

Wireless Petro-Net Modem[®]





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1. Introduction



Figure 1-1 Wireless Modem

These instructions explain setting up the modem hardware, testing the range of the radio link, some advanced (but optional) configuration possibilities and some tips for better operation.

Some installations may not be suitable for Wireless Communications. Contact OPW-FMS technical service for site survey and testing information if you are unsure of your potential installation site.

1.1 Overview

Your wireless modem can be used in many applications, including:

- Sites that cannot be connected by conduit, sites that contain obstructions, roads, railroad tracks, water, etc.
- Property with dig restrictions
- Locations with thick, reinforced concrete, such as airports, or trucking and military installations
- Up to seven (7) wireless modems can communicate within the same network.

1.2 Wireless Modem Kit

The Wireless Petro-Net Modem[®] works with the following systems:

- K800[™] (software 1.09 or higher)
- K800[™] Hybrid[®]
- System2[®]
- C/OPT[®]
- FSC3000[™]
- SiteSentinel[®] iSite[™]

The **standard kit** includes:

- Radio modems with 6 in (152.4 m) antennas
- Petro-Net connectors
- Two (2) directional antennas
- Two (2) 20 ft (6.1 m) antenna cables

2. Pre-Installation Considerations

This section provides information about Wireless Petro-Net Modem requirements and restrictions for proper installation.

2.1 Installation Restrictions and Requirements

IMPORTANT! Please Read....

- Some sites may NOT be suitable for Wireless Communication.
- Avoid metal buildings; wireless Petro-Net will not communicate through metal buildings.
- Locate the modem near a window.
- Mount the antenna on the outside of the building.
- Keep the path to the receiving modem clear. If vehicle traffic at the island blocks the view of the receiving modem, you must reposition the antenna to maintain LINE-OF-SIGHT from antenna to antenna.

Note: Improper operation due to poor installation planning is not covered under warranty; it is your responsibility to verify the suitability of the wireless application.

2.2 Conducting a Site Survey

Before you decide to install the Wireless Petro-Net Modem, you must first make sure that it will work at the desired location. Communication systems have several components that should be looked at in each system:

- Transmitting element
- Receiving device
- The environment through which communication is occurring; and
- Antennas or other focusing elements



Figure 2-1 Basic Communication System

2.2.1 Environment

The space between the transmitter and the receiver is the system's environment. This will be the main focus of your site survey. Physical obstructions and noise (interference) can enter into the environment and limit the system's ability to get information from one place to another.

Attaining RF Line-of-Sight (LOS) between the sending and receiving antennas is essential in achieving a reliable signal between the FIT and the FSC. There are two types of LOS that are generally used to describe an environment:

- Visual LOS is the ability to see from one site to the other. It requires only a straight linear path between two points.
- RF LOS requires not only visual LOS, but also a football-shaped path, called a Fresnel Zone, free of obstacles for data to optimally travel from one point to another.

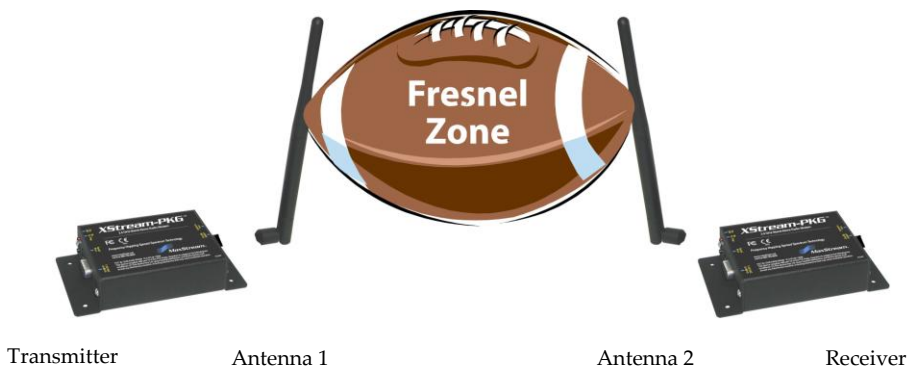


Figure 2-2 Fresnel Zone

In order to achieve the greatest range, the Fresnel Zone must be free of obstructions. Buildings, trees or any other obstacles in the path will decrease the communication range. If the antennas are mounted just barely off the ground, more than half of the Fresnel Zone ends up being obstructed by the Earth, resulting in significant reduction in range. To avoid this problem, the antennas should be mounted high enough off of the ground so that the Earth does not interfere with the central diameter of the Fresnel Zone.

It is also important to understand that the environment may change over time due to growing vegetation, building construction, etc. If obstacles exist between two points, the antennas can be raised on one end or on both ends to clear the Fresnel Zone of obstructions.

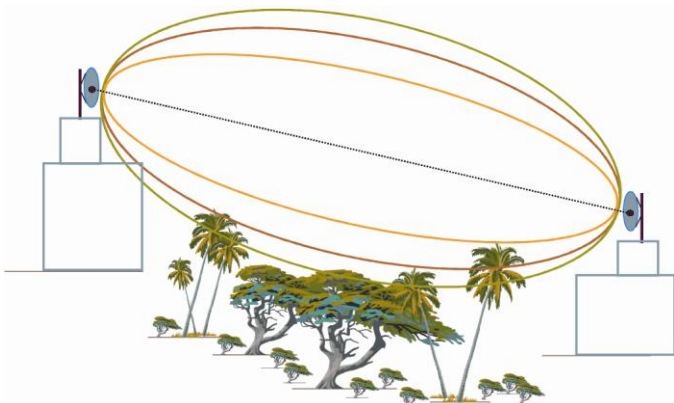


Figure 2-3 Physical Obstructions Overcome by Antenna Height

How far above the ground and other obstacles the antennas need to be is determined by the diameter of the Fresnel Zone. The diameter of the Fresnel Zone depends upon the frequency and distances between the two radios. Various data points were inserted into Fresnel Zone formulas to provide some points of reference. The following table provides approximate Fresnel Zone diameters at 1,000 ft (304.8 m) and 1-mile (1.6 km) ranges.

