# RFI-9256 WIRELESS DATA

# TRANSCEIVER



## OPERATION MANUAL
## Software Revision 1.21

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# 1. INTRODUCTION

The *RFI-9256 Data Strike Series3* **Spread Spectrum Radio Modem** Transceiver will open up new lines of unparalleled high speed reliable data communications in hostile environments.

A Spread Spectrum Radio Modem has a wide band of frequencies (in the 900MHz band) allocated to it. The transceiver uses a pseudo-random code to hop throughout this frequency band sending groups of bits at different frequencies. The receiver uses the same hopping code to receive the data. The pseudo-random code minimises interference from other radios.

The RFI-9256 is essentially a full duplex radio modem capable of emulating a standard telephone modem. The units can be configured for several types of standard link formats, including point to point (Direct) where modems continually transmit to one another and point to multipoint dialup connections where one unit can talk to many units by the use of a dialling mechanism to address the units. There is also a protocol router mode which can map protocol address to radios and forward the data to the correct radio. The radio modems come from the factory configured as point to multipoint dialup.

The modem unit maybe connected a PC, laptop or any RS-232 terminal, to display the menus and control the operation of the modem. In operation the modem may be connected to any RS-232 device. The local modem is generally configured as the Master and the remote/distant modem(s) as the Slave(s). The Master modem is used to synchronise communication, so one modem must be designated as a Master for communication to be successful. A Master can initiate communication with a Slave and visa versa, but two Slaves cannot communicate as communication will not be synchronised. Figure 1-1 shows a possible configuration for a pair of RFI-9256 units.

The RFI-9256 provides several methods for configuration. There is a Menu System and/or a set of AT Commands available through either of the Auxiliary and Main Port. The menu system provides a user-friendly interface with prompts where the AT commands enables a more automated or scripted configuration, as well as the dialling of remote modems.

The terminal and modem are connected by an RS-232 link. The number of stop and data bits, baud rate, parity and flow control is configured on the both terminal and modem must match for RS-232 communication to proceed. Each terminal and modem pair can be configured independently and does not need to match any other pair. When a Serial (RS-232) option is chosen from the menu, it will not take effect until the menu system is exited.
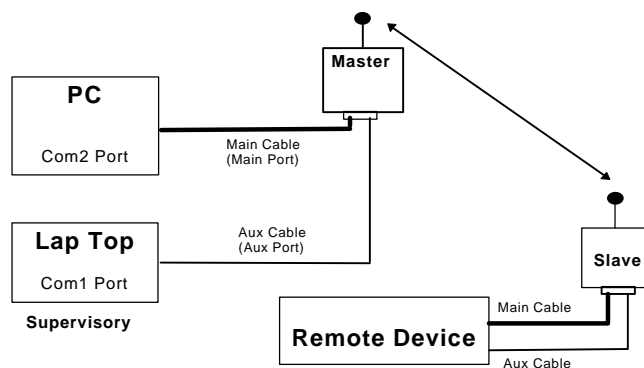


**Figure 1-1 Possible Configuration for the RFI-9256**

## 2. RS-232 MODEMS

Communication systems cannot directly transport digital information without distortion effecting the signal. A device is required to convert the digital signal into one that can be transported without distortion. A modem is a used to convert serial digital data into a form that can be transmitted by Radio Frequency (RF). The receiving modem reconverts the signal into serial data. This is summarised in Figure 2-1.
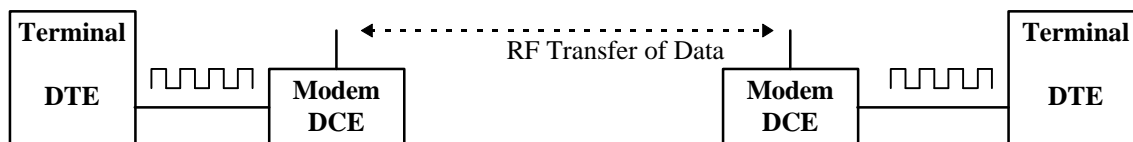


**Figure 2-1 Modem Function in Data Transfer**

Data is transferred in blocks. The communicating modems must be synchronised so that they both recognise the beginning and end of the data blocks and look for each data bit as it is sent. The alternative is Asynchronous Communication where start and stop bits must be included in every block of data. This decreases the amount of useful data inside each block.

If data is transferred in one direction only, this is known as Simplex Communication. A Duplex System is designed for communication in both directions. In Half Duplex Communication, data can only flow in one direction at a time. Full Duplex Communication allows data flow in both directions simultaneously. This is described in Figure 2-2.
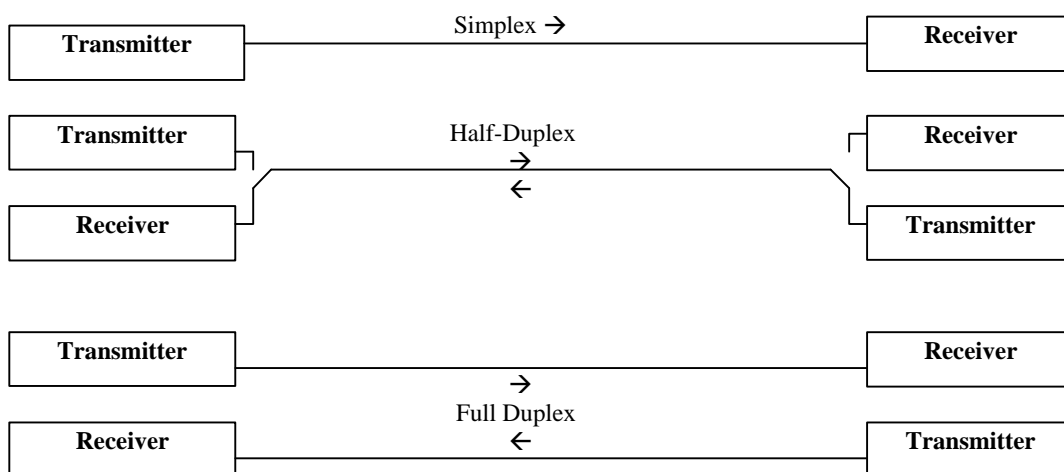


**Figure 2-2 Simplex/Duplex Modes**

RS-232 is a standard that defines the characteristics of point to point communication. It is suitable for transferring serial, binary and digital data. Communication is generally asynchronous and full duplex. Reliable communication can be achieved up to 50 feet. The RS-232 transmitter sends a logic 1 as -5 to -25 Volts and a logic 0 as +5 to +25 Volts. The hardware handshaking lines are used for interactive device control. The lines used for handshaking are RTS (Ready to Send), CTS (Clear to Send), DTR (Data Terminal Ready) and DCD (Data Carry Detect).

## 2.1  DTE vs DCE conventions

This is one of the most misunderstood areas of RS-232. **DTE stands for Data Terminal Equipment**, and **DCE stands for Data Communications Equipment**. DTE is typically either a dumb terminal or the serial port on a computer/workstation. DCE is typically a modem or other piece of data communications equipment. Where it gets confusing is when you start to talk about signal definitions and direction. For example, it's easy for someone to understand that when you transmit data, you send it **out**. However, when you talk in terms of the DCE, it becomes an **input**. This is because the specification was written from the perspective of the DTE end of the link. Another example is that the Receive Data signal is an **input** to DTE, but an **output** from DCE.

## 3. INSTALLATION

### 3.1 Setting up a connection

The following steps should be followed when establishing communications between a pair of RFI-9256 wireless data transceivers [1]received from the factory:

1. Connect each RFI-9256 radio to the serial port of a computer or device, using a suitable cable to connect the Auxiliary Port of the RFI-9256. If a cable is unavailable, a cable should be assembled using the pin assignments as a guide (see pin assignments section Table 13.2).
2. Run a suitable terminal package[2] or emulator (on the computer) with the following settings:
   - Communications Settings (RS232) as 19200 baud, 8 bit data, No Parity, One Stop Bit, No Hardware handshaking. (19200,8, N, 1).
   - Terminal Settings as No Emulator or TTY Emulation and No Echo. The Add Line Feed functions should be disabled. If using HyperTerm then send backspace as Ctrl+H and have destructive backspace disabled.
3. Verify that the RS-232 connections from the RFI-9256 will interface to the instrument to which it is being connected (ie. DTE or DCE conventions). See Figure 3-1.
4. Fasten the correct type of antenna, as required, to the modem ensuring it is properly seated.
5. Make one RFI-9256 modem a Master (Preferably the local modem)
   - Connect the modem's Aux Port to a COM port of a terminal.
   - Hold Mode Select Button (on RFI-9256) to select *MODE 6(config)* to bring up Configuration MENU (on computer).
   - Press 'R' to select Radio Configuration Menu.
   - Press 'M' to set the unit to a master.
   - Press 'Esc' (escape) twice.
   - Press 'Y' to exit MENU.
     At this point a Network Link will be established, and the Slave modem will have the Network Link and Carrier Detect LEDs activated and the Power LED Flashing. The Master will only have a Flashing Power LED.
6. Configure the Device to Radio Connection.
   - Choose which cable (Main or Auxiliary) is required and use this to connect.
     The **Main Port** has seven wires (Rx, Tx, RTS, CTS, DCD, DSR, Ground) and permits hardware flow control. It can be used when Bauds of 110 to 115,200 are required. Recommended for file transfer modes such as ZModem and XModem.
     The **Auxiliary Port** is a three wire (Rx, Tx and Ground) connection that only allows minimal flow control. It is used for medium/low usage, such as TTY-Terminal Modes, remote connection diagnostics, menu and configuration. Not recommended for file transfers.
   - Set Baud Rate for Device to communicate with Radio (Radio to Radio communication speed is fixed at 57,600 Baud while in unbiased mode. See **Directional Bias** on page 15).
7. Configure Modem to Modem Communication.
   - Choose type of communication, Point to Point or Point to Multipoint.
     **Point-to-Multipoint Communication**, the master dials a slave or visa versa. Communication is then established between these two modems and is controlled by HayesTM AT commands. This Mode is used when the master is required to communicate with more then one slave.

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[1] The terms Modem and Transceiver and Radio are used interchangeably in the manual and in the text of the setup menu. While the words have different meanings, the terms should be treated as one and the same for the purposes of use of the RFI-9256 product.
[2] Terminal software is available from the RFI website: www.rfinnovations.com.au

**Point-to-Point Communication** is similar to a wire that directly connects two devices for data transfer. Radio communication is established automatically and is transparent. This is used when data is to be sent between two devices only.

## 3.2  Point to Multipoint Connection

1. Both modems are configured point-to-multipoint by default.
2. Dial remote modem (it does not matter which modem dials)
   - Type 'atdt nnnnXX'

     where nnnn is the receiving modems' address (default setting of 20)

     XX is the address of the port (01 for Auxiliary Port

     00 for Main Port

     92 for remote menu)

     This will establish a communications link. The front panel LEDs Network Link, Carrier Detect and On-line will be activated on both modems.
     Each modem will echo the message CONNECT onto the terminal.
   - Communicate.

     The receive and transmit data LEDs will flash as information is passed. If both modems are connected to a terminal, information typed at the computer connected to one modem will be shown on the screen connected to the other.
3. Once communication is finished, hangup the modem with the following sequence:
   - Wait 1 second
   - Type '+++' on the terminal.
   - Wait 1 second and the modem should echo OK.
   - Type 'ath0'
4. The remote modem will now echo NO CARRIER.

## 3.3  Point-to-Point Communication

1. Set both modems to Point-to-Point Communication Mode by
   - Ensuring the Aux port of the modem is connected to a com port and that the terminal package has the settings as in section 3.1 step 2.
   - Hold Mode Select Button (on RFI-9256) to select *MODE 6(config)* to bring up Configuration MENU (on computer).
   - Press 'R' to select Radio Configuration Menu.
   - Press 'P' to select Mode Point to Point (Direct).
   - Enter receiving modems' address (20 by default).
   - Press 'Esc' (escape) twice.
   - Press 'Y' to exit MENU.
2. Once both modems have exited the MENU, a communication link will be established. The Network Link, Carrier Detect and On-line LEDs will be activated and the Transmit and Receive LEDs will flash as information is passed.

NOTE: The Hayes™ commands will not work in Point-to-Point Mode.
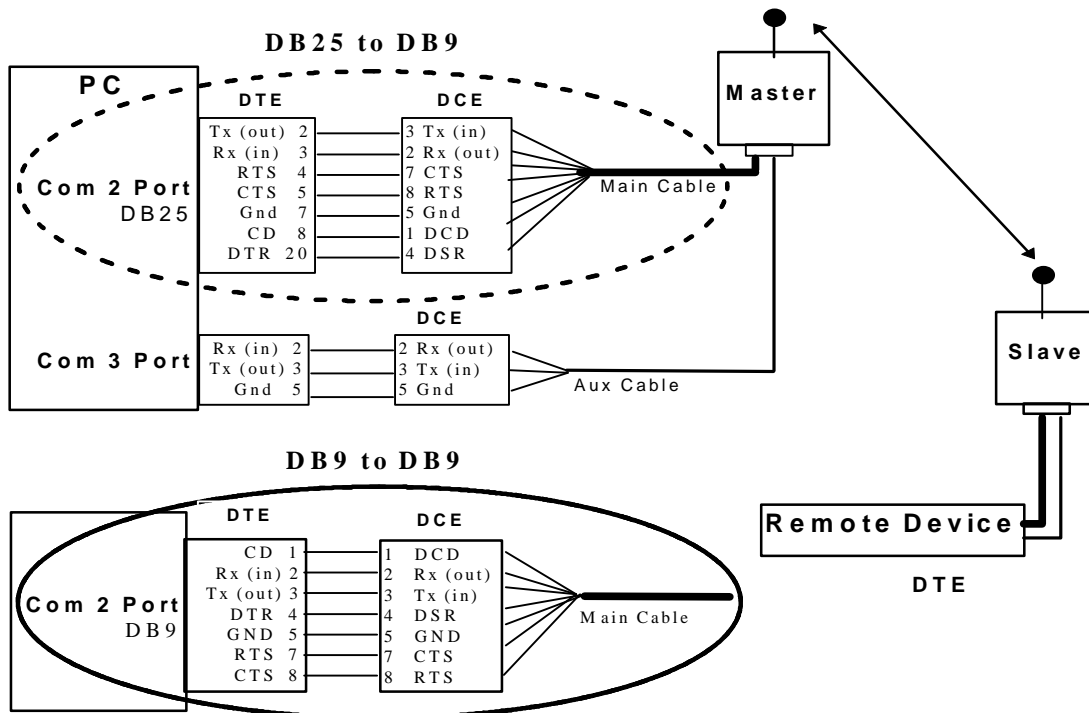
**Figure 3-1 DTE and DCE Conventions for RFI-9256**

## 3.4  RFI-9256 LOCATION

Placement of your RFI-9256 unit is likely to have a significant impact on its performance. In general the rule of thumb with RFI-9256's is that the higher the placement of the antenna the better the communication link. In practice you should also place the transceiver away from computers, telephones, answering machines, and other similar equipment. It is also advisable to keep units away from each other unless you synchronise there transmissions.

To improve the data link, directional antennas can be used to concentrate the transmitted signal towards another RFI-9256 radio. When using an external antenna, placement of that antenna is critical to a solid data link. Other antennas in close proximity are a potential source of interference; use the Radio Statistics to help identify potential problems. It is also possible that slight adjustments in antenna placement (as little as 1 meter) will solve noise problems.

