FreeWave Technologies

Multipoint Diagnostics Program

User Manual

Version 2.16D

FreeWave Technologies, Inc.
1880 South Flatiron Court
Boulder, CO 80301
(303) 444-3862
(303) 786-9948 Fax
www.freewave.com

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1 Introduction

2 The Diagnostics Program is used to monitor the performance of a FreeWave Technologies Multipoint* network. Diagnostics helps to identify actual or potential problems, quickly and conveniently, with little or no interference to the normal operation of the network. Diagnostics also makes it possible to remotely change almost any setting of any modem.

The Diagnostics System includes:

- A FreeWave Multipoint network
- A Computer running a Diagnostics Application
- A connection between the Diagnostics Computer and the Master radio.

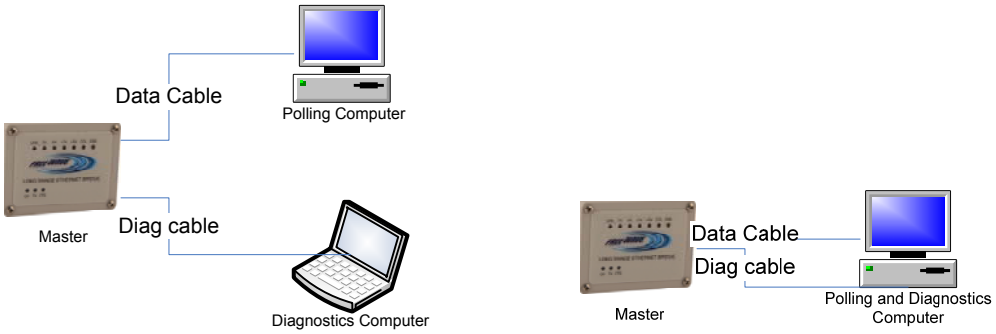
* The Diagnostics System may be used in a Point-to-point network if the network is temporarily reprogrammed as a Multipoint network.

3 Hardware set-up

To use Diagnostics, a diagnostics computer must be able to access the FreeWave network.

3.1 Diagnostics Computer

The Diagnostics Computer may be an additional computer; or it may be the computer already connected to the FreeWave network's Master radio (as long as the computer has an extra RS-232 port available, and it can run this application simultaneously).



The diagnostics computer's operating system must be Windows (’95, NT 4.0 or later).

Obtain the Diagnostics application from FreeWave Technologies (either on the User’s Manual CD or by e-mail).
Create a new folder (such as “FreeWave Diagnostics”) on the Diagnostics Computer. Place the Diagnostic application in this folder. The Diagnostic application will also store log and data files in this folder. Creating a shortcut to the Diagnostic application on the desktop will make future use easier.

3.2 Accessing the FreeWave Network

The Diagnostics Computer may access the FreeWave network Master radio in one of 3 ways:

- directly through the Diagnostics Port using RS232 (FGR, IM, and LRS series only)
- through an Ethernet network using UDP/IP (FGR and IM series Ethernet Radio only)
- through a Terminal Server and a network (LAN, Internet,…) using TCP/IP

3.2.1 Direct access through the Diagnostics Port (FGR, IM, and LRS series Master)

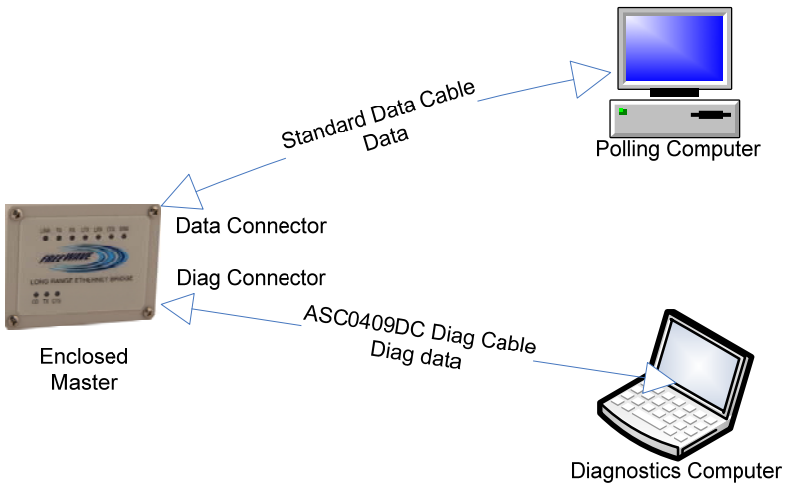
If the network's Master radio is a series FGR, IM, or LRS radio, connect the diagnostics computer to its Diagnostics Port.

> Note: Do not confuse the Diagnostics Function with the Set-Up Mode. While the Set-up Mode may use either the Diagnostics Port or the Data Port, the Diagnostics Function may only use the Diagnostics port.

Two different Diagnostics cables are available, one for enclosed radios, and one for board level radios. To acquire a diagnostics cable, contact FreeWave Technologies.

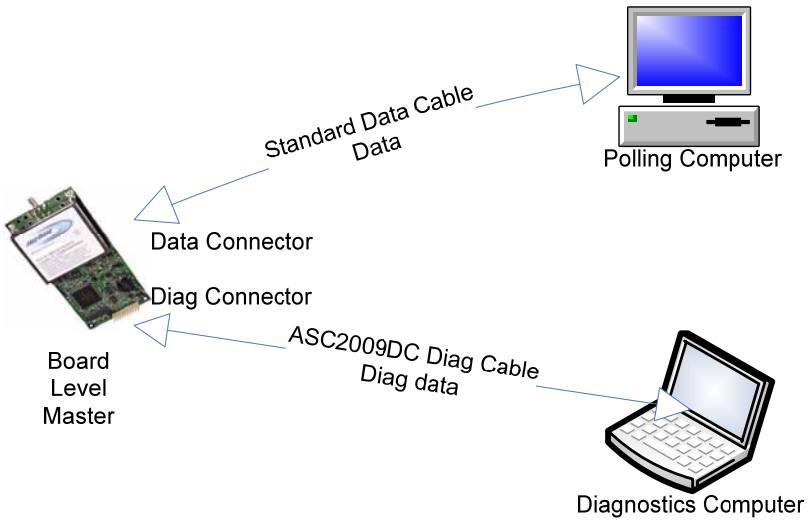
3.2.1.1 Diagnostics Cable for enclosed radio

For an enclosed FGR, IM, or LRS series, FGRM Series, and Ethernet board-level radios, the diagnostics connection is through its dedicated Diagnostics port, using the diagnostics cable ASC0409DC.



3.2.1.2 Diagnostics Cable for Board level radio

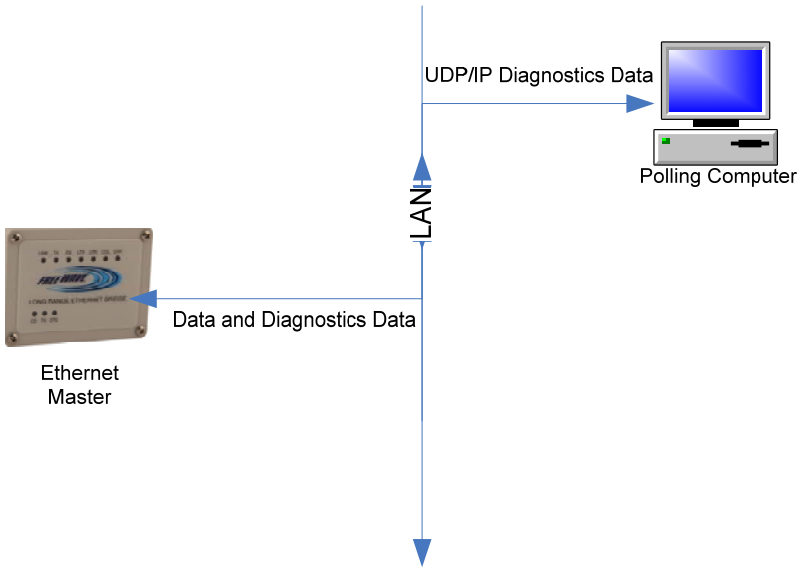
For full sized and non-Ethernet board-level FGR, IM, and LRS series Radios, the diagnostics connection is through a black 20-pin port on the board using diagnostics cable ASC2009DC.



3.2.2 Direct access through an Ethernet network

The Diagnostics application can communicate directly with an Ethernet Master Radio through an Ethernet network (such as a LAN) or even over the Internet. Both the Master Radio and the Diagnostic computer must be connected to an Ethernet network, which typically is already the

case when the Master Radio is an Ethernet model. Assign the Ethernet Master Radio an IP (Internet Protocol) address, just for diagnostic purposes (NOT the IP address of any device that communicates through the FreeWave network). For Diagnostics directly to a FGR Ethernet Master, the protocol used is UDP /IP (not TCP/IP), and no special cables are required.

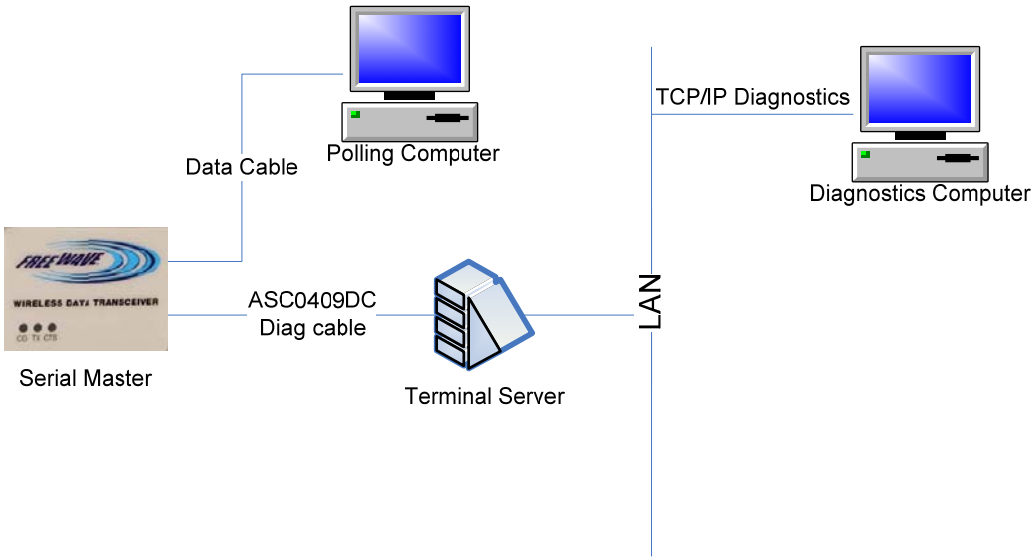


3.2.3 Indirect access through a Terminal Server

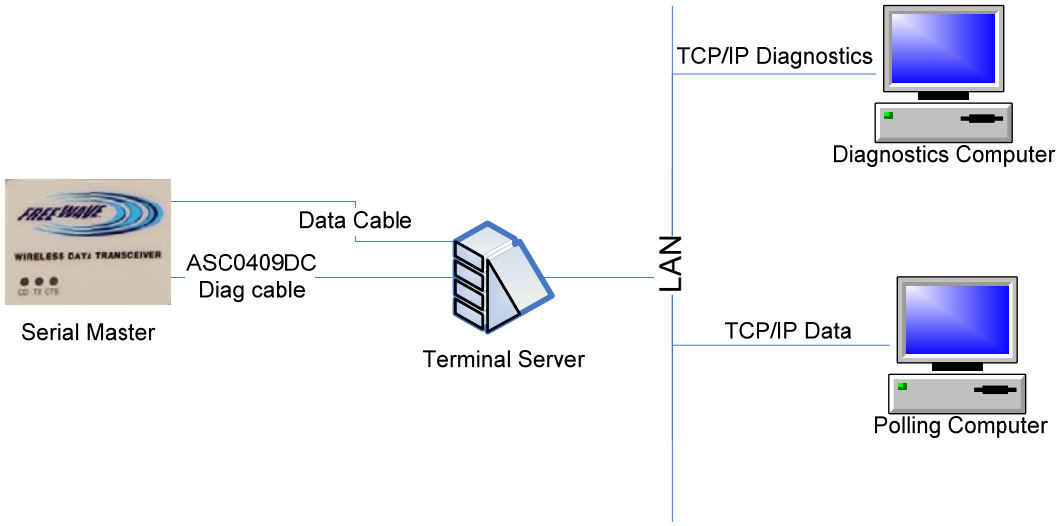
Even if the Master Radio is not an Ethernet model, diagnostics may still be accessed through an Ethernet network. An additional device will be needed: a commercially available Terminal Server. A Plus Series radio may also be used as a terminal server. Terminal Servers are an Internet server with one or more RS232 serial ports, and one Ethernet port. In this type of setup, the Diagnostics Application uses the TCP/IP protocol (not UDP/IP).

A Diagnostics Cable (ASC0409DC) is needed from FreeWave to send diagnostics from the Master to the Terminal Server.

The following two examples show the connections for FGR, IM, or LRS series Master radios, and for hosts connected either directly to the Master, or through the LAN/Internet.



FGR master, RS232 host



FGR master, Ethernet host. Note that 2 Terminal Server serial ports are used.

Enter the IP address of the Terminal Server in the "Chg IP Address" menu of the Diagnostics Application. Afterwards, the Diagnostics Application will ask for a port number; enter the number of the Terminal Server's port to which the Diagnostics cable is connected.

3.3 Limitations

Only radios with firmware at least level 2.29 (900 MHz), 1.58 (2.4 GHz) or 9.34 (1.4GHz) will support diagnostics. (Certain features require even later firmware versions, as noted in this manual).
While FreeWave radios will operate in the network regardless of the firmware revision level, Diagnostics will be able to access, monitor and remotely set-up only radios with firmware that supports diagnostics. Otherwise, the application will be limited to displaying the serial numbers of such radios. Also, the application cannot access radios (even if they support diagnostics) through repeaters with firmware that does not support diagnostics.
In the field, the firmware of any 2.4 GHz radio or any 900 MHz radio with serial number 571-0001 and higher can be upgraded. Older radios must be sent back to FreeWave for a hardware upgrade. Contact FreeWave Technologies for more information.

While running diagnostics on a network has little or no effect on network operation, FreeWave strongly recommends that the normal data flow is interrupted in a radio before using the Diagnostics Application to change any of the radio's settings.

4 Radio set-up

4.1 Set-up the Master

To use diagnostics, the Master must be setup directly through its Set-up mode.

- Ensure that the packets have at least 32 bytes
- Turn on diagnostics and set a polling rate
- Assign an IP address to the radio (if using UDP/IP)

4.1.1 Invoke the Set-Up mode

Connect a terminal to the Master radio (see the Main Manual for more information on opening a terminal window). Invoke the set-up mode (see the Main Manual for details on how to enter setup with a particular radio).

The terminal will show the Main Menu.

```
                              MAIN MENU
                        Version 2.47 5-24-2005
                          Standard Hop Table
                       Modem Serial Number 919-1968

(0)   Set Operation Mode
(1)   Set Baud Rate
(2)   Edit Call Book
(3)   Edit Radio Transmission Characteristics
(4)   Show Radio Statistics
(5)   Edit MultiPoint Parameters
(6)   TDMA Menu
(8)   Chg Password
(Esc) Exit Setup
```

4.1.2 Ensure that the packet is big enough

Diagnostics require that the minimum packet size be at least 32 bytes. The radio calculates the minimum packet size from the "Min Packet Size" and the "RF Data Rate" settings. (See the Main Manual for information regarding packet sizes)

To check packet sizes from the Main Menu, press '3' ("Edit Radio Transmission Characteristics")

The terminal will display the "Radio Parameters" menu.

```
                                RADIO PARAMETERS

WARNING: Do not change parameters without reading manual

(0)    FreqKey          5
(1)    Max Packet Size  8
(2)    Min Packet Size  9
(3)    Xmit Rate        1
(4)    RF Data Rate     2
(5)    RF Xmit Power    9
(6)    Slave Security   0
(7)    RTS to CTS       0
(8)    Retry Time Out 255
(9)    Lowpower Mode    0
(A)    High Noise       0
(B)    MCU Speed        0
(C)    RemoteLED        0
(Esc)  Exit to Main Menu
```

Note the value of the "RF Data Rate" setting (item 4).

Note the value of the "Min Packet Size" setting (item 2). With an "RF Data Rate" of '2' the “Min Packet Size" value must be '3' or more. With an RF rate of '3' the "Minimum Packet Size" value must be '6' or more.

If the minimum packet size needs to be changed, press '2" ("Min Packet Size").

> **NOTE**: If the minimum packet size setting is changed, it must also be changed in all the other radios in the network. If the Minimum Packet size is too small, diagnostics cannot change the setting over the air; the change must be done locally via EZConfig or a terminal program.

The terminal will show the "Min Packet" menu.

```
Enter Min Packet (0-9)
```

Enter '3' (if the "RF Data Rate" is '2') or '6'(if the "RF Data Rate" is '3').

Press "Esc" to return to the "Main Menu".

4.1.3 Set the Diagnostics rate

The rate at which the Master reports to the Diagnostics Computer must be set. The Diagnostics rate is inversely proportional to the value ('1' to '63') entered in the "Diagnostics" menu. With a setting of '1', the Master reports after every slot (every time the master hops to another channel). This results in a lot of data. Normally, the Master and the Diagnostics Computer are connected directly, so that's not a problem. However, if they are connected through another link, that link's throughput may be insufficient. In that case, increase the diagnostics setting to reduce the rate at which the Master reports to the Diagnostics computer. With the maximum setting ('63'), the update rate is slow, but the link is not stressed.

The Diagnostics rate is set in the Master.

To do so, from the "Multi-Point Settings" Menu, press 'B' to select the “Diagnostics" menu.

```
Enter the Diagnostics Rate (0-63)
```

Code	Function
0	Diagnostics mode off
1	Diagnostics data sent every slot
2	Diagnostics data sent every other slot
n	Diagnostics data sent every nth slot
63	Diagnostics data sent every 63rd slot

The factory default is “0” (Diagnostics Off).

Press '1', or whatever rate is desired, then press Enter.

4.1.4 Assign an IP address

If the Diagnostics of an Ethernet Master Radio will be accessed directly through UDP/IP, a unique IP address will need to be assigned to it.

> **NOTE:** This IP address is only for diagnostics, and is unrelated to the IP address of any device connected to the network.

From the Main Menu select "Set Operation Mode" ('0').
From the Operation Mode menu, select "Ethernet" ('F').
Form the Ethernet menu, select "IP Address" ('4').
Enter the IP address that will be used to access diagnostics.
Enter the address in the "Chg IP Address" menu of the Diagnostics application.