OPW does not recommend a distance greater than 5,000 feet (1524 m).

Table 2-1 Fresnel Zone Diameters

Range Distance	Required Fresnel Zone Diameter (900 MHz Radios)	Required Fresnel Zone Diameter (2.4 GHz Radios)
1000 ft. (300 m)	16 ft. (7 m)	11 ft. (5.4 m)
1 mile (1.6 km)	32 ft. (12 m)	21 ft. (8.4 m)

In order to have ground clearance, the combined antenna height should be equal to the diameter of the Fresnel Zone.

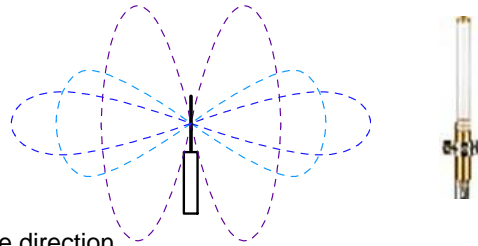
2.2.2 Increasing Antenna Gain

Transmitting and receiving antennas are used to focus and direct radio waves in specific directions. Antennas are another component that can be adjusted to increase the distance data can travel in a wireless-communication system. Antenna gain is an important variable that can be adjusted in order to increase range. Antenna gain describes the amount of focus the antenna is able to apply to the system by directing the energy. The more focus the antenna can apply, the more range the system will yield. High-gain antennas can achieve greater range than low-gain antennas, though they cover less area.

Omni-directional antennas focus energy evenly in a doughnut-shape around the antenna.

Gain vs. Vertical Beam Width (VBW)

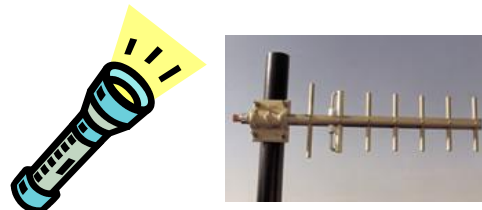
- 2.1 dBi (0 dBd) = 75° VBW
- 5.1 dBi (3 dBd) = 33° VBW
- 8.1 dBi (6 dBd) = 17° VBW



Directional antennas focus energy more specifically in one direction.

Gain vs. Vertical Beam Width (VBW)

- 8.1 dBi (6 dBd) = 70° VBW
- 11.1 dBi (9 dBd) = 55° VBW
- 15.1 dBi (13 dBd) = 35° VBW



Notice how, like the flashlight, beam width is decreased as gain is increased.

2.2.3 Mounting Considerations

When mounting an antenna, care should be taken to make sure it is as far away from metal objects as possible. If nearby metal gets too close to an antenna, it has the potential to interfere with the way the antenna radiates and may cause some undesirable results.

In some cases, a cable must be used to connect an antenna to a transmitter or receiver. All RF cables add some loss to the system. For any given cable, the longer the cable the more signal will be lost over that cable. Because of this the length of the cable should be kept as short as possible. Often a longer serial cable can be used to minimize the length of the antenna cable.

If you have two (2) wireless modems, you do not have to configure the modems and you may proceed with the installation instructions; the modems are pre-configured for two (2) or less modems.

If you have three or more wireless modems, please refer to page 26 for setting up multiple modems.

3. Typical Installations for the Wireless Petro-Net Modem®

This section covers the various mounting and wiring instructions for typical Wireless Petro-Net Modem® installations.

3.1 Typical Installations

The Wireless Petro-Net Modem® can be set up to work with various installations:

- SiteSentinel® iSite™
- FIT with Remote Antenna
- Multiple FITs
- FSC with Modem-Mounted Antenna
- FSC with Remote Modem

Check with local authority for suitability of installation.

- FSC with Remote Antenna

3.2 FIT-Mounted 6 in antenna

FIT-Mounted 6 in antenna is not suitable for all applications

When setting up the Wireless Petro-Net Modem®, you can install the antenna directly onto the FIT.

1. Connect the power supply to the power terminals in the FIT.
2. Place the modem on the bottom of the FIT.
3. Locate and drill a .375-inch hole for the antenna cable, seal this hole with silicone sealant.
4. Locate a position on the pedestal to install the antenna, drill a .25-inch hole for the connector.
5. Remember to keep line-of-sight with the FSC antenna, (e.g. this cannot be blocked by vehicle traffic at the island) otherwise proceed to FIT with remote antenna mounting.

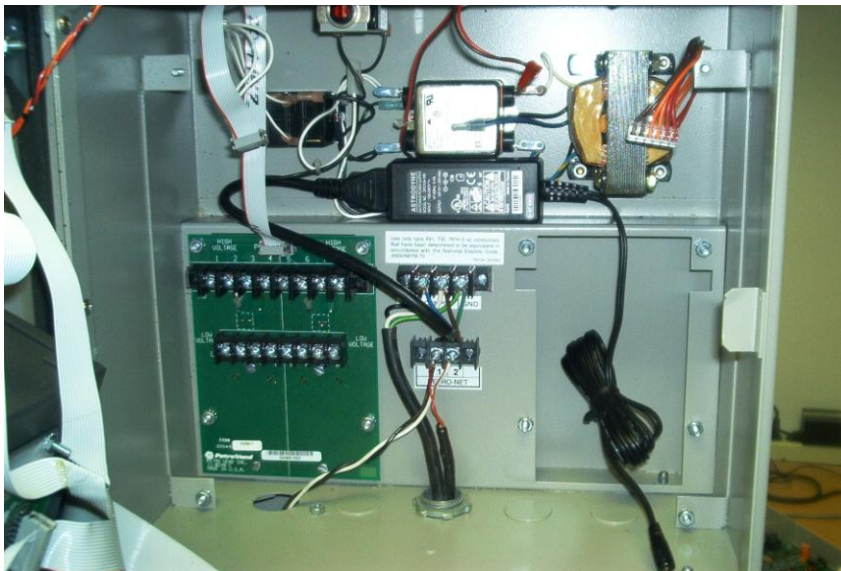


Figure 3-1 FIT-Mounted Modem Power Supply

6. Locate the power supply behind the main board.
7. Connect the power cable to the power connector on the system.
8. Connect the Petro-Net cable at this time. (Black wire to Terminal 1; White wire to Terminal 2).



