wires!

3.2.1 Electrical Specifications

- 24VDC Power Supply with 0.5 Amp minimum output
Recommend 22AWG Power Supply wire
- 2 Wire RS-485 Serial Communications Cable
Recommend Belden 3105A shielded and protected 22AWG or equivalent
- 120 Ohm, $\pm 5\%$, $\frac{1}{4}$ W resistor for RS-485 termination
- RS-485 to RS-232 converter B&B model 485LDRC9 or equivalent
- 8 AWG bare or green covered grounding cable for housing ground

In Figure 3-2, an overall wiring schematic is shown. Note that the grounding screw is located on the outside of the Base Radio housing.

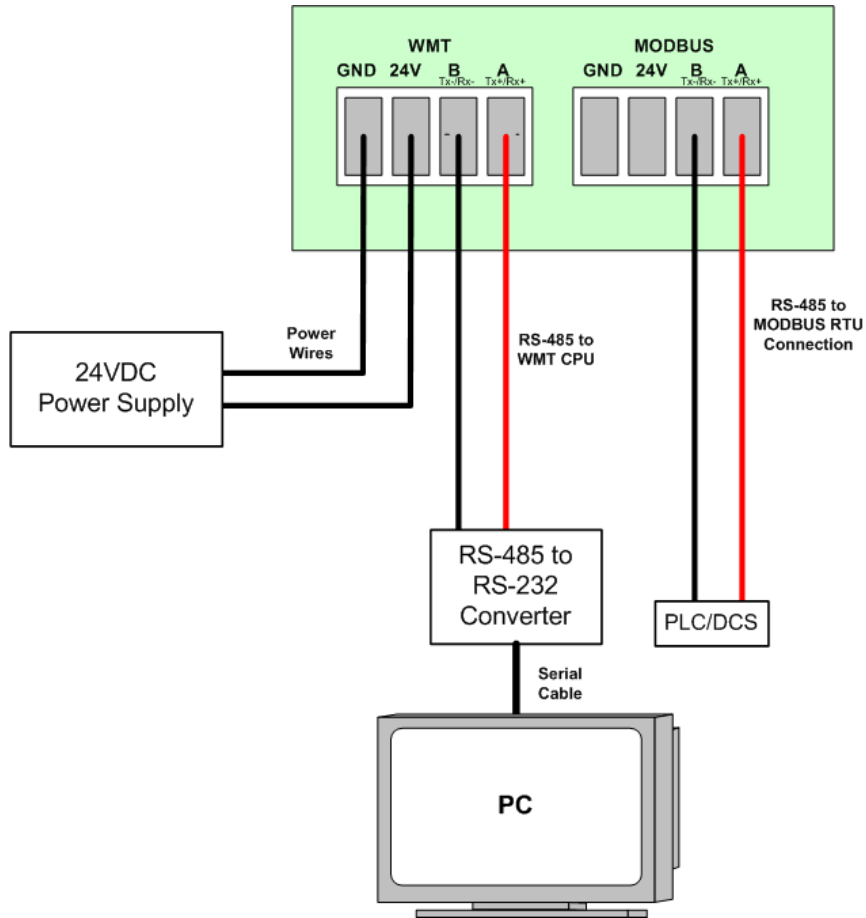


Figure 3-2 Overall Wiring Schematic



Warning! Explosions may result in death or serious injury. Do not remove the instrument cover in explosive atmospheres when power and/or communications are on.

To begin the electrical installation first remove the explosion proof housing cover from the Base Radio, if you have not already done so. Point the Base Radio antenna away from you and look at the green PC Board found directly underneath the NEXT and ENTER buttons. You should see two terminal blocks and some labels as shown in Figure 3-3.

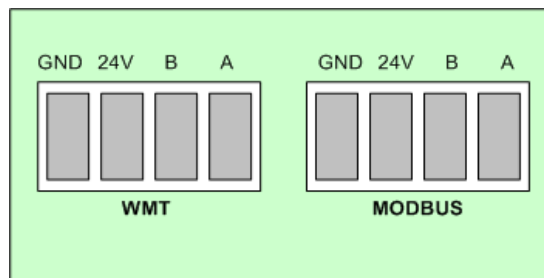


Figure 3-3 Terminal Block Labels

Once you have located these terminal blocks you can wire the Base Radio accordingly. The best way to wire the Base Radio is to:

- Remove both terminal blocks from the jacks on the Base Radio
- Insert the wire through the conduit hole on the bottom right of the Base Radio
- Secure the wire into the proper terminal blocks
- Then plug the terminal blocks back into the proper jacks on the Base Radio.



Warning! If the Transmitters 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 Transmitters will only search for the Base Radio every one hour or so. Turning the Transmitters off and back on will cause them to begin searching immediately.

3.2.2 Wiring Power to the Base Radio

The Honeywell Base Radio is designed to use a 24 VDC power supply at a minimum of 0.5 Amps. Honeywell offers a DIN rail mountable 100-240VAC 50/60Hz to 24VDC transformer for this purpose, AIC #. For more information, contact your Honeywell Representative.

The Common or Negative wire should be placed in the left most slot labeled “GND” on the PC Board of the terminal block in Figure 3-4. The Positive wire should be placed in the same terminal block in the slot labeled “24V” on the PC Board as shown in Figure 3-4.

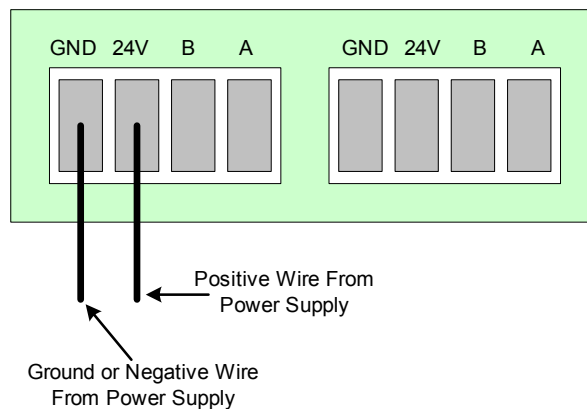


Figure 3-4 Wiring Power to the Base Radio



Caution! Make sure only **ONE** power supply is routed to the Base Radio at any time!

3.2.3 Wiring RS-485 to the Base Radio

The Base Radio also requires a half-duplex RS-485 bus to be wired for communications. Wiring communications to a PC in order to run the Wireless Management Toolkit (WMT)

software may require the use of an RS-485 to RS-232 converter, as most PCs cannot be wired directly to RS-485.

To wire the RS-485 cable to the Base Radio we recommend using a 22AWG twisted pair shielded wire. Place one of the twisted pair wires in the "A" (Tx+/Rx+) slot of the same terminal block as the power supply wires, and the other wire in the "B" (Tx-/Rx-) slot of the terminal block as shown below in Figure 3-5.

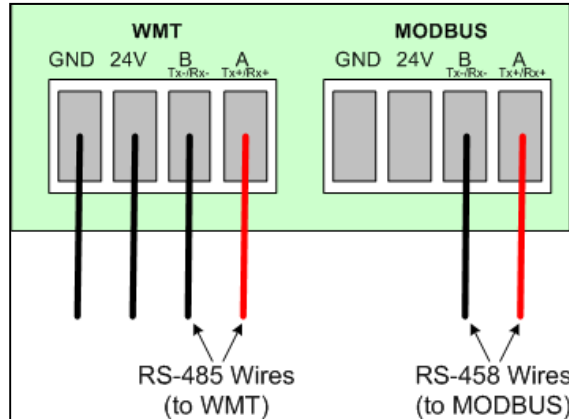


Figure 3-5 Wiring RS-485 to the Base Radio

RS-485 may be wired in-line (in series) to multiple Base Radios. This is called "daisy-chaining". Only Base Radios using Modbus RS-485 output can be daisy-chained. See Section 3.2.6. Note that Base Radios daisy-chained must be set to different RF Channels to communicate properly on the same wire.

3.2.4 Wiring the RS-485/232 Converter to the Base Radio

Honeywell offers an optically isolated, surge protected, DIN Rail mountable RS-485/232 converter, AIC #. Because there are many RS-485/232 Converters available, please see your converter's instruction manual for details as this section will only discuss the wiring of the B&B 485LDRC9 converter.

The Base Radio communicates via a RS-485 half-duplex differential signal with A being Tx+/Rx+ and B being Tx-/Rx-. To properly wire the Base Radio to the 485LDRC9, you should follow Figure 3-6.

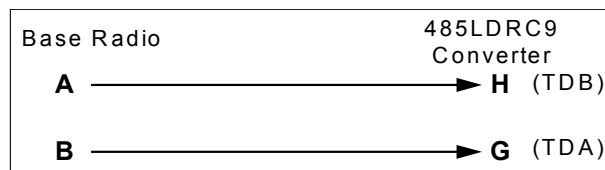


Figure 3-6 Base Radio to RS-232 Converter Wiring Diagram

To configure the 485LDRC9 to the appropriate baud rate (38.4Kbaud), a set of dip switches must be configured. These switches can be found on the side of the converter. The first four switches should be in the ON position to indicate that the communications are half-duplex. The fifth switch should also be in the OFF position as this activates the 120 Ohm termination resistor within the converter. This terminator is only useful for long RS-485 buses, or other calculated circumstances. Finally, switches six, seven, and eight should be set to the OFF position to indicate the correct baud rate. (Note: An 8.2 K resistor (R11) has been installed at the factory to achieve these higher baud rates. If you did not purchase the converter from the factory, you will need to install the resistor.)

To wire power to the 485LDRC9, place a +10 to 30 VDC supply to terminal F, and place the ground (V-) to terminal C.