## 3.5  USING AN EXTERNAL ANTENNA

In certain circumstances it may be desirable to extend the range of the RFI-9256 Transceiver by using an external antenna in place of the standard whip antenna.

**WARNING:**    Any antennas placed outdoors must be properly grounded. Use extreme caution when installing antennas and follow all instructions included with the antennas.
The use of external antennas subjects the transceiver to greater exposure to direct lightning strikes.
Long RS-232 cable runs should also be avoided in areas with increased lightning activity or static electricity unless they are properly isolated from the transceiver. Nearby lightning strikes or elevated levels of static electricity may lead to voltage spikes on the line, causing failure in the transceiver's RS-232 interface. RF Innovations manufactures a range of external Data interface converters for applications that require long cable runs.

## 4. CONFIGURATION

The RFI-9256 allows you to change several parameters to optimise its performance for your particular application. All adjustments can be made through a menu system described in section 6, USING INTERNAL MENU COMMANDS or by Hayes commands described in section 7, AT COMMAND SET.
A standard terminal program can be used to access the menu system, which eliminates the need for custom software or DIP switch settings.

While any terminal that can be set to 19200 baud will work, all examples for this manual were generated using the UDP terminal program, available from the RFI Web site (www.rfinnovations.com.au). The menu invoked is displayed in Figure 4-1. The user can configure the Modem or obtain diagnostic and statistical information from the Radio. The changes made to the operation of the transceiver are stored in non-volatile memory to maintain the latest configuration even with loss of power.

```
***   RFI-9256 MAIN MENU  (Version 1.21)   ***

Unit Name:
Serial Number: XXXXXXXXXXXX
Manufactured Date: DD/MM/YYYY

(R)    Radio Configuration Menu
(L)    Link/Port Protocol Menu
(S)    Serial Port Configuration Menu
(M)    Modem I/O Configuration Menu
(P)    Radio Personality Menu
(D)    Diagnostics Menu
(Esc)  To Exit Menu

Enter Choice:
```

**Figure 4-1 Main Menu**

## 5. USING THE FRONT PANEL MODES

The RFI-9256 has a unique front panel user interface that can be used to assess the Radio performance without any additional test equipment. A picture of the front panel is shown in Figure 5-1 below. The interface is controlled by means of a small push button switch located on the front panel. A dual colour LED bar graph display is used to signal various settings to the user.

When the Modem is first turned on the display defaults to *Mode 1.* The Operational Mode is numbered down the left-hand side of the LED Display. In this mode, the purpose of each LED is indicated in the first column on the front panel (under the heading *Mode 1*), for example the top-most LED indicates the status of the Network Link. Details can be found in Table 5.1. If the switch is pressed the display will change and indicate the current mode of operation by a RED LED. If the switch is held down longer than 1 second the Mode LED indicator will begin cycling through each mode. While the unit is in this cycling operation, the rate at which the mode selection cycles can be increased by pressing the button at a faster rate than the automatic toggle. Once the desired operational mode is reached then the switch can be released and after approximately one second delay the LED display will indicate the function for that mode.

Details of the scale for *Mode 2* ( the receive signal power indicator mode) and *Mode 3* (the transmit power indicator mode) are also included on the front panel, under the respective headings.
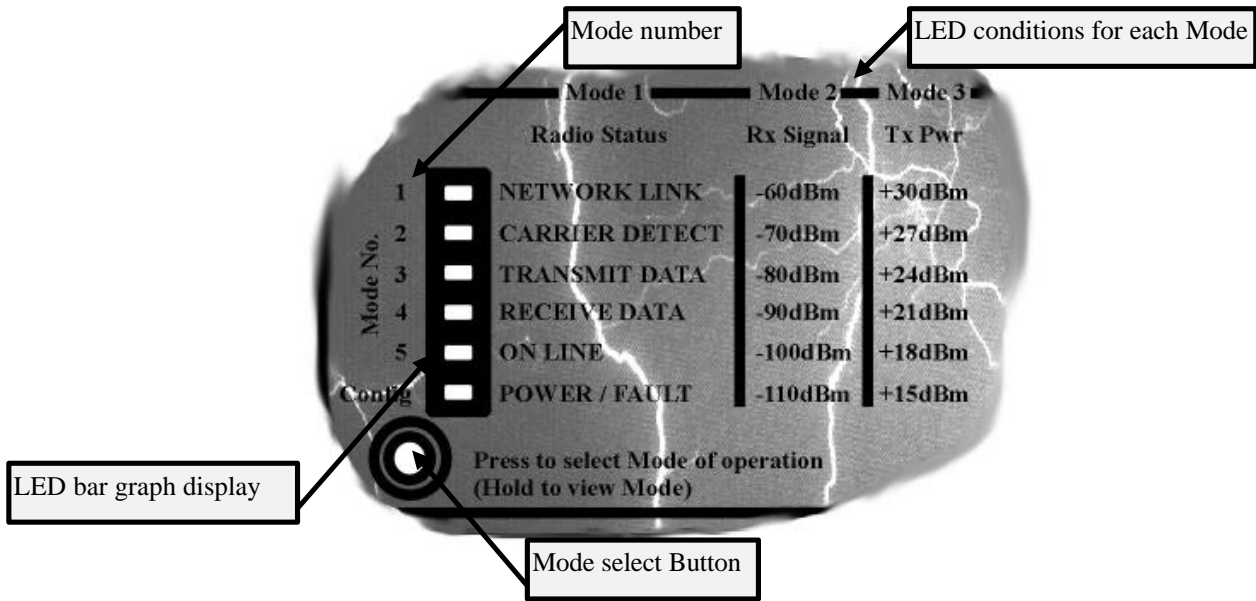


**Figure 5-1 The front panel indicator lights**

## 5.1.1  LED Indicators Mode 1

The LED indicators in Mode 1 show the general flow of data and other radio characteristics. Table 5.1 below describes the front panel indicators in Mode 1.

**Table 5.1 LED Indicators Mode 1**

| LED NAME | MODE 1 |
|---|---|
| Network Link | • Green - Modem has locked onto a signal from the same network.<br>• Red - Modem has just lost link to the operational network and will drop out if the connection is not established within the required time (as set in software). |
| Carrier Detect | • Green - An RF carrier has been detected and contains valid information.<br>• Red - An RF carrier has been detected and contains invalid information. |
| TX | • RS232 Data is being moved out the RS232 port through either the main or auxiliary port (to the terminal). |
| RX | • RS232 Data is being received from the RS232 port from either the main or auxiliary port (from the terminal). |
| Online | • Green - Data is being received from a remote modem that contains the receiving modems address.<br>• Red - A data packet has been lost or has not been able to be sent to the remote modem (automatic ARQ function fail). |
| Power | • Green - This indicator will flash on and off at one second intervals to indicate the Radio internal functions are OK.<br>• Red - This indicator will flash when the Modem has serious faults, such as channel synthesiser out of lock, low power or power supply problems, or software CRC errors. The user Fault event log can be used to find the cause of any intermittent problems (AUX port configuration). |

## 5.1.2  LED Indicators Mode 2

When the RFI-9256 is in Mode 2 the display changes to a LED bar graph display that indicates the RSSI (Received Signal Strength Indicator) value, the display has a resolution of 5dBm. Intermediate steps are indicated by a RED display and whole numbers by a GREEN display ie: the bottom two LEDs on green would indicate a received signal of -100dBm while a display of RED on the -100 level would indicate -105dBm. Table 5.2 below shows the scale RSSI according to the LEDs. Details are also shown on the front panel under the heading *Mode 2*. -60dBm is the strongest signal, and -110dBm the weakest. Any signal above -90dBm will result in a very strong signal, with high throughput. Weaker strengths will still transmit, but throughput may be affected.

**Table 5.2 LED Indicators Mode2**

| LED NAME | MODE 2 (dBm) |
|---|---|
| Network Link | -60 |
| Carrier Detect | -70 |
| TX | -80 |
| RX | -90 |
| Online | -100 |
| Power | -110 |

## 5.1.3  LED Indicators Mode 3

When the RFI-9256 is in Mode 3 the display changes to an LED bar graph display that indicates the Transmitted RF power. The display has a resolution of 3dBm steps from a maximum output power of +30dBm or 1Watt using the RED LEDs. Table 5.3 below shows the relationship between the LEDs and the indicated output power, and is included on the front panel, under the heading *Mode 3*. This display is intended to be used as an indicator to show the current level of the transmitted RF power.

To meet Spread Spectrum Standards, a radio is not allowed to radiate more than one Watt. The power adjustments (in the software) allows the radiated power to equal one Watt, taking into account power losses from cables and connectors and power gains from the antenna.

**Table 5.3 LED Indicators Mode 3**

| LED NAME | MODE 3 (dBm) |
|----------|--------------|
| Network Link | 30 |
| Carrier Detect | 27 |
| TX | 24 |
| RX | 21 |
| Online | 18 |
| Power | 15 |

## 5.1.4  LED Indicators Mode 4

When the RFI-9256 is in Mode 4 the display changes to a LED bar graph display that indicates the Temperature of the RFI-9256 Radio. The temperature is displayed using green LEDs for steps of 10°C from 10° to 60°C. Table 5.4 below shows the radio temperature according to the LEDs on the front panel. When the unit is operating within the green area the radio is operating inside its operating window.

Temperatures above 65°C are displayed as a full red bar. Temperatures below 5° are displayed as a single red LED. These are both fault conditions.

**Table 5.4 LED Indicators Mode 4**

| LED NAME | MODE 4 (°C) |
|----------|-------------|
| Network Link | 60 |
| Carrier Detect | 50 |
| TX | 40 |
| RX | 30 |
| Online | 20 |
| Power | 10 |

## 5.1.5  LED Indicators Mode 5

When the RFI-9256 is in Mode 5 the display indicates the RS232 Port status. The user can then tell the logic states of the RS232 control lines, a red LED indicates +12volts(logic on) and a green -12volts or no connection (logic off). Table 5.5 below shows the LED names and their equivalent function in Mode 5.

**Table 5.5 LED Indicators Mode 5**

| LED NAME | MODE 5 |
|---|---|
| Network Link | DSR (input) |
| Carrier Detect | DCD (output) |
| TX | TX (RS232 data out of external port) |
| RX | RX (RS232 data in from external port) |
| Online | CTS (input) |
| Power | RTS (output) |

## 5.1.6  LED Indicators Mode 6 (configuration)

When the display is set to Mode 6, the Configuration Menu options are available from the AUX port at 19200,8,N,1. A terminal must be connected to the AUX port with appropriate terminal software to communicate with the radio. A brief introduction to the menu command structure is given at the beginning of Section 4. A full explanation is given in Section 6.

The LED display on the front panel is the same as *Mode 1*. To determine which mode a unit is at any time just press the button on the front panel.

# 6. USING INTERNAL MENU COMMANDS

Modem configuration can be performed through a menu system. This provides the user with an interface that is controlled by the terminal device, with options manually entered as appropriate. There are several methods of accessing the configuration menu.

Some options are do not come into effect until the menu system has been exited.

## 6.1 Accessing the Configuration Menu

### 6.1.1 METHOD 1: Front Panel Mode 6 (config)

The setup menu is invoked by:
- Connecting the Auxiliary Port of the RFI-9256 to any terminal program.

- Set the baud rate for that terminal to 19200, 8, N, 1.

- On the modem press and hold the front panel switch until MODE 6 (config) is activated then release the switch.

### 6.1.2 METHOD 2: Local Hayes Command

If the front panel of the radio is inaccessible and the modem has a port configured as a Dialup then setup menu can be invoked by:
- Connecting either RFI-9256 Port configured as Dialup any terminal program.

- Ensure the terminal communications settings are the same as those set on the modem.

- Type the AT? Command.

For more information see section AT COMMAND SET on page 36

### 6.1.3 METHOD 3: Remote Menu

If the modem itself is in accessible the setup menu can be invoked by:
- Dial the remote modem with port address 92 (see 3.2 Point to Multipoint Connection)

The internal menu, once invoked from *MODE 6(config)*,will display on the terminal screen as below in

```
        ***   RFI-9256 MAIN MENU  (Version 1.21)   ***

        Unit Name:
        Serial Number: XXXXXXXXXXXX
        Manufactured Date: DD/MM/YYYY

        (R)    Radio Configuration Menu
        (L)    Link/Port Protocol Menu
        (S)    Serial Port Configuration Menu
        (M)    Modem I/O Configuration Menu
        (P)    Radio Personality Menu
        (D)    Diagnostics Menu
        (Esc)  To Exit Menu

        Enter Choice:
```

**Figure 6-1 RFI-9256 Main Menu**

## 6.2 (R) Radio Configuration Menu

The Radio Configuration Menu allows the radio's function within a network to be changed for different applications. The following menu in Figure 6-2 is an example of what is displayed.

```
***   RADIO CONFIGURATION MENU   ***

Unit is a SLAVE
Network Address =    32
Rx Address      =    20
Hopping Pattern =     0
Point to Multipoint Dialup Connection

(M)    Set unit as Master
(S)    Set unit as Slave
(N)    Set Network address
(L)    Set Local Rx address
(P)    Set ports as Point to Point Direct
(D)    Set ports as Point to MultiPoint Dialup
(R)    Set ports as Dialup Repeater
(B)    Set unit as Back To Back Repeater
(1)    Special Controls Menu
(2)    Link control Menu
(3)    Radio characteristics Menu
(F)    Restore Factory defaults
(Esc)  Previous Menu

Enter Choice:
```

**Figure 6-2 Radio Configuration Menu**

### (M) Set unit as Master

In any communications link, one modem must be configured as a Master. The Master synchronises communications. When this function is selected the radio is configured as a master. The menu is then updated to show that the unit is now set as a Master.

### (S) Set unit as Slave

In any communication link one unit must be set as a Master and the rest as Slaves. Slaves can initiate communication but follow the synchronisation of the Master. Modems are configured as Slaves, by default. When this function is selected the radio is configured to operate as a slave.

### (N) Set Network Address

The Network Address is the network identification number. Slaves synchronise with the Master that has the same Network Address. Radios ignore data originating from modems with another network address. The network address must be the same for every Radio on that particular network.

To change the network address is (N) must be pressed in the Radio Configuration Menu. The following is displayed:

```
Enter Network Address value (0-63): 32
```

The default address is 32 but can have a value from 0-63.

## (L) Set Local Rx address

The Local Rx Address is used to identify individual modems for communication. Each Radio within a point to multipoint network must have a unique address, otherwise more then one modem will answer when the address is dialled. Point to point communication does not use dialling, so both modems may have the same Rx number. Units setup in a Repeater arrangement (see page 52 on DIALUP NETWORKING ) are often given the same Rx number. Radios in different networks can have the same Local RX Address.

When the Local Rx address is changed by pressing (L) the following sentence is displayed.

```
Enter Rx Address value as (0-9999): 20
```

The current Rx address is displayed as 20 but can have a value from 0-9999. This value can be overwritten to change the current Rx address to a new address.

## (P) Set Mode Point to Point Direct

Point to point communication is used to for communication between two devices only. Communication is equivalent to a wire between the devices, and the modems effectively become transparent. For more information, see Section 9.1.1 on page 55.

If the point to point connection is desired then (P) must be selected. This will bring up the following menu.

```
Point To Point requires a Tx Address
Enter Tx Address value as (0-9999): 20
```

The transmit address is the address of the receiving radio. A Tx Address must be selected for this mode to operate correctly and as shown above is the default, 20. This can be overwritten to have a value between 0-9999.