Figure 3-2 FIT-Mounted Modem: Inside View

9. Place the modem on the bottom of the FIT cabinet, connect the power and Petro-Net connectors.
10. Route the 1-foot antenna cable through the .375-inch hole to the .25-inch hole in the pedestal.
11. Seal the hole in the FIT with silicone.



Figure 3-3 FIT Remote Antenna: Outside View

3.3 FIT with Remote Antenna (recommended)

The Wireless Petro-Net Modem[®] can also be set up with a remote antenna. For remote antenna mounting, attach the directional antenna to a pole or other surface using the supplied mounting brackets. Connect the 20-foot antenna cable to the modem or to the 1-foot cable in the FIT. When mounting the antenna remotely be sure to protect the antenna cable with the appropriate conduit.

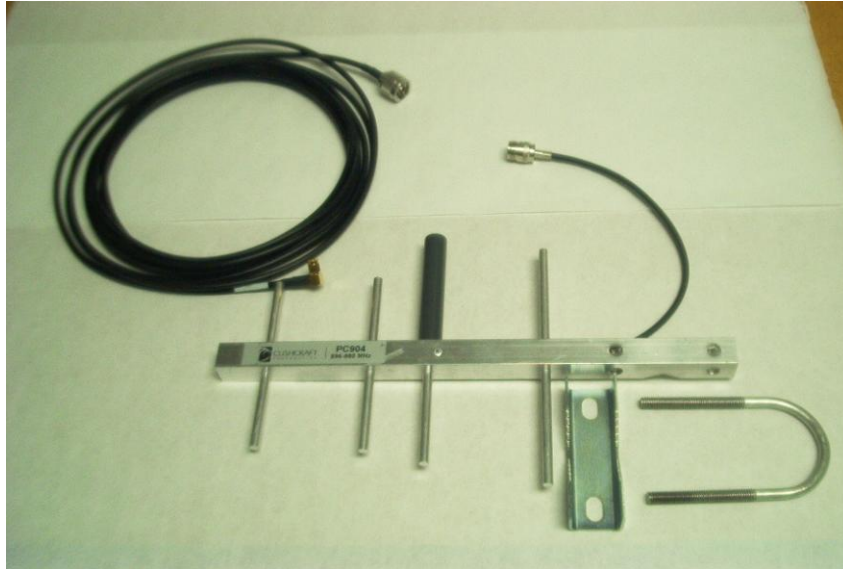


Figure 3-4 Remote Directional Antenna

3.4 Multiple FITs (Networking)

In cases where you have multiple FITs you can set up the antennas to send signals from one FIT to another.

Up to seven (7) sets of modems can operate independently in the same area.

The **Networking > HP Command** is used to set the modem's hopping channel number. In order for modems to communicate with each other, the modems must have the same channel number since each network uses a different hopping sequence. Different channels can be used to prevent modems in one network from listening to transmissions of another. For example, you could set system A to HP 1 and system B to HP 5. You can use the channels between 0 and 6. The wireless modem comes is set at 0 by default.

3.5 FSC with Remote Antenna (Recommended by Manufacturer)

In areas where line-of-sight is blocked to the FSC, you can use a remote antenna. For example, the antenna can be placed on top of the building so that it is in line-of-site with the antenna on the FIT. When determining where to place the antenna, remember to avoid all current and possible future obstructions.

1. Attach the 20-foot antenna cable to the modem.
2. Route the cable to the remote antenna.
3. Mount the antenna to a pole or suitable surface using the hardware provided.
4. Power the modem by plugging the power supply into a wall outlet.

3.6 FSC with Remote Modem

In areas where the FSC does not have a direct line-of-site with the modem and the antenna cable is too short it is necessary to use a remote modem.

1. Extend the Petro-Net cable to position the modem where desired (1,000 feet maximum).
2. Mount the modem in a secure location (or enclosure) and attach the 20-foot antenna cable to the modem.
3. Route the cable to the remote antenna.
4. Mount the antenna to a pole or suitable surface using the hardware provided.
5. Power the modem by plugging the power supply into a wall outlet.

3.7 FSC with Modem-Mounted Antenna (Not Recommended)

The antenna at the FSC can be mounted directly on the modem. This modem must be in the line-of-site with the antenna at the FIT (i.e. must be near a window).

3.8 Automated Tank Gauge Console

A wireless modem is connected to the VSmart Module to provide wireless communication option between the VSmart and the SiteSentinel® iSite™. The wireless modem should ideally be placed in an area where there is line-of-sight to the Console. Another modem is then wired to the SiteSentinel® iSite™ Console's RS-485 port.

The Wireless option will not communicate through metal buildings.