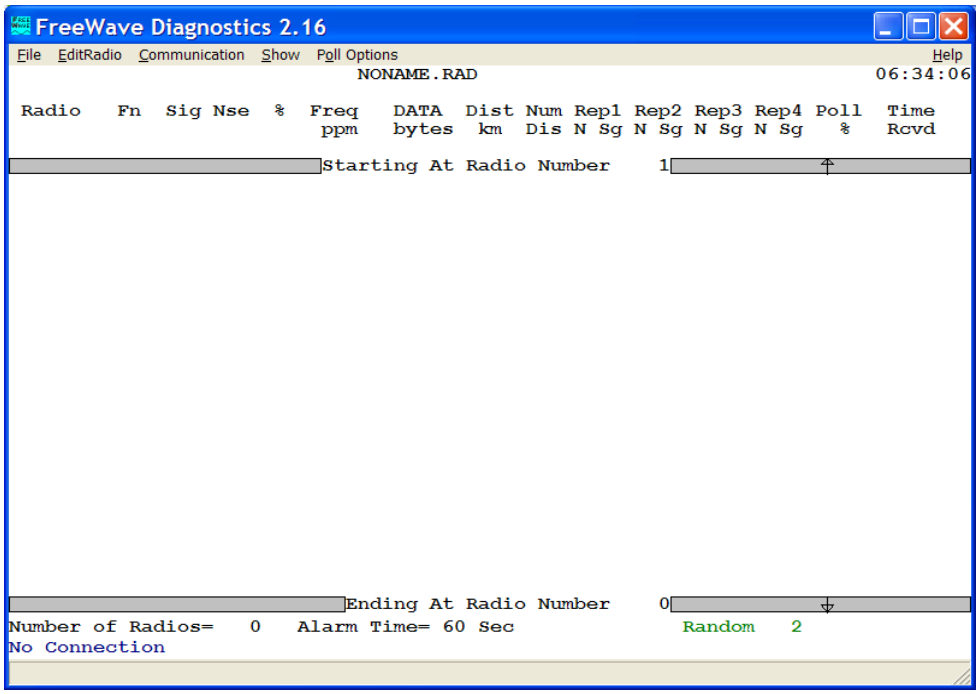
See the Ethernet addendum for more information.

4.2 Set up the other radios in the network

If the Master's "Min Packet Size" was changed, the setting must be changed in the other radios in the network, through Set-Up mode (changing the min packet size requires a direct connection to the radio: the setting can't be changed over the network from the Diagnostics Computer). Instructions on invoking the Set-up mode and changing the "Min Packet Size" setting are in the previous section.

5 Communications set-up with the Master

In the Diagnostics computer, start the Diagnostics application. The program will open with "Screen 0", with no diagnostics data and with the message “No Connection” (bottom left).



A connection between the Diagnostics Application and the Master radio must be established.

As mentioned, the Diagnostics Computer may access the Master radio in one of 3 ways:

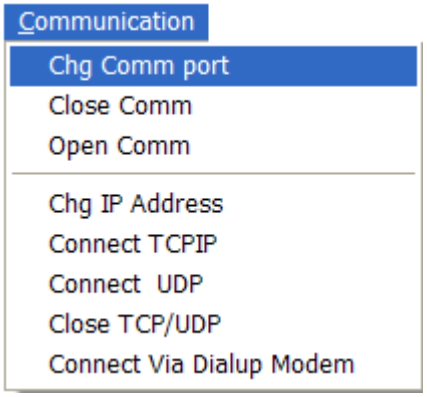
- directly through Serial Ports using RS232
- directly through an Ethernet network using UDP/IP (Ethernet Master Radio only)
- indirectly through a Terminal Server and a network (LAN, Internet,…) using TCP/IP

5.1 Direct access through Serial Ports

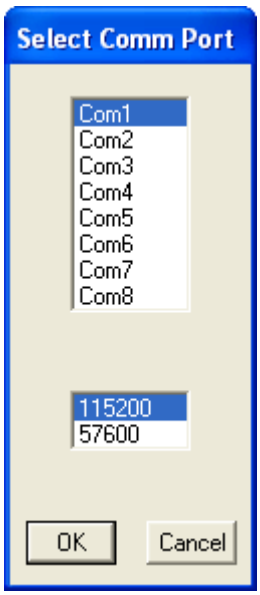
To access the FreeWave network through a Serial Port (Data Port or Diagnostics Port):

- Connect the Master Radio to the Diagnostics computer using a Diagnostics cable;
- Select the Serial Port to which the Diagnostics cable is connected;
- Open that Serial Port.

The Diagnostics Computer can use any of its Serial Ports (COM1 to COM8). The default is COM1. Change the serial port via the "Communication" / "**Chg Comm Port**" menu.



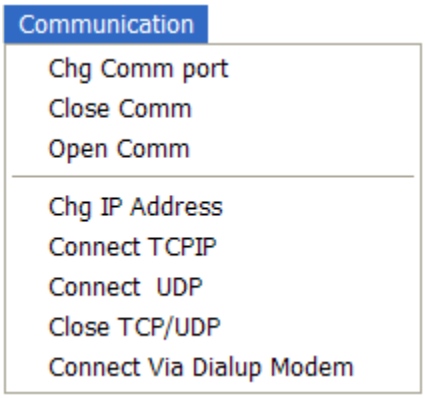
A dialog opens. The currently selected port is highlighted.



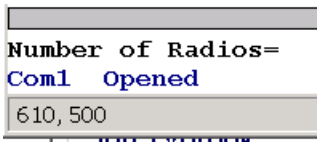
Select the Serial Port, or press "Cancel" to retain the previous selection.

> **NOTE:** If connected to a 1.4GHz network, the diagnostics baud rate must be changed to 57600. Both 900MHz and 2.4GHz use the 115200 baud rate.

Then, open the port with the "Communication" / "**Open Comm**" menu.



The bottom right corner of the screen changes to:



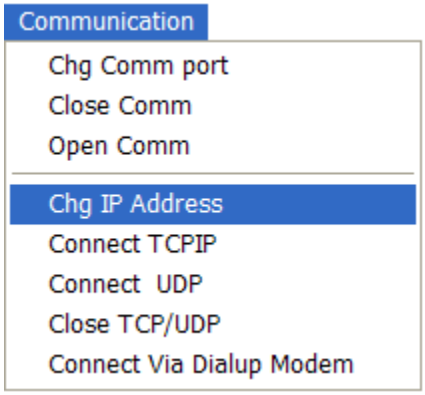
A Com1 Opened message doesn't necessarily mean that the Diagnostics Application has established communications with the Master radio. When the program does connect, the Application will display a list of the radios in the network in "Screen 0".

5.2 Direct access through an Ethernet network

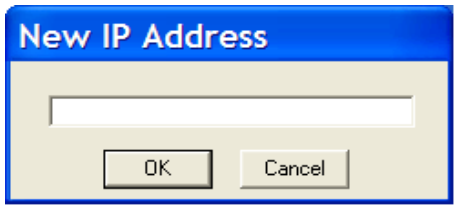
To access an Ethernet Master Radio directly:

- Assign an IP address to the Master Radio (described in the "Software Set-up" section above)
- Connect the Master Radio to the Ethernet network
- Connect the Diagnostics Computer to the Ethernet network
- Have the Diagnostics Computer create a connection to the Internet (The Application will not create an Internet connection)
- Specify the IP address of the Master Radio
- Start the UDP/IP connection

Specify the IP address of the Master Radio with the "Communications"/"Chg IP Address" menu.

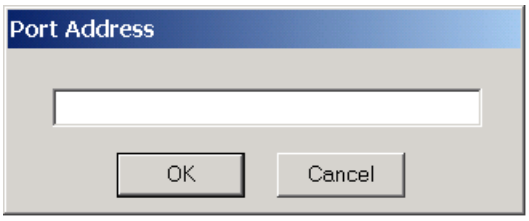


A dialog opens.



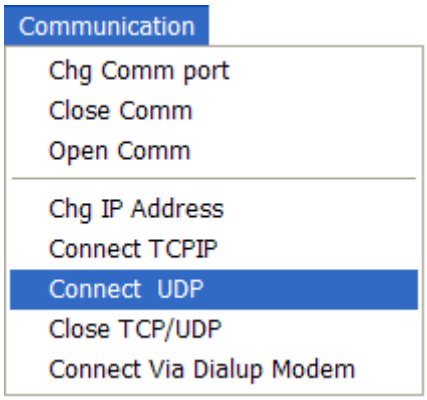
Enter the new IP address of the Master Radio and click "OK".

A new dialog opens.



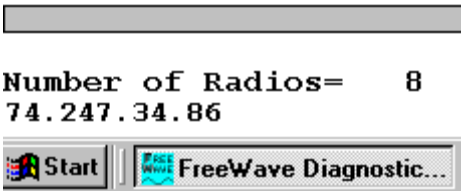
Click "OK" (the Master Radio doesn't use a Port Number).

Establish the IP connection with the "Communications"/"**Connect UDP**" menu.



The Application will try to establish the connection for approximately one minute. During that time, the Application will stop responding to actions. If the IP connection is not established within the time-out period, the Diagnostic Application will respond to commands and the “No Connection” message remains on the screen.

If the connection is established, the Application displays the IP address in the lower left corner of the screen.



The Application saves the IP settings when the Network file is saved (see "Saving the Network List").

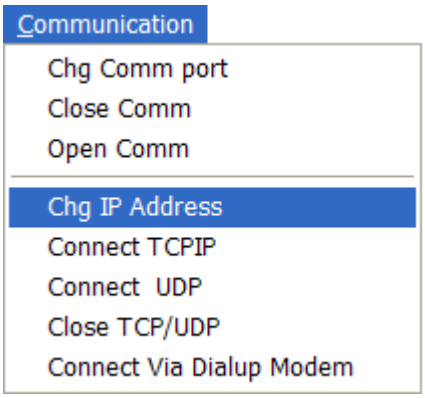
5.3 Indirect access through a Terminal Server

To access the Master Radio through a Terminal Server:

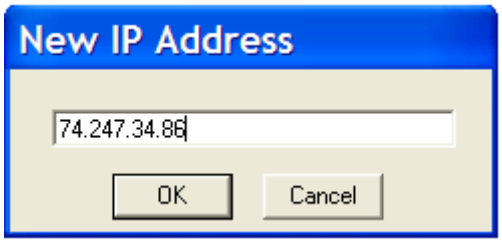
- Connect the Master Radio to a serial port on the Terminal Server.
- Connect the Diagnostics Computer to the Internet
- Have the Diagnostics Computer create a connection to the Internet (The Application will not create an Internet connection by itself)
- Specify the IP address of the Terminal Server;
- Specify the port number of the Terminal Server;

- Start the TCP/IP connection

Specify the IP address of the Terminal Server with the "Communications"/"**Chg IP Address**" menu.

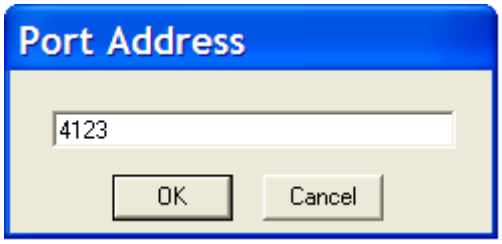


A dialog opens.



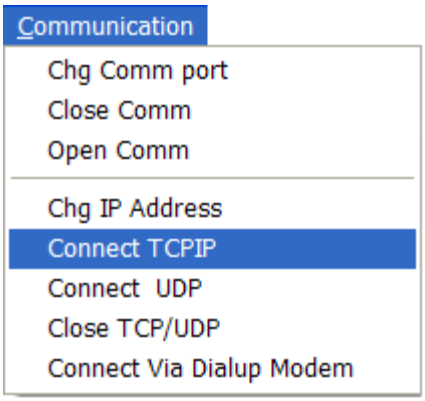
Enter the new IP address of the Terminal Server and click "OK".

A new dialog opens.



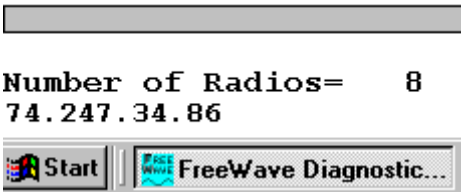
Enter the port number of the Terminal Server to which the diagnostics cable is connected and click "OK". (If a 'Y" diagnostics cable is used, use the port to which the end labeled "Diagnostics Computer" is connected.)

Establish the IP connection with the "Communications"/"**Connect TCPIP**" menu.



The Application will try to establish the connection for about one minute. During that time, the Application will stop responding to commands. If the IP connection is not established within the time-out period, the Diagnostic Application will respond to commands and the “No Connection” message remains on the screen.

If the connection is established, the Application displays the IP address in the lower left corner of the screen.



The Application saves the IP (Internet Protocol) settings when the Network file is saved (see "Saving the Network List").

IMPORTANT NOTE: If either a 900MHz or 2.4GHz radio is being used, the baud rate on the terminal server should be set to 115,200kbps. If a 1.4GHz radio is being used, the baud rate should be set to 57,600kbps.

5 Managing the Network List

5.1 Adding radios to the list

The Diagnostics Application prepares a list of the radios in the network automatically.

A network list from a file that was previously saved may be retrieved.

Radios may also be added, edited or deleted manually.

Note that, once a radio is included in the list, and that radio is removed from the network, the serial number will not be automatically removed from the list. The serial number should be removed from the list manually.

5.1.1 Adding a radio automatically

Once the Diagnostics Application has established a connection with the Master Radio, the software begins compiling a list of the radios in the network automatically. As the software finds a radio, the radio will be added to the Network List, in the order that the radios were found. As the software discovers a Repeater radio, the radio is assigned an "R #" number. The number corresponds to the order in which the repeater functionality was found. The software also assigns all of the radios a default name: "New Radio".

> **NOTE:** A radio will not be listed as an “Rx” (Repeater) until a slave has been found beyond the repeater.

The Application finds radios in two ways:

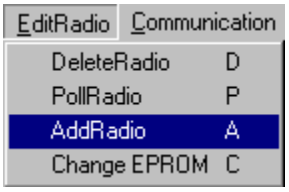
- If a radio happens to communicate within the network, the Diagnostics Application notices the radio and the serial number will be added to the list
- If "Random polling" is selected, the Diagnostics Application generates random Serial Numbers and asks the Master to call them. If a radio by that Serial Number happens to be in the network, and responds to the call, the Diagnostics Application will add the serial number to the list. The Diagnostics Application will eventually find any radio capable of communicating with the Master.

For more information on polling see “Polling Method” later in this manual.

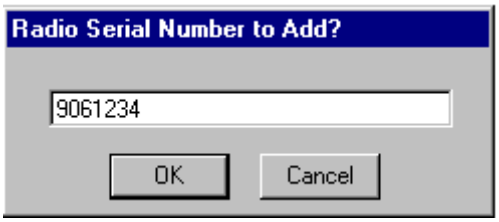
5.1.2 Adding a radio manually

A radio that wasn't discovered automatically may be added manually. However, its Serial Number must be known.

Select the "EditRadio" / "AddRadio" menu, or press 'A' on the keyboard.

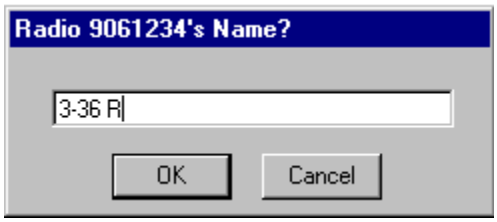


A dialog opens.



Enter the radio's seven-digit Serial Number. Do not enter any other character (such as spaces or hyphens) or the application will truncate the number.
Click OK.

A second dialog opens.



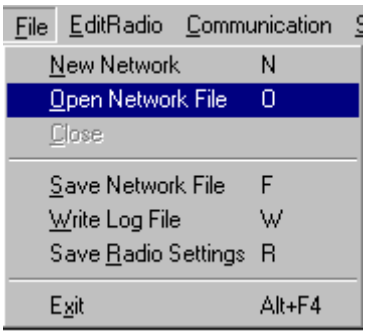
Optionally, enter a name for the radio, up to 8 characters long (any character is OK).
(This name is used for your identification purposes only)
Click OK.

5.1.3 Retrieving a Network List

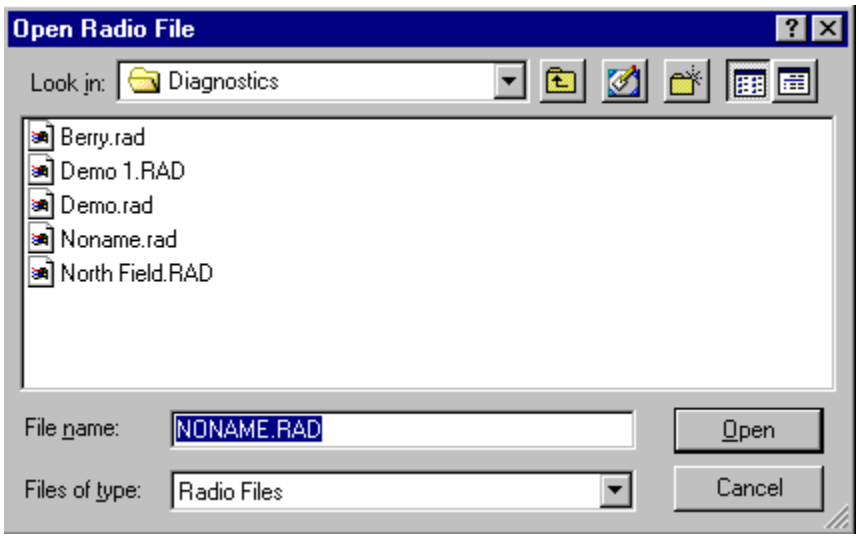
If a Network List was previously saved, the list may be retrieved (instead of letting the Diagnostics Application create the list from scratch every time the Application is run).

For more information on saving a network list, see "Saving The Network List" later in this manual.

Select the "File" / "Open Network File" menu or press alt-F-O.



The Windows' standard Open File dialog opens.



Find and select and open the Network List file desired, using standard Windows methods. (If the file name is typed in, the ".rad" extension is not needed.)

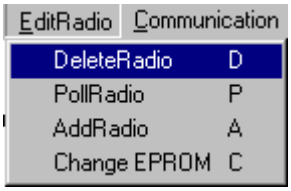
5.2 Editing a radio's name

The only data about a radio that can be edited is its name. The radio's Serial Number must be known. Follow the same procedure used to add a radio, and enter the new name.

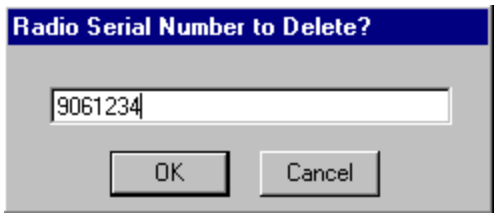
5.3 Deleting a radio

If a radio is removed from the network, the Diagnostics Application will not automatically remove the serial number from the Network List. Instead, the radio must be removed manually. To do so, the radio's Serial Number must be known.

Select the "EditRadio" / "DeleteRadio" menu, or press 'D' on the keyboard.



A dialog will open.



Enter the radio's seven-digit Serial Number. Do not enter any other character.