## (D) Set Mode Point to Multipoint (Dialup)

In this mode the Master unit will act the same as a Hayes™ telephone line modem, and may be used to dial out to any remote site. Repeaters can be used in this configuration and Slave devices can dial back to the Master as per normal Hayes™ modem conventions. For more information, see Section 9.1.2, page 56.
To configure the radio to have a point to multipoint connection (D) must be selected..

## (R) Set unit as a Dialup Repeater

A repeater regenerates a signal and is used to extend the distance between end point radios. Repeaters are in pairs (back to back) with one configured as a Master and one as a Slave. They are interlinked (by connecting the Main Ports of each) so that data can be transferred via their RS-232 ports. Auxiliary I/O must also be interconnected to provide pass-through. See Figure 8-3, page 53.
To configure the radio as a Dialup Repeater press (R). This mode allows radios to be connected back to back through the Main port and transfer data through them.
The Dialup repeater mode also enables a number stripping mechanism to allow repeaters to be chained in a network or connected to a PSTN modem. Each repeater Slave strips its own RX address from the dialled number sequence and then dials the radio or PSTN modem connected to the main port. See  DIALUP NETWORKING on page 52. Although the baud rates and other configuration issues are still to the users discretion. Some parameters for communication are automatically preset but may be overridden. Ie. Hayes echo off and sync mode.

## (B) Set unit as a Back to Back Repeater

This mode sets the radio as a Back to Back Repeater similar to Dialup Repeater with the addition of the Hayes and Serial port being automatically configured for optimum performance through the repeater for common usage.

## (1) Set Special Controls

When the antennas from more than one radio placed in close proximity, the radios must be synchronised so that they do not block the transmission of each other. Although the radios are individually configured to work within separate networks (with different hopping patterns, network addresses) they must transmit and receive information at the same time to prevent signal blocking. One modem must be configured as the sync output controller and the rest as sync output followers (note that a Slave unit cannot be set as a follower because it has to synchronise with the master on the network). This will synchronise transmission, but the frame size/length must be the same to enable synchronisation to work.

NOTE:  If the modem is configured as a Slave then the option (1) Follow Sync Signal, is not available.

```
        ***    SPECIAL CONTROLS MENU    ***

        Sync Mode = Output Sync Signal

        (1)     Follow Sync Signal
        (2)     Output Sync Signal
        (3)     Repeater Sync Mode
        (4)     No Sync Mode
        (Esc)   Previous Menu

        Enter Choice:
```

- (1) To set a modem (Always a Master) to follow a synchronisation signal provided by another.
- (2) To set a modem (Usually a Master or a Slave repeater) to output a frame synchronisation signal.
- (3) To set a modem in a repeater setup (usually the Master repeater) to follow the synchronisation signal sent by the slave repeater in a repeater/follower fashion.
- (4) To disable synchronisation mode.

## (2) Set Link Control Parameters and Timers

Link control parameters can be adjusted by selecting (2). This will bring up the following menu.

```
        ***    LINK CONTROL MENU    ***

        ARQ Retries = 50
        Network fail timer = 5000ms
        Online request timer = 1000ms
        Backoff Retry is Disabled

        (A)     Number of retries for ARQ
        (F)     Network fail timeout
        (O)     Online requests timer
        (B)     Enable/Disable Backoff Retry
        (Esc)   Previous Menu

        Enter Choice:
```

**Figure 6-3 Link Control Menu**

- (A) The Number of Retries for ARQ (automatic repeat request) controls the number of times the Radio Modem will try to resend a packet of lost information before it gives up. This can be set as high as 255 retries. Each Link/Port can be configured independantly allowing for modes like broadcast to co-exist on the same modem. Ie a broadcast mode would normal be set to only 3-5 retries.

- (F) The Network Fail Timeout controls the time the system waits when a signal is lost before attempting to re-synchronise. This loss is also indicated by the Network Link LED on the front panel. The factory setting is 5000mS.

- (O) The Online Requests Timer controls the length of time between integrity checks on remote Slaves by the Master. This setting will affect the carrier detect LED on the front panel for the Master modem as data will only be returned from the Slave modems at the preset time interval. The default setting is used in a large system so that RF air time is not wasted on the Slave to Master link, and the Master is not always tied up checking for Slave integrity. This setting is also used to keep the system alive when no data is being passed.

- (B) The "Backoff and Retry" functionality is only available for Slave radios. This function is mainly for scenarios where you wish to connect to several slave radios simultaneously from a Master or where there is a possibility of multiple slaves trying to dial or send protocol data to a single master/base radio.

### (3) Set Radio Characteristics

The radio characteristics can also be adjusted. By selecting (3) in the Radio Configuration menu the following menu in Figure 6-4 is displayed.

```
     ***   RADIO CHARACTERISTICS MENU   ***

Hopping Pattern =      0
Power setting = 20 dBm
RSSI trigger level = -110
Frame Time = 20 milliseconds
Max Tx bytes per frame = 114
Directional Bias is Disabled

(H)    Hopping Pattern Sequence
(P)    Tx Power Menu
(R)    RSSI trigger level
(F)    Frame Time Menu
(B)    Directional Bias Menu
(Esc)  Previous Menu

Enter Choice:
```

**Figure 6-4 Radio Characteristics Menu**

- **Hopping Pattern Sequence -** There are 32 (0-31) hopping patterns available. The hopping pattern determines how the modem hops through the frequency spectrum when transmitting (and receiving) data. Radio Modems on alternate hopping patterns will reduce interference from each other and maximise system throughput.

- **Max Tx Power -** Allows the transmit power to be changed. Figure 6-5 below shows what output power levels are available. System engineers should use the minimum amount of power consistent with maintaining a solid data link. This will minimise the amount of interference between units and other equipment. Also the total output from the Antenna should not be more than 1 watt E.I.R.P (30dBm) noting that your antenna may provide gain and your cables and connectors produce a loss.

```
     ***   TX POWER MENU   ***

Power setting: 20 dBm

(0)    0  dBm
(1)    10 dBm
(2)    20 dBm
(3)    25 dBm
(4)    30 dBm
(5)    OFF
(Esc) Previous Menu

Enter Choice:
```

**Figure 6-5 Tx Power Menu**

- **RSSI Trigger Level -** This value can be set between -120dBm and -50dBm. The RSSI trigger level is only used by a slave modem when the unit first looks to lock onto the operating network. Different values are used to enable the slave to better reject noise when first acquiring network link. The factory setting is optimal for most circumstances. Increase RSSI in situations where the signal strength of noise is unusually high.

- **Frame Time -** This function changes the maximum length (in time) of each packet frame. If a frame was 8ms long, then there is less data transferred per frame than would be transmitted in a 35ms size frame. The throughput of data will decrease as the frame size decreases. The frame length also controls the data latency. The factory default is 20ms. The 5ms frame time is only available in Point to Point Mode. Figure 6-6 shows the frame size menu.

```
***    FRAME TIME MENU    ***

Frame Time = 20 milliseconds

(1)     5 milliseconds
(2)     8 milliseconds
(3)    10 milliseconds
(4)    15 milliseconds
(5)    20 milliseconds
(6)    25 milliseconds
(7)    30 milliseconds
(8)    35 milliseconds
(Esc)  Previous Menu

Enter Choice:
```

**Figure 6-6 Frame Time Menu**

- **Directional Bias** (a.k.a. Fame Bias) - This function is for systems that require high throughput in a single direction. For example audio, video and Internet applications. This option allows an air speed rate of approximately 115kbps in one direction and approximately 9600bps in the other. Modems must be configured so that they have complimentary (opposite) bias configurations. This is shown in Figure 6-8. shows the menu that is displayed.

```
***    DIRECTIONAL BIAS MENU    ***

Directional Bias is Disabled

(O)    Outgoing/Upload
(I)    Incoming/Download
(D)    Disabled
(Esc)  Previous Menu

Enter Choice:
```

**Figure 6-7 Directional Bias Menu**



~115kpbs

~9600bps

Modem

Modem

Video Camera
Upload Bias Enabled

Display
Download Bias Enabled

---
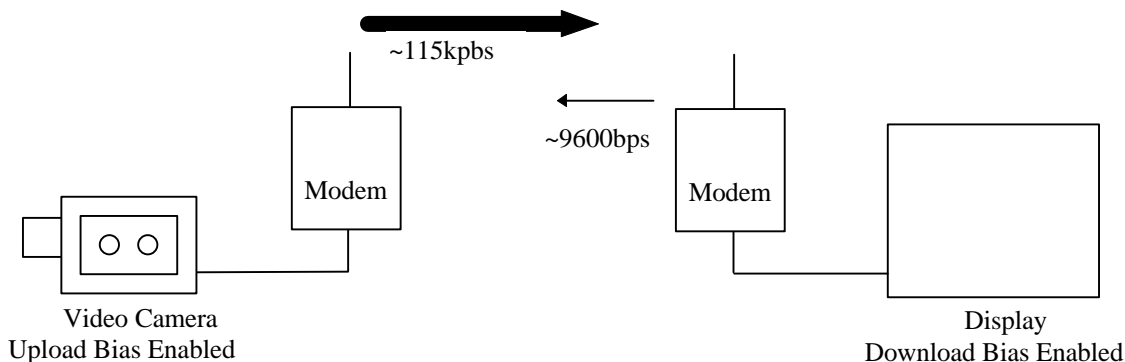
Figure 6-8 Example Use of Directional Bias

### (F) Restore Factory defaults
In order to select the original factory defaults (F) must be selected, the operator is then prompted if he wishes to continue as all current settings will be overwritten.

## 6.3 (L) Link/Port Protocol Menu

This menu is brought up by the second option of the RFI-9256 main menu (Figure 6-1, page 10) and is concerned with the protocol used across the terminal/modem link.

```
        ***    LINK/PORT PROTOCOL MENU    ***

Main Port:  Protocol Type:  Hayes Dialup
Aux  Port:  Protocol Type:  Hayes Dialup

(A)     Protocol Selection Menu
(C)     Protocol Configuration Menu
(Esc)   Previous Menu

Enter Choice:
```

**Figure 6-9 The Link/Port Protocol Menu**

## 6.3.1 (A) Protocol Selection Menu (assign)

From this menu you can assign a new protocol to individual ports. Figure 6-8 shows the menu that is presented when this menu option is selected. After a protocol selection is made the port to which the protocol is to be assigned must be chosen, for this purpose the menu in Figure 6-10 is used.

```
        ***    PROTOCOL SELECTION MENU    ***

Main Port:  Protocol Type:  Hayes Dialup
Aux  Port:  Protocol Type:  Hayes Dialup

(P)     Point to Point
(B)     Broadcast
(D)     Hayes Dialup
(M)     Modbus
(H)     Honeywell
(3)     DNP3
(T)     TDE
(X)     Disabled
(Esc)   Previous Menu

Enter Choice:
```

**Figure 6-10 Protocol Selection Menu**

```
        ***    PORT SELECTION MENU    ***

(M)     Main Port
(A)     Aux  Port
(Esc)   Previous Menu

Enter Choice:
```

**Figure 6-11 Port Selection Menu**

### (P) Point to Point
For more information See **Set Mode Point to Point (Direct)** on page 12.
In this mode link control parameters and Timers can be set. (see **Protocol Configuration Menu** on page 18 )

## (B) Broadcast

This mode allows data to be broadcast from a Master to multiple slaves. The messages are not ARQ'd (acknowledged) by the slave radios so data integrity is not guaranteed on data being sent from the Master to Slaves but data being sent by Slaves to Master is ARQ'd in the normal manner. The Master still utilises the ARQ retry setting (see **Set Link Control Parameters and Timers** on page 13) and will resend each packet to the Slaves by this number. The slaves will automatically discard duplicate messages so the only configuration issue is the ARQ settings must be adjusted for reasonable performance (1 to 5) retries. Both Master and Slave units must be set to the broadcast protocol for them to coexist properly.

## (H) Hayes Dialup

For more information See **Set Mode Point to Multipoint (Dialup)** on page 12.
In this mode Hayes Command Controls can be set. (see **Hayes<sup>TM</sup> Command Control Menu** on page 26 )
To set link control parameters and timers **Set Link Control Timers Menu** on page 13

## (M) Modbus

The protocol decoder reads data from the assigned serial port and processes it as a Modbus RTU protocol. The decoder conforms to the Modbus timing to determine beginning and ending of packets. The address is extracted and checked against a routing table (see **Protocol Decoder and Router** on page 19). If a destination radio can be located in the table then the packet is immediately forwarded to the remote radio. Data will continue to be passed to the destination radio until the protocol decoder has found an "End of Packet" as determined by the Modbus timing specifications.
Modbus protocol only supports a single byte destination address that only allows 255 radios to be addressed.
In this mode the routing table, packet timer and link control parameters and Timers can be set. (see **Protocol Configuration Menu** on page 18 ).

## (H) Honeywell

This is a Honeywell protocol. Honeywell protocol works similar to Modbus in the protocol decoding and routing except packets are of specific size so there is no need for a packet timer.

In this mode the routing table, and link control parameters and Timers can be set. (see **Protocol Configuration Menu** on page 18 ).

## (3) DNP3

This is the FT3 Frame format (LPDU).

In this mode the routing table, and link control parameters and Timers can be set. (see **Protocol Configuration Menu** on page 18 ).

## (T) TDE

This is an Introl Systems protocol.

In this mode the routing table, and link control parameters and Timers can be set. (see **Protocol Configuration Menu** on page 18 ).

## (X) Disabled

Disables any transmission of data though the selected port to a remote radio. No protocol or mode is assigned. The port can still receive and output data sent from a remote radio but cannot reply.

NOTE:  The configuration menu will still be accessible on the AUX port.

## 6.3.2 Protocol Configuration Menu

If a protocol is configurable then this menu will display the available options relevant to it. Figure 6-12 shows a protocol configuration menu for a port which is assigned to a Modbus protocol.

```
***   PROTOCOL CONFIGURATION MENU   ***

Main Port:  Protocol Type:  Modbus
Main Port:  Packet Timers: OutPut = 256ms , Input = Disabled

(R)     Route Manager Menu
(P)     Tx (Out) Packetiser Timer
(L)     Link Control Menu
(Esc)   Previous Menu

Enter Choice:
```

**Figure 6-12 Modbus Example of a Protocol Configuration Menu**

### (L) Link Controls and Timers

```
***   LINK CONTROL MENU   ***

Main Port: ARQ Retries = 50
Network fail timer = 5000ms
Online request timer = 1000ms
Backoff Retry is Disabled

(A)     Number of retries for ARQ
(F)     Network fail timeout
(O)     Online requests timer
(B)     Backoff Retry Enable/Disable
(D)     Set to Defaults
(Esc)   Previous Menu

Enter Choice:
```

**Figure 6-13 Link Control Timers Menu**

This configuration menu allows you to change the value for:
- **Number of Retries for ARQ** (acknowledgment) - The number of retransmissions the unit tries when it fails to receive an ARQ before giving up on sending a packet.
- **Network Fail Timeout -** The time the unit will wait after losing signal before trying to resynchronise.
- **Online Requests Timer -** Controls the amount of time before checks of the slave's integrity by the master.
- **Backoff Retry Enable/Disable -** If the modem has sent a number of retries without an ARQ then the modem waits a random period of time before it sends again if backoff retry is enabled.

NOTE:  The some of these settings are not port dependent, they are the settings for the modem and therefore the settings for both ports.

### Hayes<sup>TM</sup> Command Control

The Hayes<sup>TM</sup> Command Control options can be edited here for each port when a port is in Hayes Dialup mode. For instruction on how to use this menu refer to **Hayes<sup>TM</sup> Command Control Menu** on page 26.