3.8.1 SiteSentinel® iSite™ with VSmart Pole-Mounted Outside

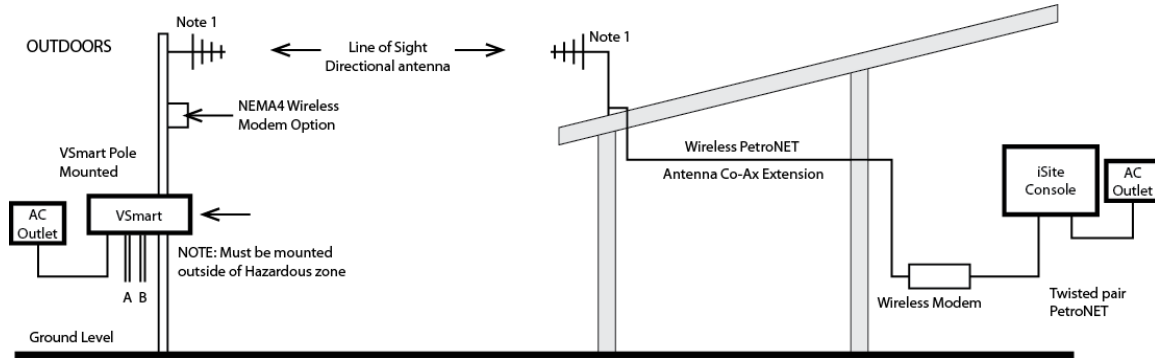


Figure 3-5 Wireless Petro-Net Installation with VSmart Pole Mounted Outside

Some installations will require an external antenna; refer to [FIT with Remote Antenna](#) on page 15 for the VSmart and console antenna installation.

3.8.2 SiteSentinel® iSite™ with VSmart in a Building

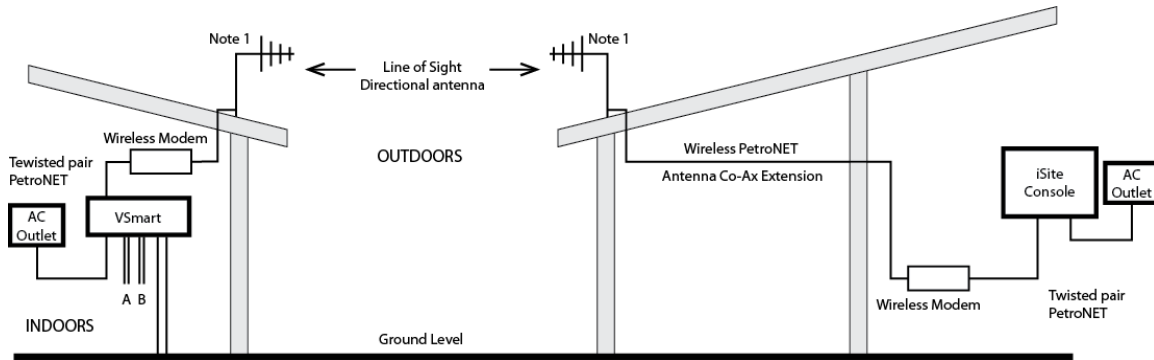


Figure 3-6 Wireless Petro-Net Installation with VSmart Inside a Building

It is highly recommended that wireless Petro-Net installations are subjected to a site survey prior to installation in order to identify potential interference problems.

3.9 Communication

After determining the range of the modems, you can permanently install and wire the remote station modem.

Polarity is critical with all RS-485 communications. Petro-Net Terminal 1 goes to pin 8 on the modem, and Terminal 2 goes to pin 2 on the 9-pin modem connector. Both modems are wired the same. Use the supplied Petro-Net connector; connect the black wire to #1 on the Petro-Net Terminal and the white to the #2 Terminal.

RS-485 (Petro-Net) polarity is critical!

3.9.1 Pre-wired Petro-Net Connector

Petro-Net	To Modem Pin #
1 (BLACK)	8
2 (WHITE)	2

3.10 FIT Wiring

The FIT must be powered by a dedicated circuit. The FIT cannot be powered by the pump circuit or reset, as communication problems will occur. The system warranty is void if this is not followed.

3.10.1 FIT Installation Location Wiring

See Fig. 3-7 on page 18.

1. Place the modem inside the FIT.
2. Connect the modem power pack to line voltage using the pigtail supplied.
3. Petro-Net: Use the supplied Petro-Net Connector and connect the black wire to #1 Terminal and white to the #2 Terminal.
4. Drill a .375-inch hole for the antenna cable in the bottom of the FIT cabinet.

When drilling through the pedestal, make sure to clean up all metal chips.

5. Route the 1-foot cable from the modem to the antenna location. (Seal this hole with silicone sealant). Be sure to maintain line-of-sight to the FSC.
6. Drill a .250-inch hole in the pedestal and attach the cable to the pedestal of the FIT and secure with the supplied nut.
7. Attach the antenna cable.

For remote antenna mounting, attach the directional antenna to a pole or other surface using the supplied mounting brackets. Antenna cables are available in 20-foot lengths. When mounting the antenna remotely be sure to protect the antenna cable with conduit.

Always keep in mind where the fuel island (remote) modem is! You must maintain a line-of-sight with the remote modem for best results.

3.11 FSC Installation Location Wiring

1. Place the modem on a table or shelf near the fuel site controller.
2. Plug the power pack into a wall outlet. Connect the cable from the power pack to the modem.

The indoor modem comes with a 6-inch antenna, for some applications this will work fine. When choosing a location, keep the REMOTE modem (at the fuel island) in mind. The modems communicate better when they are "in sight" of each other. If you experience problems, move the modem until reception is better.

3. Use the junction box cover to make the connections at the FSC. Petro-Net wire can be used to remote either modem for best performance. Limit the wire length to 1,000 feet.

In some cases, the directional remote antenna and 20-foot cable should be used to improve communications to the FSC when installed in metal buildings or other areas which may have poor signal strength.