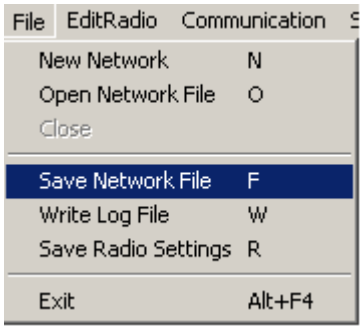
Click OK.

The Application removes that radio from the Network List.

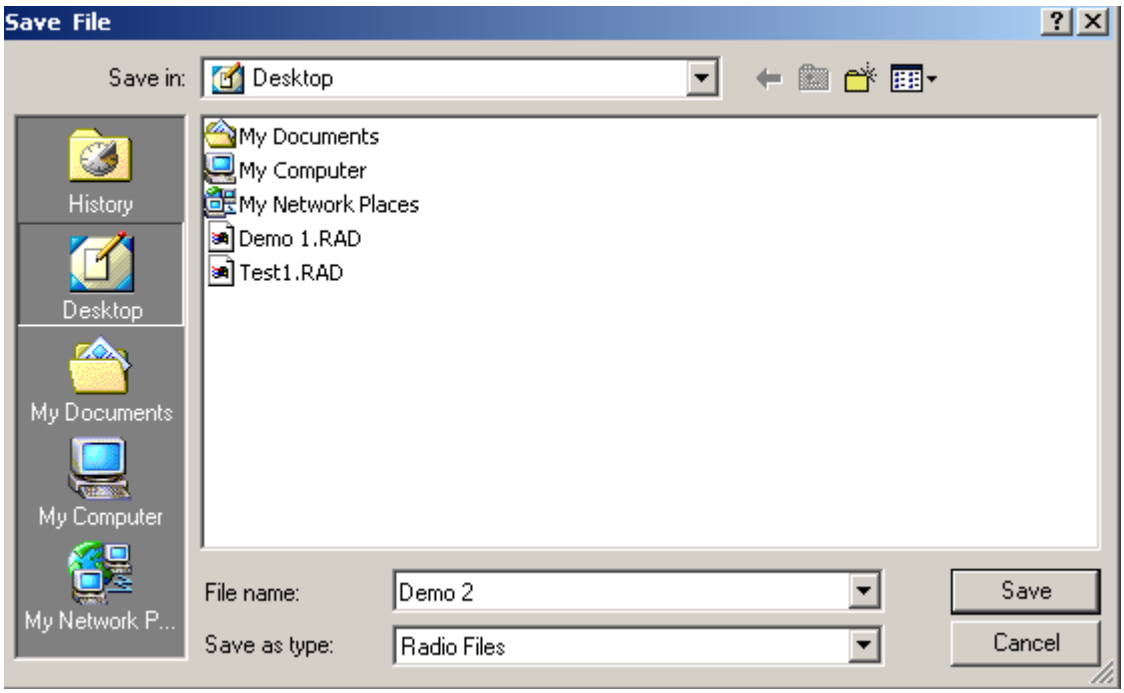
5.4 Saving the Network List

Once the Network List of radios is complete, the list may be saved. The Network List will be available the next time the same network needs to be analyzed. Saving the list has the advantage of being faster and avoids having to manually enter the radios' names. Saving the Network List also saves the IP (Internet Protocol) settings.

Select the "File" / "Save Network File" menu or pressing 'F' on the keyboard or alt-F-S.



The Windows' standard Save File dialog opens. Give the network a name so the list can be easily accessed in the future. Save the Network List file using standard Windows methods.



6 Gathering and saving Data

The Diagnostics Application gathers data from the radios in the network through polling. Specifically, the software gives the Master Radio the Serial Number of a radio to call. If the radio with that Serial Number is accessible by the Master, the Application queries the radio about its settings, performance and conditions.

6.1 Polling method

There are 3 polling methods: Random, Sequential and Manual.

Initially, the Application polls random Serial Numbers; random polling allows the Diagnostics Application to eventually find any radio capable of communicating with the Master. Random Polling is inefficient because there are 10,000,000 possible Serial Numbers, and the network has relatively few radios. Once the Network List is complete, FreeWave recommends polling the network through Sequential Polling.

In either case, a specific radio may be manually polled, if the Serial Number is known.

6.1.1 Random Polling

Select “Poll options” / “Poll in RANDOM mode”. Alternatively, press R while the Application is the active window.

The application will poll all the possible Serial Numbers, randomly.

6.1.2 Sequential Polling

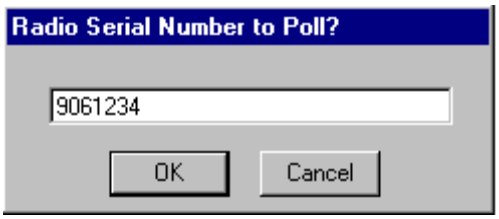
Select “Poll options” / “Poll in Sequential mode”. Alternatively, press S while the Application is the active window.

The application will poll all the radios in the Network List, sequentially.

6.1.3 Manual Polling

Select the "EditRadio" / "PollRadio" menu or press 'P' on the keyboard.

A dialog opens:



Enter the radio's seven-digit Serial Number. Do not enter any other character (such as spaces or hyphens) or the application will truncate the number.
Click OK.

The Application will poll that specific serial number.

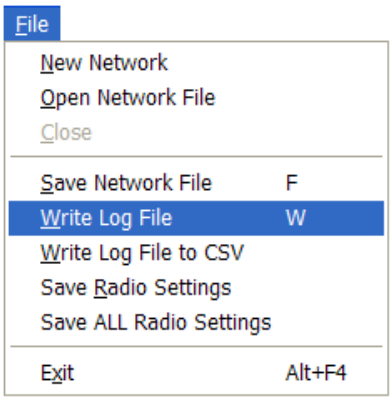
6.2 Saving data

The Diagnostics Application saves files with logs of the networks performance.

6.2.1 Generating a Diagnostics Log

When first opened, the Application creates a "Current.log" file (replacing any such file that may have already been present). Every minute, the Application automatically logs events and diagnostics data into this file.

A file with a snapshot in time of that log may also be created: select the "File" / "Write Log File" menu or press 'W' on the keyboard or alt-F-W.



The Application will create an "xxxxxxxxx.log" file with that snap shot. The name of the file is based on when the snapshot was taken (month, day, hour, and minute). For example, the file 09072146.log was created on September 7 at 21:46 (9:46 PM).

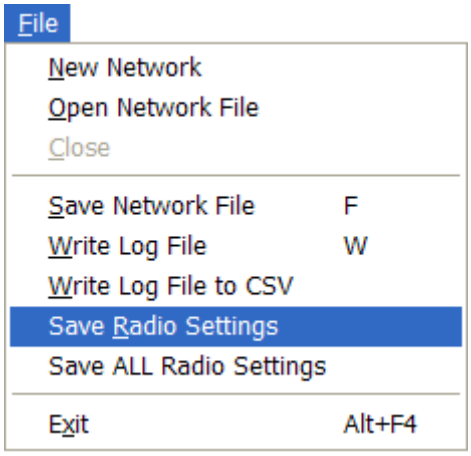
These files can be opened with any text editor or word processor. The following example of a log file was opened in WordPad.

```
                                Diagnostics FGR Version 2.16
                             C:\Demo2.RAD
                                  08-20-2005  12:44:35        424

 Radio      Name  Fn      ID   Rev Temp VTG  RCD Sig Nse  %  Freq   Data    Dist Num Rep1 Rep2 Rep3 Rep4 Poll     Time
                                   C    V                    ppm   bytes         Dis N Sg N Sg N Sg N Sg   %     Rcvd

9191968           M            47  29  13.6          44                0                                          12:44:35

9191812 SR1       R2    9999   47  29  13.8  LHL  89 57   99 -0.1      0    0.3    0  1 88                 100 12:42:06
9191814 Rep1      R1    9999   47  30  13.7  LHL  95 31  100  0.2      0    0.4    0  0 98                 100 12:42:52
9192125 SR Slave  S     9999   47  27  13.1  LHL  98 71  100 -1.1      0    0.2    0  2 98 1 87            100 12:43:02
9192159 R1 Slave  S     9999   47  30  13.3  LHL  85 62   92  0.2      0    0.4    0  1 75                 100 12:43:55

Number Radios=4
```

6.2.2 Saving Radio Settings and plot data

The settings of the presently selected radio and the data gathered from the radio over time can be saved into a file.

Select the "File" / "Save Radio Settings" menu or press alt-F-R. The application will switch to Screen 2.



The Application will create a file named "yyyyyyy.dat" where "yyyyyyy" is the serial number of the selected radio. In Screen 0 or 1, yyyyyyy will be the radio at the top of the radio list. (Since the Master is above the list, the Master's settings from Screen 0 or 1 can't be saved.)

These files can't be opened by double-clicking them because of the extension (".dat") which is reserved by Windows. Instead, the file must be opened utilizing a text editor. Right clicking on the file and selecting a text editor will also work.

Here is an example of such a file opened in Notepad.

Remote Radio Setup Settings
Radio Number 0 Serial 9065064 NAME:MASTER

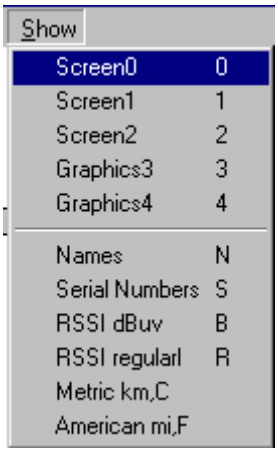
0	Modem Mode	2
1	Baud Rate	48
2	Baud High Byte	0
3	RS232 Mode	16
4	MODBus RTU	255
5	Retry TimeOut	255
6	Xtal Tune	53
7	SlicerThreshold	144
8	Frequency	131
9	Freqkey	5
10	Max Packet Size	8
11	RF Data Rate	3
12	Min Packet Size	9
13	Xmit Power	255
14	RTS/CTS Control	0
15	Hop table size	112
16	Number Repeaters	1
17	Master Repeat	2
18	Max Slave Retry	9
19	Retry Odds	9
20	DTR Connect	0
21	Repeater Freq	0
22	LowPower	255
23	PPS Enable	255
24	Slave/Repeater	255
25	Master Sync	255
26	Network ID High	2
27	Network ID Low	232
28	SubNet ID	255
29	Radio ID High	255
30	Radio ID low	255
31	Freq Table	0
32	Diagnostics	0
33	Radio ID Super	255
34	Reflected Power	0
35	High Noise	255
36	Turn On Delay	255
37	Turn Off Delay	255
38	Xmit Power Cal.	168
39	Remote LED	0
40	Radio Name	1634

7 Interpreting the Data

The application uses five separate screens to display diagnostics data. These screens provide comprehensive monitoring of all radio network settings including automatic logging of data from each radio in the network. Screen 2 also allows changes to the operating settings of any radio in the network from the Master radio.

- "Screen 0" and "Screen 1" report the performance of all the radios in the network.
- "Screen 2" display the settings of a given radio and allows changes to them.
- "Graphics 3" plots the performance of a given radio over time
- "Graphics 4" plots the conditions of a given radio over time

Select a Screen with the "Show" menu, or simply type its number on the keyboard.



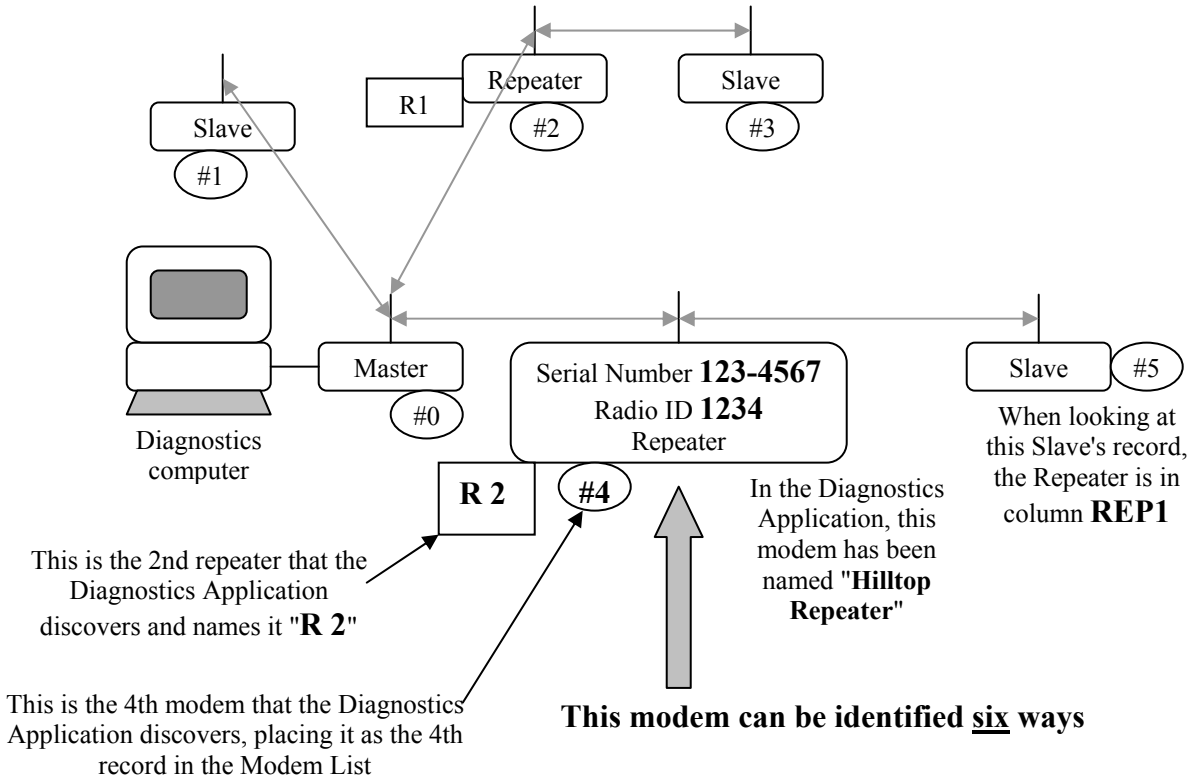
7.1 Identifying Radios

In the following discussion there are as many as six ways of identifying a particular radio:

- Serial number (such as "123-4567"), a unique number permanently assigned to each radio at the factory.
- Radio ID (such as "1234") which may be assigned to a radio, for convenience (not necessarily a unique number).
- Name (such as "Repeater 2") which can be defined within the Diagnostics Application. In newer firmware (2.64 for 900MHZ, 3.64 for 2.4GHz, and 8.34 for 1.4GHz), the radio name can be assigned as an alpha-numeric value in the radio while being set up through HyperTerminal.
- Radio Number (such as Radio # 0, which is the Master, and Radio #1, which is listed in the top-most line in Screens '0' and '1'). The Diagnostics Application assigns this number sequentially, as radios are discovered, and as radios are manually entered.
- Repeater Number (such as "R 3", which is the 3rd Repeater in Screens '0' and '1'). The Diagnostics Application assigns this number sequentially, as radios are discovered to be a Repeater. Note: a Repeater is not labeled as such until a Slave has reported through it.
- Repeater Order (such as "Rep1"; when the Diagnostics Application shows the record of a given Slave, the Repeater Number of the Repeater directly linked to the Slave is placed in the "Rep1" field).

Of these, only the Serial Number, the Radio ID, and the Radio Name are actually physically located in the radio. All the other identifiers exist only within the Diagnostics Application, and are exclusively for use of that application.

For example:
A radio to which the factory assigned the Serial Number of "**123-4567**", and into which a Radio ID of "**1234**" is set by the user. In addition, within the Diagnostics Application, the radio name "**Hilltop Repeater**" is entered by the user. (There is a 20-character limit on each radio name.)
The radio is programmed as a Repeater and placed in service within a Network. The radio is directly linked to the Master and to a Slave.
Start the Diagnostics application, which first discovers the Master. Then 3 more radios are discovered before serial number 123-4567 is found. Diagnostics assigns the radio a Radio Number '**4**' and displays the serial number in the 4th line of the Radio List in Screens '0' and '1'.
The Diagnostics Application acknowledges the radio as a Repeater. The first radio is also a Repeater, so radio S/N 123-4567 is labeled "**R 2**".
The path of a radio may be deciphered by examining the **"Repx"** columns in screen 1. The columns will always follow the same pattern: **Rep1** is closest to the radio **Rep2** is next and so on. See paragraph 7.3.15 for information on Repeaters.



This radio is identified as:

- Serial Number **123-4567**
- Radio ID **1234**
- "**Hilltop Repeater**"
- "**R 2**"
- **#4** in the Radio List
- in the **Rep1** column of Radio #5

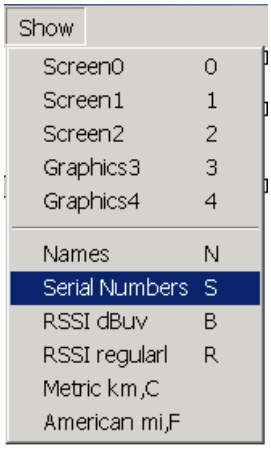
7.2 Selecting display preferences

The Diagnostics Application offers a few choices for its displays.

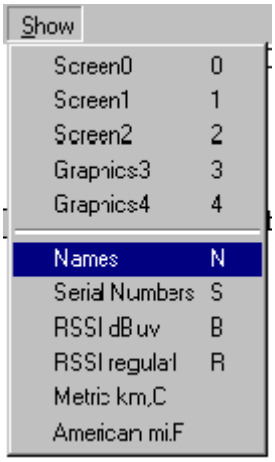
7.2.1 Displaying Radio Serial Numbers or Names

In Screens 0 and 1, there is a choice of displaying the radio's Serial Numbers or the names that have been assigned to them. Use the 'N' key on the keyboard to toggle between Serial Numbers and names.

To display Serial Numbers, select the "Show" / "Serial Numbers" menu (warning: pressing 'S' doesn't work: 'S' has a very different function)



To display names, select the "Show" / "Names" menu.

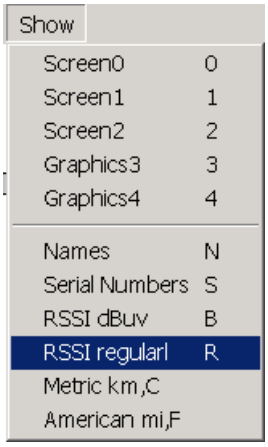


7.2.2 Selecting Signal Units

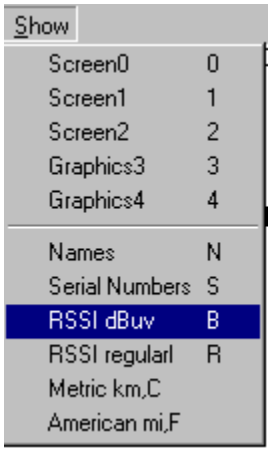
In Screens 0 and 1, the units for Signal Strength and Noise Level are either standard (just as they would be displayed in the Radio's Statistics Menu), or in dBµV.

Note that the units in Screen 3 are standard (dBµV cannot be displayed in that plot).

Select the "Show"/"RSSI regular" menu to select standard units.