### (B) Router Manager Menu

This menu is for route-able protocols such as Modbus, Honeywell, DNP3 or TDE. The router menu is a large part of configuring a protocol a therefor has been put in a separate section (see **6.3.3 Router Menu**)

**(P) Tx (Out) Packetiser Timer**

The packet timer is used to in conjunction with Modbus protocol. When no data has been received from a remote modem for the Packet Timer duration then current cache of data is then passed out the serial port. For more information see page 25.

## 6.3.3  Router Menu

### 6.3.3.1  Protocol Decoding/Routing

The protocol decoder for the packet protocols such as Modbus, DNP3 etc, allows a system of extracting the destination RTU address from the protocol and then mapping it to radio RX addresses. If a system contained a number of RTUs connected to a base unit then the Master/Base unit could decode the RTU address of each slave and convert it to a remote slave Rx address. RTU is an acronym for Remote Terminal Unit.

The Rx Address is the address of the RFI modem. Each modem must have an address so that it can determine whether the RF data received (through its antenna) was intended for it or not. The RTU address is the address of the device attached to the modem. This is analogous to dialling a telephone which has a PC attached. The telephone has its own number which must be dialled, yet the PC also has an IP address. The RTU address is part of the protocol header sent from the Master Control to the RFI-9256 along the RS-232 link. It is up to the Routing Table to determine to which radios Rx Address the data must be sent to in order for the correct RTU to receive the information. These ideas are demonstrated in the following figure, using the Modbus protocol.
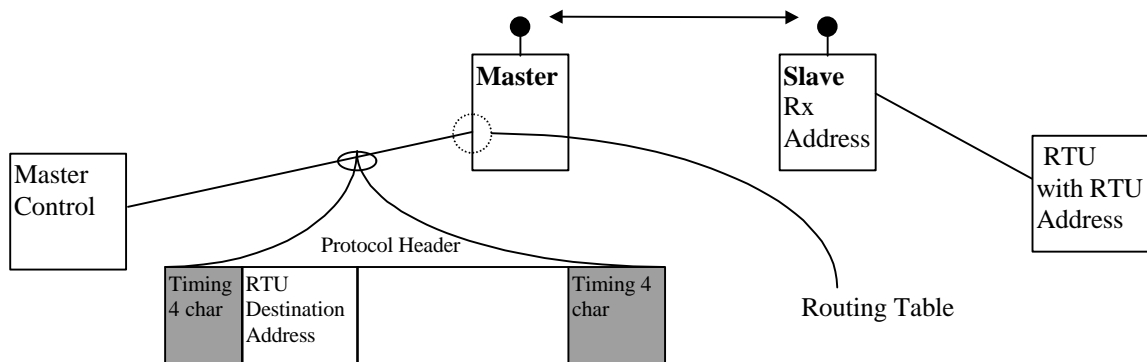


**Figure 6-14 Modbus Protocol Routing Example**

The Link/Port Protocol Menu shown in Figure 6-9 can assign a new protocol to a serial port or configure an existing protocol. The configuration of an existing protocol menu will display different options depending on the protocol of the ports.

## 6.3.3.2  Route Manager Menu

This menu is for route-able  protocols such as Modbus, Honeywell, DNP3 or TDE. If a new protocol is assigned to a port then any previous route settings for that port are removed.

```
        ***    ROUTE MANAGER MENU    ***

        Main Port: Protocol Type:  Modbus
        Total Routes :     0
        Used Space   :     0
        Free Space   : 3946

        Single Route :     0
        Mapped Route :     0
        Range Route  :     0
        No Default Route

        (A)    Add Route
        (D)    Delete Route
        (X)    Delete All Routes
        (L)    List All Routes
        (T)    List Routes by Type
        (1)    List Routes by Address
        (Esc)  Previous Menu

        Enter Choice:
```

**Figure 6-15 Route Manager Menu**

### (A) Add a Route

When adding a route the route selection menu (Figure 6-18) is initiated. The Routes are defined as follows:

```
        ***    ROUTE TYPE MENU    ***

        (D)    Default Route
        (S)    Single Route
        (M)    Mapped Route
        (R)    Range Route
        (Esc)  Previous Menu

        Enter Choice:
```

**Figure 6-16 Route Selection Menu**

- **Default Route -** This route is mostly used by Slaves and is probably a <u>must have</u> entry for any Slave in a protocol network. This route only requires the Rx address of the destination radio. This route is used when no other route can be matched in the routing table.

- **Single Route -** This route explicitly maps an RTU address to a radios Rx address. It is the highest privilege in a routing table.

- **Mapped Route -** This route maps a relationship between RTU address and radios Rx addresses. This is a very efficient method of describing a network providing the RTUs and radios can be numbered sequentially and have some correlation. This route configuration requires an RTU address to be assigned as the base for the route and an RTU address to define the range of addresses to be used by the route . It also requires the slave Rx address associated with the RTU address used as the base.

    The algorithm works as described in the next paragraph.

---

The decoder subtracts RTU base address from the newly decoded RTU address the result acts as an offset which is added to the Rx (Radio) address that was assigned as base address. For example if a following diagram was entered in the router then the base RTU address would be **20** and the range could be **23** or more the Radios Rx address would be **1000**. When the decoder sees RTU address **21** it subtracts it from the base RTU which would leave **1** this result is added to the Rx address would be Rx address **1001** (RTU 21).
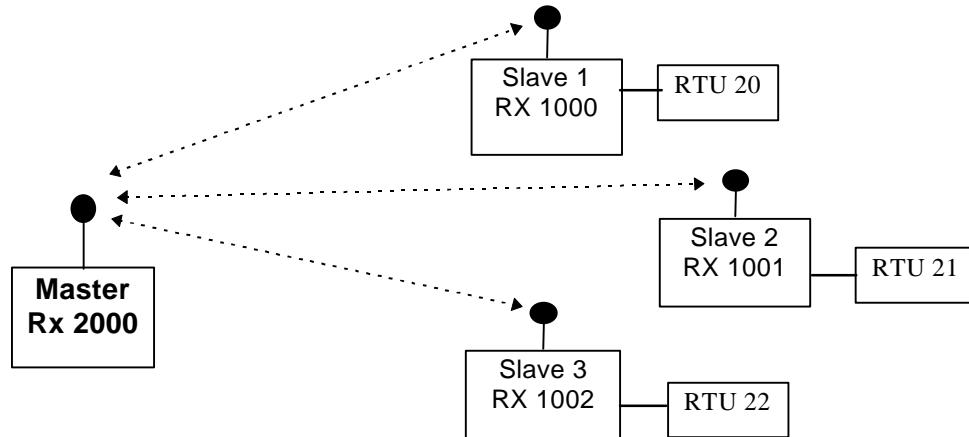


**Figure 6-17 Relationship between Rx and RTU**

- **Range Route -** This route mode routes any RTU address between a range of address to a single Radio Rx address. It requests a start address for the range of RTU address, an end address and an Rx address of the destination radio.

### (D) Delete a Route
When this option is selected a route type menu (Figure 6-16) is brought up to select the type of route to be deleted. Once a route type is selected all the routes of that type is listed and the IDX (route identification number) is used to select the desired route to delete.

### (X) Delete all Routes
This option is used to delete all routes in the routing table for the selected port

---

## (L) List All Routes

This is an example of a Route table in a Master/Base Radio. Slave/RTU radios usually do not require an extensive routing table but should always have a Default Route configured. Figure 6-18 shows an example routing table where the:

- IDX is the individual route identifier.
- Route Type is the function of the route ( see next section for definitions)
- Route Source is the address that is found in the protocol packet and therefor the intended destination of the packet.
- Destination Radio is the radio that the packet is sent to.

```
IDX  ROUTE TYPE      ROUTE SOURCE                    DESTINATION RADIO

 0  Single Route  | Address     10             --> Dest. 9000:00
 1  Single Route  | Address     12             --> Dest. 9020:00
 2  Single Route  | Address     16             --> Dest. 9050:00
 3  Mapped Route  | From  [     20   to     30 ] --> Base  2000:00
 4  Mapped Route  | From  [     50   to     60 ] --> Base  4200:00
 5  Range Route   | From  [     80   to    120 ] --> Dest. 6000:00
 6  Range Route   | From  [    130   to    150 ] --> Dest. 7000:00
 7  Default Route | All Other                   --> Dest. 4000:00

Press Any Key to return
```

**Figure 6-18 Route Table Listing**

## (L) List Route by Type

When this option is selected a route type menu (Figure 6-16) is brought up to select the type of route to be listed. Once a route type is selected all the routes of that type is listed.

## 6.4 (S) Serial Configuration Menu

The serial configuration menu is the third option of the RFI-9256 main menu (Figure 6-1). The Serial Configuration Menu, shown in Figure 6-19, lets the user select the desired modes of operation of each of the two serial ports.

```
***   SERIAL PORT SELECTION MENU   ***

Main Port:  19200 Baud, No Parity, 8 Data, 1 Stop, No Flow
Main Port:  Packet Timers: OutPut = Disabled, Input = Disabled
Aux  Port:  19200 Baud, No Parity, 8 Data, 1 Stop, No Flow
Aux  Port:  Packet Timers: OutPut = Disabled, Input = Disabled

(M)   Main Port
(A)   Aux  Port
(Esc) Previous Menu

Enter Choice:
```

**Figure 6-19 Serial Port Selection Menu**

Once the desired port is selected the serial port settings menu in Figure 6-20 is displayed. The menu is the same for both ports.

```
***    SERIAL PORT CONFIGURATION MENU    ***

Main Port:  19200 Baud, No Parity, 8 Data, 1 Stop, No Flow
Main Port: Packet Timers: OutPut = Disabled, Input = Disabled

(B)     Baud Rate Menu
(F)     Flow Control Menu
(N)     No Parity
(E)     Even Parity
(O)     Odd Parity
(1)     One Stop Bit
(2)     Two Stop Bits
(7)     Seven Bit Data
(8)     Eight Bit Data
(A)     Advanced Settings Menu
(D)     Set to Defaults
(Esc)   Previous Menu

Enter Choice:
```

**Figure 6-20 Serial Port Configuration Menu**

## (B) Baud Rate

The baud rate can be changed to several different speeds. When selected the following menu shown in Figure 6-21 is displayed. Both ports use the same menu however the ports are configured independently.

```
***    BAUD RATE MENU    ***

Main Port: Baud Rate = 19200

(0)     115200
(1)     57600
(2)     38400
(3)     19200
(4)     9600
(5)     4800
(6)     2400
(7)     1200
(8)     600
(9)     300
(A)     110
(Esc)   Previous Menu

Enter Choice:
```

**Figure 6-21 Baud Rate Menu**

## (F) Flow Control

This option allows you to select the type of flow control between the modem and local device. Flow Control is used to prevent data loss from a buffer overflow. The modem and terminal must use the same type of flow control. The type of flow control is selected when the menu option is chosen. This is shown in Figure 6-22 below. The main port and auxiliary port are configured independently however the auxiliary port does not support hardware flow control.

```
***    FLOW CONTROL MENU    ***

Main Port:  No Flow

(H)     Hardware Flow (RTS/CTS)
(S)     Software Flow (XON/XOFF)
(N)     No Flow
(Esc)   Previous Menu

Enter Choice:
```

**Figure 6-22 Flow Control Menu**

### (N) (E) (O) No/Odd/Even Parity

These selections change the parity used for the serial connection. When a selection is made it is displayed in the menu but not implemented until the menu is exited.

### (1) (2) One/Two Stop Bits

These selections change the number of stop bits used in the serial connection. When a selection is made it is displayed in the menu but not implemented until the menu is exited.

### (7) (8) Seven/Eight Data Bits

These selections change the number of data bits used in the serial connection. When a selection is made it is displayed in the menu but not implemented until the menu is exited.

### (D) Set to Defaults

This selection restores factory defaults for the selected serial port (see **Factory Defaults** page 68)

### (A) Advanced Functions Menu

The packetiser system is a mechanism to group or bundle data to avoid inter character or interpacket delays induced by delays in communication and the network traffic. The Tx (Out) Packetiser

```
        ***    ADVANCED FUNCTIONS MENU    ***

    Main Port:  Packet Timers: OutPut = Disabled, Input = Disabled

    (T)    Tx (Out) Packetiser Timer
    (R)    Rx (In) Packetiser Timer
    (Esc)  Previous Menu

    Enter Choice:
```

**Figure 6-23 Advanced Functions Menu**

### (S) Tx (Out) Packetiser Timer

This selection allows a Packet timer value to be set. The modem will send a bundled packet of information out throught the serial Tx port when no data has been received for this period of time. To disable the Packet Timer then enter a timer value of 0. Figure 6-24 below shows the menu.

```
Packet Timer requires a timer value or 0 to disable
Enter Timer in number of milliseconds (0-1000): 0
```

**Figure 6-24 Packet Timer Prompt**

### (R) Rx (In) Packetiser Timer

This selection allows a Packet timer value to be set. The modem will send a bundled packet of information out throught the serial Tx port when no data has been received for this period of time. To disable the Packet Timer then enter a timer value of 0. Figure 6-24 below shows the menu.

## 6.5 (M) Modem Configuration Menu

The modem configuration menu is the fourth option of the RFI-9256 main menu (Figure 6-1). The Modem Configuration Menu in Figure 6-25 below allows the lower levels of the modems operations to be configured according to specific requirements. The selections available from this menu are shown below. This section is designed to mimic a Hayes™ compatible modem.

NOTE: If handshaking is enabled on the serial ports then the corresponding control lines will not be available within this menu selection, ie if hardware is enabled on the Main port then (1) DCD Control Menu will not be available.

```
***    MODEM AND I/O CONFIGURATION MENU    ***

(H)    Hayes Command Control Menu
(D)    DCD Control Menu
(R)    RTS Control Menu
(A)    Auxiliary I/O Port
(Esc)  Previous Menu

Enter Choice:
```

**Figure 6-25 Modem Configuration Menu**

### (H) Hayes™ Command Control Menu

The Hayes Commands are a lower level of communication (then the menu system) between a modem and device. These commands allow the RFI-9256 to emulate a land-line telephone modem. Details of the Hayes™ commands are in Section 7 **AT COMMAND SET**. The following menu in Figure 6-26 is displayed when (H) is selected to change the Hayes™ modem operating parameters. First, the port which is to have its parameters changed must be selected. Then its parameters can be changed. This menu is shown below. Both the Main port and Auxiliary port use the same menu as shown in Figure 6-27.

```
***    MODEM PORT SELECTION MENU    ***

MAIN: Hangup on DTR dropped, Echo is ON, Response is ON
Escape character  = + Escape guard time = 1000(ms)
Connect Time      = 10000 (ms)
AUX:  Echo is ON, Response is ON
Escape character  = + Escape guard time = 1000(ms)
Connect Time      = 10000 (ms)

(M)    Main Port
(A)    Aux Port
(Esc)  Previous Menu

Enter Choice:
```

**Figure 6-26 Modem Port Selection Menu**

```
***    HAYES COMMAND CONTROL MENU    ***

Main Port: Hangup on DTR Dropped, Echo is ON, Response is ON
Escape character  = + Escape guard time = 1000(ms)
Connect Timeout   = 10000(ms)

(C)    Connect Timeout
(0)    Escape character (ie +)
(G)    Escape guard time
(H)    Hangup on DTR (low)
(2)    Hangup on DTR Dropped
(L)    Local on DTR (low)
(I)    Ignore DTR
(E)    Echo (ON/OFF)
(R)    Modem returns response codes (ON/OFF)
(D)    Set to Defaults
(Esc)  Previous Menu

Enter Choice:
```

**Figure 6-27 Hayes Command Control Menu**

NOTE:  Options involving DTR are not available on the AUX Port Menu.