The final step in installing the converter is to attach a DB-9 RS-232 (serial) cable from the converter to an available serial port on your computer.



Note The RS-485 bus is half-duplex. If the Base Radio in the application is wired to a RS-485 to RS-232 converter, the A (Tx+/Rx+) and B (Tx-/Rx-) wires may need to be crossed for correct operation. Please see the converter's manual for further instructions.

3.2.5 Wiring the RS-485/USB Converter to the Base Radio



Note The RS-485 cable should **NOT** be connected to the RS-485/USB converter before the converter drivers have been installed.

Honeywell also offers a non-optically isolated RS-485 to USB converter. The USB Converter provides easy connectivity between the PC and standard communication ports, not requiring PC reconfiguration, assignment of IRQs, or jumper settings.

Use of this device requires a PC with a USB port compliant with USB 1.1 or later.

The RS-485 to USB converter is equipped with a USB cable and a USB type A connector for connection to a PC USB port and a male DB-9 for connection to an RS-485 equipped data or communication terminal.

3.2.5.1 USB Driver Installation

1. Power on the PC. Verify the USB port is enabled and insert the CD that has been provided.
2. Connect the USB cable of the converter to the USB port of the PC. Make sure not to have the RS-485 cable plugged into the converter at this time.
3. Windows™ should detect the USB device, and if the driver does not already exist on the PC the “**Add New Hardware Wizard**” will be displayed. Click the **NEXT** button.
4. From this new screen select “**Specify a Location**” and specify the PC's drive letter for the CD-ROM drive where the provided CD has been inserted. Click the **NEXT** button to begin the search.
5. Once the drivers have been located a new screen will be displayed. Click **NEXT** to continue.
6. At this point Windows™ has finished installing the RS-485 to USB converter drivers. Click **FINISH**.

7. Once Windows™ has detected the USB device, click **NEXT**.
8. Now connect the RS-485 cable to the converter's DB-9 terminal.
9. Click **START, SETTINGS, CONTROL PANEL**, then select **SYSTEM**, and click on **DEVICE MANAGER**. Verify that the converter is listed in COM PORTS as "USB to Serial Adapter".
10. The converter installation is now complete. The PORTS section of the DEVICE MANAGER, mentioned in step 9, shows the new COM PORT number next to the "USB to Serial Adapter". You need this number to set the WMT's RF Server to look at the correct COM PORT for incoming information.
11. To specify this COM PORT, start the RF Server and **Right-Click** on the RF Server Icon (see the WMT User's Guide, Section 4 for more details). Select **Options**. Then click **ADD** to add the converter's COM PORT. The baud rate should remain at 38400. Then select **OK** and the added port will be displayed. Select **OK**.

3.2.5.2 Wiring the DB-9 RS-485 Cable to the Base Radio

Using the converter's Male DB-9 Connector chart wire up a **Female** DB-9 connector such that Pins 2 and 9 (Tx+ and Rx+) go to the Base Radio's WMT terminal A, and Pins 1 and 3 (Tx- and Rx-) go to the Base Radio's WMT terminal B. (See Figure 3-5 for details on WMT Terminal A and B).

USB Converter's Male DB-9 Connector

| PIN # | SIGNAL |
|-------|--------|
| 1 | Rx- |
| 2 | Tx+ |
| 3 | Tx- |
| 4 | NC |
| 5 | GND |
| 6 | NC |
| 7 | NC |
| 8 | NC |
| 9 | Rx+ |

3.2.5.3 USB Driver Un-installation

1. Unplug the converter from the PC's USB Port.
2. Insert the converter's driver CD used for installation.
3. Run the FTDIUNIN.EXE program.
4. Restart the PC.

3.2.6 Daisy-Chaining Multiple Base Radios to Single RS-485/Power

Two or more Base Radios may be placed on a single RS-485 communication line, and a single power supply line (provided the power supply and wiring can handle the load). This section will provide the information needed to daisy-chain multiple Base Radios. However, be sure to complete Section 3.2.8 on correct Base Radio termination if doing so.

3.2.6.1 Daisy-Chaining Power to Multiple Base Radios

A consideration when daisy-chaining power to multiple Base Radios is the power draw at power supply. Each Base Radio will typically draw 200mA @ 24VDC. This means a single Base Radio will draw a typical average power of 4.2W.

If using the supplied DIN rail mounted 15W power, it is suggested that no more than three Base Radios be tied parallel to this supply.

To daisy-chain two or more Base Radios together, each Base Radio should be wired in parallel to the next while making sure power is not supplied from two separate supplies to any single Base Radio. A typical wiring setup is shown in Figure 3-7 below:

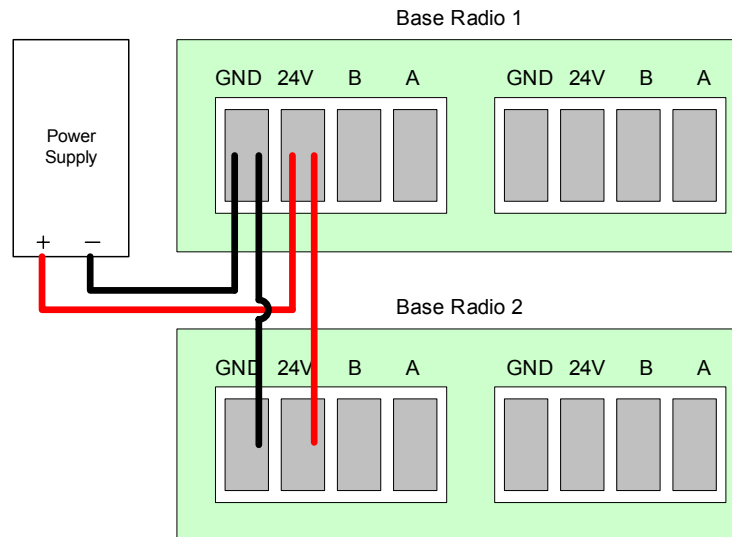


Figure 3-7 Daisy-Chaining Power to Multiple Base Radios

3.2.6.2 Daisy-Chaining RS-485 to Multiple Base Radios

Modbus connections can be daisy-chained together, but WMT connections cannot. There can only be one Base Radio, multiple Output Modules, and a PC on the same WMT RS-485. If you have two Base Radios connected to a PC running WMT, you must have two COM ports.

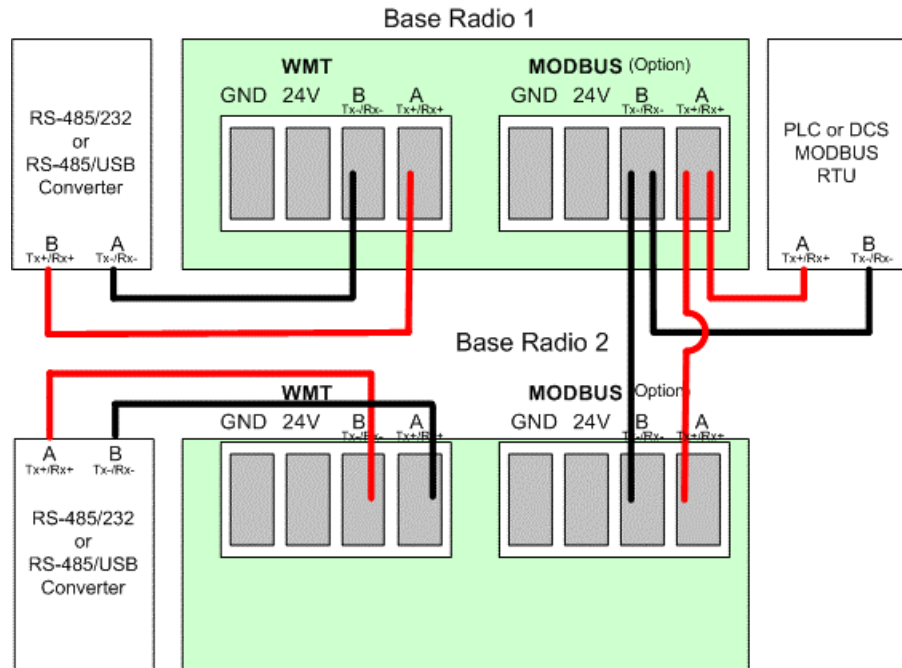


Figure 3-8 Daisy-Chaining RS-485 to Multiple Base Radios

3.2.7 Terminating Communications Wiring to the Base Radio

RS-485 is capable of maintaining communications over a maximum distance of 4000 feet. In most (and we recommend all) situations the unit that comprises an “end” of an RS-485 network should be terminated by a resistor wired across the A and B wires.

In the case of a daisy-chained application the end unit should be terminated. The end unit is the unit that is located at the end of the series of units. In a PC to Base Radio only application, the end unit is the Base Radio. Note: a PC is also an end unit, but the termination for this end unit is done within the converter. In a multiple unit daisy-chain application the end unit is shown in Figure 3-9.

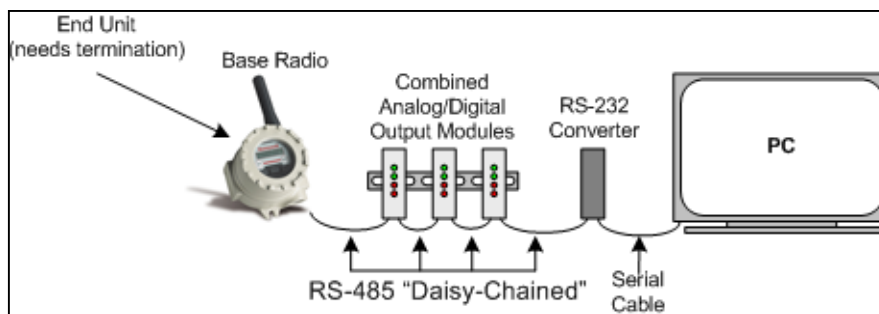


Figure 3-9 Example of End Unit in Daisy-Chain Configuration

Termination of an end unit is done by placing a resistor across the A and B wires of the RS-485 cable. The value of this resistor should match the characteristic impedance (Z_0) of the RS-485 cable. The characteristic impedance (Z_0) is published by the manufacturer of the RS-485 cable you are using. If you are using the Belden RS-485 wire

(recommended in section 3.2.1) the value of the resistor should be a 120 Ohm ¼ watt resistor.