Select the "Show"/"RSSI dBµV" menu to select dBµV units.

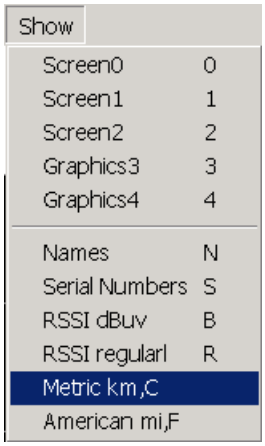


7.2.3 Selecting Imperial ("American") or Metric Units

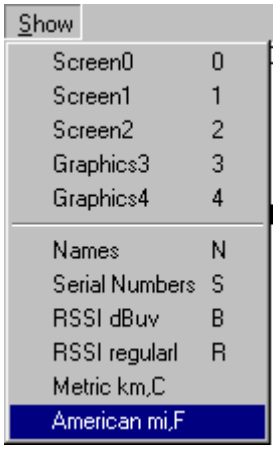
In Screens 0 and 1, the units for Distance and Temperature are either Imperial ("American"), or metric.

Note that Screen 4 displays temperature in Celsius (that plot can't display Fahrenheit).

Select the "Show"/"Metric km, C" menu to select metric units (distance in Kilometers, temperature in degrees Celsius).

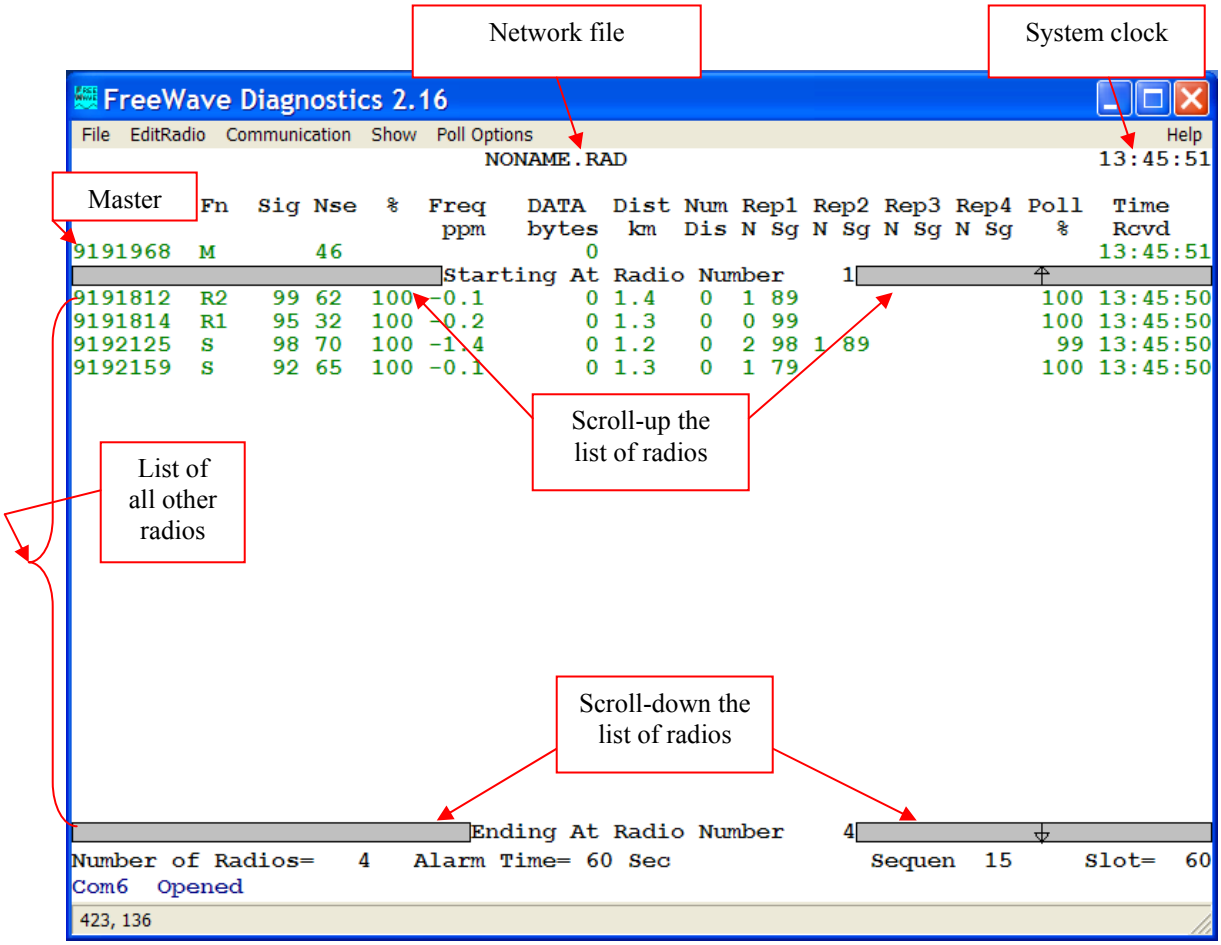


Select the "Show"/"American mi, F" menu to select Imperial ("American") units (distance in miles, temperature in degrees Fahrenheit).



7.3 Reading Screen 0

Diagnostic Screen 0 reports the RF performance of each individual radio link in the network.



7.3.1 Network file

This is the name of the file (and its path) from which the present network info was taken.
Typically, each network is given a name. When the application is setup to monitor that network, a file can be saved and typically, the network's name is used as the file name.
For a new, unsaved network, the application default is "NONAME.RAD".

7.3.2 System Clock

This is the present time of day according to the CPU system clock.

7.3.3 Master Radio line

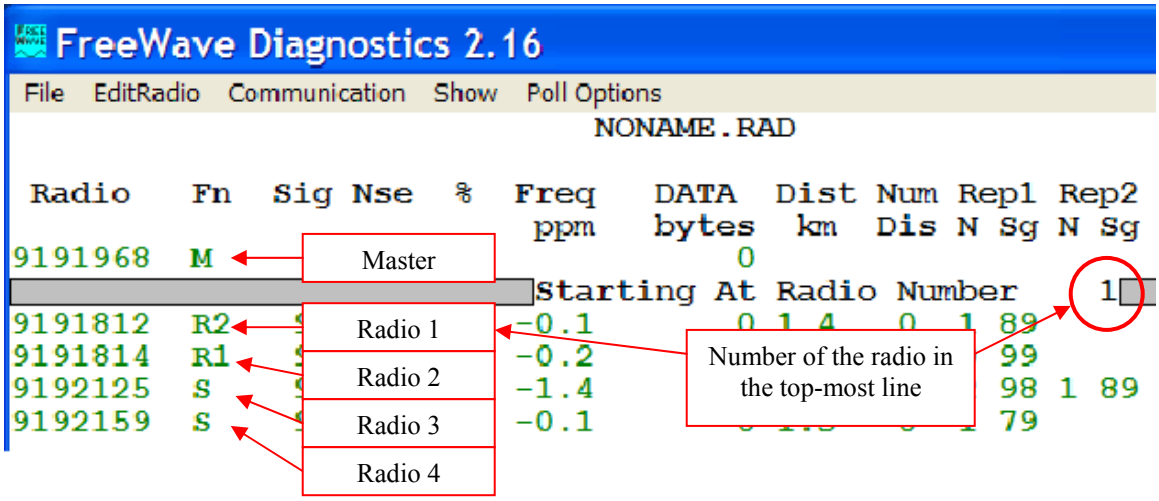
This screen displays a line for each radio in the network. The top-most line, above the bar, is the Master Radio. This line displays fewer items than the other lines, as much of the data is relative only to the Master and are meaningless in the context of the Master itself.

7.3.4 List of radios

Below the bar is a list of all the radios other than the Master. Just below the bar is a line for what is referred to as radio number 1; below that is a row for radio 2; etcetera. The radios are listed in the order that the application detected them, or in the order they were entered by hand.

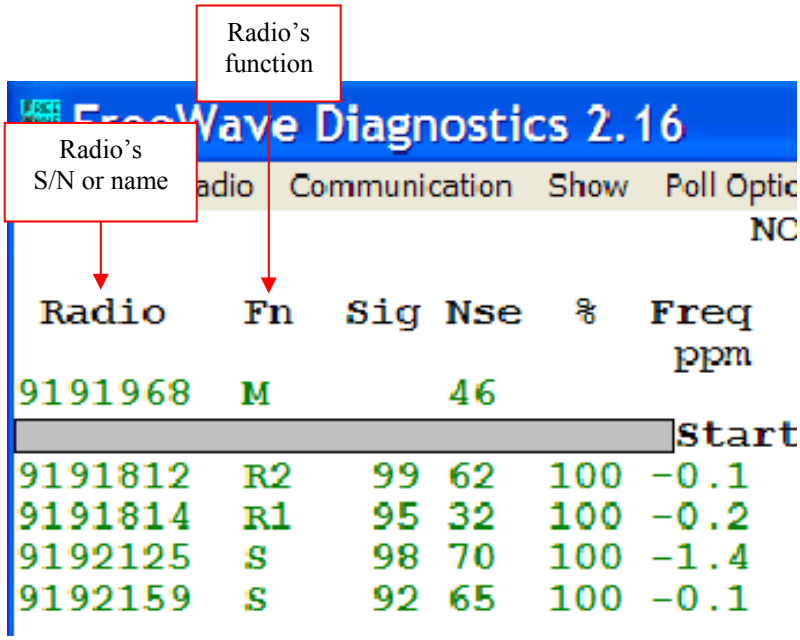
7.3.5 Scroll bars

Two bars at the top are buttons that scroll up the list on radios. Similarly, two bars at the bottom are buttons that scroll down. The Master radio line does not scroll. When the list is scrolled all the way down, the top-most line is for radio number '1'. Otherwise, the text in the middle of the top scroll bar displays the number of the radio in top-most line.



Up to 33 radios plus the master radio may be displayed on a single page of Screen 0. Scroll bars at the top and the bottom of the page allow the radio list to be scrolled up or down to display additional radios. The upper scroll bar contains the message "Starting At Radio Number" followed by the network number of the radio listed immediately below the upper scroll bar. The lower scroll bar contains the message "Ending at Radio Number" followed by the network number of the radio immediately above the lower scroll bar. The radio list may be scrolled up or down by moving the mouse pointer to either scroll bar and clicking on the bar. The display may also be scrolled up or down by pressing the up or down arrow keys on the keyboard.

The following discussion describes the items in each radio's line.



7.3.6 Radio's Serial Number or Name ("Radio")

"Radio" is the Serial Number or the name of the radio. See paragraph 7.2.1 for information on toggling the Serial number/Name display. When the application discovers a radio, the radio is named "New radio".
See paragraph 3.7 for instructions on renaming radios.

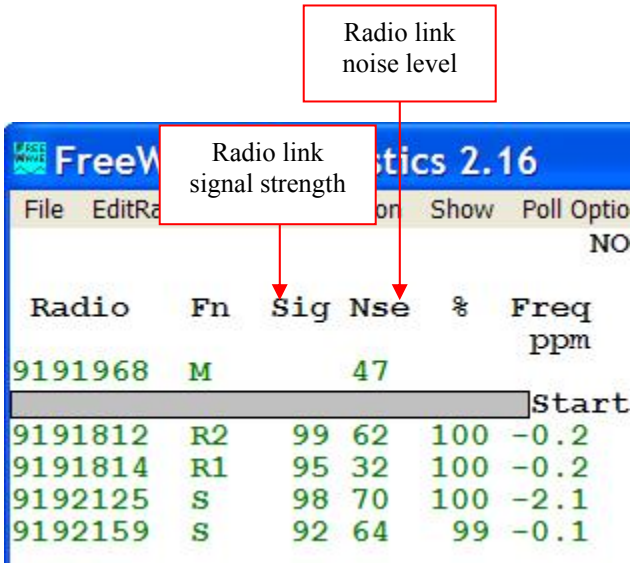
Radio names and serial numbers are saved in the network file.

7.3.7 Radio's function ("Fn")

"Fn" is the function of the radio within the network.

M	Master Radio
S	Slave Radio
R n	Repeater Radio (n is a number assigned by this application).

The application automatically assigns a number to each repeater. The numbers are assigned in the order that the Diagnostic application detects each repeater. Although a radio may be programmed to be a repeater, the radio will be indicated as a slave until the Diagnostic application detects other radios that are linked through the radio into the network.

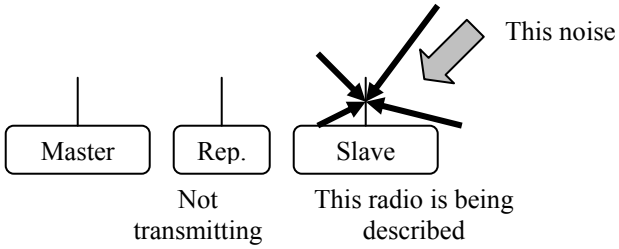


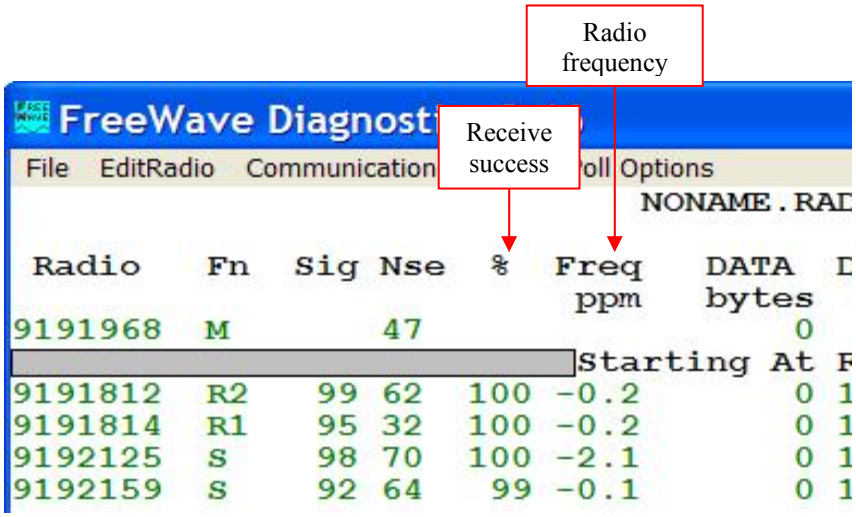
7.3.8 Radio link signal strength ("Sig")

"Sig" is the strength of the signal that the radio receives. For repeaters, "Sig" refers just to the radio link towards the Master. The units are either standard (as they would be displayed in the Radio Statistics Menu), or in dBµV. See paragraph 7.2.2 for information on Selecting Signal Units.
For reliable radio performance under all conditions, the signal level should be at least 40 (in standard units). (RSSI = Received Signal Strength Indicator.)

7.3.9 Radio link noise level ("Nse")

Nse is the average level of the noise the radio receives when linked and not transmitting. The units are the same as for the signal strength. For reliable radio performance under all conditions, the "Nse" value should be at least 30 (in standard units) below the signal strength reading. If the difference is less than 30, the application displays the value in red.



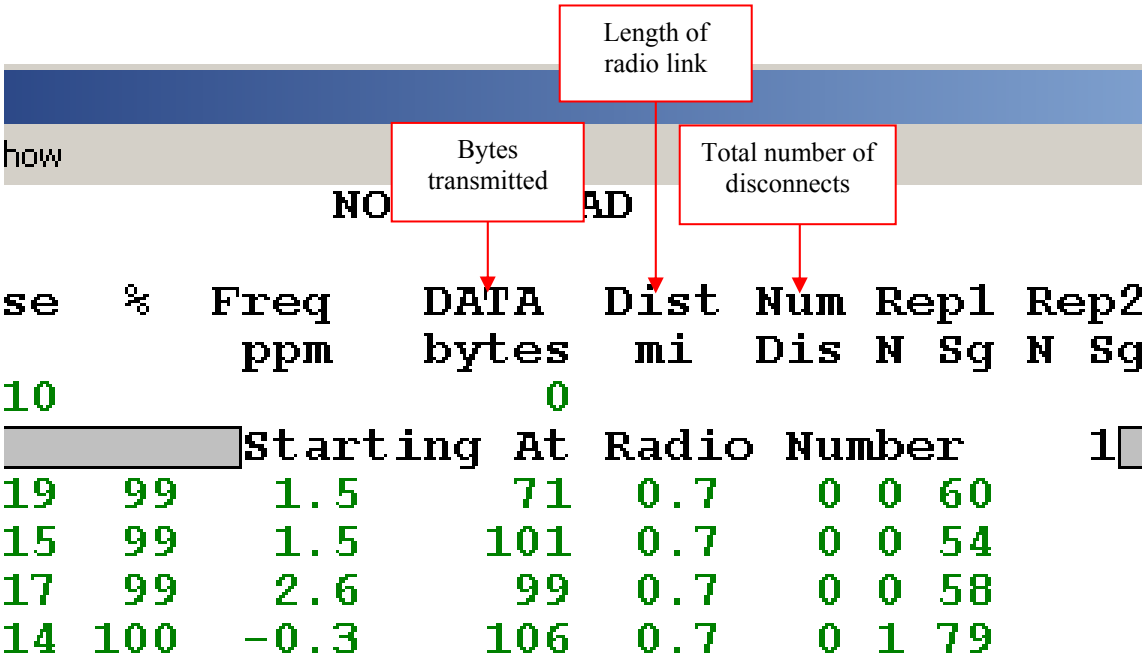


7.3.10 Receive success rate (“%”)

“%” is the percentage of data packets that the radio has successfully received on the first try. If the radio is a repeater, the “%” refers to the radio link towards the Master. The value should be at least 75%. If less than 75%, the application will highlight the value in red.

7.3.11 Radio frequency error (“Freq ppm”)

The PPM is the error of the radio’s frequency with respect to the Master. The value should be within ± 10 ppm. If the value exceeds ± 5 ppm, the application will highlight the serial number in red. If all the values are biased in one direction, the Master radio is where the frequency has drifted. A radio with a high Frequency Error may need to be sent into FreeWave to be re-tuned.



7.3.12 Bytes transmitted (“DATA bytes”)

The “DATA bytes” column is the number of bytes that the radio has transmitted from the data port (since the application started monitoring the radio). Since Repeaters do not generate data themselves, but repeat data from another radio, a ‘0’ will be displayed. However, if the radio is a Slave/Repeater, the count is for the data transmitted while operating as a Slave.