- **Connect Timeout -** Wait Time for CONNECT, is the time the radio will wait for a valid connection. This time can be set between 100-30000ms.

- **Escape Character -** Allows the escape character to be changed. This is the character that is used in the escape sequence to hangup the modem. The escape sequence consists of the escape character being typed three times, with a set communication-free period of time before and after the sequence. The default is "+". Figure 6-28 shows the prompt which is displayed.

```
Enter new escape character: +
```

**Figure 6-28 New escape character prompt**

- **Escape Guard Time -** The escape guard time is the time before and after the escape sequence has been entered that no activity is allowed on the data line. Otherwise the escape sequence will be ignored.

- **Hangup on DTR (low) -** DTR is an RS-232 signal used to indicate to the modem whether the local terminal is ready to communicate. This option, and the following three, tell the modem how to respond when the DTR signal goes low. Hangup on DTR (low), is used to disconnect the call from a slave device when DTR is low.

- **Hangup on DTR Dropped -** Hangup on DTR dropped is used to disconnect call from a slave device when DTR changes from a high to a low.

- **Local on DTR (low) -** When DTR is low the modem goes into local mode. This is the equivalent to entering the escape sequence. Once the unit is local it stays local until the online command (ATO) is used.

- **Ignore DTR -** Used to tell the radio to ignore the state of the DTR signal.

- **Echo (ON/OFF) -** Toggles the echo setting between on and off every time it is selected. This controls the RS232 data responses. When toggled off, (while in local command state) the charactered typed at the terminal will not be echoed back to the screen.

- **Modem returns response codes (ON/OFF) -** Modem returns response codes (ON/OFF), toggles the setting between on and off every time it is selected, and is used to suppress codes that can be sent from the Modem such as the CONNECT response.

- **Set to Defaults -** Restores factory defaults for the selected port (see **Factory Defaults** page 68 for settings).

### (D) DCD Control Menu

DCD (Data Carrier Detect) is used for flow control. The following menu in Figure 6-29 allows the DCD signal to be asserted by one of the following conditions. Each time a selection is made between (0) and (8) that function becomes the DCD MODE.

NOTE: This menu is not available if the Aux port handshaking is set to hardware.
Valid control conditions for DCD are ON (active) = + 12volts / OFF= - 12volts as per RS232 conventions.

```
***   DCD OUTPUT CONTROL MENU   ***

DCD MODE: DCD Always ON

(0)    ONLINE controls DCD
(1)    NETWORK LINK controls DCD
(2)    CARRIER DETECT controls DCD
(3)    Remote DSR controls DCD
(4)    Local DSR controls DCD
(5)    Remote CTS controls DCD
(6)    Local CTS controls DCD
(7)    DCD Always ON
(8)    DCD Always OFF
(9)    DCD disabled
(Esc)  Previous Menu

Enter Choice:
```

**Figure 6-29 DCD Output Control Menu**

- **ONLINE controls DCD -** DCD is active when the radio unit is ONLINE

- **NETWORK LINK controls DCD -** DCD is active when the NETWORK LINK is active.

- **CARRIER DETECT controls DCD -** DCD is active when a valid carrier signal is detected from another radio.

- **Remote DSR controls DCD -** DCD is active when a remote radio's DSR input line is active.

- **Local DSR controls DCD -** DCD is active when the local radio's DSR input line is active.

- **Remote CTS controls DCD -** DCD is active when a remote radio's CTS input line is active.

- **Local CTS controls DCD -** DCD is active when the local radio's CTS input line is active.

- **DCD Always ON -** DCD is always set to ON.

- **DCD Always OFF -** DCD is always set to OFF.

- **DCD disabled -** DCD control has been disabled.

## (R) RTS Control Menu

RTS (Request to Send) is used in flow control. The following menu in Figure 6-30 allows the RTS signal to be asserted by one of the following conditions.

NOTE: This menu is not available if the Aux port handshaking is set to hardware. Valid control conditions for RTS are ON = +12volts, OFF = -12volts as per RS232 conventions.

```
***   RTS OUTPUT CONTROL MENU   ***

RTS MODE: RTS Always ON

(0)   ONLINE controls RTS
(1)   NETWORK LINK controls RTS
(2)   CARRIER DETECT controls RTS
(3)   Remote DSR controls RTS
(4)   Local DSR controls RTS
(5)   Remote CTS controls RTS
(6)   Local CTS controls RTS
(7)   RTS Always ON
(8)   RTS Always OFF
(9)   RTS disabled
(Esc) Previous Menu

Enter Choice:
```

**Figure 6-30 RTS Output Control Menu**

- **ONLINE controls RTS -** RTS is active when the radio unit is ONLINE.

- **NETWORK LINK controls RTS -** RTS is active when the NETWORK LINK is active.

- **CARRIER DETECT controls RTS -** RTS is active when a valid carrier signal is detected from another radio.

- **Remote DSR controls RTS -** RTS is active when a remote radio's DSR input line is active.

- **Local DSR controls RTS -** RTS is active when the local radio's DSR input line is active.

- **Remote CTS controls RTS -** RTS is active when a remote radio's CTS input line is active.

- **Local CTS controls RTS -** RTS is active when the local radio's CTS input line is active.

- **RTS Always ON -** RTS is always set to ON.

- **RTS Always OFF -** RTS is always set to OFF.

- **RTS disabled -** RTS control has been disabled.

## (A) Auxiliary I/O Port

This menu configures the auxiliary Input/Outputs described in section 10 on page 59.
The following menu in Figure 6-31 shows the options available.

```
***   AUX I/O CONTROL MENU   ***

Sample Time = 500 (ms)
Aux I/O follows Remote = ON

(C)    Configure Port Menu
(P)    Powerup defaults
(S)    Sample Timer
(F)    Aux I/O follows remote
(E)    Enable/Disable Aux I/O
(Esc)  Previous Menu

Enter Choice:
```

**Figure 6-31 Auxiliary I/O Control Menu**

- **Configure Port Menu -** Selecting this option allows the I/O line to be toggled between being either an input or an output. The following menu in Figure 6-32 is displayed when it is selected.

```
***   AUX I/O CONTROL MENU   ***

Input: 7 6 5 4 3 2 1 0
       1 1 1 1 1 1 1 1

BIT    MODE
(0)    OUTPUT
(1)    INPUT
(2)    OUTPUT
(3)    INPUT
(4)    INPUT
(5)    INPUT
(6)    INPUT
(7)    INPUT
(Esc)  Previous Menu
Enter Choice:
```

**Figure 6-32 Auxiliary I/O Bit Set Menu**

The I/O pin is toggled between input and output when its corresponding bit number is selected. The first line of the display shows the current status of the I/O control.

- Set Power-up Defaults - Selecting this option allows the power up states of the I/O lines to be configured. If an I/O line is set as an input then it cannot be configured to be high or low at power up, since it is a high impedance input. Therefore, the status will not change when the I/O port numbers are selected. The settings are toggled between low and high every time the I/O port number is selected. An example of the menu is shown below in Figure 6-33.

```
***   AUX I/O POWERUP MENU   ***

BIT    MODE
(0)    LOW
(1)    N/A
(2)    LOW
(3)    N/A
(4)    N/A
(5)    N/A
(6)    N/A
(7)    N/A
(Esc)  Previous Menu
```

**Figure 6-33 Aux I/O Power-up Menu**

---

- **Set Sample Rate -** This allows the sampling time of the I/O port to be changed. The sampling time can be set between 8ms and 5000ms (5seconds).

- **Auxiliary I/O Follows Remote -** This allows the I/O port to be controlled by another radio. Every time it is selected the function is toggled to either Aux I/O follows remote = ON, or Aux I/O follows remote = OFF. This is used when data needs to be passed from one radio to another for control applications.

- **Enable/Disable Auxiliary I/O -** Whenever this key is pressed the Auxiliary Remote setting toggles between ON and OFF. When OFF the Aux I/O will not operate and the power up defaults will not be in operation.

## 6.6 (P) Radio Personality Menu

The Radio Personality menu is the fifth option of the RFI-9256 main menu (Figure 6-1 on page 10). The personality menu is shown below in Figure 6-34. It is used to set the name, set the menu password and set the customer security ID.

```
      ***   PERSONALITY MENU   ***

      Unit Name:
      Time: 00:10:59
      Menu Password is Disabled
      Security Code is Disabled
      Menu Timeout is 15 minutes


      (U)    Set Unit Name
      (P)    Set Menu Password
      (R)    Remove Menu Password
      (S)    Set Security Code
      (D)    Delete Security Code
      (T)    Set Current Time
      (M)    Set Menu Timeout
      (Esc)  Previous Menu

      Enter Choice:
```

**Figure 6-34 Radio Personality Menu**

- **Set Unit Name -** This selection allows the name of the unit to be set. This can help identify each unit on the network by name, location, number or function.

- **Set Menu Timeout -** This selection allows the menu password to be changed. Therefore an unauthorised person cannot enter the menu system and change the radio's settings.

- **Remove Menu Password -** This selection removes the password used to access the radio's menu. With the password removed the password protection is disabled.

- **Set Security Code -** This selection allows the user to set the security code. The security code protects the users radio network from interference from other networks using RFI-9256 modems. The code is a 32bit (9 digit) number which allows 0 to 4294967295 combinations.

- **Delete Security Code -** This selection allows the user to delete the security code

- **Set Current Time -** This allows the real time clock's time to be set. Allow the RFI-9256 doesn't contain a true real time clock it can maintain a fairly accurate notion of time.

- **Set Menu Timeout -** The allows the user to select the amount time a menu remains idle before it is closed. Default is 15 minutes.

## 6.7 (1) Radio Statistics Menu

The radio statistics menu is the sixth option of the RFI-9256 main menu (Figure 6-1 on page 10). As the Modem operates in its normal modes it builds up a picture of how well it is operating in any given environment and keeps track of the statistics for that operation. The user may access these statistics and use them to accurately predict the link performance, data throughput or other operational parameters. The following menu Figure 6-35 shows the functions available.

```
      ***    STATISTICS MENU    ***

      (N)    Show channel signal/noise
      (L)    Show Stats/Logging
      (P)    Clear Physical Layer Logging
      (S)    Clear Serial Logging
      (Esc)  Previous Menu

      Enter Choice:
```

**Figure 6-35 Statistics Menu**

### (N) Show channel signal/noise

When this function is selected, a table in Figure 6-36 is displayed showing the signal and noise levels for each channel used within that hopping pattern. The following table is an example of what is displayed. The reading on the signal row is the RSSI (received signal strength indicator in dBm) of the radio for each channel the unit operates on. If a ?? is displayed for the signal value then there wasn't a recent sample for that channel.

```
Channel     1     2     3     4     5     6     7     8     9    10    11
Signal   -098  -099  -097  -126  -100  -104  -095  -102  -099  -098  -103
Noise    -122  -120  -124  -126  -123  -124  -131  -126  -122  -128  -129

Channel    12    13    14    15    16    17    18    19    20    21    22
Signal   -123  -104  -098  -095  -100  -103  -102  -097  -099  -095  -099
Noise    -123  -123  -128  -128  -123  -123  -122  -123  -125  -127  -125

Channel    23    24    25    26    27    28    29    30    31    32    33
Signal   -096  -104  -102  -099  -096  -098  -100  -127  -105  -103  -100
Noise    -125  -122  -129  -128  -132  -120  -127  -127  -132  -122  -130

Channel    34    35    36    37    38    39    40    41    42    43    44
Signal   -102  -096  -100  -097  -099  -103  -102  -097  -095  -101  -105
Noise    -130  -125  -121  -127  -125  -120  -127  -121  -125  -130  -125

Channel    45    46    47    48    49    50    51
Signal   -101  -104  -097  -099  -102  -098  -096
Noise    -124  -121  -125  -125  -128  -120  -128

Average signal = -95
Average noise = -112

Press Any Key to continue or ESC to quit
```

**Figure 6-36 Example of a Channel Signal/Noise Log**

## (L) Show Stats/Logging

This function shows the statistics relating to the quality of the data throughput and information regarding the performance of both serial ports. The following table in Figure 6-44 is an example of what is shown when this function is selected.

```
Frame count      =     63972  Empty Frames =     63972
Good packets     =         0  Bad packets  =         0
Lost packets     =         0  Retries       =        0
Good Headers     =         0  Bad Headers  =         0
Lost Frame Lock  =       255  Low RSSI     =         0
Data Sent        =    187693  Data Recv    =    187693
Rx Overflows     =         0  Rx Overruns  =         0
Tx Overflows     =         0
-----------------------------------------------------------
MAIN:  Tx =  187693  Rx =     187693
Rx Errors =         0  Overflow =       0 Overrun =      0 Framing =     0
Tx Errors =         0  Overflow =       0

AUX:   Tx =   90600  Rx =       531
Rx Errors =         0  Overflow =       0 Overrun =      0 Framing =     0
Tx Errors =         0  Overflow =       0

Press Any Key to return
```

**Figure 6-37 Logging Screen**

## (P) Clear Physical Layer Logging

This function simply clears the physical layer logging information from memory.

## (S) Clear Serial Layer Logging

This function simply clears the serial layer logging information from memory.

## 6.8 (D) Diagnostics Menu

The radio diagnostics menu is the final option of the RFI-9256 main menu (Figure 6-1 on page 10). The diagnostic Menu shown in Figure 6-38 is used to test functions of the Radio Modems performance.

```
***    DIAGNOSTICS MENU    ***

(S)    Display Status
(F)    Fault Log Menu
(T)    Test Indicator LEDs
(N)    Show channel signal/noise
(L)    Show Logging
(M)    Test Link Margin
(1)    Radio Statistics Menu
(2)    Display Tasks
(3)    Display Links
(Esc)  Previous Menu

Enter Choice:
```

**Figure 6-38 Diagnostics Menu**

## (S) Display Status

This function gives a summary of the information regarding the configuration of the radio. The following table in Figure 6-39 gives an example of what information is shown when this function is enabled.

```
------------------------- STATUS -------------------------
Unit Name:
Serial Number: 111311B00507
Manufactured Date: 10/9/1999
RFI-9256 Version 1.21 Rev.c  Australia
Build Date: Feb  1 2000 Time: 13:56:15
Unit is a MASTER
Point to Multipoint Dialup Connection
Network Address =     1
Rx Address      =    20
Hopping Pattern =     1
Power setting = 20 dBm
RSSI trigger level = -110
Frame Time = 20 milliseconds
Max bytes per frame = 114
Directional Bias is Disabled
NETWORK LINK  CARRIER DETECT  ON LINE  LOCKED
RSSI = -79 Noise floor = -112
Temperature = 41.0c
CRC32 = 8335EBB5 of size 127960 bytes
CRC check Correct

Press Any Key to return
```

**Figure 6-39 Unit Status Display**

## (F) Fault log menu

The following menu in Figure 6-40 shows the logging menu which is for general debugging information used only by RFI or to obtain feedback from a customer.

```
***   LOG MANAGER MENU   ***

Log Level = Debug Information

(V)    View Log
(L)    Set Logging Level
(C)    Clear Log
(Esc)  Previous Menu

Enter Choice:
```

**Figure 6-40 Fault Log Menu**

- **View Log -** Used to actually view the debugging information supplied by the radio modem.
- **Set Logging Level -** Selected to change the type of information logged by the radio modem for display when using the (V) command as shown below in Figure 6-41.

```
***   LOG LEVEL MENU   ***

Log Level = Debug Information

(0)    Errors Only
(1)    Warnings and Errors
(2)    Status Information
(3)    General Information
(4)    Debug Information
(Esc)  Previous Menu

Enter Choice:
```

**Figure 6-41 Log Level Menu**

- **Clear Log -** Used to clear the logging file so new data can be logged for debugging purposes.