To terminate a Base Radio, place one end of the resistor in the open terminal block's B slot and place the other end of the resistor in the open terminal block's A slot. Doing so will place the resistor across the A and B wires, as needed. An example of this is shown in Figure 3-10.

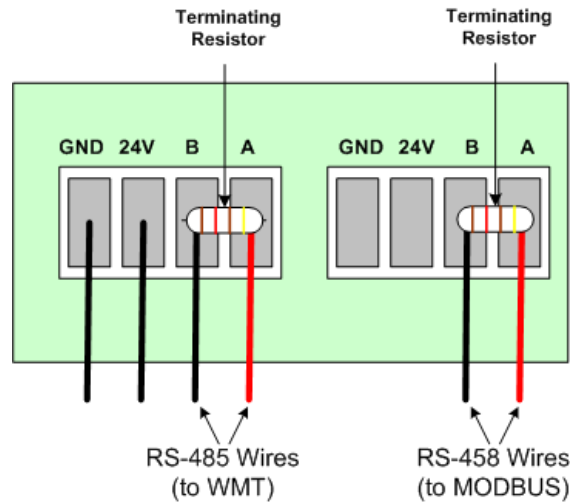


Figure 3-10 Example of Correct Termination Resistor Setup

3.2.8 Grounding the Base Radio

In order to assure safety requirements on your Base Radio, the Base Radio housing must be grounded. We have provided a grounding screw located on the left side of the Base Radio housing. To ground the Base Radio simply place a wire from the grounding screw to a grounded object.

Possible grounded objects include:

- The building's metal frame-work
- Any electrical conduit
- A suitable grounding or lightning rod

3.2.9 High Gain Antenna

A high-gain antenna is available for the Base Radio. This antenna generally doubles the signal range of the Base Radio, but requires an installation in a general-purpose area.

4 General Configuration

This section discusses the generalities around configuring the Base Radio via the NEXT and ENTER buttons. The subsections are as follows:

- 4.1: Base Radio Displayed Messages
- 4.1.1: The Read Only Sequence
- 4.2: Overall Configuration Menu Map
- 4.3: Setting the User Password

4.1 Base Radio Displayed Messages

The Base Radio should be on if power is being supplied (See Section 3.2: Electrical Installation). Upon power-up, the Base Radio will display a Power-Up Sequence, and then go into an Operations Sequence. These Sequences are shown in Figure 4-1 below:

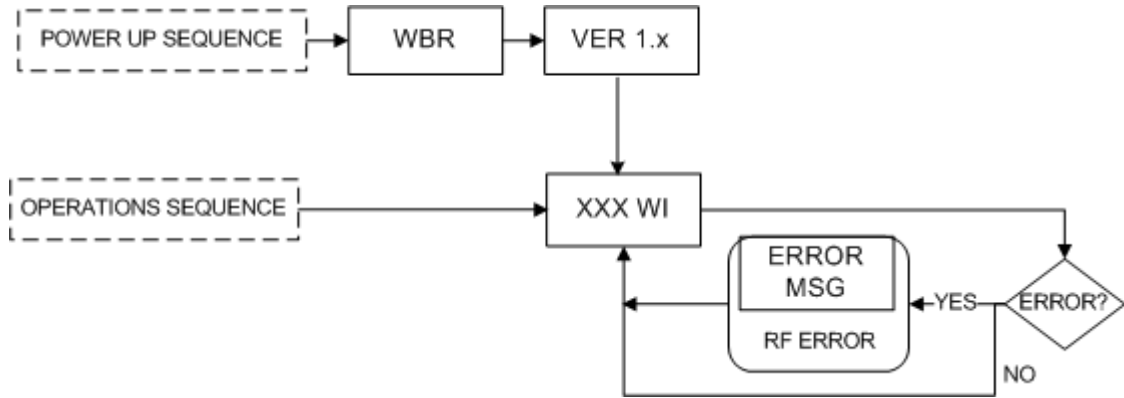


Figure 4-1 Base Radio Power-Up and Operations LCD Sequences



Note During configuration and testing, keep Transmitters at least six feet from the Base Radio and other Transmitters to ensure good communications.

4.1.1 The Read Only Sequence

Once the Base Radio is in the Operations Sequence, a user 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 Base Radio that is not seen during the Operations Sequence. No changes may be made to these settings here.

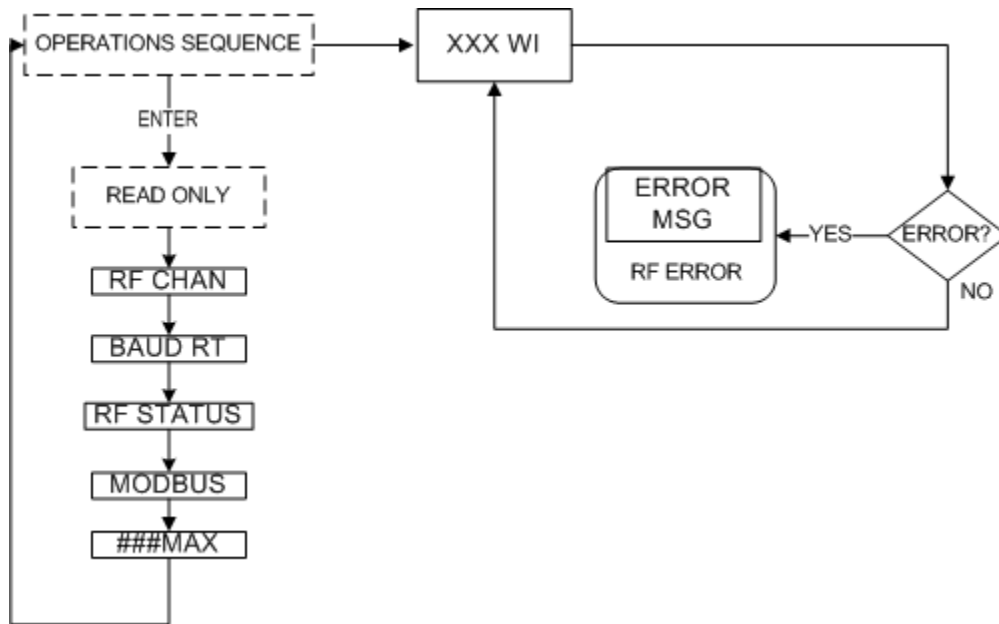


Figure 4-2 The Read Only Sequence

4.2 Overall Configuration Menu Map

A complete Base Radio Menu Map is shown in Appendix B. Below is an overall view of the configuration menu to aid the user in setting up the Base Radio for proper operation.

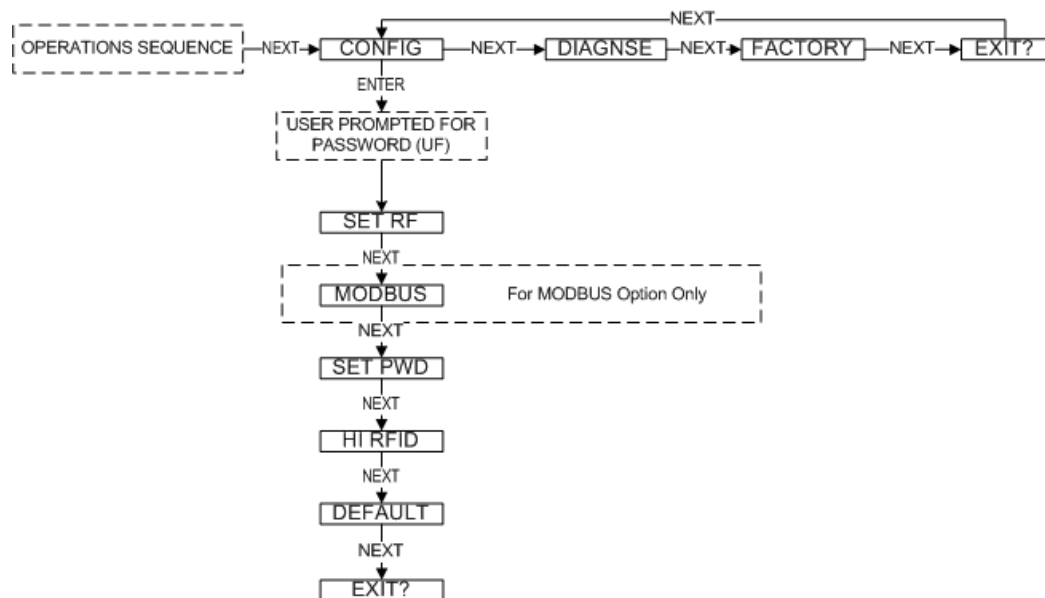


Figure 4-3 Overall Configuration Menu Map



Note The user must enter a four-digit password to enter the CONFIG and DIAGNSE. The FACTORY menu is for factory use only. The default user password is 0000. For more information on the password see Section 4.3.

4.3 Setting the User Password

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

The password is a four-digit password. The factory default is 0000. If you wish to select a different password, follow the Base Radio Menu Map shown in Figure 4.5 to change it.