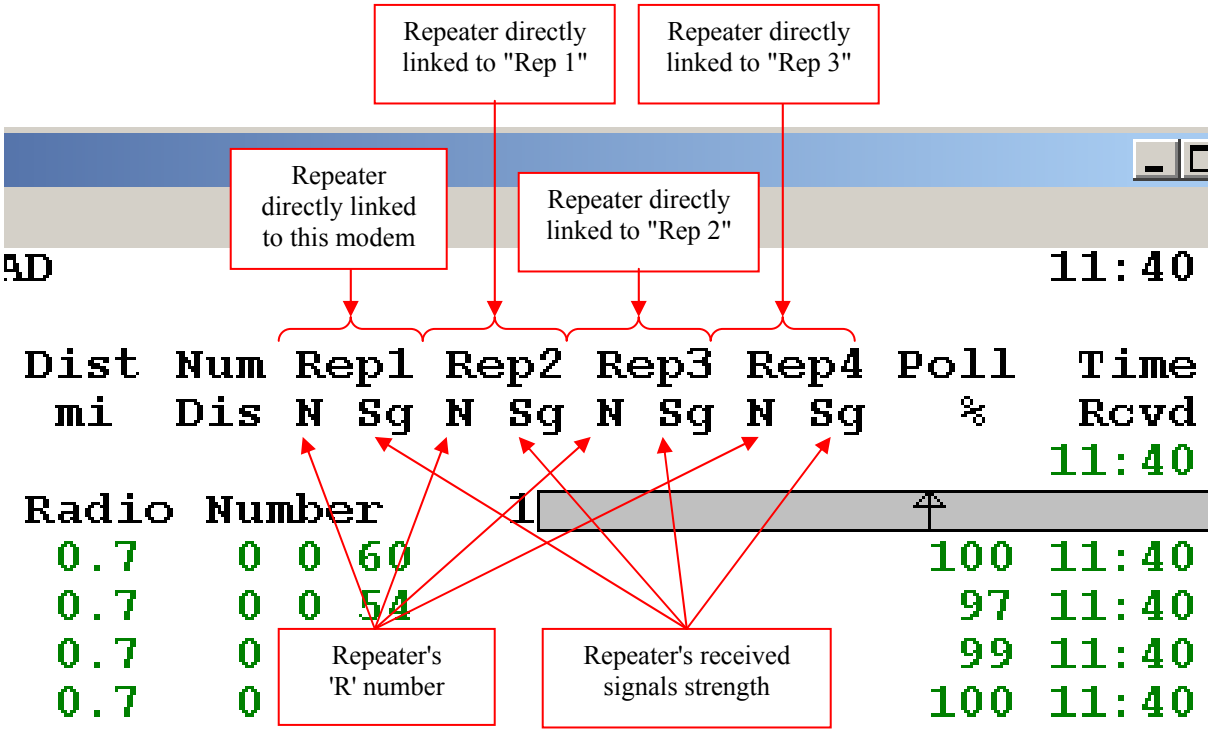
7.3.13 Length of radio link (“Dist”)

The Dist is the distance between the selected radio and the radio to which the selected radio is directly linked. If the radio is linked directly to the Master, Dist is the distance to the Master. Otherwise, Dist is the distance to the repeater to which the radio is linked. Distances greater than 1 km are typically accurate to within 30 meters. Shorter distances are not reported accurately. The units are km or miles; use the “Show”/”Metric km/C” menu to select km, and the “Show”/”American mi/F” menu to select miles.

7.3.14 Total number of disconnects (“Num Dis”)

The Num Dis is the total number of times that the selected radio has lost connection to the network (since the radio was turned on or since Set-up mode was ended).
A disconnect may be due to:

- a poor radio link path,
- temporary removal from operation of any radio in the complete path,
- using Diagnostics to change another radio’s setting.



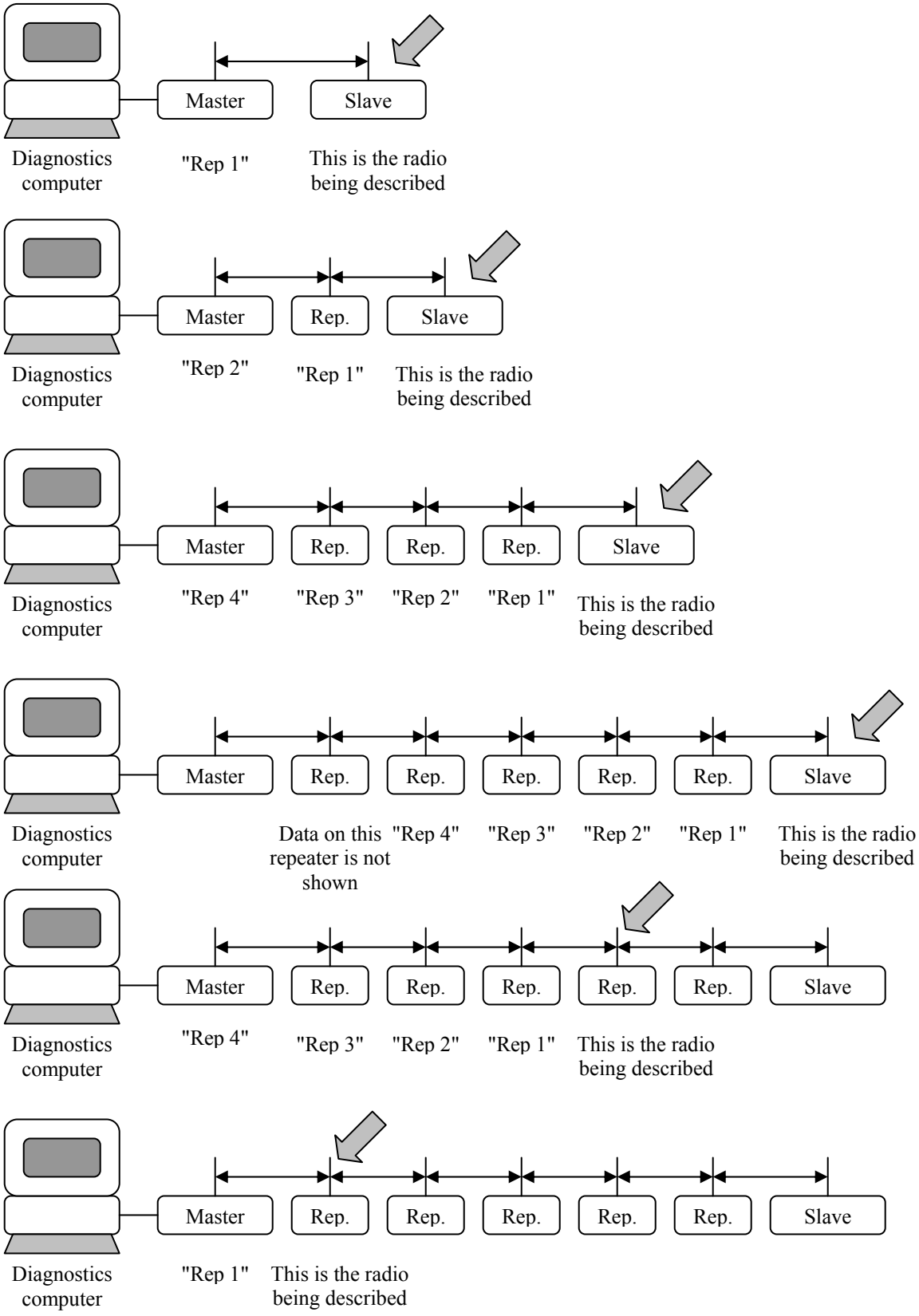
7.3.15 Repeater info (“Rep n” "N" "Sg”)

“Rep n N Sg” is the path that the radio uses to communicate to the Master. “Rep 1” refers to the radio (Master or repeater) to which the radio is directly linked. “Rep 2” is the repeater (not the master) to which “Rep 1” is directly linked, and so forth. Use the table below to see what each column refers to.

# of repeaters	“Rep1””	“Rep2”	"Rep3"	"Rep4"
0	Master			
1	Repeater			
2	Rep. closest to slave	Other rep.		
3	Rep. closest to slave	2nd rep.	3rd rep.	
4	Rep. closest to slave	2nd rep.	3rd rep.	4th rep.
5+	Rep. closest to slave	2nd rep.	3rd rep.	4th rep.

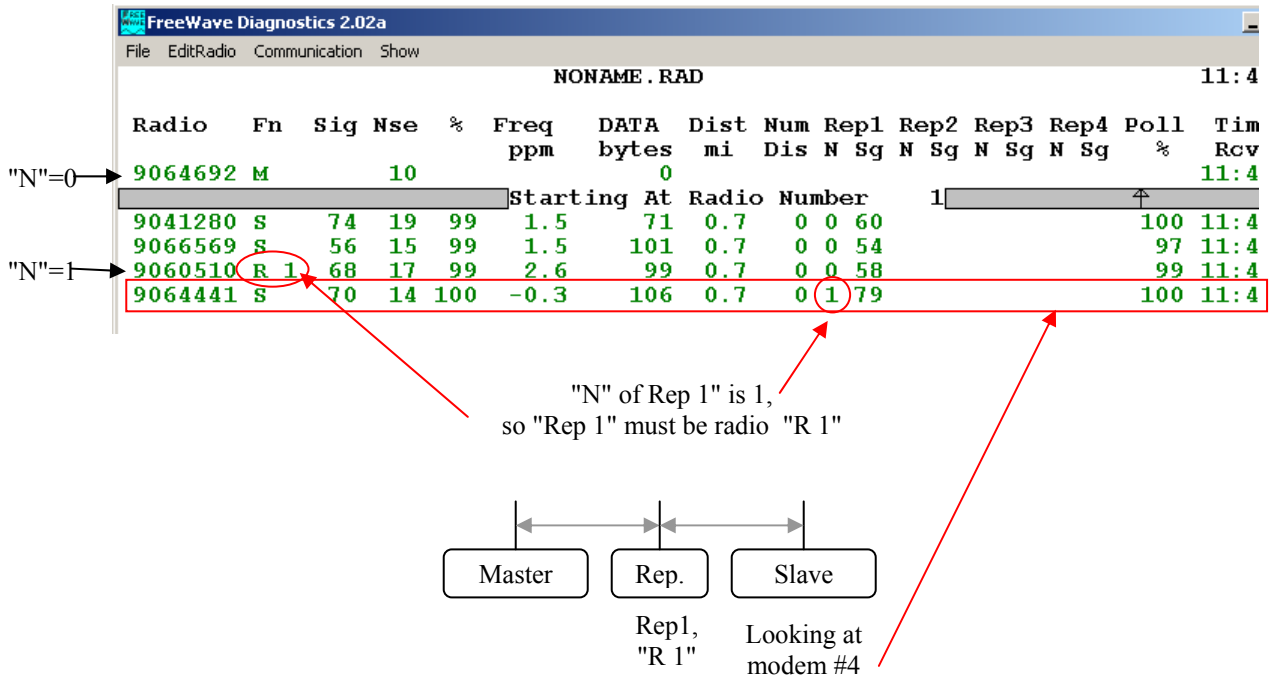
Up to 4 repeaters are shown (the 4 "closest" to the radio being displayed). The rest of the path may also be derived: first observe which radio is listed under the "Rep 4" column (for example "R 5") then, in the "Fn" column, find that repeater ("R 5" for this example); that line will display the rest of the path, from that repeater, towards the Master.

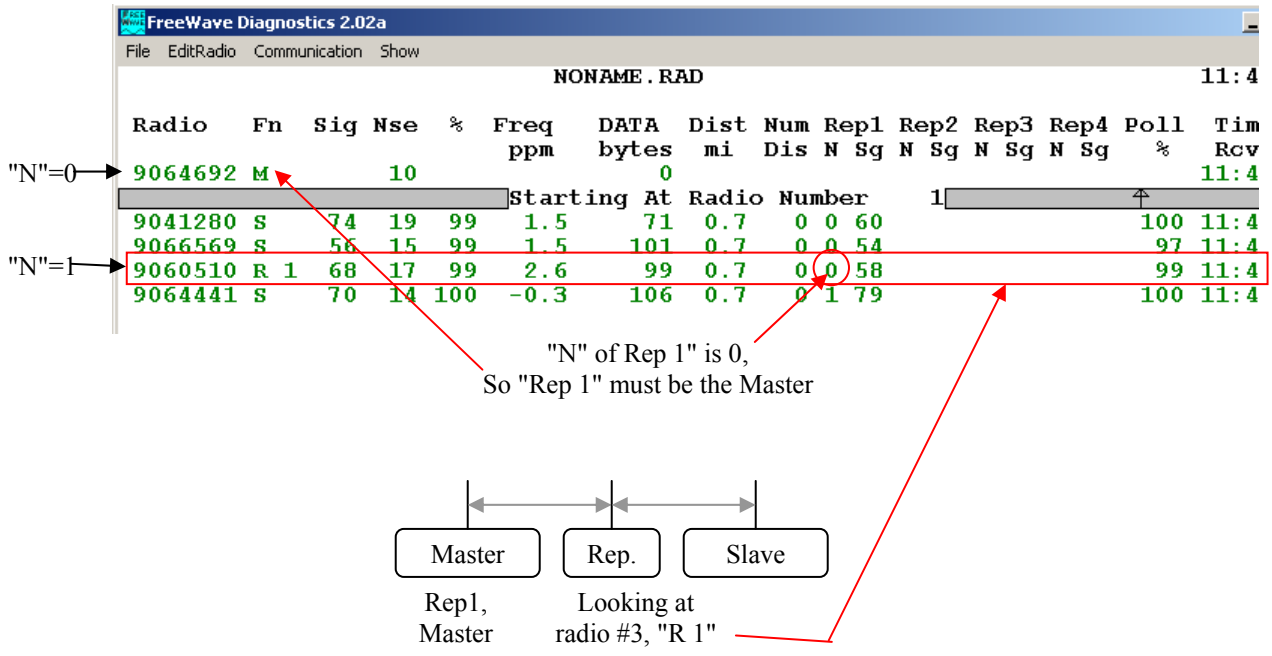
The next drawings show some examples of networks and how these networks may be numbered.


Master
Slave
Diagnostics computer
"Rep 1"
This is the radio being described
Master
Rep.
Slave
Diagnostics computer
"Rep 2"
"Rep 1"
This is the radio being described
Master
Rep.
Rep.
Rep.
Slave
Diagnostics computer
"Rep 4"
"Rep 3"
"Rep 2"
"Rep 1"
This is the radio being described
Master
Rep.
Rep.
Rep.
Rep.
Rep.
Slave
Diagnostics computer
Data on this repeater is not shown
"Rep 4"
"Rep 3"
"Rep 2"
"Rep 1"
This is the radio being described
Master
Rep.
Rep.
Rep.
Rep.
Rep.
Slave
Diagnostics computer
"Rep 4"
"Rep 3"
"Rep 2"
"Rep 1"
This is the radio being described
Master
Rep.
Rep.
Rep.
Rep.
Rep.
Slave
Diagnostics computer
"Rep 1"
This is the radio being described

Each "Rep n" column has 2 items: "N" (number) and "Sg" (signal).

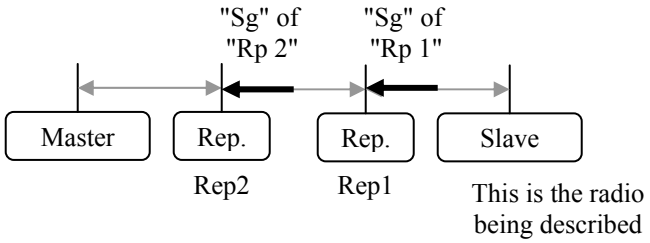
"N" is the number of the next repeater down the path. For example, 'N' = '1' refers to the radio that has "R 1" in the "Fn" column. 'N' = '0' refers to the Master (in the top line, just above the scroll bars).
Don't confuse repeater "R 1" with "Rep 1": repeater "R 1" is the 1st repeater that the application found, while "Rep 1" is the 1st repeater down the path, from the radio towards the Master (not necessarily the same location). The “N” digit will define the Fn location of the repeater.

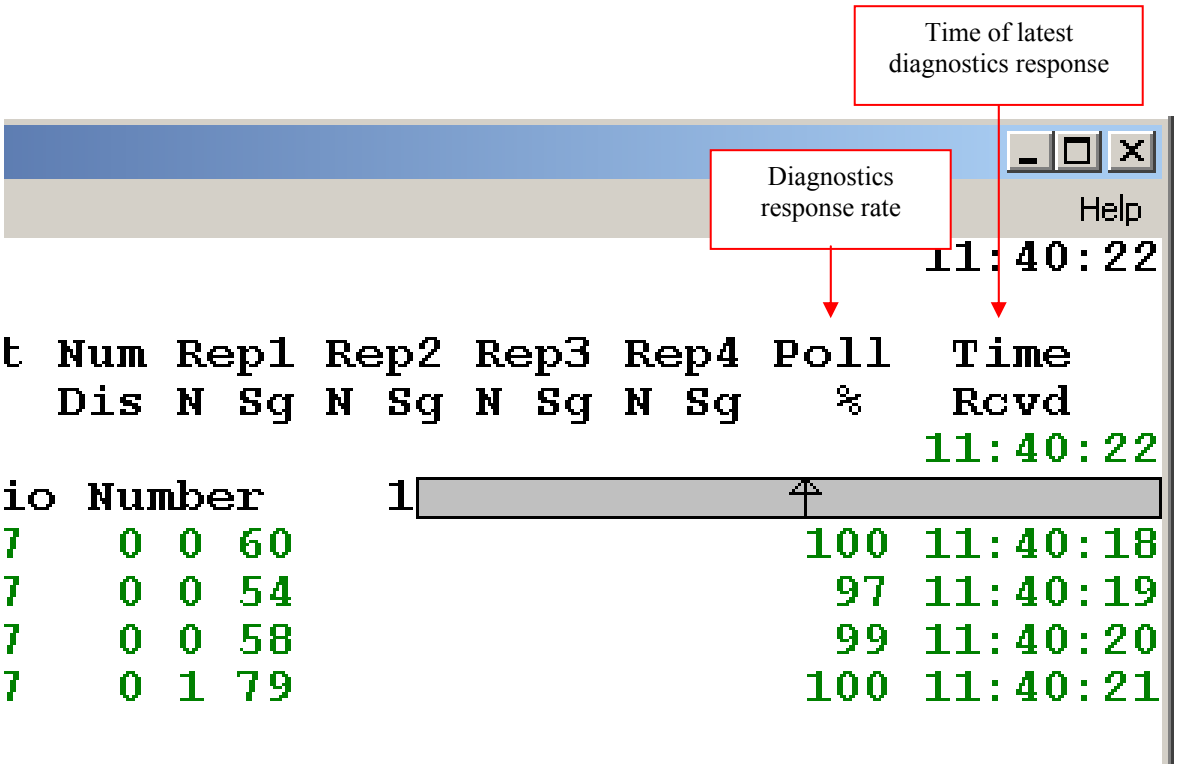




In the example above, serial number 906-0510 has been detected as a repeater and assigned repeater number "R 1". Serial number 906-4441 is linked into the network through repeater "R 1" as shown in the Rep1 column. All of the other radios in the network, including repeater "R 1", are connected directly to the master as indicated by the '0' in the Rep1 column.

"Sg" is the signal strength received by the next radio down the line (towards the Master). In the "Rep 1" column, is the strength of the signal that the "Rep 1" repeater receives from the radio being looked at. In the "Rep2" column, is the strength of the signal that the next radio (be it another repeater or the Master) receives from repeater "Rep 1".