3.12 Tank Gauge Installation Location Wiring

The SiteSentinel® iSite™ wireless Petro-Net installation requires two wireless modems:

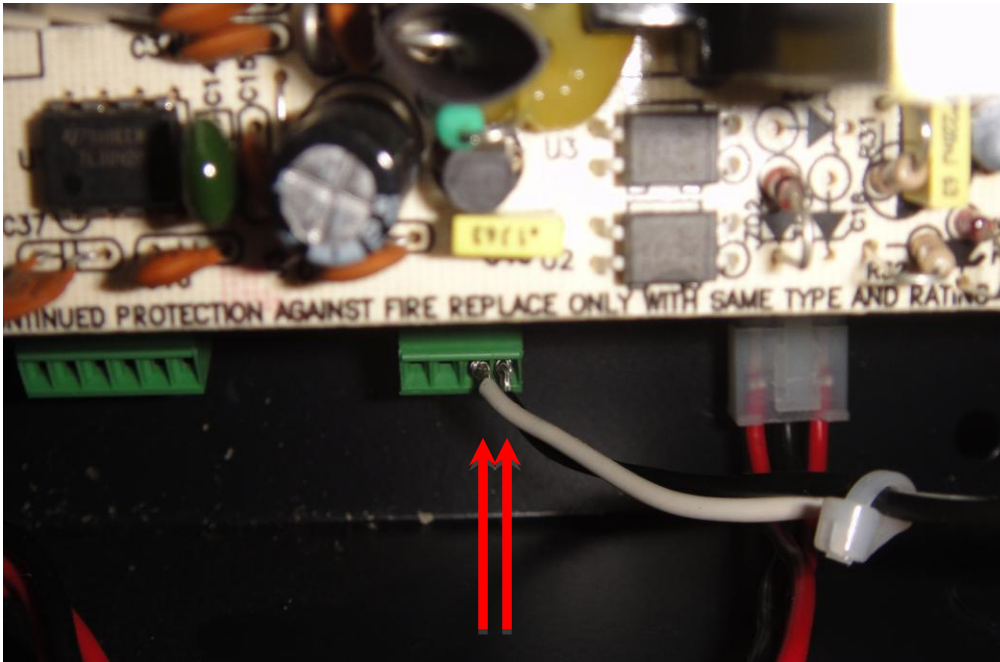


Figure 3-7 Terminal Connections to iSite Console

3.12.1 SiteSentinel® iSite™ Console Connection

1. Connect the wireless modem two-wire connector to the console Petro-Net connectors.
 - Black to terminal 1.
 - White to terminal 2.

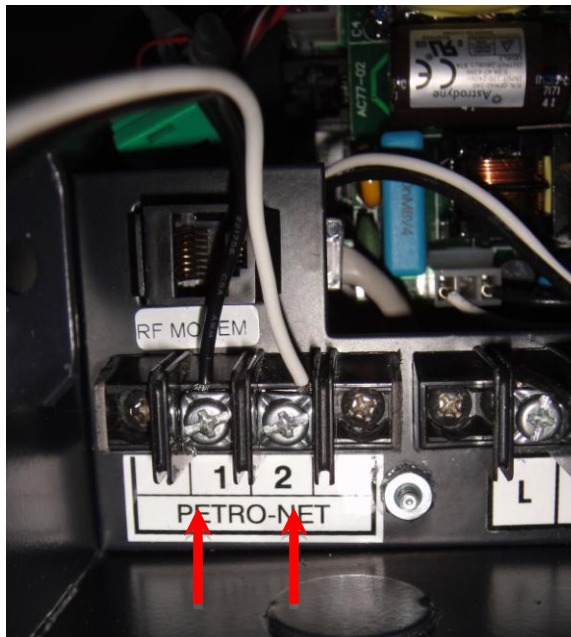


Figure 3-8 Terminal Connections to VSmart

3.12.2 VSmart Connection

1. Connect the VSmart wireless modem black and white wires to the Petro-Net terminals.
 - Black to terminal 1.
 - White to terminal 2.

4. XTEND Modem Advanced Configuration

This section describes how to configure modems with XTEND Advanced Configurations.

Advanced Modem Configuration is ONLY needed if you have 3 or more modems.

4.1 What You Will Need

A computer with Windows® 98, SE, 2000, or XP operating system and an available RS-232 (DB-9) serial com port is required for XTEND Advanced Configurations.

4.2 Configuration Settings

The Wireless Petro-Net Modem®s are configured at the factory and are ready to install. You can verify the configuration using a computer (Windows® 98, SE, 2000 or XP) and the software provided. DIP switch settings #1, #5, #6 ON to configure and run the range test; switch settings #5, #6 ON for OPW normal operation. If the site has communication interference, change the hopping channel on **both** modems to another channel.

4.3 Installing the Software

Double-click the “setup_X-CTU.exe” file and follow the prompts of the installation screens. This file is located in the *software* folder of the MaxStream CD and also under the *downloads* section of the following Web page:

www.maxstream.net/helpdesk/

- **X-CTU Software**—MaxStream provides software that can be used to:
 - **Setup** PC serial com ports to communicate with Wireless Petro-Net Modem®s
 - **Test** Wireless Petro-Net Modem® parameters
 - **Configure** Wireless Petro-Net Modem® parameters
1. Place the auto-running software CD in your computer’s CD drive.
 2. Double-click the **setup_X-CTU.exe** file.
 3. Follow the prompts.