If you forget your password you must call your Honeywell Sales Representative to have it reset.

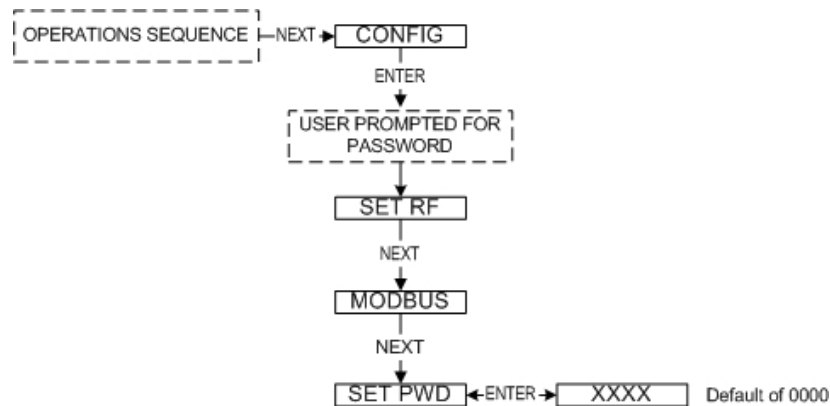


Figure 4-5 Menu Map to Password Setting

5 Configuring the RF Communications

In order for the Base Radio and the Transmitter to communicate they must be on the same RF Channel, and must be transmitting at the same Baud Rate. All Transmitters and Base Radios are set to RF OFF default configurations at the factory, and must be field configured for proper operation. The subsections are as follows:

- 5.1: RF Channel Selection
- 5.2: RF Baud Rate Selection
- 5.3: High RF ID Setting



Warning! If the Transmitters 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 Transmitters will only search for the Base Radio every one hour or so. Turning the Transmitters off and back on will cause them to begin searching immediately.

5.1 RF Channel Selection

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

Each Base Radio comes from the factory set to the RF OFF channel. This means the Base Radio will not communicate with any Transmitters. To set the Base Radio for communication, first determine the channel that you wish to use. To determine which RF Channel to use, you should know if there are any other Base Radios in the same vicinity and then choose a different channel number. After deciding on the RF channel number, then follow the Base Radio menu map shown below in Figure 5-1 to configure the RF Channel.

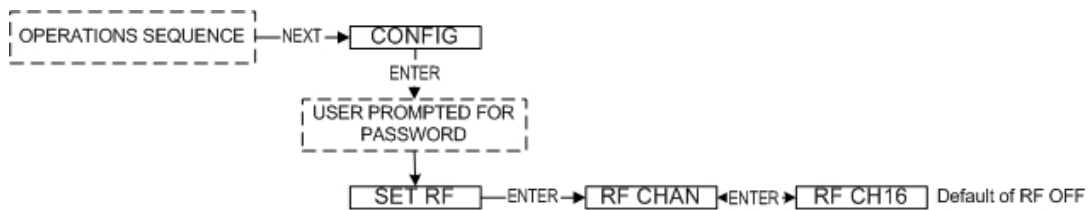


Figure 5-1 Menu Map to RF Channel Setting

Once you are in the RF Channel menu, you can increment it by pressing the NEXT button. When selecting the RF Channel, do not choose an RF Channel that is currently being used by other Honeywell 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 Transmitters communicate. There are three selectable settings with the quickest update times and longest communication ranges listed below:

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

A faster RF Baud Rate will allow you to transmit more information in a certain period of time, but it will also limit your range. If you need more distance out of your Transmitters or are encountering difficulties by frequently losing communications, then select a slower baud rate or switch to a high gain antenna.



Note If you change the baud rate of the Base Radio, you must also change the baud rate of all other Transmitters that are communicating with that Base Radio.

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.

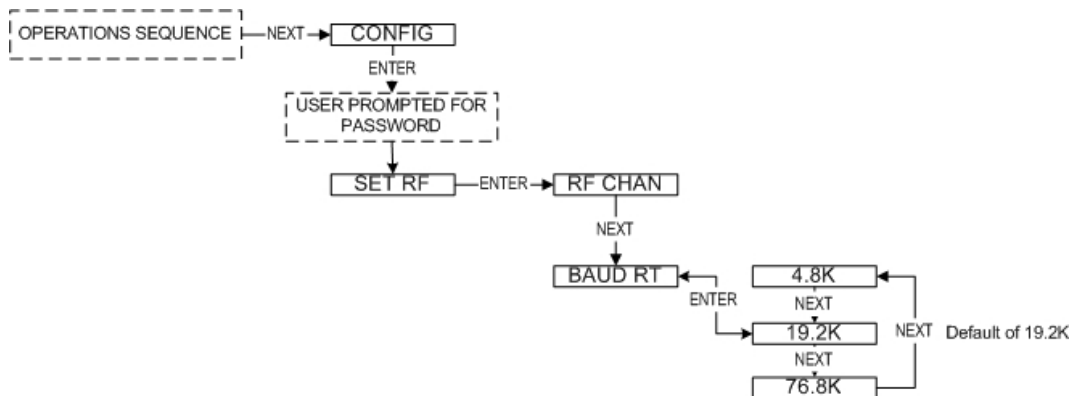


Figure 5-2 Menu Map to RF Baud Rate Setting

5.3 High RF ID Setting

The Base Radio uses this parameter along with the RF CHAN and BAUD RT parameters to set up communication with Transmitters. This setting should be a number between 1 and 100 corresponding to the Transmitter with the highest RFID on the system. Any Transmitter with an RFID set above the HI RFID setting will not communicate with the Base Radio. The factory default is 001.

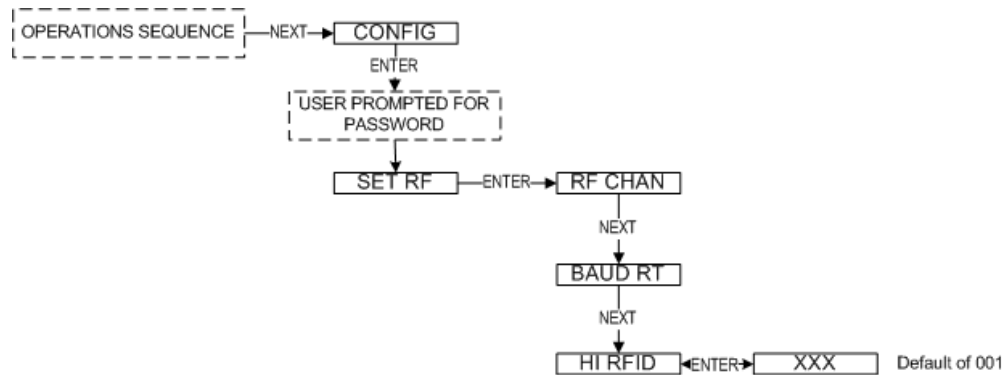


Figure 5-3 High RFID Setting



Note that the Output Modules with firmware prior to 1.7 (purchased before May 2006) will not work with the Base Radio when the HI RFID setting is set above 50.

6 Configuring the Modbus Communications

The subsections are as follows:

- 6.1: Base Radio Setup
 - 6.1.1: *Modbus Baud Rate Setting*
 - 6.1.2: *Modbus Device ID Setting*
 - 6.1.3: *Modbus Parity Setting*
 - 6.1.4: *Modbus Mapping Mode Setting*
- 6.2: Modbus Communication Protocol
- 6.3: Modbus Commands
 - 6.3.1: *Command 03-Read Holding Registers*
 - 6.3.1.1: *Base Radio Holding Registers*
 - 6.3.1.1.1: *Base Radio Device Type Holding Registers*
 - 6.3.1.1.2: *Base Radio Device Status Holding Registers*
 - 6.3.1.1.3: *Base Radio On/Offline Transmitter Registers*
 - 6.3.1.2: *Transmitter Holding Registers*
 - 6.3.1.2.1: *Transmitter Device Type Holding Registers*
 - 6.3.1.2.2: *Transmitter Device Status Holding Registers*
 - 6.3.2: *Command 08- Diagnostic*
 - 6.3.3: *Command 11- Get Com Event Counter*
 - 6.3.4: *Command 12- Get Com Event Log*
 - 6.3.5: *Command 17- Report Slave ID*
 - 6.3.6: *Command 43- Read Device ID*
- 6.4: Base Radio Holding Registers
 - 6.4.1: *Base Radio Device Type Registers*
 - 6.4.2: *Base Radio Device Status Registers*
 - 6.4.3: *Base Radio On/Offline Transmitter Registers*
- 6.5: Transmitter Holding Registers
 - 6.5.1: *Device ID Mapping Mode*
 - 6.5.2: *Register Mapping Mode*
 - 6.5.3: *Transmitter Device Type Holding Registers*
 - 6.5.4: *Transmitter Device Status Registers*



Note This device supports Modbus RTU (Binary) communications. Note that the ASC-II transmission mode is not supported.

6.1 Base Radio Setup

The purpose of this section is to guide you through the configuration of the Base Radio in order to enable communications with your particular Modbus Protocol.

6.1.1 Modbus Baud Rate Setting

In order for the Base Radio to communicate with other devices, such as the server computer or an existing PLC/DCS system, they must share the same Modbus Baud Rate.

To set the Modbus Baud Rate, first determine which rate your system requires. If your system will allow any baud rate, we suggest you use the fastest setting; however, some systems cannot handle these faster baud rates due to external noise and transmission

distance. If you encounter communication problems between the Base Radio and server computer or existing system, try a slower baud rate setting.

Once you have determined the Modbus Baud Rate you wish to use, follow the Base Radio menu map shown in Figure 6-1 to configure the Baud Rate. The factory default is 19.2 K.