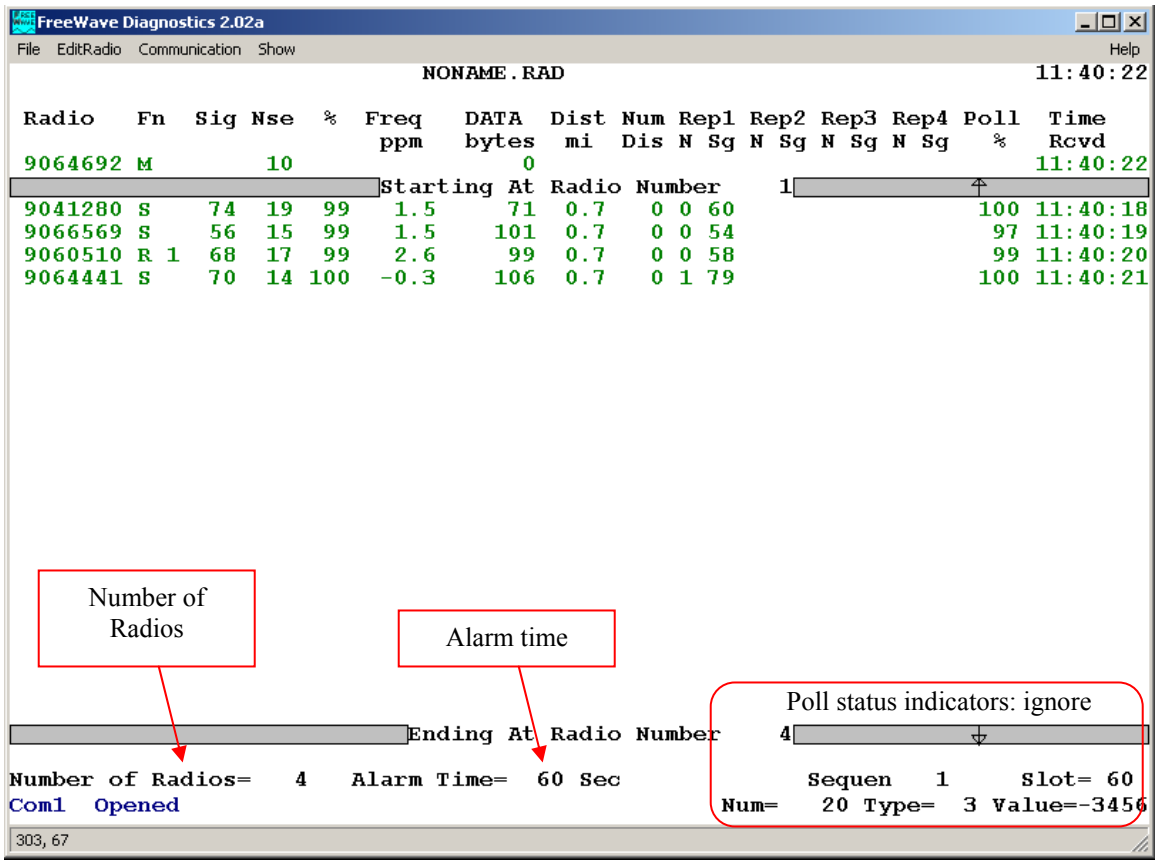


7.3.16 Diagnostics response rate ("Poll %")

The Poll% is the percentage of the time the radio has reported back diagnostics data when polled. If the radio is used to transmit a large amount of data as part of normal operation, the radio will have less time to respond to the Master polling diagnostics data; in that case, the diagnostics response rate will decrease. If the value is 0, it may be because the radio is disconnected from the network.

7.3.17 Time of latest diagnostics response ("Time Rcvd")

The Time Rcvd is the time (measured using the System Clock) when the radio last replied to diagnostics polling. If the lag in response exceeds the Alarm Time (see "Alarm Time" below, paragraph 7.3.19), the application highlights Time Rcvd in red.



7.3.18 Number of Radios ("Number of Radios")

The Number of Radios is the total number of radios in the list, not counting the Master. (A radio may be listed even if the radio is no longer in the network, as radios must be deleted from the list manually.)

7.3.19 Alarm Time

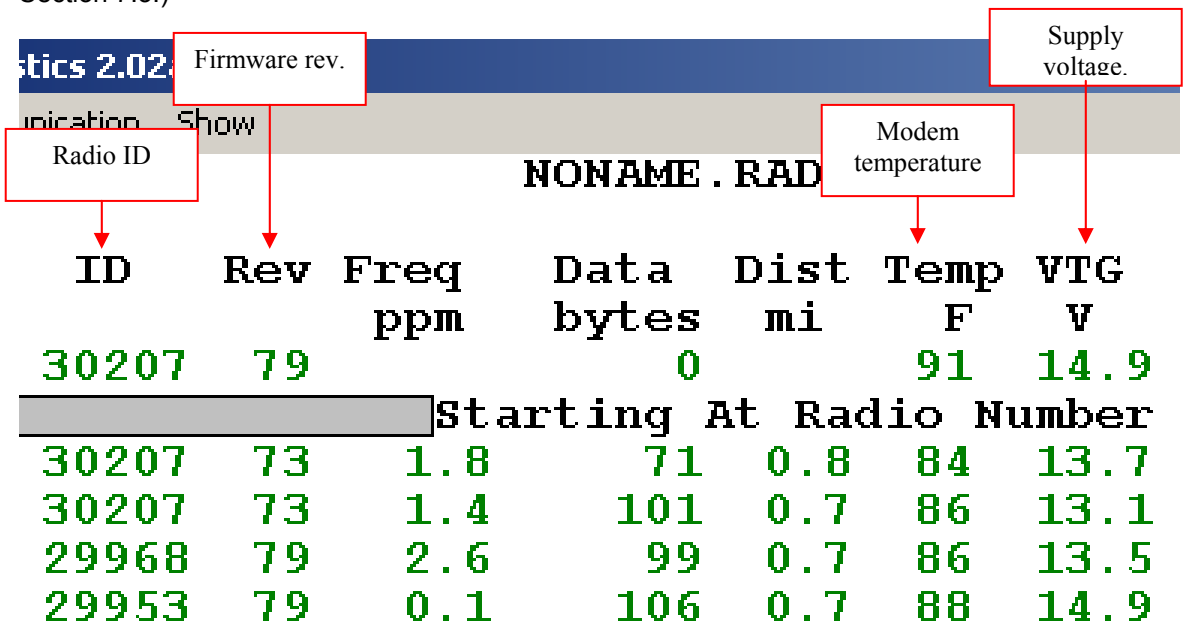
The Alarm Time is the maximum acceptable time without a diagnostics response from a given radio (see "Time of latest diagnostics poll" above, paragraph 7.3.17). After that time, the application highlights in red the radio's "Time Rcvd" time. The default is 60 seconds. Use the '+' and '-' keys of the computer's numeric keypad to change the value.

7.3.20 Poll Status Indicators

The counters and indexes displayed on the lower right corner of the display are troubleshooting indicators for use by FreeWave Technologies. They serve no purpose in the Diagnostic application other than to provide an indication that the program is running correctly. One of the indicators will display Random or Sequen depending on the polling method that is active, either random or sequential. If Sequen is displayed, the number indicates which radio number in the list is currently being polled. The number display next to the indicator indicates where the diagnostic program is in the polling process.

7.4 Reading Screen 1

Screen 1 is very similar to "Screen 0". Screen 1 provides additional information about the radios, such as the status of the data port lines (RS-232 only) and information on the operating environment. Some fields in screen 1 are the same as in "Screen 0", the following section describes only the fields that are unique to "Screen 1". (For information on the other fields, see Section 7.3.)



7.4.1 Radio ID ("ID")

“ID” is the radio ID that was set in the radio's programming ("multipoint settings" menu, 'D' sub-menu). The ID may be used to identify the radio's site or to track a device connected to it. The default is 65535.

7.4.2 Firmware Revision ("Rev")

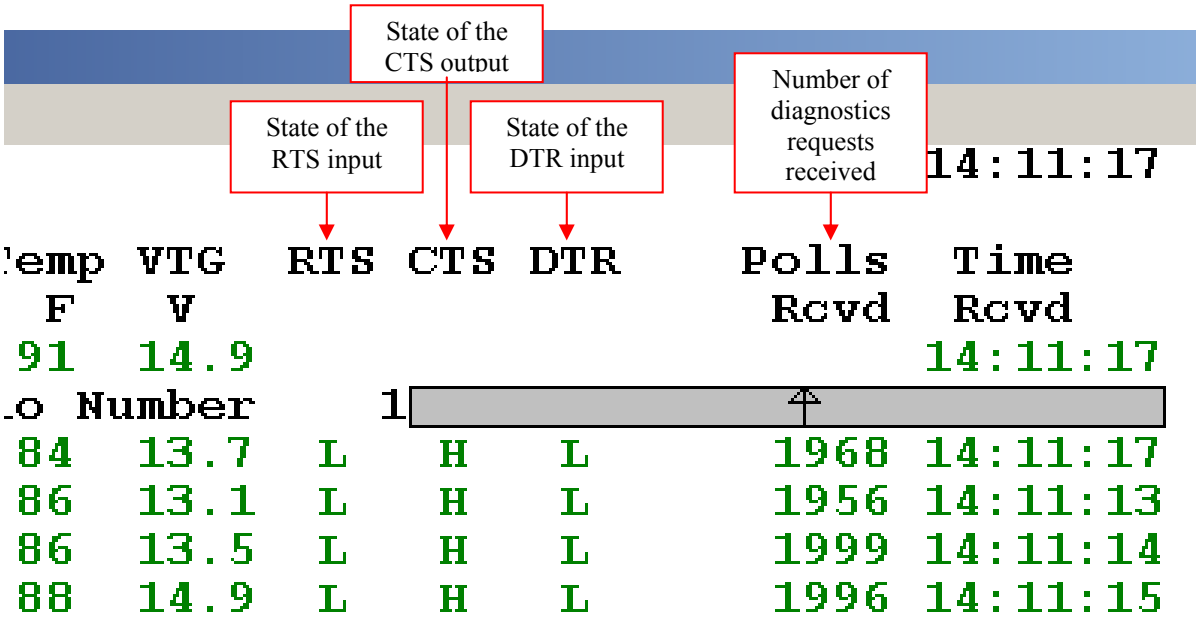
“Rev” is an indirect indication of the version of the firmware installed in this radio. FreeWave technical support can convert the Rev number to the actual revision level.

7.4.3 Radio temperature ("Temp")

“Temp” is the operating temperature of the radio. The units are degrees Celsius (default) or Fahrenheit; use the "Show"/"Metric km/C" option to select Celsius, and the “Show"/"American mi/F" option to select Fahrenheit. All FreeWave radios are 100% tested for operation over a temperature range of –40 C to +75C (-40F to +167F).

7.4.4 Supply voltage ("Vtg")

"Vtg" is the supply voltage of the radio, in Volts.



7.4.5 State of RS232 port lines ("RTS", "CTS", "DTR")

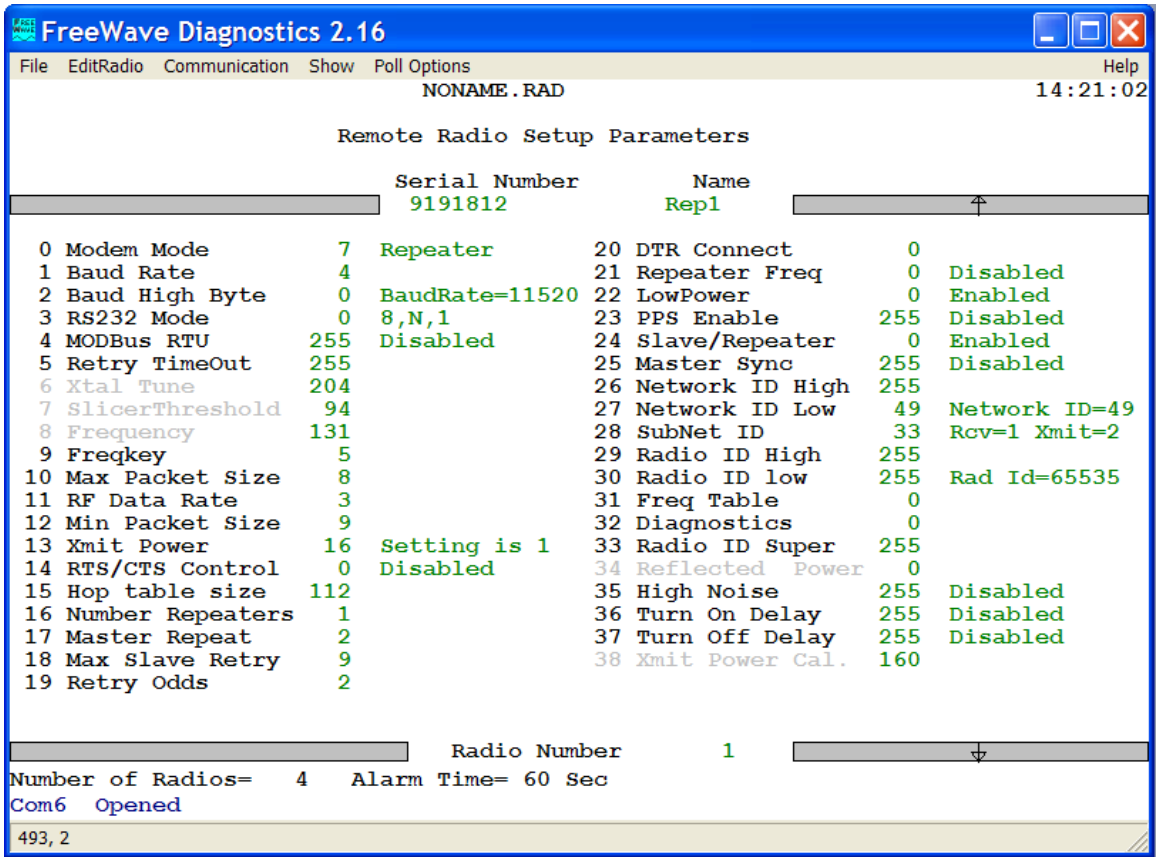
"RTS", "CTS", and "DTR" refer to the states of the RTS, and DTR inputs and the CTS output of the radio's Data Port. 'H" refers to a high state (~ 10 V, asserted, logic '0') and 'L' refers to a low state (~-10 V, deasserted, logic '1'). Note that in inverted-TTL models, the screen reports '0' if the line is high (5 V) and vice versa.
In RS485 radios only the state of the DTR input is reported.
In Ethernet radios there are no such inputs, so these reports are invalid.

7.4.6 Number of diagnostics requests received ("Polls Rcvd")

"Polls Rcvd" is the total number of replies to diagnostic polling that the master received from the radio, since the application started. (In a multipoint network, a master may miss some messages from another radio.)

7.5 Reading Screen 2: "Remote Radio Setup Settings"

Screen 2 displays a single radio's settings and allows them to be edited.

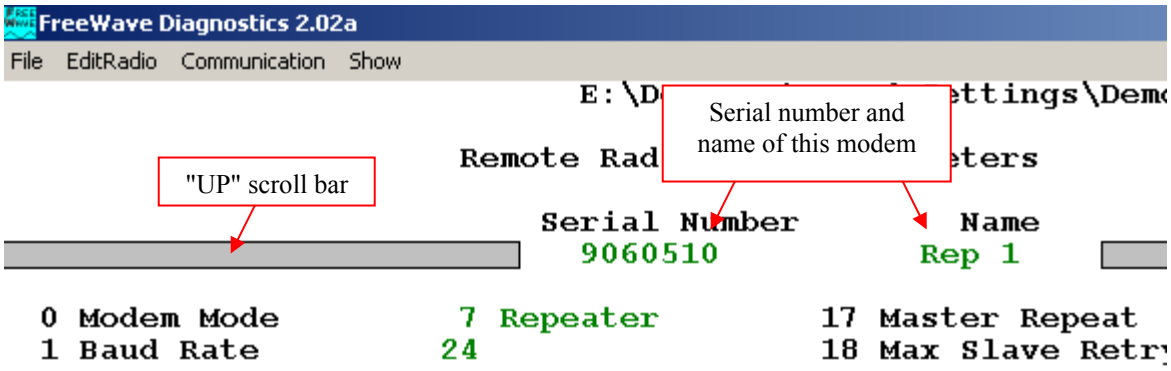


Note: If the firmware version of the Master is earlier than 5.68 (900 MHz), 1.60 (2.4 GHz) or 9.34 (1.4GHz), the settings cannot be edited or viewed.

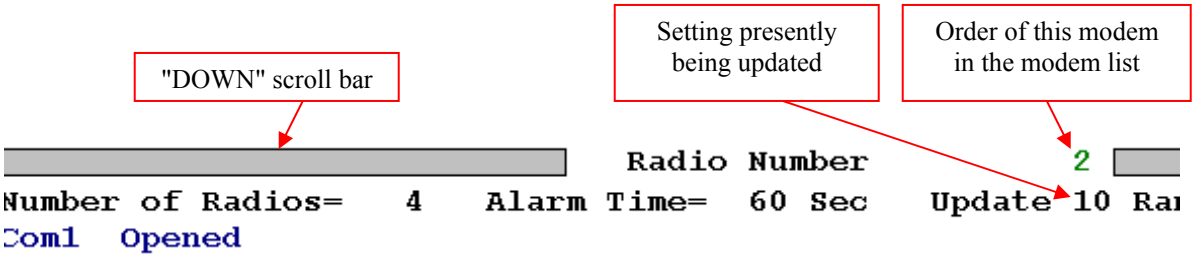
7.5.1 Selecting a particular Radio

To select another radio, scroll through the radio list, either by clicking on the gray scroll bars, or by pressing the up and down arrow keys on the diagnostics computer. When either end of the list is reached, the list restarts from the opposite end.

At the top of the screen, the Serial Number and the radio's name are displayed.

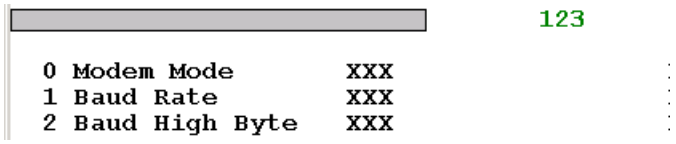


At the bottom, the screen displays the order of the radio within the radio list (of the previous screens). Specifically, '0' refers to the Master.

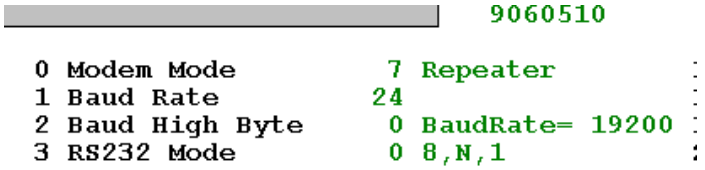


7.5.2 Settings' display

Initially, the application uses "XXX" for the value of each setting.