### (T) Test Indicator LEDs

Selecting this function starts a test of the front panel LEDs. This is a visual test and the LEDs must be observed while this test is in progress. It simply turns the LEDs on and off operating using all the colours in a predefined sequence.

### (N) Show channel signal/noise

This function is exactly the same as in the Radio Statistics Menu explained in section 6.7

### (L) Show Logging

This function is the same as the in the Radio Statistics Menu explained in section 6.7.

### (M) Test Link Margin

This function displays the average signal and average noise the radio modem is measuring.
If the unit is configured as a Master then it will require an address of the Slave as shown in Figure 6-42

```
Enter Remote Tx Address value (0-9999):
```

**Figure 6-42 Remote Transmit Address Prompt**

When selected, a test is started, and the following message is displayed.
The test output is the same as that shown in Figure 6-36. The Diagnostic menu is then displayed again.

```
Testing Link Margin - Please Wait
```

**Figure 6-43 Link Margin Test Prompt**

### (2) Display Tasks

The Tasks, which are displayed below in Figure 6-44 are assigned to the radio's controller when they are enabled. These tasks are performed at predetermined times by the controller and do not affect the transfer of data. It is an indication of the amount of work the controller is doing. Tasks are added or removed from the list as functions are enabled or disabled by the user.

```
Idx     Timer   Handle   Param    Task Name
  0       0      100      0       Serial Flow MAIN
  1      10      101      0       Front Button
  2      10      102      0       Front Panel
  3      10      103      0       Modem Ctrl
  4      10      104      0       AltComm Status
  5       5      105      0       Hayes Modem MAIN
  6       5      106      1       Hayes Modem AUX
  7      10      107      0       Online Status
  8       1      108      0       Link Layer
  9      10      117      0       Console
 10      12      118      0       Main Menu
-------------------------------------

Press Any Key to return
```

**Figure 6-44 Tasks Display**

## (3) Display Links

This display is for diagnostics only.

The Links display shows the current status of communication connections to the Radio. An example of the Dialup Link display and Point To Point Link in Figure 6-45.

```
Idx LocSrc LocExt DestSrc DestExt DestAddr State  Link Name
 0    0      0      0       0       1000     5    MAIN Dialup

Idx LocSrc DestSrc DestAddr State   Link Name
 1    1      1      1001     3     AUX PtoP
-----------------------------------------------------------
Press Any Key to return
```

**Figure 6-45 Links Display**

- Idx            is the Index Number is used internally but indicates the number of links.

- LocSrc         is the local port number that is the source/destination for the data.

- LocExt         is the extension that has been dial if a remote has dialled this unit.

- DestSrc        is the remote port that is the source/destination for the data.

- DestExt        is the extension that this unit has dialled.

- DestAddr       is the remote unit address.

- State          is the state of the link (i.e. idle, active).

- Link Name      is the name assigned to the link. It reflects the mode of operation for that link.

The source/destination ports are one of three ports, the main, auxiliary or the virtual port.
The virtual port is an internal port used by the radio to communicate through the menus.

# 7. AT COMMAND SET

The RFI-9256 supports many Hayes™ compatible commands and command sequences, this enables users and operators to fully control and operate the Radio Modem and in most cases emulate land line or phone modems for their communication needs. Some commands are implemented for completeness only and do not perform any function.

The Hayes™ commands may be entered manually through a terminal or automated through dialler programs and scripts. Most commands, with exception of the % register (Table 7.10) and Connection Commands (Table 7.8), may be concatenated into a single command string. Commands or command strings must be terminated with a Carriage Return **<CR>** code produced by the Enter key. AT Commands may be used if the terminal attached to the modem will not understand the menu system, for example a PLC terminal. In addition to the modem configuration, AT Commands are used to dial and hangup the remote modem for Point to Multipoint Communication.

## 7.1 The AT Commands

The AT commands are a group of special commands recognised by your modem. These commands derive their name from the letters AT, which are used to prefix commands. Before continuing:
- Run your communications software and enter local mode (or terminal mode) at 19200 baud, 8 bit data, No parity, One stop bit and no flowcontrol or handshaking. If these values have been changed for the modem then the communications software needs to be set the same as the unit it is communicating to.

NOTE: Either port can be used for this exercise.

## 7.2 The Attention Code

An **AT** (sometimes known as the **AT**tention code) usually precedes all commands being sent to the modem. It is used to gain the modem's attention, informing it that you are about to send a command. For example:
- Type the command: ATI2 <CR>

Your modem's firmware identity message will appear on your terminal screen. If you type I2 only, your modem will not respond.

You may enter the attention code in all upper case, or all lower case letters, such as: **AT** or **at**

## 7.3 Multiple Commands

You may place multiple modem commands after an AT provided the total number of characters does not exceed 255. For example, a valid command to display the modem's internal temperature twice is:
- Type in the command: ATI9I9 <CR>

An AT is not required in front of the second I9 command. You only need one attention code for each command line. To make this command more readable, you can add spaces between the two commands:
- Type in the command: AT I9 I9 <CR>

The modem will execute the command as if the spaces are not there.

NOTE: There are some commands that cannot be linked as multiple commands. These commands have to appear on their own and are outlined in the tables on page 49.

## 7.4 Port Selection Modifier

Unlike conventional modems the RFI-9256 has two serial ports. Each can be configured independently. So to allow access and configuration of alternative ports a modifier may be appended to the end of the command string. This modifier is a colon followed by a port number from 0-1. For example **:00** would be port 00 also called the Main port, **:01** would be the Auxiliary port.
- Typing in the command: ATS80:01 <CR> , would connect the port to the auxiliary port of the remote unit addressed 80 (Rx = 80).

---

## 7.5  The Escape Sequence

When there is no communications link established to a remote modem, and you issue commands, all dialogue is occurring between your computer and the local modem. This situation is known as Local Command State.

When you connect to a remote modem, dialogue is occurring between your computer and the remote modem (or what is connected to the remote modem). This is known as On-line State. Once a modem enters on-line state, it assumes all the data you send it is to be sent on to the remote modem, so it ignores any AT commands you give it.

To force the modem to return to local command state, enter an escape sequence. An escape sequence consists of a one second delay, three characters (default is '+') typed rapidly and another one second delay. For example if you dial a remote modem:

- Type: ATDT 2000  <CR>

If the remote modem connects then the local modem will enter on-line state and your terminal  will display the message CONNECT.

Now try to view the modem's firmware identity code:
- Type: ATI2  <CR>

Your command will be ignored. This is because the modem assumes you are typing characters to be sent to a remote system.

Now type an escape sequence. Do not type any characters for one second, type +++ rapidly and wait another full second. The modem responds with an OK message.

You may now view the modem's firmware identity.
- Type: ATI2  <CR>

The H0 command is used to hangup and end the test.
- Type: ATH0  <CR>

Unlike the other commands, you should not type AT before the escape sequence, or type a carriage return after it. Instead, wait a full second before you type the escape sequence and then a full second after typing it. As soon as the modem returns to local command state, it will respond with the message: OK

This waiting period before and after the escape sequence is called the Escape Sequence Guard Time. This allows the modem to distinguish the escape sequence from the normal flow of information between modems.
You can change the character used for the escape sequence by changing the value of **S** Register 2.
You can change the length of the escape sequence guard time by changing the value of **S** Register 12.

## 7.6  Response Codes

Your modem is capable of telling you, with on screen messages, what it is doing. These messages are known response codes or result codes, and you will see them from time to time.

For example:
    After a command is successfully executed, the response is: OK
    After a connection is established, the response is: CONNECT

---

## 7.7  Dialling

The AT commands may be used to initiate dialling with the modem.

The **D** (Dial) command is used to initiate a telephone call. The most basic form of the **D** Command is:

ATD number

Where the number is the telephone number you are dialling.

Having set your communications software for 19200 bps operation:

* Type: ATD1234 <CR>

  Your modem dials the number '1234'. You may substitute this number for the number of any remote modem. If your modem receives a character from your computer while dialling is being performed, it immediately hangs up, sends a NO CARRIER response message to the computer and returns to local command state.

After a few seconds the message, CONNECT appears on the screen.

If a NO CARRIER message appears, your modem has not been able to make a connection. Check your communications software is set for 19200 bps operation and your modem is correctly connected to your computer.

To hang up the modem, type an escape sequence (+++). The modem responds with an OK message.

* Type: ATH0  <CR>

The modem hangs up.

## 7.8  Hanging Up

The H0 command is used to hang up the modem. After you have finished communicating with another modem you must hang up your modem.

Similarly, you must hang up the phone after calling another person. If you don't, no one will be able to call you.

To hang up your modem:

* Type: ATH0  <CR>

The modem will return an OK response message.

NOTE:  If you are getting no response it is likely to because local command state has not been entered. See section 7.5 **The Escape Sequence**.

## 7.9  Configuring the Modem

Your modem allows you to tailor its operating parameters to suit your own particular requirements. The modem uses S Registers to alter the configuration profile. Each S Register contains a decimal value to represent a time delay, an ASCII character or the modems phone number (the interpretation of each value differs with each S Register).

The modem allows you to save the contents of the S Registers and certain communication settings in non-volatile memory (**&W**). This means the entire configuration profile will be retained after you have switched your modem off.

The modem also has factory default settings stored internally, allowing you to change the communication settings and S Register values and then recall the factory default configuration profile stored in your modem when you originally purchased it. The factory defaults have been selected so most users will be able to make immediate use of their modem, with minimum changes.

You may restore your modem to its factory defaults at any time:

* Type: AT&F  <CR>

## 7.10 Viewing the Current Configuration

The **&V** command allow you to view the current configuration of your modem. When you issue the **&V** command, your modem sends a list of the current AT command and S Register settings to your computer.

## 7.11 Modem Commands

### 7.11.1 AT? Menu Mode

This command allows you to use a menu system to configure the modem. There are many extended modes of operation only available from the menu, the protocol settings for example. After you exit the menu through the Escape key the modem will return to the command mode. This menu command is more versatile than the one brought up by the front panel button because it works for any serial port settings (as long as the modem and terminal software have the same settings).

### 7.11.2 ATD Dial

This command allows you to dial a telephone number. The basic dialling command is:

ATDXXXX:YY

ATD followed by the remote modem Rx address (XXXX) and port number (YY).

For example:
To dial the number  2356 78
• Type: ATD2356 78 <CR>
You may use hyphens or spaces. They will be ignored by the modem, but they will make it easier to read the command line.
For example:
• Type: ATD  2356-78 <CR>
☞ D command must be the final command on a command line.

### 7.11.3 ATE Echo

The E command allows you to select whether the characters you type at your keyboard (while in the local command state) will be echoed back to your computer screen by the modem.
**Options**
ATE0 Disable local command state echo
ATE1 Enable local command state echo
**Range**    0-1

### 7.11.4 ATH Hang Up

The H command forces the modem to hang up.
ATH0 Hang up

### 7.11.5  ATI Information

To display various information about your modem including its firmware version.

**Options**

| | |
|---|---|
| ATI | Display Modems Firmware ID |
| ATI0 | Display numeric identity code (UNIMODEM PnP response) |
| ATI1 | Display CRC 32 Firmware checksum value |
| ATI2 | Display  ERROR or OK for the CRC Firmware checksum |
| ATI3 | Display firmware revision level |
| ATI4 | Display firmware revision/build date |
| ATI5 | Display Modem Manufacture Date |
| ATI6 | Display Modem Serial Number |
| ATI7 | Display Modem Identification String. |
| ATI8 | Display Get Connect Type |
| ATI9 | Display Internal Temperature in Deg C |
| ATI10 | Display Offline time in milliseconds |
| ATI11 | Display Average RSSI value |
| ATI12 | Display Average NOISE value |
| ATI13 | Display Get current port ID |
| ATI14 | Display Link Status |

**Range**       0-14

### 7.11.6  ATO Return to On-Line State

The **O** command enables you to return to on-line state from local command state.

When you are on-line (connected to a remote computer), anything you type is sent on to the remote computer. If you want to send commands to your modem, you must return to local command state by typing the escape sequence (+++). When you are ready to return to on-line state, use the **O** command.

☞ The **O** command must be the last command on the command line.

**Examples**

- Type: +++ Your modem will return to local command state.
- Type: ATO <CR> Your modem will return to on-line state.

### 7.11.7  ATQ Quiet (Suppress Response Codes)

Your modem has a variety of messages or response codes which it sends in response to various commands. Examples of these codes are the OK and CONNECT messages.

The **Q** command allows you to switch these messages on and off.

If you switch the messages off, no response codes will be displayed on your screen — with the exception of responses from the ATSn? Command and AT&V command.

**Options**

ATQ0 Send response codes to the screen

ATQ1 Do not send response codes to the screen

**Range**       0-1

### 7.11.8  ATV Verbal Response Codes

Your modem can display either verbal or numeric response codes in response to various commands. The **V** command enables you to select which type of response codes you want displayed.

See Table 7.11 for a full list of the response codes supported by your modem.

**Options**

ATV0 Numeric response codes

ATV1 Verbal response codes

**See Also**

7.11.7 ATQ Quiet (Suppress Response Codes)

**Range**       0, 1

### 7.11.9  ATW Delayed Response

To support software that cannot cope with the high connection establishment speed of the radio then this option allows the response to be delayed for 1 second before returning the CONNECT response.

The **W** command enables you to select which type of response speed you want.

**Options**

ATW0 Fast Response Mode

ATW1 Slow Response mode

**Range**       0, 1

### 7.11.10  AT&C Controlling Data Carrier Detect

DCD is an RS-232 signal used to indicate to the computer that remote modem is ready to communicate. The **&C** command is used to tell the modem how it will control the DCD output.

**Options**

| | |
|---|---|
| AT&C0 | DCD is alway asserted (the computer assumes the remote modem is ready to communicate). |
| AT&C1 | DCD follows the online produced by a connection to a remote modem. |
| AT&C2 | DCD follows the DSR from a remote modem |
| **Range** | 0-2 |

### 7.11.11  AT&D Controlling Data Terminal Ready

DTR is an RS-232 signal used to indicate to the modem whether your local computer is ready to communicate. The **&D** command is used to tell the modem how it will react when the DTR signal goes low.

**Options**

| | |
|---|---|
| AT&D0 | The modem ignores the DTR signal and acts as if it is asserted (the modem assumes the computer is ready to communicate). |
| AT&D1 | If DTR is lowered, the modem returns to local command state (as if an escape sequence has been typed). |
| AT&D2 | The modem hangs up, returns to local command state if DTR has been asserted (high) and then goes low (transition). |
| AT&D3 | The modem hangs up, returns to local command state whenever DTR goes low. The modem with this configuration must have DTR asserted before dialling or answering or an immediate hang-up may occur. |
| **Range** | 0-3 |

### 7.11.12  AT&F Restore Factory Defaults

Your modem comes with factory default settings for all communications settings and S Registers. The **&F** command enables you to restore the factory default values.

You must use the **&W** command if you wish to save the factory default values to non-volatile memory, and thus preserve these values when you switch the modem off.