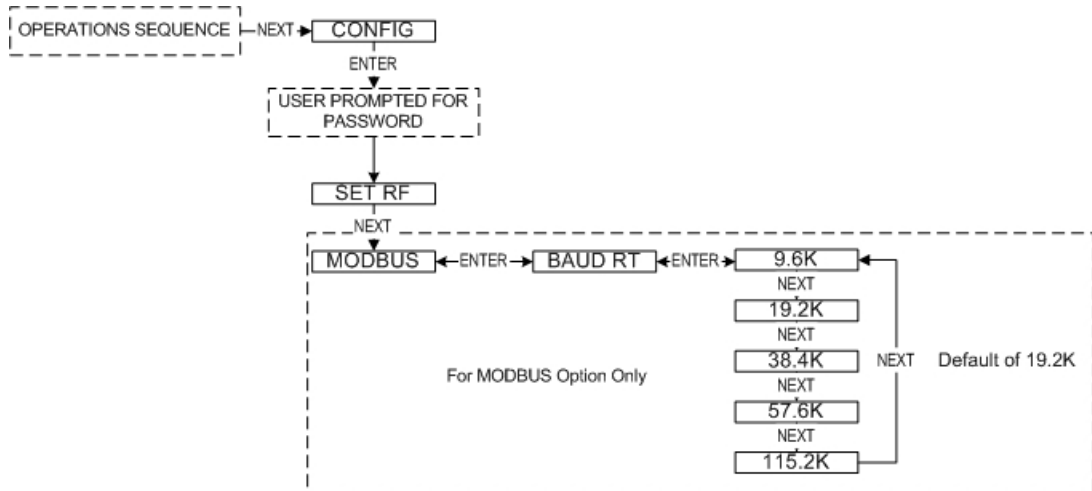


Figure 6-1 Menu Map to Modbus Baud Rate Setting

6.1.2 Modbus Device ID Setting

The Modbus Device ID allows a PLC or DCS to find the proper Base Radio on a RS-485 Network.

Because Modbus needs a device ID for each Transmitter, they have been virtually mapped according to the Base Radio with which they are communicating. The device ID range is dependent on the MODMAP setting in the Base Radio. (See Modbus Mapping Mode section 6.1.4 for more information.)

In the Register Mapping Mode you may select any device ID from 1 to 247. This number will be the device Modbus device ID at which all the readable registers for the Base Radio and every Transmitter will be located. More detail about each register, and its meaning can be found in the Modbus Communications Protocol section.

In the Device ID Mapping Mode you may select any device ID from 1 to 247 minus the number of Transmitters communicating with this Base Radio. The change in the device ID ceiling is due to the fact that each Transmitter's device ID is located at its RF ID + the Base Radio device ID. Thus you need the space beyond the Base Radio address to contain all of the Transmitters' addresses.

For example: If there are two Base Radios on the Modbus RS-485 network, and each of the two Base Radios are communicating with three Transmitters, the device ID scheme would result as follows:

- Base Radio with Modbus device ID 001
 - ⇒ Transmitter with RF ID 1 is found at Modbus device ID 002
 - ⇒ Transmitter with RF ID 2 is found at Modbus device ID 003
 - ⇒ Transmitter with RF ID 3 is found at Modbus device ID 004
- Base Radio with Modbus device ID 101
 - ⇒ Transmitter with RF ID 1 is found at Modbus device ID 102
 - ⇒ Transmitter with RF ID 2 is found at Modbus device ID 103
 - ⇒ Transmitter with RF ID 3 is found at Modbus device ID 104

More detail about the registers at each address, and their meaning, can be found in the Modbus Communications Protocol section.

Once you have determined the Modbus Device ID you wish to use, follow the Base Radio menu map shown in Figure 6-2 to configure the device ID. The factory default is 001:

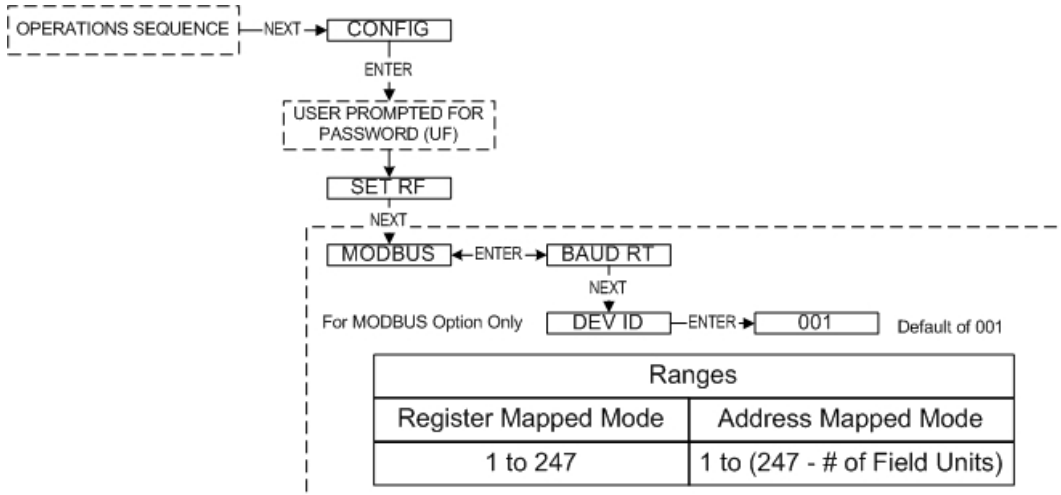


Figure 6-2 Menu Map to Modbus Device ID Setting



Note The Base Radio provides different Device ID modes in order to support a wide range of Modbus equipment.

In the **Register Mapping Mode** the data for the Base Radio and all Transmitters are located under a single device ID. This ID may be any allowable Modbus address between 1 and 247 that doesn't conflict with an address of existing device or Modbus network.

In the **Device ID Mapping Mode** each Transmitter is given its own unique ID and registers. The Transmitter ID is equal to the value of the Base Radio ID added to the Transmitters RF ID.



Note Make sure that the **HI RF ID** setting has been configured properly or the Modbus addressing scheme could be affected.

To properly set the **HI RF ID** setting see Section 4.2.

6.1.3 Modbus Parity Setting

The Modbus Parity distinguishes which type of parity is used to validate each packet of information on the RS-485 Network. The type of parity required is usually indicated by the user's PLC.

Selecting EVEN or ODD parity will automatically include one STOP bit per frame. Selecting a parity of NONE will automatically include two STOP bits as per the Modbus communications specification.

Follow the Base Radio menu map shown in Figure 6-3 to configure the parity. The factory default is EVEN parity.

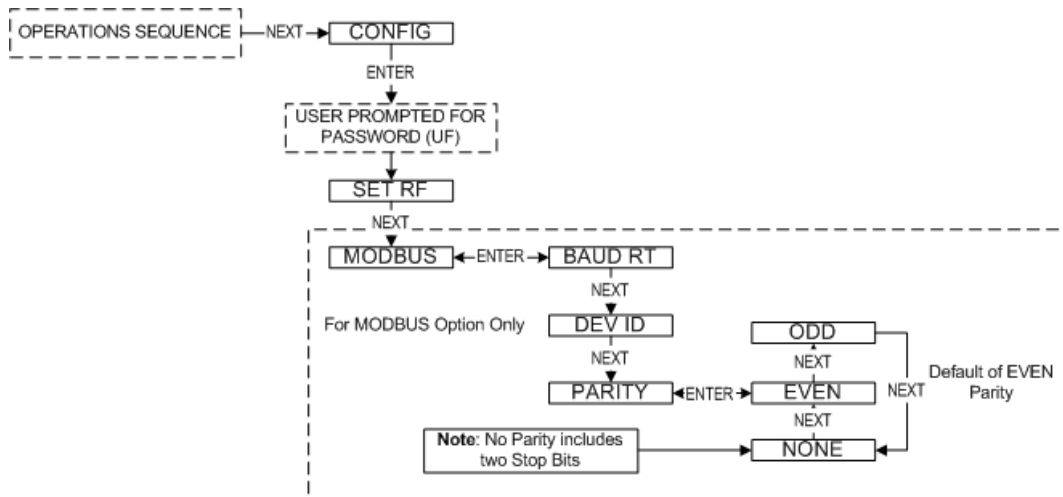


Figure 6-3 Menu Map to Modbus Parity Setting

6.1.4 Modbus Mapping Mode Setting

The Modbus Mapping mode distinguishes which type of mapping mode is used to map the Modbus registers according to the device IDs.



Note Make sure that the **HI RF ID** setting has been configured properly or the Modbus addressing scheme could be affected. To properly set the **HI RF ID** setting see Section 4.2.

There are two possible mapping modes that can be used. The first is the Device ID mapping mode. Using this mode gives the Base Radio a device ID equal to its device ID setting. There are then 10 Modbus registers located at this device ID for this Base Radio. Each Transmitter communicating with this Base Radio is then located at device ID X, where X is the RF ID of the Transmitter + the Device ID of the Base Radio. There are 10 Modbus registers for each Transmitter located at that Unit's device ID. For more information on the registers, see Section 6.2: Modbus Communications Protocol.

The other possible mapping mode that can be used is the Register Mapping mode. Using this mode gives the Base Radio a device ID equal to its device ID setting. Then, the 10 Base Radio Modbus registers are registers 1 – 10, and the Transmitter with RF ID 1 is located at the SAME device ID as the Base Radio but its registers are registers 11-20. Each subsequent Transmitter is mapped similarly. For more information on the registers, Section 6.2: Modbus Communications Protocol.