As the radio reports a setting, the application displays the value.

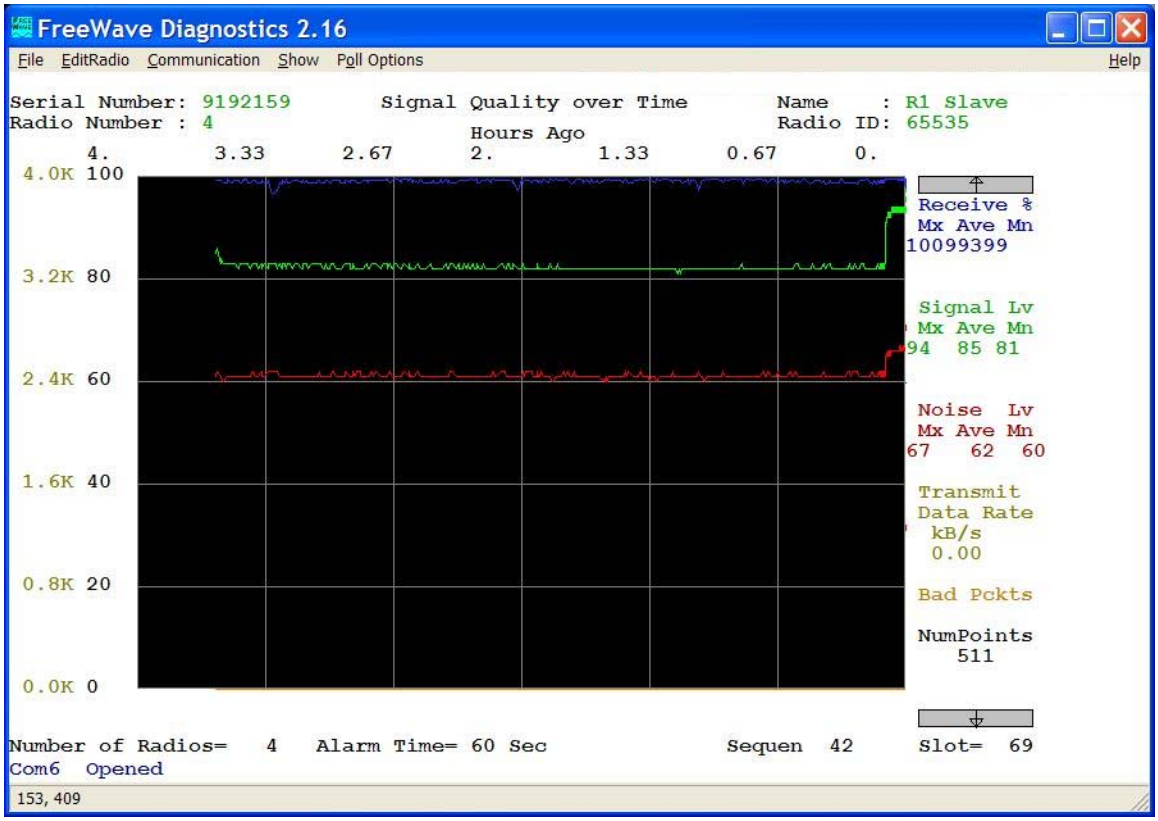


The process is slower if the network is transferring a lot of data. Pressing 'P' on the diagnostics computer keyboard will force the radio to respond quicker, as this sends a poll request to that specific radio for all of its settings.

Each setting is marked with a number, 0 to 40. (Screen 2 handles only the most important 35 settings.) At the bottom right, the screen shows which setting is presently being updated.

7.6 Reading Screen 3, Signal Quality over Time

Screen 3 displays a rolling graph of the performance over time of a single radio.

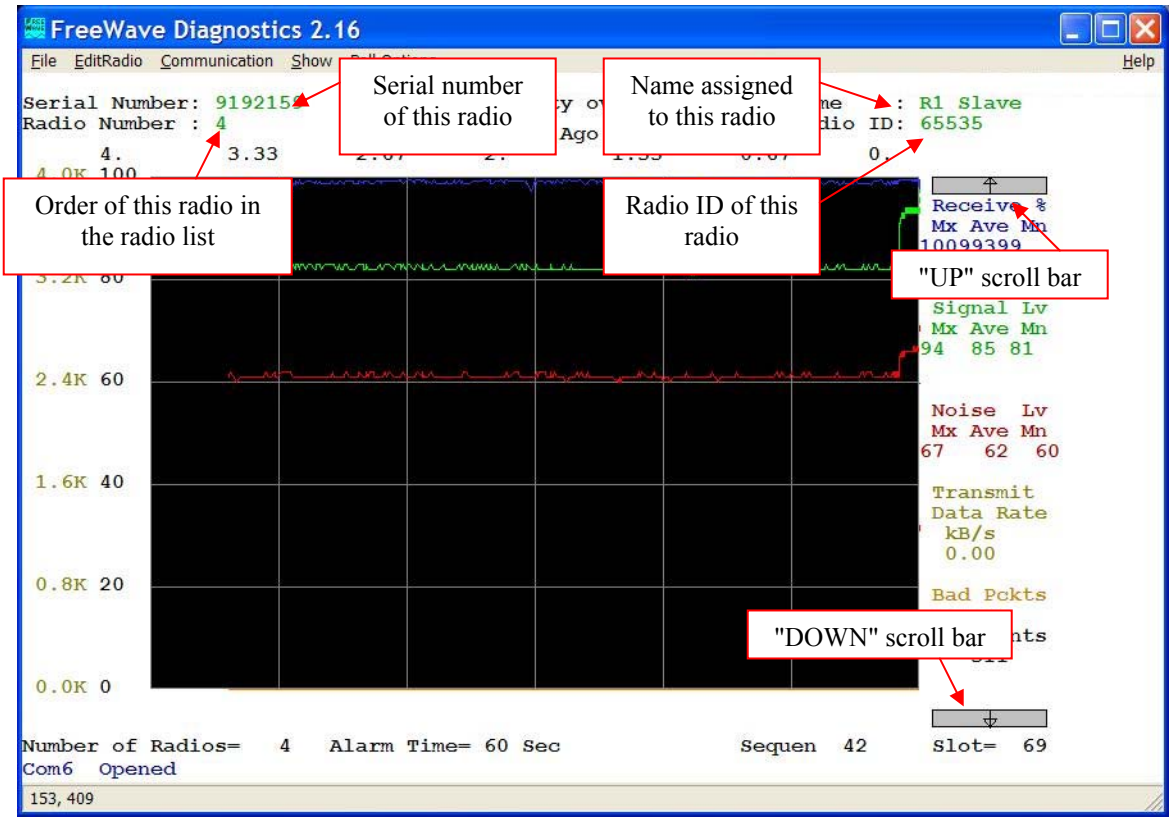


7.6.1 Selecting a particular Radio

To select another radio, scroll through the radio list, either by clicking on the gray scroll bars, or by pressing the up and down arrow keys on the keyboard. When either end of the list is reached, the list will restart from the opposite end.

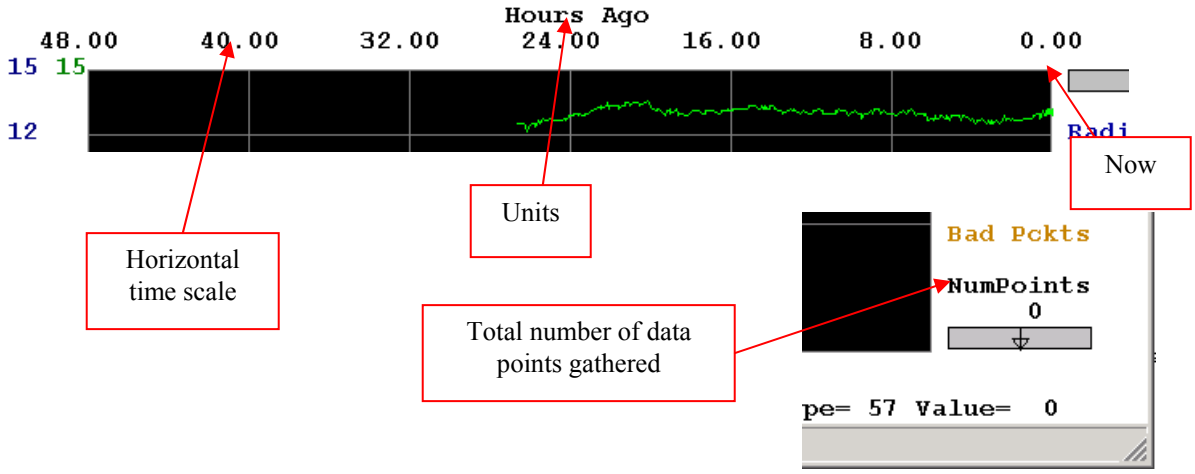
At the top left, the screen displays the Serial Number of the selected radio, and the order of the radio within the radio list (of the '0' and '1' screens). Specifically, '0' refers to the Master.

At the top right, the screen displays the name of the selected radio, and the Radio ID.



7.6.2 Horizontal time scale

The application starts gathering data when first started. The software displays the data starting from the right edge, and then rolls to the left. The right edge of the graph is always "now". Each time the traces reach the left end, the application changes the horizontal time scale by a factor of 2, so that all the data is displayed in a single screen. The numbers at the top of the graph indicate the horizontal time scale (in minutes or hours); '0' is on the right, representing 0 hours (or minutes) ago.

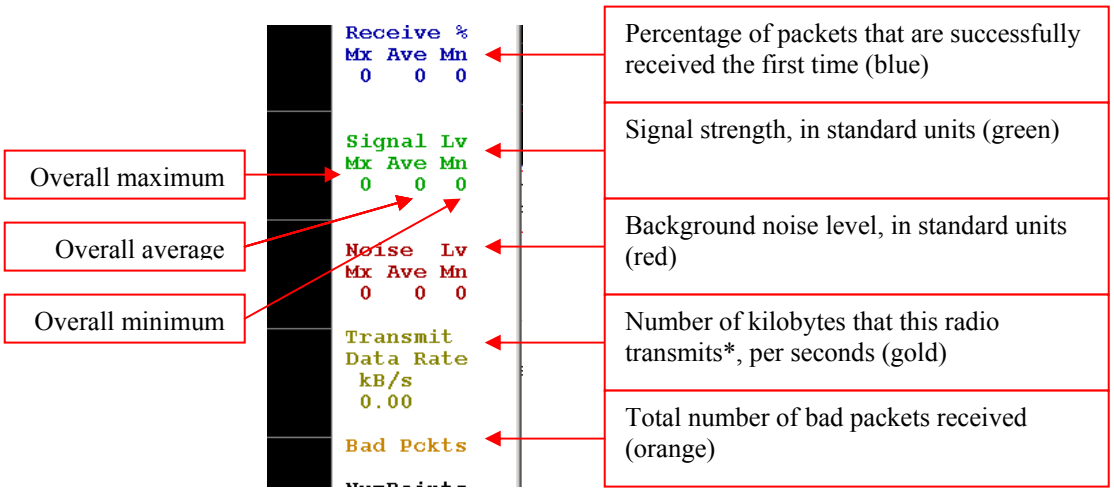


7.6.3 Variables displayed

The graph plots 5 variables:

- "Receive %": the percentage of packets that are successfully received the first time
- "Signal Lv": the signal strength, in standard units (dBµV is not available)
- "Noise Lv": the background noise level, in standard units
- "Transmit Data Rate": the number of kilobytes that the radio transmits*, per seconds
- "Bad Pckts": portion of packets received that are bad

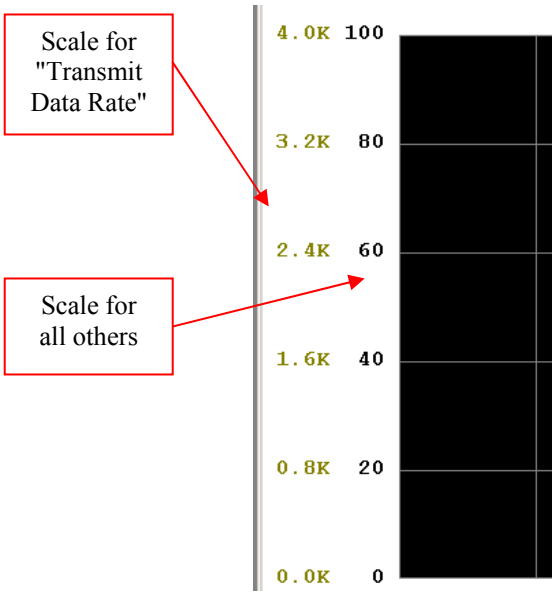
* For repeaters, this is only that data that is locally generated (non-zero only when a Slave/Repeater is operating as a Slave). Repeaters with older firmware also include the data that is repeated through them.



The first 3 variables display the overall minimum, maximum and average.

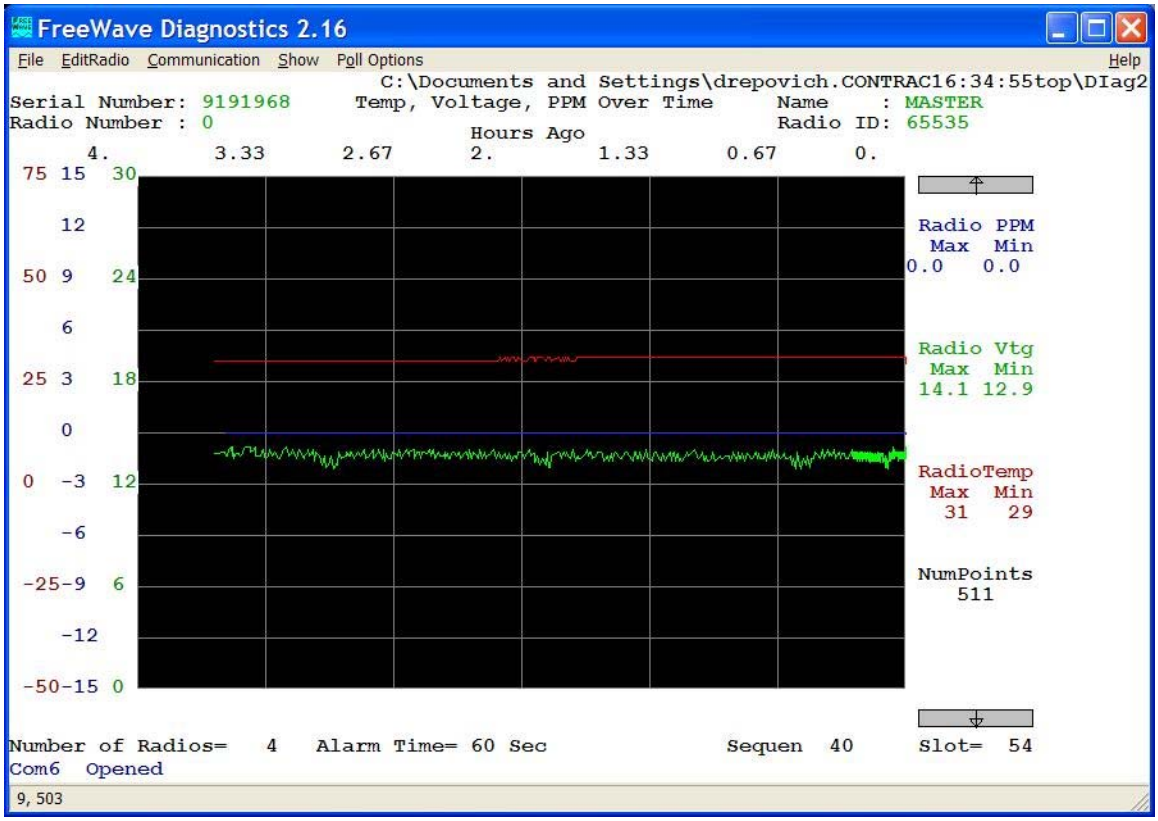
7.6.4 Vertical scale

The graph has 2 vertical scales. The gold colored scale ("0.0K“ to "4.0K") is for the Transmit Data Rate. The black scale ("0" to "100") is for all the other variables.



7.7 Reading Screen 4: "Temp, Voltage, PPM Over Time"

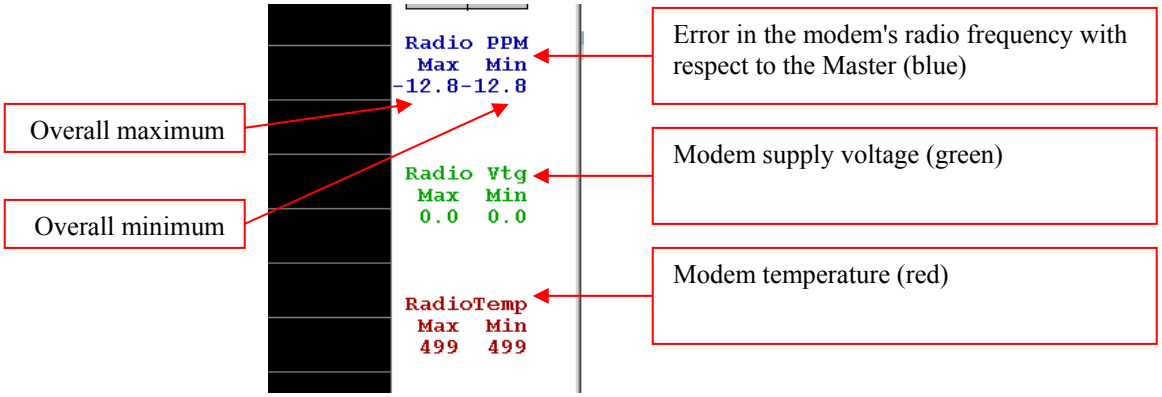
Screen 4 displays a rolling graph of the operating parameters over time of a single radio. Screen 4 is similar to Screen 3, except for the variables that are plotted. The following section describes only those differences. .