The X-CTU software interface is divided into the four (4) following tabs:

- **PC Settings**—Setup PC serial com ports to interface with the Wireless Petro-Net Modem®
- **Range Test**—Test Wireless Petro-Net Modem®s range under varying conditions
- **Terminal**—Read/Set Wireless Petro-Net Modem® parameters and monitor data communications
- **Modem Configuration**—Read/Set Wireless Petro-Net Modem® parameters

4.4 FSC to Multiple FIT Operation (3 or More Wireless Modems)

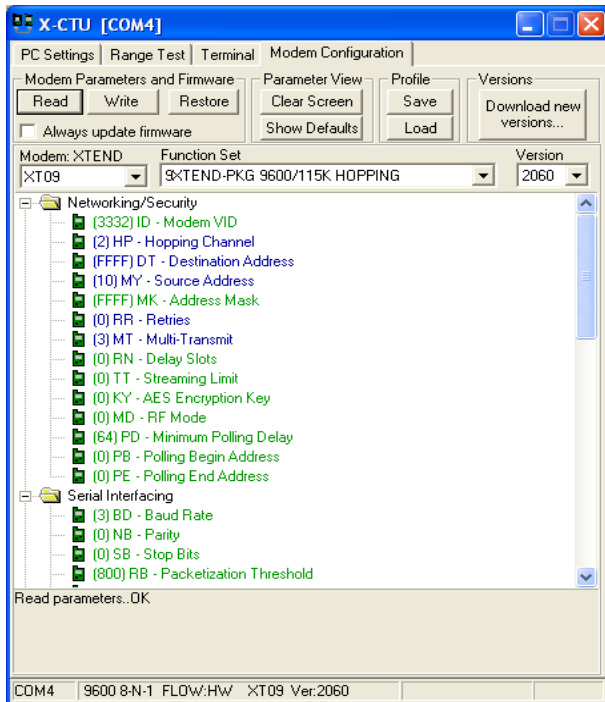
If you only have two (2) wireless modems, you do not have to configure the modems and you may proceed with the installation instructions; the modems are pre-configured for two (2) or less modems.

If you have three (3) or more wireless modems, continue with the configuration instructions below:

When configuring these modems with the XTC software, set DIP switches to #1, #5/#6 ON and all others OFF. For normal operation, #5/#6 ON and all the rest OFF.

Each modem must be configured for its EXACT location.