Follow the Base Radio menu map, shown in Figure 6-4, to configure the mapping mode. The factory default is the Device ID mode.

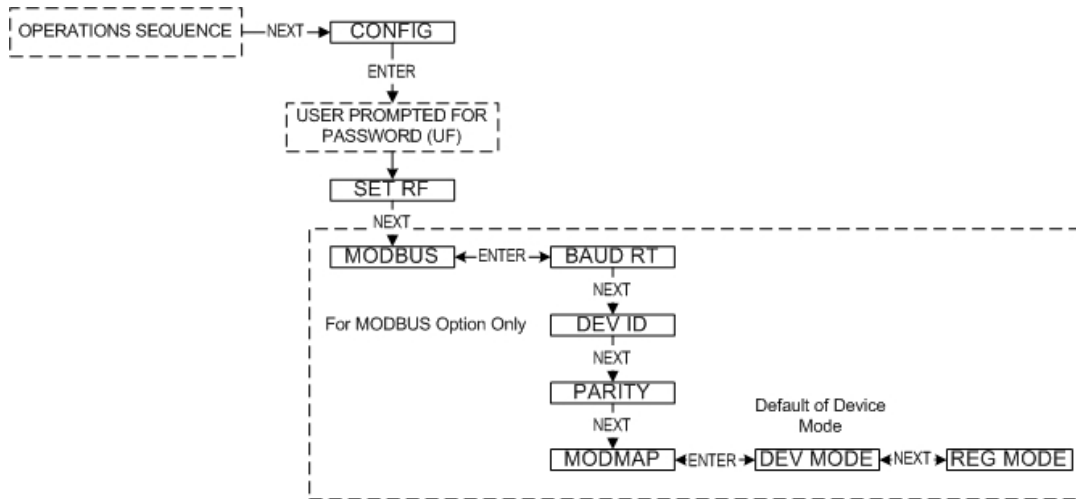


Figure 6-4 Menu Map to Modbus Mapping Mode Setting

6.2 Modbus Communication Protocol

The Base Radio connects to the Host (Master) system using Modbus over a serial RS-485 line. The Base Radio supports Modbus RTU transmission mode at baud rates of 9600, 19200, 38400, 57600, or 115200 baud with even, odd, or no parity and 8 data bits. One stop bit is used if even or odd parity is selected and two stop bits are used if the no parity option is selected to fill out the character frame to a full 11-bit character. Unless modified by the user, default values of 19200 baud, 8 data bits, even parity, and one stop bit are used.



Note This device supports Modbus RTU (Binary) communications. Note that the ASC-II transmission mode is not supported.

The Base Radio is always located at the device ID selected by the **DEV ID** menu item. Transmitters can be configured either to be assigned to an individual Modbus device ID or to holding registers within the Base Radio device ID through the appropriate selection in the **MODMAP** menu item. There are two **MODMAP** modes available: **DEV MODE** and **REG MODE**.

If the device ID mode (**DEV MODE**) is selected, a Transmitter's data may be accessed with the Modbus Read Holding Register Command (03) by using the Transmitter's equivalent Modbus device ID. The Transmitter's equivalent Modbus device ID is the Base Radio's device ID + the Transmitter's RF ID. For example, if the Base Radio's device ID was 10 and a Transmitter's RF ID was 5, the Transmitter would be accessed under Modbus device ID 15. Using the device ID mapping mode adjusts the upper limit of the Base Radio's device ID to 247 minus the number of Transmitters on the RF network. For example, if 5 Transmitters were on the Base Radio's network, the maximum Modbus device ID would be 242.

If the register-mapping mode (**REG MODE**) is selected, a Transmitter's data may be accessed with the Modbus Read Holding Register command (03) using the Base Radio's

device ID. The Base Radio uses register addresses 1 through 10 with each subsequent group of 10 registers used by a Transmitter.

The RF online/offline status of a Transmitter can be determined through a number of different sources. In the Base Radio holding registers, a count of the current number of online Transmitters can be found at address 00004. Also the individual online/offline status of each Transmitter is stored in the Base Radio holding registers at addresses 00005, 00006, 00007, and 00008. These registers are bit field variables with each bit of the 16-bit number representing the status of a Transmitter. If the bit is set, the corresponding Transmitter is online. If the bit is cleared, the corresponding Transmitter is offline.

In the Transmitter holding registers, bit 1 in the Transmitter & Sensor Status holding register holds the online/offline status of the particular device. Any Transmitter that is currently offline will return NaN (Not a Number) when queried for its primary or secondary measurement value. Note that if a Transmitter is online and is a single measurement device type, NaN will also be returned for the Secondary Sensor Value, as the measurement does not exist in these devices.

6.3 Modbus Commands

The Base Radio responds to six Modbus commands including the Read Holding Registers (03), Diagnostic (08), Get Com Event Count (11), Get Com Event Log (12), Report Slave ID (17), and Read Device Identification (43). The Read Holding Registers command provides the bulk of the functionality with the remaining commands being used for diagnostics/troubleshooting purposes. No other Modbus commands are supported and will be responded to with an ILLEGAL FUNCTION exception (code 01). A description of each command code is listed in the following sections.

6.3.1 Command 03-Read Holding Registers

This command is used to read the contents of a contiguous block of holding registers in a Base Radio or Transmitter. If an invalid register address is requested, an ILLEGAL DATA ADDRESS exception (code 02) will be returned.

Section 6.4 lists the holding registers for the Base Radio and Transmitters, as well as how to understand the contents of the registers.

6.3.2 Command 08- Diagnostic

This command provides a number of tests for checking the communications between the Base Radio and the Host master device.

| Subfunction Code | Transmitter Device Status |
|------------------|---|
| 0 | Return Query Data |
| 1 | Restart Communications Option |
| 2 | Return Diagnostics Register |
| 3 | Change ASC-II Input Delimiter (NOT SUPPORTED) |
| 4 | Force Listen Only Mode |
| 5-9 | NOT USED |
| 10 | Clear Counters & Diagnostics Register |
| 11 | Return Bus Message Count |

| Subfunction Code | Transmitter Device Status |
|------------------|--------------------------------------|
| 12 | Return Bus Communication Error Count |
| 13 | Return Bus Exception Error Count |
| 14 | Return Slave Message Count |
| 15 | Return Slave No Response Count |
| 16 | Return Slave NAK Count |
| 17 | Return Slave Busy Count |
| 18 | Return Bus Character Overrun Count |
| 19+ | NOT USED |

Note that identical information is returned for any device ID that the Base Radio has control of (i.e. including Transmitters mapped to virtual device IDs when operating in the device ID mapping mode (See Section 6.2)).

6.3.3 Command 11- Get Com Event Counter

This command returns a two-byte status word and the device's event counter. The status word will either be 0 or 65535 if the previous command is still being processed. The event counter is incremented for each successful message received. The counter is not incremented for commands that return exception responses or commands that fetch event counters. The event counter will eventually roll over to 0 after reaching a count of 65535. Note that identical information is returned for any device ID that the Base Radio has control of (i.e. including Transmitters mapped to virtual device IDs when operating in the device ID mapping mode).

For further details on this command, please consult the Modbus protocol specification.

6.3.4 Command 12- Get Com Event Log

This command returns a status word, communications event counter, message count, and a field of bytes from the communications event log. The status word and communications event counter are identical to those returned by Command 11 (Get Com Event Counter) above. The message count is a count of the total number of messages received by this device, including messages intended specifically for this device as well as other devices on the Modbus network. The event log keeps track of information on the last 7 communications events. Note that identical information is returned for any device ID that the Base Radio is controlling (including Transmitters mapped to virtual device IDs when operating in the device ID mapping mode).

For further details on this command, please consult the Modbus protocol specification.

6.3.5 Command 17- Report Slave ID

This command returns the device type, device status, and a run indicator status byte. The 16-bit device type and device status words are identical to those held in the holding registers. The run indicator status byte is 255 (0xFF hex) if the device is online and 0 (0x00 hex) if the device is offline. Unlike some of the other diagnostics commands, different information is returned depending on whether the device ID used in this command corresponds to the Base Radio or one of the Transmitters mapped to a device ID when operating in the device ID mapping mode.

For further details on this command, please consult the Modbus protocol specification.

6.3.6 Command 43- Read Device ID

This command returns identification information relating to the device. The conformity level of this command is level 01, basic identification (stream access only). As with most of the other diagnostic commands, identical information is returned for any device ID that the Base Radio is controlling (including Transmitters mapped to virtual device IDs when operating in the device ID mapping mode).

For further details on this command, please consult the Modbus protocol specification.

6.4 Base Radio Holding Registers

The following are the Base Radio holding registers for all mapping modes (i.e. Device ID and Register mapping modes). The values for each address are listed later in this section.