7.7.1 Variables displayed

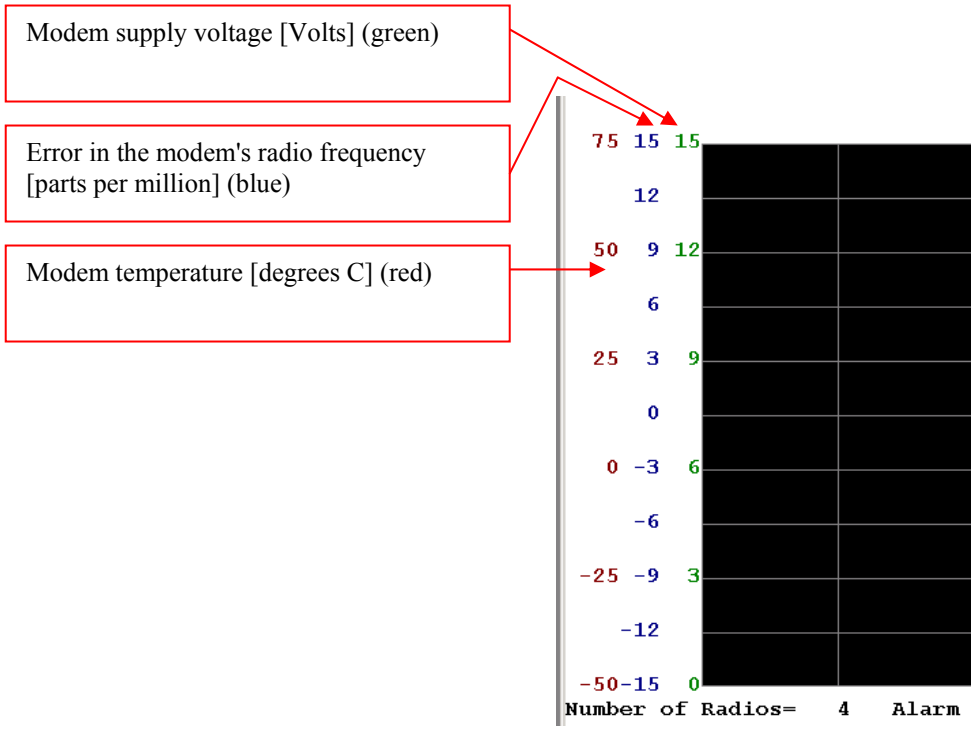
The graph plots 5 variables:

- "Radio PPM": Error in the radio's radio frequency with respect to the Master [ppm]
- "Radio Vtg": the voltage of the radio's power supply {Volts]
- "RadioTemp": the temperature of the radio [C]



7.7.2 Vertical scale

The graph has 3 vertical scales. The green scale (0 to 15) is for the voltage of the radio's power supply [Volts]. The blue scale (-15 to 15) is for the error in the radio's radio frequency [parts per million]. The red scale (-50 to 75) is for the temperature of the radio [degrees Celsius].



8 Editing the Radio's Settings

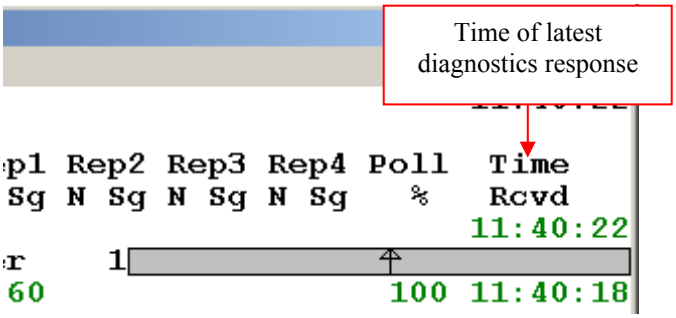
The selected radio's settings can be edited through Screen 2.

Only one setting can be changed at a time. **FreeWave strongly recommends that the normal data flow through a radio be interrupted while changing any settings using diagnostics.**

8.1 Strategy

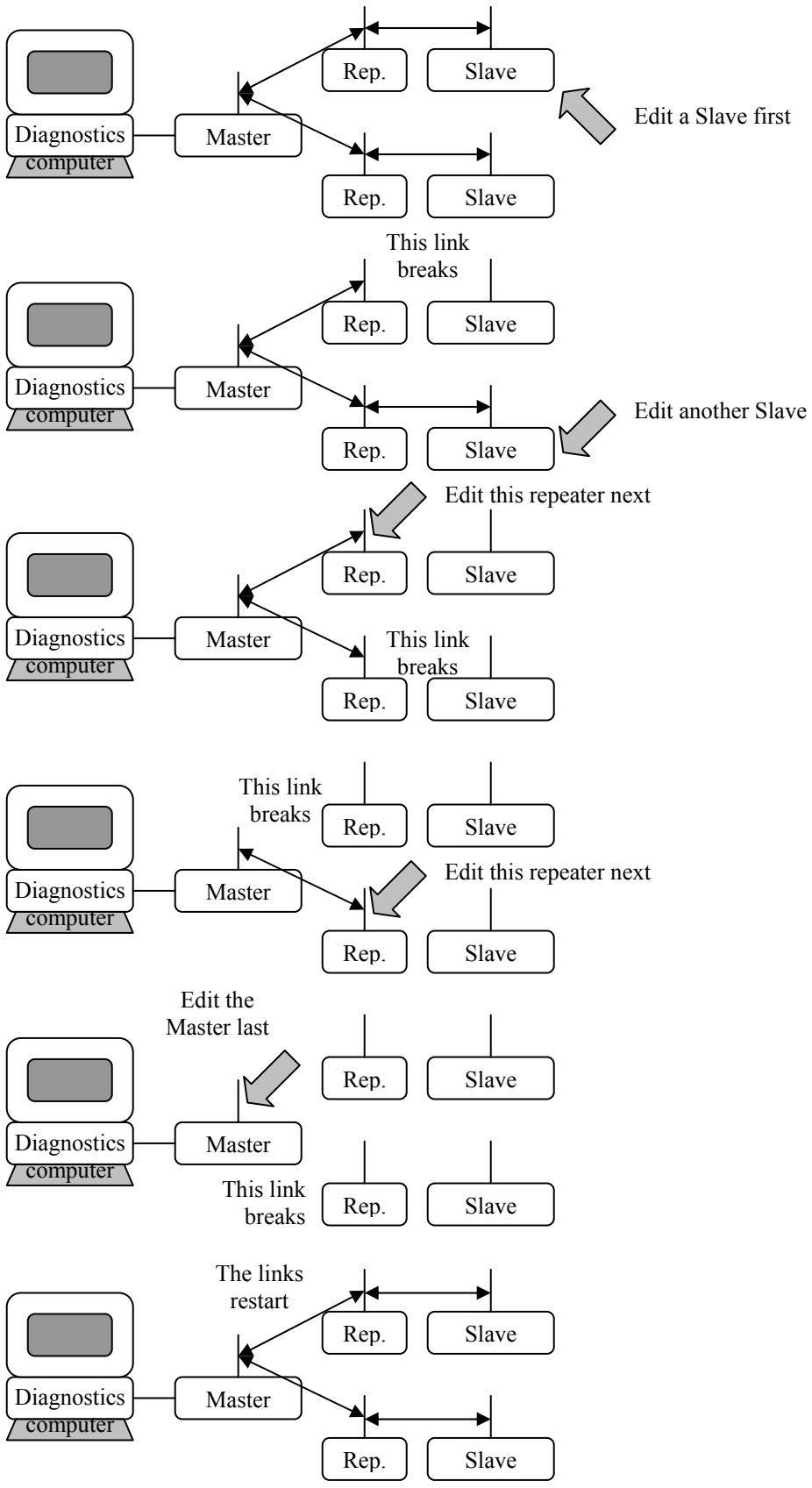
FreeWave recommends that the radio not be used to transfer data until all settings changes are complete. The reason is because the radio disconnects from the network when settings are changed. Afterwards, if the radio is able to reestablish the link, it will do so automatically.

> **Tip**: To see whether or not a radio is connected, go to Screen 0 and look at the "Time Rcvd" field, to see when the radio last sent diagnostics data.



All changes should be verified before another change is made.

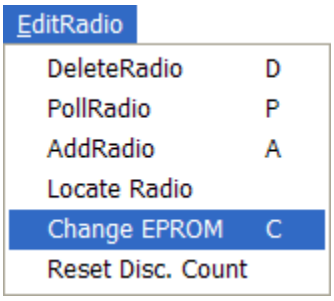
Certain settings must match throughout the entire network. These settings must be changed in every radio in the network. Start from the Slaves, and work inward toward the Master; if a repeater is changed before all the slaves beyond it are changed, the "outer" radios will lose the link and not be able to reconnect once the master is reconfigured.
Verify each change before attempting to change a different setting.


Diagnostics computer
Master
Rep.
Slave
Edit a Slave first
This link breaks
Edit another Slave
Edit this repeater next
This link breaks
This link breaks
Edit this repeater next
Edit the Master last
This link breaks
The links restart

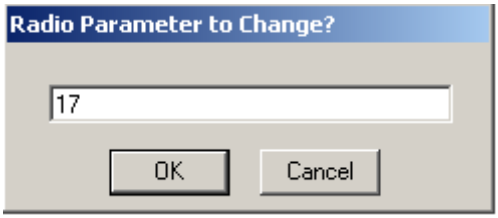
8.2 Changing a Radio's Settings

To change a setting in a radio, use Screen 2 and select that radio (using the arrow keys on the keyboard, or clicking the scroll bars).

Select the "EditRadio" / "Change EPROM" menu (or press the 'C' key).

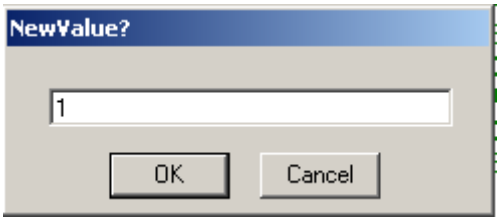


A dialog appears.



Enter the number of the setting that is going to be changed (0 to 40) and click "OK".

A new dialog appears.



Enter the new value of the setting and click "OK"

8.3 Details about the Settings

Changing these settings is similar to changing them through a radio's "Set-Up" mode, with following differences.

- The application only displays 40 and makes editable 35 of the radio's settings.
- These settings are all available from a single screen (instead of a hierarchy of menus)
- Five of these settings are not editable and are not reported in the "Set-up" mode.
- Enter the Radio ID with 3 bytes instead of 4 decimal digits.
- Some settings appear different in the Application than in the Set-up menu

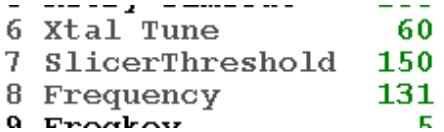
Please refer to the Main Manual for an explanation of the significance of each setting displayed in the screen, and what values are acceptable for each setting.

8.3.1 Risky changes

Changing certain parameters through Diagnostics is somewhat risky, as communication may be lost. Therefore, a change may not be undone without going to the remote site to correct the offending entry by use of direct access to the radio through "Set-Up" mode.

8.3.2 Xtal tune / SlicerThreshold / Frequency

These 3 settings report data that are not editable and are not even reported in the normal "Set-up" mode. They are not described either here or in the Main Manual. They are only useful to a FreeWave Technologies technician.



8.3.3 Settings that appear different from the Set-UP menu

The following settings relate directly to the settings in Set-Up mode however, they are displayed differently. See the Main Manual for information of what these settings mean. Described here is how they differ from the Set-Up menu:

8.3.3.1 Baud Rate

Baud rate is set using two parameters: 1- Baud Rate and 2- Baud High Byte.

Baud Rate	Set-up Menu setting	Diagnostics setting	
		2- Baud High Byte	1- Baud Rate
1200	9	1	128
2400	8	0	192
4800	7	0	96
9600	6	0	48
19200	5	0	24
38400	4	0	12
57600	3	0	8
76800	2	0	6
115200	1	0	4
230400	0	0	2

8.3.3.2 RS232 Mode

Data Bits, Parity, Stop Bits	Set-up Menu setting	Diagnostics setting
8,None, 1	0	0
7,Even, 1	1	2
7, Odd, 1	2	3
8, None, 2	3	16
8, Even, 1	4	18
8, Odd, 1	5	19

8.3.3.3 MODBus RTU

MODBus RTU	Set-up Menu setting	Diagnostics setting
Enabled	1	0
Disabled	0	255

8.3.3.4 Xmit Power

Set Up	Diagnostics
0	0
1	16
2	32
3	48
4	64
5	80
6	96
7	112
8	128
9	144
10	160

8.3.3.5 RTS/CTS Control

RTS/CTS Control	Set-up Menu setting	Diagnostics setting
Enabled	1	255
Disabled	0	0

8.3.3.6 Repeater Freq

Repeater Frequency	Set-up Menu setting	Diagnostics setting
Enabled	1	255
Disabled	0	0

8.3.3.7 Low Power

Repeater Frequency	Set-up Menu setting	Diagnostics setting
Disabled	0	255
LEDs dimmed	1	1
LEDs dimmed, radio sleeps every other slot	2	2
LEDs dimmed, radio sleeps 2 of 3 slots	3	3
LEDs dimmed, radio sleeps number of slots corresponding to setting.	…	…
LEDs dimmed, radio sleeps 62 of 63 slots.	63	63

8.3.3.8 PPS Enable

PPS Enable	Set-up Menu setting	Diagnostics setting
Enabled	1	255
Disabled	0	0

8.3.3.9 Slave/Repeater

Slave Repeater	Set-up Menu setting	Diagnostics setting
Enabled	1	0
Disabled	0	255

8.3.3.10 Master Sync

Master Sync	Set-up Menu setting	Diagnostics setting
Enabled	1	0
Disabled	0	255

8.3.3.11 Network ID

Network ID	Set-up Menu setting	Diagnostics setting	
		High Byte	Low Byte
0 to 255	Network ID	255	Network ID
256 to 511	Network ID	0	Network ID - 256
512 to 767	Network ID	1	Network ID - 512
768 to 1023	Network ID	2	Network ID - 768
1024 to 1279	Network ID	3	Network ID - 1024
1280 to 1535	Network ID	4	Network ID - 1280
1536 to 1791	Network ID	5	Network ID - 1536
1792 to 2047	Network ID	6	Network ID - 1792
2048 to 2303	Network ID	7	Network ID - 2048
2304 to 2559	Network ID	8	Network ID - 2304
2560 to 2815	Network ID	9	Network ID - 2560
2816 to 3071	Network ID	10	Network ID - 2816
3072 to 3327	Network ID	11	Network ID - 3072
3328 to 3583	Network ID	12	Network ID - 3328
3584 to 3839	Network ID	13	Network ID - 3584
3840 to 4095	Network ID	14	Network ID - 3840

Note: Radios with firmware versions earlier than 5.68 (900 MHz) or 1.62 (2.4 GHz) will not accept Network ID values larger than 255. The entry into the Low Byte up to 255 is the number that is desired for the Network ID. For Network ID's above 255 set the High Byte accordingly and subtract the stated value from the desired Network ID number. e.g. A network ID of 2000 is desired. Set the High Byte to 6 and the Low Byte will equal (2000-1792) 208.

8.3.3.12 SubNet ID

SubNet ID	Set-up Menu setting	Diagnostics setting
Rcv & Xmit = 01h to FFh	Rcv 1-F, Xmit 1-F	1 to 255

Diagnostics requires that the Subnet be entered as a decimal number. The 2 values of the Receive and Xmit settings are loaded as one byte into the EPROM. The table below shows the correlation of how to calculate the proper value to load into the diagnostic location.
For example, if the value desired in the Set-Up menu is Rcv = E and Xmit = 3. The corresponding decimal number will be 62. Enter 62 into the SubNet ID setting. Please note that a setting of 255 (Rcv = F and Xmit = F) will set the SubNet ID to Disabled.

		Receive Subnet ID (X_)															
		0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
Transmit Subnet ID (_X)	0	N/A	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	1	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
	2	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
	3	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63
	4	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79
	5	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
	6	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111
	7	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127
	8	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143
	9	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159
	A	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175
	B	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191
	C	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207
	D	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223
	E	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239
	F	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255

8.3.3.13 Radio ID

The Diagnostics Application allows any number below 2^24 to be set. While the radio's Set-up mode will display the entire number, Diagnostics will only let numbers up to 9999 be entered.

Radio ID	Set-up Menu setting	Diagnostics setting		
		Super Byte	High Byte	Low Byte
0 to 255	Radio ID	0	0	Radio ID
256 to 9999	Radio ID	0	INT((Radio ID MOD 65535) / 256)	Radio ID MOD 256
10000 to 65535	Not available	0	INT((Radio ID MOD 65535) / 256)	Radio ID MOD 256
65536 to 16777215	Not available	INT(Radio ID / 65535)	INT((Radio ID MOD 65535) / 256)	Radio ID MOD 256

The Radio ID must be set using 3 entries:

- Super byte: "33 Radio ID Super".
- High byte: "29 Radio ID High".
- Low byte: "30 Radio ID Low".

Each entry uses a value between 0 and 255.

Radio ID = 65535 * Super byte + 256 * High byte + Low byte.

8.3.3.14 32 Diagnostics

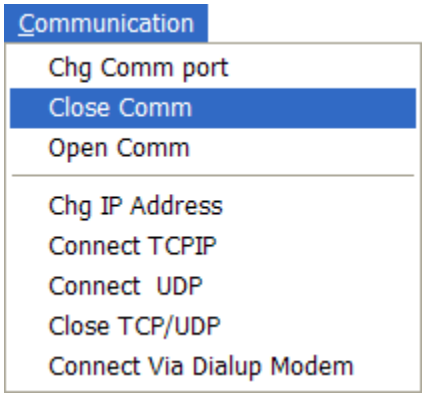
Diagnostics	Set-up Menu setting	Diagnostics setting
Enabled	1 to 63	1 to 63
Disabled	0	255

9 Ending the session

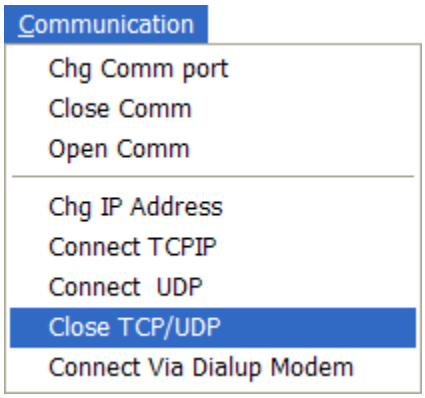
Saving the information gathered through the session may be a good idea if it has not already been saved previously. See paragraph 5.4 Saving Network File and paragraph 6.2 Saving Data for further information.

When done, communication with the Master must be ended.

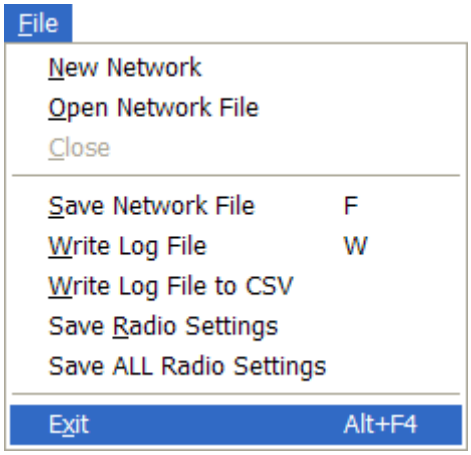
If the communication was directly through the serial port, close the port with the "Communication" / "Close Comm" menu.



If the communication was directly through an Ethernet Network (either TCP/IP or UDP/IP), close the connection with the "Communication" / "Close TCP/UPD" menu.



Quit the application with the "File" / "Exit" menu or press alt-F4 or alt-F-X.



10 Troubleshooting

To run the diagnostic program, make sure that:

- The network is Point-to-multipoint.
- The Diagnostics computer is able to access the FreeWave network
    - either through its Master (through a Diagnostics Cable)
    - or through the Internet.
- The Diagnostics application is installed and running on the Diagnostic computer.
- The Diagnostics setting in the Master radio is set to a value between 1 and 63, inclusive.