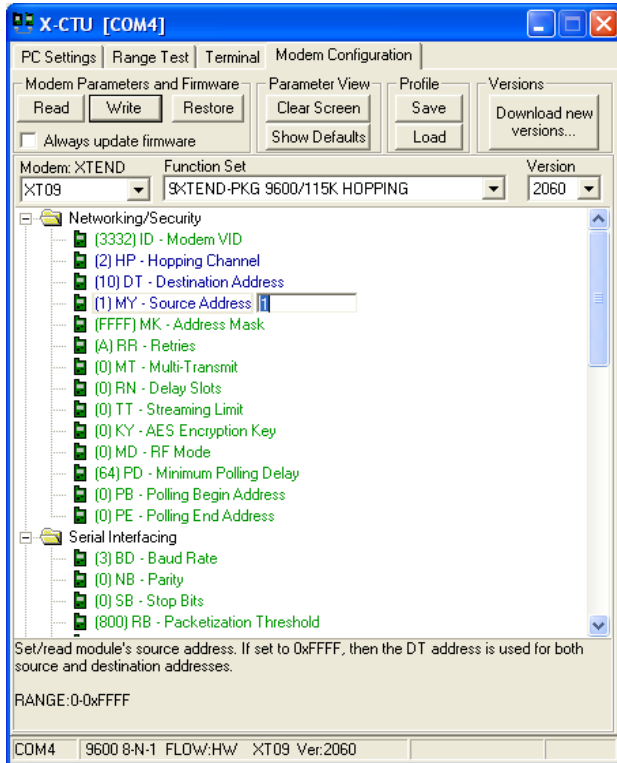
4.4.1 FSC Modem Configuration



FSC Modem	
MY	10
DT	FFFF
RR	0
MT	3
HP	Must match all modems

Figure 4-1 FSC Modem Configuration

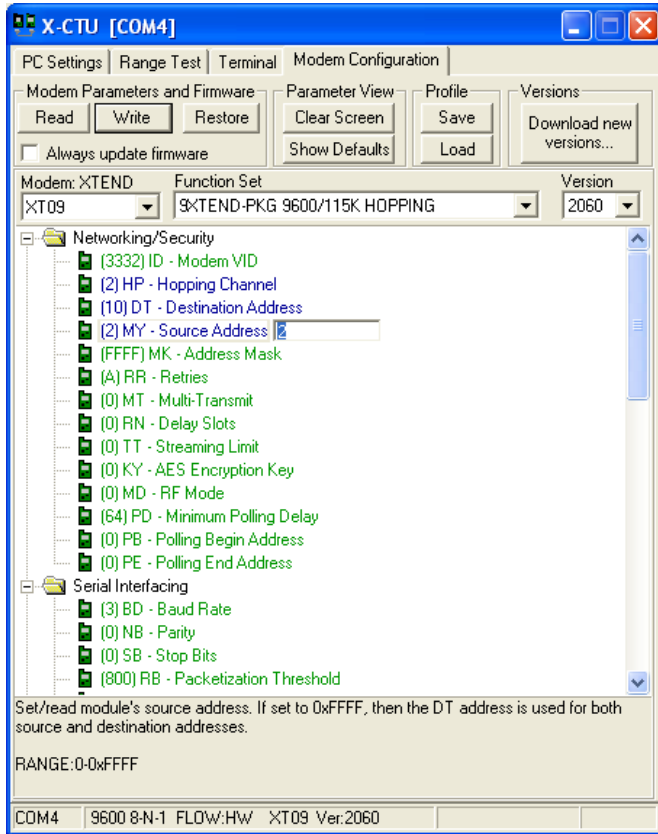
4.4.2 FIT #1 Modem Configuration



FIT #1 Modem	
MY	1 (FIT #)
DT	10 (FSC #)
RR	A
MT	0
HP	Must match all modems

Figure 4-2 FIT #1 Modem Configuration

4.4.3 FIT #2 Modem Configuration



FIT #2 Modem	
MY	2 (FIT #)
DT	10 (FSC #)
RR	A
MT	0
HP	Must match all modems

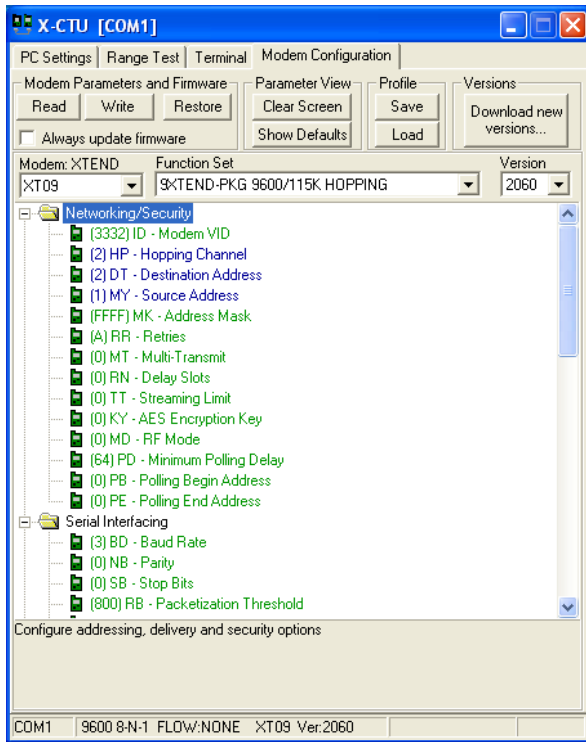
Figure 4-3 FIT #2 Modem Configuration

4.5 Point-To-Point Operation (2 Wireless Modems)

When configuring these modems with the XTC software, set DIP switches to #1, #5/#6 ON and all others OFF. For normal operation, #5/#6 ON, all the rest OFF.

It does not matter which modem is connected to the FSC or the FIT.

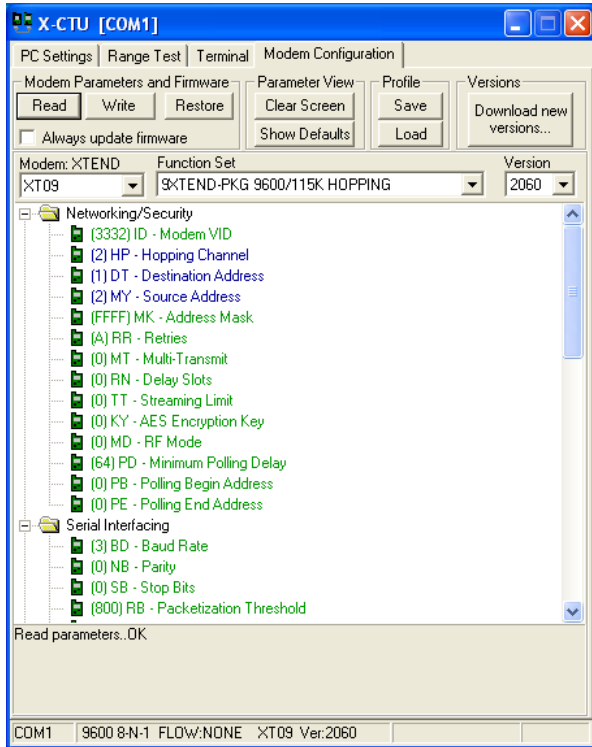
4.5.1 Modem #1 Configuration



FIT #1 Modem	
MY	1 (FIT #)
DT	2
RR	A (10)
HP	Must match all modems

Figure 4-4 Modem #1 Configuration

4.5.2 Modem #2 Configuration



FIT #2	
MY	2 (FIT #)
DT	1
RR	A (10)
HP	Must match all modems

Figure 4-5 Modem #2 Configuration

5. Operation and Troubleshooting

This section describes how to operate and troubleshoot the Wireless Petro-Net Modem®.



Figure 5-1 DIP Switches

5.1 Hardware Setup

Wireless Petro-Net Modem®s will be referred to as “Radio 1” and “Radio 2”.

1. Set both Radio DIP switches to RS-232 mode: [Switch #1, #5, #6 up (ON) and the remaining switches are down (OFF)].
2. Connect Radio 1 to a PC using an **RS-232 cable** (included with Wireless Petro-Net Modem® part numbers that end with an “-RA” suffix).
3. Attach the **serial loopback adapter** (red connector) to the DB-9 serial port of Radio 2. [The serial loopback adapter configures Radio 2 to function as a repeater by looping data back into the module for transmission.]
4. Attach **RPSMA antennas** to Radio 1 and Radio 2.
5. **Power** Radio 1 and Radio 2 through their power connectors.



Figure 5-2 Range Test Cable Setup

6. Use the “PC Settings” and “Range Test” tabs of the X-CTU Software to:
 - Assign which PC Serial Com Port to use when communicating with Wireless Petro-Net Modem®s [Section 5.1.1: Performing a Range Test.]
 - Measure Wireless Petro-Net Modem®s range [steps 1-7].

5.2 Range Test Setup

Once you have completed your site survey, you must run a range test to verify the suitability of the site before installation. The range of a wireless modem varies with its mounting location, but can be up to a mile or more. To maximize range, survey the site. Keep the sending and receiving antennas in line-of-sight with each other.

5.2.1 Performing a Range Test

Follow the steps below to perform a range test.

1. Launch the X-CTU software. [Start > Programs > MaxStream > X-CTU]
2. Under the PC Settings tab, select the **PC serial comp port** from the drop-down menu that will be used to connect to Radio 1.
3. Select the **baud rate** (9600) that matches the fixed RF data rate (over-the-air-baud) of Radio 1. Use default values for the remaining fields.
4. Select the **Range Test** tab.
5. (Optional) Check the box in the **"RSSI"** section to enable its display.
6. Click the **Start** button to begin the range test.
7. Move Radio 2 (with loopback adapter) away from Radio 1 to measure the modem's range.
8. After successful range test proceed to installation.