**Options**

AT&F0 Restore basic modem interface to factory defaults.
AT&F1 Restore radio and modem interface to factory defaults.
**See Also**
7.11.15 AT&V View Active Profile
7.11.16 AT&W Store Active Profile

## 7.11.13 AT&G Exclusive Port Control

Since this is a dual port radio there are times when a program may require exclusive control of a radio.
This command prevents or blocks the opposite port from being able to dial out. The opposite port will be presented with a BUSY response whenever it dials. You should restore the port to multi-port operation after hanging up from the remote radio or at the end of session. The G2 option give a port priority so that if the opposite port has already established a connection then that connection will be immediately disconnected when the port with priority issues a dial command.
**Options**
AT&G0 Multi Port operation.
AT&G1 Exclusive port operation.
AT&G2 Priority use of this port.

## 7.11.14 AT&K Flow Control

The **&K** command enables you to select the type of flow control used between your modem and the local computer. You may want to do this to prevent possible data loss resulting from buffer overflow.

Using flow control guarantees that data buffers in your modem and computer won't overflow. Your modem and your terminal or computer must be using the same type of flow control.
**Options**

| | |
|---|---|
| AT&K0 | Flow control disabled |
| AT&K3 | RTS/CTS (hardware) flow control. The modem and computer use the CTS (Clear to Send) and RTS (Request to Send) signals on the RS-232 serial connection to control data flow. |
| AT&K4 | XON/XOFF (software) flow control. The modem and computer use the XON and XOFF characters (DC1 and DC3) to control the flow of data. |

**Range**    0, 3, 4

## 7.11.15 AT&V View Active Profile

The **&V** command allows you to view many of the modem settings. These values correspond to S register and other commands that were saved into the modem's non-volatile memory and used as power up defaults.
**Options**

| | |
|---|---|
| AT&V | Display All Registers (Except I registers). |
| AT&V1 | Display I registers - Information. |
| AT&V2 | Display S registers only. |
| AT&V8 | Display current links. |
| AT&V9 | Display Fault/Diagnostics Log. |

**Range**    1,2,8,9

## 7.11.16 AT&W Store Active Profile

The **&W** command allows you to save the modem settings and submit serial communications settings. These values will be saved into the modem's non-volatile memory and used as power up defaults. Not all changes require the &W command, the ones that do are outlined in the AT command tables on page 49.
**Option**

| | |
|---|---|
| AT&W | Save general modem configuration data |
| AT&W1 | Submit serial port configuration |

**Range** 1

## 7.12  S Register Commands

To set the value of an S Register the command is in the form:

ATS**r**=**n**

where **r** is the register and **n** is the value to be placed in the S Register.

The value of the S Register can be read with the ATSr? Command where r is the register.

**Examples**

Type: ATS2=64 <CR> Sets S Register 2 with a value of 64

Type: ATS51? <CR>  Displays S Register 51 with the Unit Address (Phone number).

### 7.12.1  ATS0 Rings Before Answer

Supported for compatibility but only reports OK.

### 7.12.2  ATS2 Escape Character

S Register 2 contains the ASCII values of the character which forms the escape sequence.

The default value for this register is 43. The modem will recognise three + characters (+++) as the escape sequence.

**Examples**

ATS2=36 Recognise three dollar symbols $$$ characters as the escape sequence

ATS2=45 Recognise three minus --- characters as the escape sequence

**Range**      0-255

**Default**    43 (the + character)

**See Also**

7.12.4 ATS12 Escape Sequence Guard Time.

### 7.12.3  ATS7 Wait for Carrier

S Register 7 contains a value, in seconds, equivalent to the length of time the modem will wait for a carrier signal after dialling. If a carrier is not detected within the time specified in this register, the modem will hang up and return a NO CARRIER message.

**Examples**

ATS7=20 Wait up to 20 seconds for a connection

**Range**      1-60

**Default**    10

### 7.12.4  ATS12 Escape Sequence Guard Time

The Escape Sequence Guard Time is the time delay required immediately before and after entering an escape sequence.

For your modem to distinguish the escape sequence from ordinary data, there must be a period of silence both before and after the escape sequence is entered. If the Escape Sequence Guard Time is one second and the escape sequence character has been defined as +, for the modem to recognise an escape sequence you must maintain silence on the line for one second, then type +++ in rapid succession, and then maintain another second's silence.

The guard time is in units of milliseconds (or 1/1000 of a second).

☞ S Register 12 is also used to time the period between the escape sequence characters as they are typed. If the period between the first and second escape characters or second and third escape characters being entered is greater than the value in S Register 12, the modem will not recognise the escape sequence.

**Examples**

ATS12=990            Maintain silence on the line for 0.99 seconds before and after entering the escape sequence

**Range**     0-10000
**Default**   990
**See Also**
7.12.2 ATS2 Escape Character

### 7.12.5  ATS21 Set Security Code

Set the Network Security Code for this modem. For more information see **Radio Personality Menu** section on page 30.
**Range**     0 - 4294967295
**Default**   Disabled

### 7.12.6  ATS30 Inactivity Time out

Supported for compatibility but only reports OK.

### 7.12.7  ATS40 Packet Timer

Sets the Packet timer in number of milliseconds. Enter 0 to disable. See page 24 on Serial Configuration Menu.
**Range**     0-1000
**Default**   0

### 7.12.8  ATS41 Number of retries for ARQ

Set the number of retries ARQ Link control parameter. For more information see **Set Link Control Parameters and Timers** page 13.
**Range**     0-255
**Default**   50

### 7.12.9  ATS42 Network fail timeout

Set the Network fail timeout parameter. For more information see **Set Link Control Parameters and Timers** page 13.
**Range**     100- 30000
**Default**   5000  (5 seconds)

### 7.12.10  ATS43 Online requests timer

Set the Online request timer parameter. For more information see **Set Link Control Parameters and Timers** page 13.
**Range**
0-30000     Must be less than Network Fail Timer.
**Default**   1000

### 7.12.11  ATS44 Hopping Pattern Sequence

Set the Hopping Pattern Sequence parameter. For more information see **Set Radio Characteristics** page 14.
**Range**     0-31
**Default**   0

### 7.12.12  ATS45 Max TX Power

Set the Maximum Transceiver output power parameter. For more information see **Set Radio Characteristics** page 14.
**Range**     0,10,20,25,30
**Default**   20

### 7.12.13  ATS47 Frame Time

Set the Frame Time parameter. For more information see **Set Radio Characteristics** page 14.
**Range**   8,10,15,20,25,30,35  (milliseconds)
**Default**  20

### 7.12.14  ATS48 Frame Bias

Set the Frame Bias parameter. For more information see **Set Radio Characteristics** page 14.
**Range**
0          Disable
1          Outgoing/Upload
2          Incoming/Download
**Default**  0

### 7.12.15  ATS50 Network Address

Set the Network Address parameter. For more information see **Set Radio Network Address** page 11.
**Range**   00-63
**Default**  32

### 7.12.16  ATS51 Unit Rx address

Set Unit Local Rx Address parameter (Phone number). For more information see **Set Local Rx Address** page 12.
**Range**   0000-9999
**Default**  20

### 7.12.17  ATS52 Unit Tx address

Set Remote Tx Address parameter (Phone number). This only applicable if the unit is to be switched to Point to Point mode. For more information see **Set Point to Point Mode** page 12.
**Range**   0000-9999
**Default**  20

### 7.12.18  ATS60 Set Logging Level

Set Fault / Debug logging level. For more information see **Fault log menu** page 33.
**Range**   0-5
**Default**  20

### 7.12.19  ATS61 Set UNIX Date/Time

Set the time in seconds since 1970
**Range**   0-2147483647
**Default**  0

### 7.12.20  ATS62 Set System/Log Timer

**Range**   0- 86400000
**Default**  0

### 7.12.21  ATS70 Set Port Protocol Type

**Range**   0-5
**Default**  0

### 7.12.22  ATS80 Get Local Auxiliary I/O Hex data

Get/Set the 8 bit auxiliary I/O port. For more information see **Auxiliary I/O Port** on page **29.**

**Range**     0x00-0xFF (0-255)

### 7.12.23 ATS81 Get Remote Auxiliary I/O Hex data

Get/Set the bit direction of the 8 bit auxiliary I/O port of the remote radio. You must already be connected to a remote radio either by dialling and returning to local command mode or by having the opposite port having already established a connection to a remote by dialling or in a point to point mode. For more information see - **Auxiliary I/O Port** on page **29.**

**Range**     0x00-0xFF (0-255)

### 7.12.24 ATS82 Get Auxiliary I/O Direction Mask

Get/Set the bit direction of the 8 bit auxiliary I/O port on the radio that you are connected to. For more information see - **Auxiliary I/O Port** on page **29.**

**Range**     0x00-0xFF (0-255)
**Default**   0x00

### 7.12.25 ATS83 Set Auxiliary I/O Power-up Default

Get/Set the power defaults for the 8 bit auxiliary I/O port. For more information see - **Auxiliary I/O Port** on page **29.**

**Range**     0x00-0xFF (0-255)
**Default**   0x00

### 7.12.26 ATS84 Set Auxiliary I/O Sample Timer

Get/Set the sample timer for the 8 bit auxiliary I/O Port sample timer. For more information see - **Auxiliary I/O Port** on page **29.**

**Range**     8-5000
**Default**   500

### 7.12.27 ATS90 Set DCD control

Set the DCD Control of a Serial Port. For more information see the **DCD Control Menu** section on page 27

0     ONLINE controls DCD
1     NETWORK LINK controls DCD
2     CARRIER DETECT controls DCD
3     Remote DSR controls DCD
4     Local DSR controls DCD
5     Remote CTS controls DCD
6     Local CTS controls DCD
7     DCD Always ON
8     DCD Always OFF
9     DCD disabled

**Range**     0-9
**Default**   0

### 7.12.28 ATS91 Set RTS control

Set the RTS Control of a Serial Port. For more information see the **RTS Control Menu** section on page 28

0     ONLINE controls RTS
1     NETWORK LINK controls RTS
2     CARRIER DETECT controls RTS
3     Remote DSR controls RTS
4     Local DSR controls RTS
5     Remote CTS controls RTS

6   Local CTS controls RTS
7   RTS Always ON
8   RTS Always OFF
9   RTS disabled
**Range**     0-9
**Default**    0

### 7.12.29  ATS100  Set Port baud rate

Set the Baud Rate of the Main Serial Port. For more information see the section - **Serial Configuration Menu** on page 22 and Baud Rate info on page 23.
☞ Must be used in conjunction with the AT&W1 command.
**Range**     300,600,1200,2400,4800,9600,19200,38400,57600,115200
**Default**    19200

### 7.12.30  ATS101 Set Port parity

Set the Parity of the Main Serial Port. For more information see **Serial Configuration Menu** section on page 22.
☞ Must be used in conjunction with the AT&W1 command.
**Options**
0                      No Parity (default).
1                      Odd Parity
2                      Even Parity
**Range**     0,1,2
**Default**    0

### 7.12.31  ATS102 Set Port data bits

Set the Data Bits of the Main Serial Port. For more information see **Serial Configuration Menu** section on page 22.
☞ Must be used in conjunction with the AT&W1 command.
**Options**
7                      Seven Bit Data
8                      Eight Bit Data
**Range**     7,8
**Default**    8

### 7.12.32  ATS103 Set Port stop bits

Set the Stop Bits of the Main Serial Port. For more information see **Serial Configuration Menu** section on page 22.
☞ Must be used in conjunction with the AT&W1 command.
**Options**
1                      One Stop Bit
2                      Two Stop Bits
**Range**     1,2
**Default**    1

### 7.12.33  ATS104 Set Port flow control

Set the Flow Control of the Main Serial Port. For more information see the **Serial Configuration Menu** section on page 22.
☞ Must be used in conjunction with the AT&W1 command.
**Options**
0                      No Flow Control
1                      Software (Xon/Xoff) Flow
2                      Hardware (RTS/CTS) Flow

**Range**    0,1,2
**Default**    0

## 7.13  % Register Commands

The % Registers usually store string values and data entry must be terminated with a Carriage Return <CR>. String values may contain spaces but will have leading and ending spaces removed. The % Register commands **cannot** be concatenated, each must be terminated with the <CR>.

To set the value of an % Register the command is in the form:

    AT%**r**=**n**

    where **r** is the register and **n** is the value to be placed in the % Register.
The value of the % Register can be read with the AT%r? command where r is the register.

### 7.13.1  AT%20 Set Unit Name

Set the Unit Name for this modem. For more information see the **Radio Personality Menu** section on page 30.
**Range**    16 Alphanumeric characters.
**Default**    Blank

### 7.13.2  AT%22 Set Menu Password

Set the Menu Password  for this modem. For more information see the **Radio Personality Menu** section on page 30. If the password is already set then this command will not change it. You must first remove the password via the menu. Or reset the modem to factory defaults.
**Range**
12 Alphanumeric characters.
**Default**    Disabled

### 7.13.3  AT%62 Set RTC Date/Time

Set the time of day in seconds since midnight.
**Range**    0-86400
**Default**    0

## 7.14  Other Commands

There are more AT commands available on the RFI-9256, to many to list in descriptive form. The other commands can be found in the tables on page 49 onwards.

**Table 7.6 General Commands**

| Command | Description | L | &W | Command | Description | L | &W |
|---------|-------------|---|----|---------|-------------|---|----|
| ? | Help / Menu | × | | &F | Hayes™ only defaults | | |
| E0 | Echo OFF | | × | &F1 | Set Factory defaults | | |
| **E1** | Echo ON | | × | **&G0** | **Multi modem ports** | | |
| L0 | Lowest speaker volume | | | &G1 | Exclusive use by this port | | |
| L1 | Low speaker volume | | | &G2 | Priority use of this port | | |
| L2 | Mid speaker volume | | | **&K0** | **No flow control** | | |
| L3 | Highest speaker volume | | | &K3 | Hardware RTS/CTS flow control | | |
| M0 | Speaker off | | | &K4 | Software Xon/Xoff flow control | | |
| M1 | Speaker on when connecting | | | **&L0** | **Set Modem to SLAVE mode** | | |
| M2 | Speaker on | | | &L1 | Set Modem to MASTER mode | | |
| **Q0** | **Response ON** | | × | &M0 | Set Ports to Point to Point | | × |
| Q1 | Response OFF | | × | **&M1** | **Set Ports to Multipoint Dialup** | | × |
| V0 | Numeric response codes | | × | &M2 | Back To Back Repeater | | × |
| **V1** | **Verbal response codes** | | × | &M2 | Dialup Repeater | | × |
| **X0** | **Set to basic response codes** | | × | **&S0** | **Sync Mode Off** | | |
| **W0** | **Fast Response** | | | &S1 | Sync Mode - Input (Follow) | | |
| W1 | Delayed Connect Response | | | &S2 | Sync Mode - Output | | |
| X4 | Set to extended response codes | | × | &S3 | Sync Mode - Repeater | | |
| Z | Initialise (power on reset) | | | &T8 | Warm Start - Reset | × | |
| &A0 | Auxiliary I/O Disable | | | &T9 | Cold Start - Reset | × | |
| **&A1** | **Auxiliary I/O Enable** | | | &V | View current profile | × | |
| &A2 | Auxiliary I/O Follows Remote | | | &V0 | View all basic Hayes register information | × | |
| &C0 | DCD always on | | | &V1 | View all 'I' Register profile information | × | |
| **&C1** | **DCD follows Online** | | | &V2 | View all 'S' register profile information | × | |
| &C2 | DCD Follows remote DSR | | | &V8 | View Current Links | × | |
| &D0 | Ignore DTR | | × | &V9 | View Logging | × | |
| &D1 | Go local on DTR low | | × | &W | Write All Configuration | × | |
| **&D2** | **Hangup on DTR high to low transition (dropped).** | | × | &W1 | Submit Serial Port Configuration. | × | |
| &D3 | Hangup if DTR low | | × | | | | |

NOTE: Items in **bold** are factory defaults.