Note Use this table for RF IDs 1 through 50 and for backwards compatibility.

| Base Radio Holding Register (All Mapping Modes) | Device ID: 1 To 247 Max. | |
|---|---|---------------------|
| Register Address | Description | Register Type |
| 00001 | Device Type | 16-Bit Unsigned Int |
| 00002 | Device Status | 16-Bit Unsigned Int |
| 00003 | Number of Transmitters Expected | 16-Bit Unsigned Int |
| 00004 | Number of Transmitters Communicating | 16-Bit Unsigned Int |
| 00005 | Online/Offline Status Of Transmitters 1-16 | 16-Bit Unsigned Int |
| 00006 | Online/Offline Status Of Transmitters 17-32 | 16-Bit Unsigned Int |
| 00007 | Online/Offline Status Of Transmitters 33-48 | 16-Bit Unsigned Int |
| 00008 | Online/Offline Status Of Transmitters 49-50 | 16-Bit Unsigned Int |
| 00009 | Diagnostic Counter | 16-Bit Unsigned Int |
| 00010 | Reserved For Future Use | 16-Bit Unsigned Int |



Note Use the table below if more than 50 are being used (RF IDs 51 through 100).

| Register Address | Description |
|------------------|--|
| 10001 | Base Radio Device Type (Mirrored from the existing value at address 00001.) |
| 10002 | Base Radio Status (Mirrored from existing value at address 00002.) |
| 10003 | Number of Expected Transmitters on this Network (Mirrored from existing value at address 00003.) |
| 10004 | Number of Transmitters that are Actually Online (Mirrored from existing value at address 00004.) |
| 10005 | Online/Offline Status of Transmitters with RF IDs 1-16 (Mirrored from existing value at address 00005.) |
| 10006 | Online/Offline Status of Transmitters with RF IDs 17-32 (Mirrored from existing value at address 00006.) |

| | |
|-------|--|
| 10007 | Online/Offline Status of Transmitters with RF IDs 33-48 (Mirrored from existing value at address 00007.) |
| 10008 | Online/Offline Status of Transmitters with RF IDs 65-80 (New information.) |
| 10009 | Online/Offline Status of Transmitters with RF IDs 65-80 (New information.) |
| 10010 | Online/Offline Status of Transmitters with RF IDs 81-96 (New information.) |
| 10011 | Online/Offline Status of Transmitters with RF IDs 97-100 (New information.) |

6.4.1 Base Radio Device Type Registers

The Base Radio Device Type value is 255. This is the only possible value for the Device Type holding registers for a Base Radio. Note that the register is a 16-bit unsigned int for Base Radios.

6.4.2 Base Radio Device Status Registers

The following are the values for the Device Status holding registers. These registers are bit field registers represented as a 16-bit unsigned int for Base Radios.

| Value | Base Radio Device Status |
|-------|--------------------------|
| 1 | Base Radio Online |
| 2+ | Reserved For Future Use |

6.4.3 Base Radio On/Offline Transmitter Registers

Below are the values for the Online/Offline Status of Transmitters 1-16 holding register in the Base Radio. The other online/offline status holding registers hold the status of the remaining Transmitters with RF IDs 17 through 50.

| Value | Transmitter Device |
|-------|------------------------------|
| 1 | Transmitter 1 Online Status |
| 2 | Transmitter 2 Online Status |
| 4 | Transmitter 3 Online Status |
| 8 | Transmitter 4 Online Status |
| 16 | Transmitter 5 Online Status |
| 32 | Transmitter 6 Online Status |
| 64 | Transmitter 7 Online Status |
| 128 | Transmitter 8 Online Status |
| 256 | Transmitter 9 Online Status |
| 512 | Transmitter 10 Online Status |
| 1024 | Transmitter 11 Online Status |
| 2048 | Transmitter 12 Online Status |
| 4096 | Transmitter 13 Online Status |
| 8192 | Transmitter 14 Online Status |
| 16384 | Transmitter 15 Online Status |
| 32768 | Transmitter 16 Online Status |

To decode the status register, take the value of the register and subtract the largest value listed in the table above that does not cause the result to be negative. Take the resulting

total from the subtraction and subtract the next largest number possible and so on until the result is zero. Each value that was used in the subtraction indicates that the Transmitter is online.

For example: The On/Offline Status holding register contains the value 15. In this case the largest value we can subtract is 8, which leaves a result of 7. Now we can subtract 4 from 7 and get 3. Now subtract 2 from 3 and we get 1. Finally we subtract 1 from 1 and get 0, so we are done. Which Transmitters are online? We subtracted 8,4,2 and 1, and these numbers correspond to Transmitters' with RF IDs 1,2,3 and 4.



Note An alternate method to determining which Transmitter(s) are online is to look at the Base Radio Holding Register as a binary number with the rightmost bit representing Transmitter 1 and the leftmost bit representing Transmitter 16. For example, the binary representation for Transmitters 1-4 online is as follows:

000000000001111

In another example, say the On/Offline Status holding register contains the value 6. We can subtract 4 to get 2. Then we can subtract 2 to get 0. Thus Transmitter 2 and 3 are online, but Transmitters 1 and 4 are offline.

6.5 Transmitter Holding Registers

The following are the Transmitter holding registers when used in the **Device ID Mapping Mode** (First Table) and the **Register Mapping Mode** (Second Table).

6.5.1 Device ID Mapping Mode

| Transmitter Holding Registers (DEVMODE Only) | Device ID = Base Radio Modbus ID + RF ID | |
|--|--|----------------|
| Register Address | Description | Register Type |
| 00001 | Device Type | 32-Bit IEEE |
| 00002 | Device Type | Floating Point |
| 00003 | Device Status | 32-Bit IEEE |
| 00004 | Device Status | Floating Point |
| 00005 | Primary Sensor Value | 32-Bit IEEE |
| 00006 | Primary Sensor Value | Floating Point |
| 00007 | Secondary Sensor Value | 32-Bit IEEE |
| 00008 | Secondary Sensor Value | Floating Point |
| 00009 | Tertiary Sensor Value | 32-Bit IEEE |
| 00010 | Tertiary Sensor Value | Floating Point |

6.5.2 Register Mapping Mode

| Transmitter Holding Registers (REGMODE Only) | Device ID = Base Radio Modbus ID | |
|--|----------------------------------|----------------|
| Register Address | Description | Register Type |
| 00001 + (RF ID * 10) | Device Type | 32-Bit IEEE |
| 00002 + (RF ID * 10) | Device Type | Floating Point |
| 00003 + (RF ID * 10) | Device Status | 32-Bit IEEE |
| 00004 + (RF ID * 10) | Device Status | Floating Point |

| | | |
|----------------------|------------------------|----------------|
| 00005 + (RF ID * 10) | Primary Sensor Value | 32-Bit IEEE |
| 00006 + (RF ID * 10) | Primary Sensor Value | Floating Point |
| 00007 + (RF ID * 10) | Secondary Sensor Value | 32-Bit IEEE |
| 00008 + (RF ID * 10) | Secondary Sensor Value | Floating Point |
| 00009 + (RF ID * 10) | Tertiary Sensor Value | 32-Bit IEEE |
| 00010 + (RF ID * 10) | Tertiary Sensor Value | Floating Point |



Note If you have purchased any Wireless **Differential Pressure Transmitters**, please see the User Guide for specific Modbus holding register differences from those listed in the following sections.

6.5.3 Transmitter Device Type Holding Registers

The following are possible values for the Device Type holding registers. Note that the register is a 32-bit floating point value for Transmitters.

| Value | Device Type |
|-------|---|
| 0 | Acoustic Monitor Transmitter |
| 1 | RTD Transmitter |
| 2 | Pressure Transmitter |
| 3 | Dual 0-10V Input Transmitter |
| 4 | Dual 4-20mA Input Transmitter |
| 5 | Thermocouple Transmitter |
| 6 | Reserved |
| 7 | Level Sensor Transmitter |
| 8 | Split RTD Transmitter |
| 9 | Split Pressure Transmitter |
| 10 | Split Dual Thermocouple Transmitter |
| 11 | Differential Pressure Transmitter (100 IN. H2O) |
| 12 | Split Differential Pressure Transmitter (100 IN. H2O) |
| 13 | Differential Pressure Transmitter (300 IN. H2O) |
| 14 | Split Differential Pressure Transmitter (300 IN. H2O) |
| 15 | Differential Pressure Transmitter (25 PSID) |
| 16 | Split Differential Pressure Transmitter (25 PSID) |
| 17 | Differential Pressure Transmitter (100 PSID) |
| 18 | Split Differential Pressure Transmitter (100 PSID) |
| 19 | Differential Pressure Transmitter (300 PSID) |
| 20 | Split Differential Pressure Transmitter (300 PSID) |
| 21 | Reserved |
| 22 | Reserved |
| 23 | Gauge and Submersible Level Transmitters |
| 24 | Split Gauge and Submersible Level Transmitters |
| 25 | Advanced Development |
| 26 | Switch Input Transmitter |
| 27 | Switch Input Transmitter with Output Options |

6.5.4 Transmitter Device Status Registers

The following are the values for the Device Status holding registers. These registers are bit field registers represented as a 32-bit floating point values for Transmitters.

| Value | Transmitter Device Status |
|-------|--|
| 1 | Transmitter Online |
| 2 | Low Battery Condition |
| ▶ 4 | Alarm Condition (WN571 only) |
| 8 | Sensor Error Condition |
| 16 | Sensor Overrange Condition |
| 32 | System Error Condition |
| 64 | Switch Input 1 Closed |
| 128 | Switch Input 2 Closed |
| ▶ 256 | Sq. Root Funct. (Diff. Pressure only - see below) |

Again, like Section 6.4.3, the status can be resolved by subtracting the largest number listed above from the value received from the holding register, and then subtracting the next highest and so on until the result is 0. Each of the values used indicate the respective condition listed above.

For example, the holding register reads 9, then subtract 8 and get 1. Then subtract 1 from 1 and get 0. Thus from the list above, we have a Sensor Error Condition and the Transmitter is online.

6.6 Square Root Function

The Square Root Function only works with the Differential Pressure Transmitter. When the DP Transmitter is in Orifice mode, a Square Root calculation is performed. You have the option to display the Square Root Calculation. If this option is enabled, it will be displayed as Percent Square Root in WMT and sent to a Modbus Register.

The Square Root Calculation must be enabled through WMT. To display the Square Root Calculation, first open the Configuration dialog box for the DP Transmitter and select the Operation Mode tab. Make sure you have selected **Orifice Flow** from the mode menu. Then, from the Flow Units drop-down list, select **Percent - Vol Flow**. If the Density check box is selected, then **Percent - Mass Flow** can also be selected from the Flow Units drop-down list to show the Square Root Calculation.