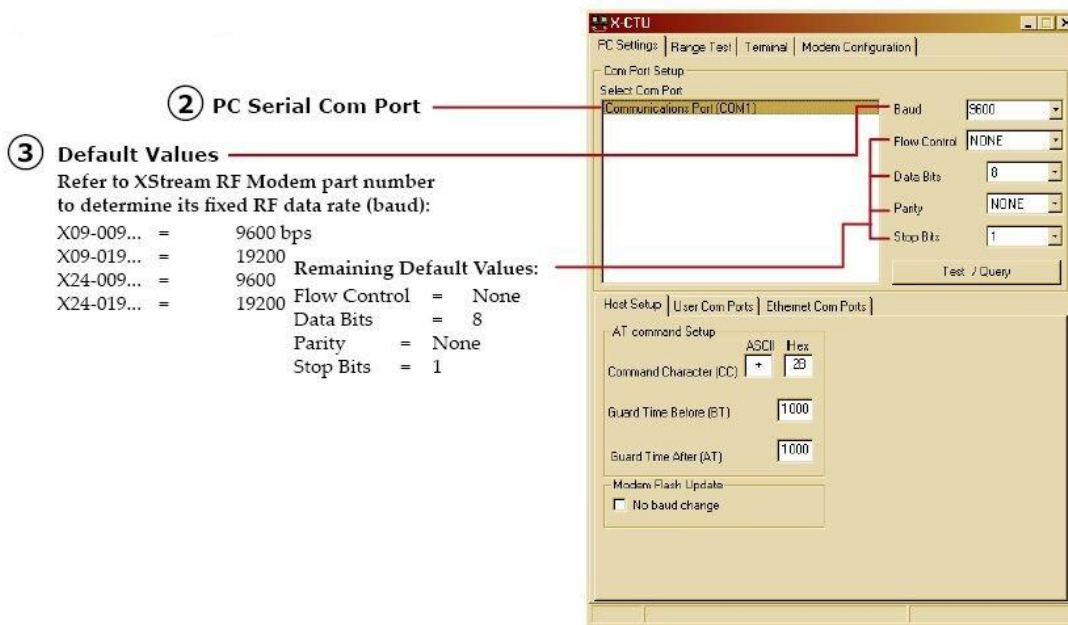
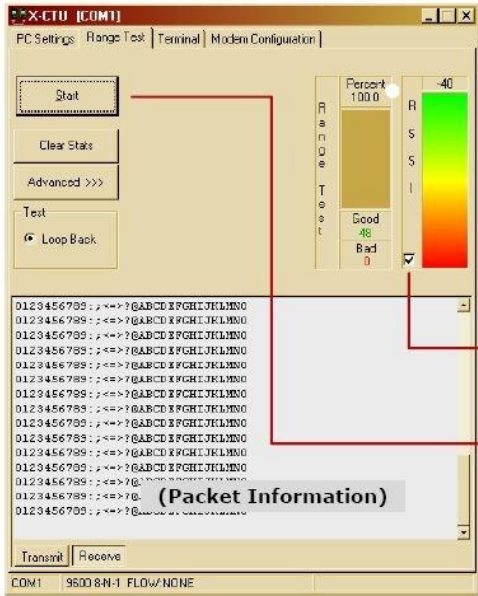


Figure 5-3 PC Settings Tab



- ⑤ RSSI check box
 RSSI stands for "Received Signal Strength Indicator".
- ⑥ Start/(Stop) button

Figure 5-4 Range Test Tab

5.3 Switch Settings

The XTEND-PKG-R DIP Switch allows users to configure “Serial Interface”, “Termination” and “Parity” command parameter settings.



Figure 5-5 DIP Switch Settings (Settings applied only when powering on)

For operation, change the hopping channel to 6.

5.4 Troubleshooting

Performing a range test will give an initial indication of the expected performance. If the loopback test indicates that additional range may be required, ask the following questions about the installation:

Do I have clear RF line-of-sight?

If the Fresnel Zone is not clear of the ground or other obstructions, often the best way to improve range is to raise the antennas higher off the ground to help transmit over vegetation or other obstacles.

What frequency am I using?

The Wireless Petro-Net Modem[®] comes in two varieties: 900 MHz and 2.4 GHz. The 900 MHz waves penetrate objects and travel better than their 2.4 GHz counterparts. If you are in the U.S., Canada, Australia or Israel, you are using the 900-MHz radios. The 2.4-GHz radios must be used in European countries and where the ETSI standard is required.

Can I use a directional antenna?

Directional antennas will have better gain than the omni-directional antennas. While the omni-directional-gain antennas can improve performance in line-of-sight applications, the performance in non-line-of-sight situations is very similar to a dipole. If you need to maximize range, using a gain antenna may be the best solution.

Is the antenna mounted properly?

Using long antenna cables or having the antenna right next to metal can reduce performance. Antenna cables add loss to a system. Using a shorter antenna cable can help keep the losses to a minimum. Often, a longer serial data cable can be used in conjunction with a shorter coaxial cable to keep antennas in a desired location. The radiating portion of the antenna should not touch other metal objects or be mounted right next to them. This can cause the antenna to operate inefficiently. It is best to allow at least several inches of separation between the antenna and other metal structures or objects.

5.4.1 OPW Switch Settings

- 1-watt modem (6 LEDs near connector).
- Set DIP Switch #1 and #5/#6 ON, all others OFF.
- Connect the supplied RS-232 cable to the modem and to the serial port on the PC.
- Launch the X-CTU software and select PC settings to test the serial port, when OK (all default settings).
- Connect power to the modem and make sure power switch is up, then select modem configuration and read. You will see the current configuration of the modem.
- Under Networking, change the HP to #6.
- You can now do a range test or, for a 2-modem system, set switch #5/#6 ON and all others OFF.
- Ready to test with a system or to ship out.