7 Technical Specifications

Power Characteristics

- 10VDC-30VDC, 24 VDC @ 200mA typical

RF Characteristics

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

Output Options

- RS-485 digital communications with conversion to RS-232 or USB for interface with PC or server and WMT (WMT) (optional)
- Serial Modbus RTU (Binary) over RS-485
- Modbus over TCP/IP (via optional converter)

Physical Characteristic

- Baked enamel explosion-proof, weather-proof and corrosion-proof housing
- Electromagnetic Compatibility
- (CE Compliance)
- Operates within specification in fields from 80 to 1,000 MHz with field strengths to 10 V/m. Meets EN 50082-1 general immunity standard and EN 55011 compatibility emissions standard

Industrial Certification

- Rated for industrial use FM rated: -40°F to 185°F(-40°C to 85°C) CSA Rated: -40°F to 104°F(-40°C to 40°C)
- FM Approved as explosion-proof (XP) for Class I, Division 1, Groups B,C,&D, T6; as dust ignition-proof for Class II/III, Division 1, Groups E, F, &G, T6; indoor and outdoor (Type 4X) hazardous (classified) locations.
- CSA Approved as explosion-proof (XP) for Class I, Division 1, Groups B,C,&D, T6; as dust ignition-proof for Class II/III, Division 1, Groups E, F, &G, T6; indoor and outdoor (Type 4X) hazardous (classified) locations.
- NEMA 4X explosion-proof housing

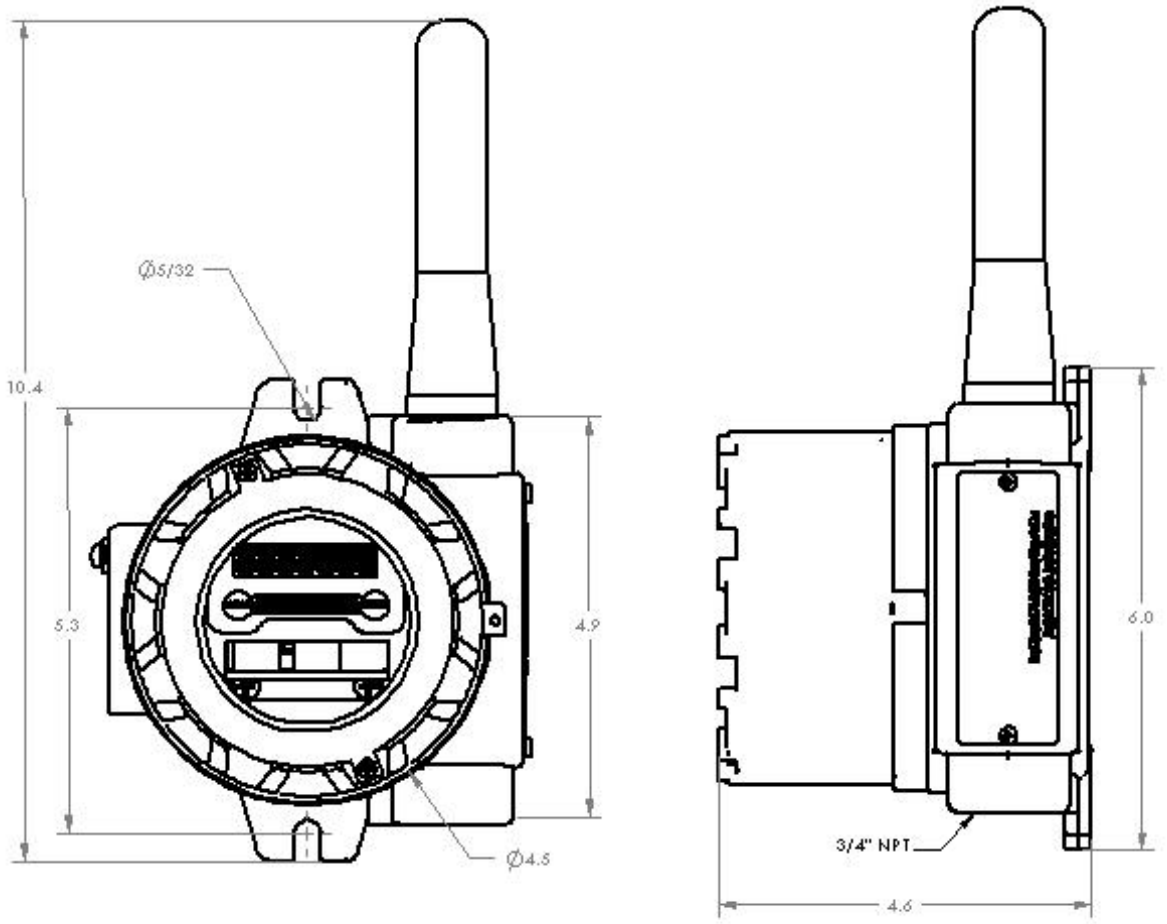


Figure 7-1 Overall Base Radio Dimensions

Appendix A Navigating the Menus

Pressing either the NEXT or ENTER buttons located on the front of the Transmitter or Base Radio just below the Liquid Crystal Display (LCD) screen is all that is needed to navigate the respective menus. Pressing both of these buttons for one second will turn the unit on.

Pressing the NEXT button at any time while the Base Radio is cycling through the normal messages causes the Base Radio 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 submenu 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 submenu that requires a numerical input, such as 001, the leftmost 0 will be blinking. This indicates that pressing the NEXT button will increment this value with each press from 0 to 9 and back to 0 again. 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 to the return from the sub menu.

Appendix B Base Radio Menu Map

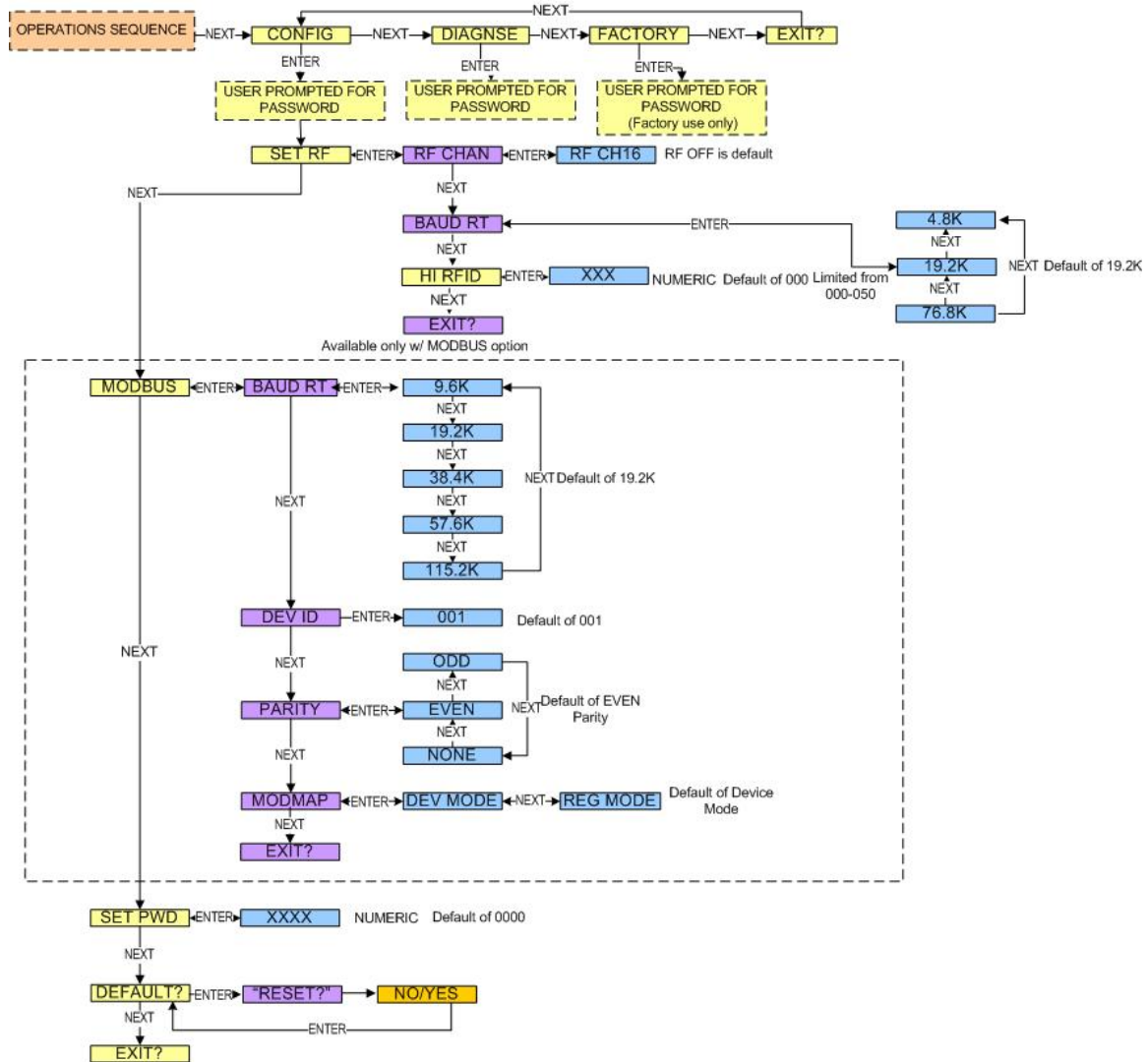


Figure A- 1 Base Radio Menu Map

Appendix C 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
```


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