An × in the L column indicates that the command has to feature as the last command on a line.

An × in the &W column indicates that the command needs to be followed by an AT&W command before changes take place.

**Table 7.7 Information Commands**

| Command | Description | Command | Description |
|---------|-------------|---------|-------------|
| I | Firmware ID | I7 | Modem ID |
| I0 | UNIMODEM PnP response | I8 | Get Connect Type |
| I1 | Return CRC 32 Firmware checksum | I9 | Internal Temperature in Deg C |
| I2 | CRC Firmware checksum Error or OK | I10 | Offline time in milliseconds |
| I3 | ROM Revision | I11 | Average RSSI |
| I4 | ROM Date | I12 | Average NOISE |
| I5 | Manufacture Date | I13 | Get current port ID |
| I6 | Modem Serial Number | I14 | Get Link Status |

**Table 7.8 RFI-9256 Connection Commands**

| Command | Description |
|---------|-------------|
| A | Answer |
| D | Dial number |
| DT | Dial number using tone |
| H | Hangup modem |
| H0 | Hang up modem |
| O | Go Online |
| O0 | Go Online |

NOTE: The connection commands must appear as the last command on a line.

**Table 7.9 S Register Commands**

| Command | Description | &W | &W1 | Command | Description | &W | &W1 |
|---------|-------------|----|----|---------|-------------|----|----|
| S0 | Rings before answer 0 disables | × | | S52 | Remote Tx Address (Point to Point) | | |
| S2 | ESC character | × | | S60 | Logging Level | | |
| S6 | Wait for DialTone Timeout | | | S61 | UNIX Date/Time seconds since 1970 | | |
| S7 | Wait for Carrier Timeout | × | | S62 | System/Log Timer in milliseconds | | |
| S12 | ESC guard time | × | | S70 | Port Protocol Type | | |
| S21 | Set Security Code | | | S80 | Local Auxiliary I/O | | |
| S30 | Inactivity Time out | × | | S81 | Remote Auxiliary I/O | | |
| S39 | Rx (In) Packetiser Timer | | | S82 | Auxiliary I/O Bit Mask (Direction) | | |
| S40 | Tx (out) Packet Timer 0 to disable | | | S83 | Auxiliary I/O Bit Power up default | | |
| S41 | Number of retries for ARQ | | | S84 | Auxiliary I/O Sample Timer | | |
| S42 | Network fail timeout | | | S90 | DCD control | | |
| S43 | Online requests timer | | | S91 | RTS control | | |
| S44 | Hopping Pattern Sequence | | | S100 | Port baud rate | × | × |
| S45 | Max TX Power | | | S101 | Port parity | × | × |
| S47 | Frame Time in milliseconds | | | S102 | Port data bits | × | × |
| S48 | Do Set Frame Bias | | | S103 | Port stop bits | × | × |
| S50 | Network Address | | | S104 | Port flow control | × | × |
| S51 | Unit Rx address | | | | | | |

NOTE: An × in the &W1 column indicates that the command requires only a &W1 update but will also work with a &W update.

An × in the &W column indicates that the command needs to be followed by an AT&W command before changes take place.

**Table 7.10 % Register Commands**

| Command | Description | S |
|---------|-------------|---|
| %20 | Set Unit Name | × |
| %22 | Set Menu Password | × |
| %62 | Set RTC Date/Time (HH:MM:SS) | × |

NOTE: The % register commands are single line commands and cannot be stringed together with other commands.

**Table 7.11 Response Codes**

| Num | Verbal | Description |
|-----|--------|-------------|
| 0 | OK | Command accepted |
| 1 | CONNECT | Connection established |
| 2 | RING | Incoming call detected |
| 3 | NO CARRIER | Carrier not detected |

| 4 | ERROR | Command error |
|---|---|---|
| 7 | BUSY | The dialled number or extension is busy |
| 8 | NO ANSWER | Extension not supported |
| 255 | FAULT | Protocol or other error |

# 8. DIALUP NETWORKING

The RFI-9256 provides several features to allow networking, dual port control and remote configuration. The RFI-9256 has 2 independent serial ports that can be used in communication.

## 8.1 Extension Numbers

To allow access to internal and external ports the modem provides extension numbers. These extension numbers work like an internal PABX where the user appends a two-digit extension number to the destination radios dial string. The radio has several preset extension numbers as in the following table:

| Extension Number | Description |
| --- | --- |
| 00 | MAIN Serial Port |
| 01 | AUX Serial Port |
| 91 | Virtual Hayes Connection |
| 92 | Remote Menu Connection |
| 93 | Remote Logger Connection |
| 99 | Loop-back Connection |

**Table 8.1 Extension (Port) Numbers**

The MAIN and AUX port extensions allow the dialling Modem to select which port it wants to connect through. The Virtual Hayes connection provides an interface for automated or scripted configuration and management of the radio.
The Remote Menu connection provides the user with a friendly interface into a remote radio (see USING INTERNAL MENU COMMANDS, page 10). This interface has restrictions to prevent the user for accidentally changing the radio specific attributes which could break the connection.
The Remote Logger connection dumps the currently stored event/fault log. Must be disconnected with a Hayes hangup sequences.
The Loop-back connection echoes any data entered and allows you to diagnose link quality.

## 8.2 Repeaters

To provide a simple network functionality the RFI-9256 provides a several Repeater modes and uses a number analyses system.

The Back to Back Repeater mode configures the Main serial port and removes its control from the Serial Configuration Menu. To connect the modems for repeater operation the Main ports of each modem must be fully connected so that all the serial lines are exchanged.
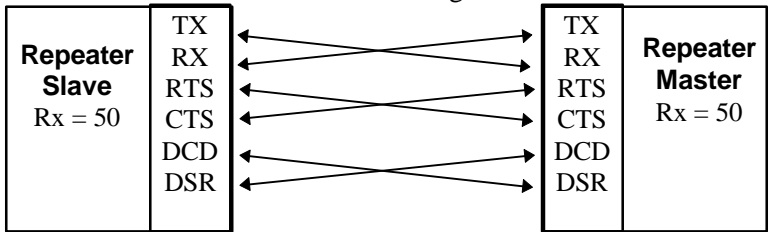


**Figure 8-1 Back to Back Repeater Link Exchange**

This mode also has the option of synchronising the Slave and Master for increased performance, to do this pin 10 of each Radio can be linked to pin 10 of the opposite Radio Modem.

The numbering system requires the following rules:

- All Repeater radios must only have a two digit Rx Address (unit id).
- All "End Point" radios should use a full four digit Rx address (unit id) and will require a mandatory two-digit extension number.

For example a destination "End Point" radio's Rx address may be 4022 and required port may be the MAIN port, which is extension 00, so the End Point number would be 402200 (6 digits in total).

To dial a connection to MAIN port (Ext 00) on radio **4022** would be:

ATDT **402200**



**Figure 8-2 Single Point Connection**

To dial a remote menu (Ext 92) connection on radio **4022** would be:

ATDT **402292**

To dial through a back to back repeater the repeater Rx address will be prefixed to the dial string. In the example the user is dialling a menu extension (Ext 92) on the remote slave "End point" radio (radio 4022) using repeater 50.
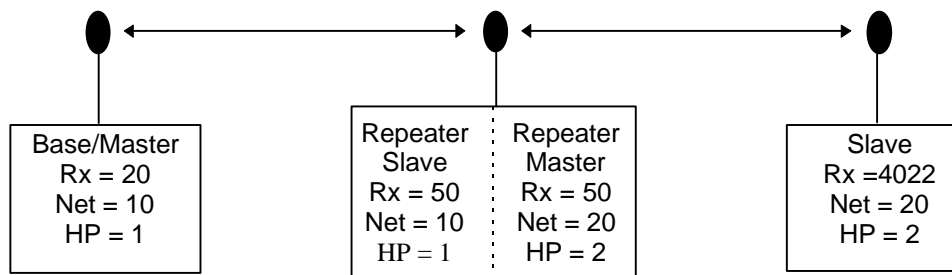
ATDT **50402292**


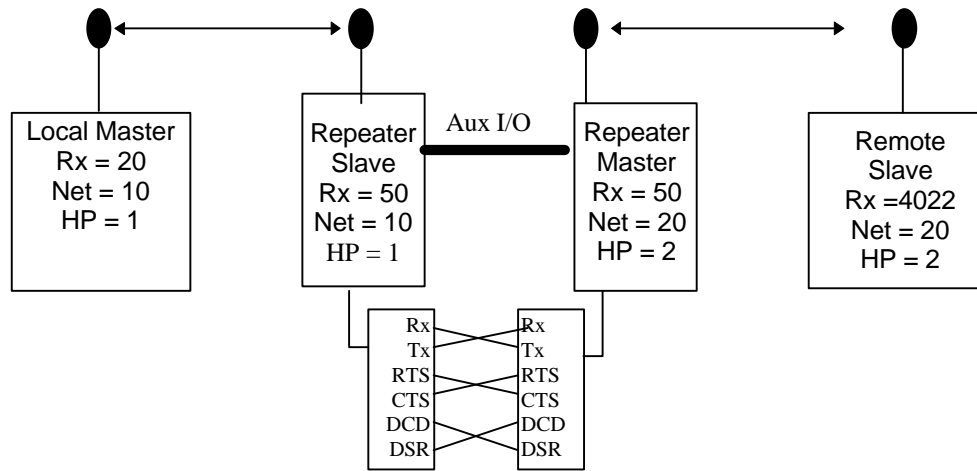
**Figure 8-3 Repeater - Logical Connection**

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**Figure 8-4 Repeater - Physical Connection**

This simple numbering system allows several repeaters to be concatenated and allows repeaters to branch to other repeaters in a tree like formation.

# 9. ESTABLISHING COMMUNICATIONS LINKS

NOTE:  This section is concerned with the **logical** configuration and set up of networks.

## 9.1.1  Point to Point

The RFI-9256's versatility allows data communication links to be established using a variety of different configurations. This, in turn, makes it possible to extend the range of RFI-9256's and get around obstacles. Figure 9-1 and Figure 9-2 show the most common and straightforward link, a master communicating to a slave in a dedicated link. Both radios should be set to point to point (direct).
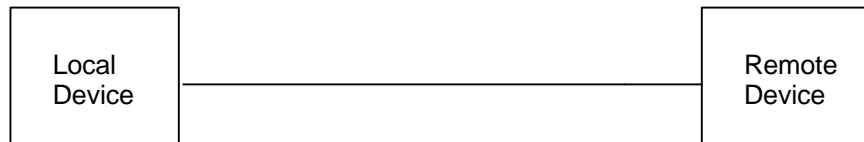


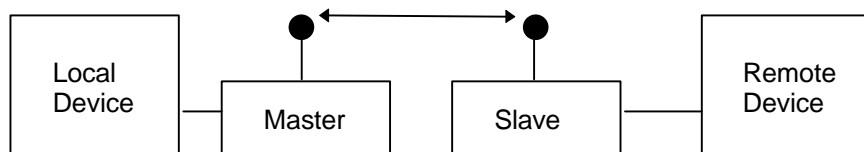**Figure 9-1 Point-to-Point Local Connection**



**Figure 9-2 Point-to-Point Physical Connection**

Once selected, and the menus have been exited, this mode automatically connects the modems and establishes a communication link. Communication is **no longer** controlled by the AT commands [Section 7.1]. In this mode the units are always connected and the *NETWORK LINK* LED and *ON LINE* should always be ON. The *CARRIER DETECT* LED is used to indicate the link quality, by the ratio of green to red (if the LED is green 100% of the time, the link is perfect). The *CARRIER DETECT* LED on the slave will always indicate the link quality. On the Master the link quality is indicated more accurately when it is running a Margin Link Test (See **Diagnostics Menu** on page 49)

## 9.1.2 Point to Multipoint Dial connection

A point to multipoint dial connection behaves just like a telephone line modem. By using the ATDT command followed by the number of the slave, the slave will then be connected to the master. The radios use a subset of the Hayes™ compatible commands as shown in Section 7 AT COMMAND SET. This allows two RFI-9256 radio modems to look like a direct telephone line connection. Only one slave can be connected to the master at any one time in this mode, but the master can communicate with any slave within its network. One possible topology of the network that could be employed in this situation is shown in Figure 9-3. For this mode to be enabled the radio's in the network must be configured as point to multipoint (dial) modems.
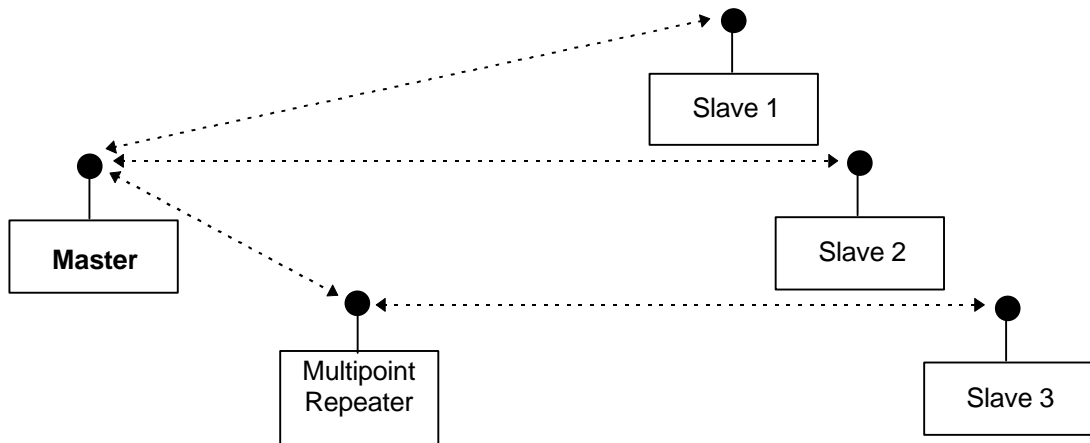


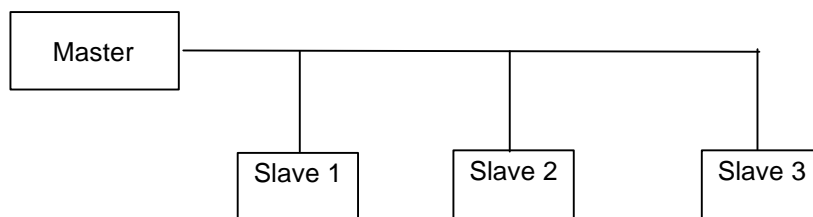**Figure 9-3 Point-to-Multipoint Physical Connection**



**Figure 9-4 Point-to-Multipoint Logical Connection**

### 9.1.3  Point to Point Repeater

Radios may be wired as back to back repeaters, to extend the range of a point to point system. The modems are not configured as repeaters (in the menu they configured in Point to Point Mode) but are wired together as back to back repeaters. Figure 9-5 and
Figure 9-6 depict how a link might be set up using a repeater. The repeater may be sitting on a hilltop or other elevated structure to link the master to the slave. In this configuration it may be desirable to use Yagi antennas to extend the range between the Repeater and either or both the Master and Slave.
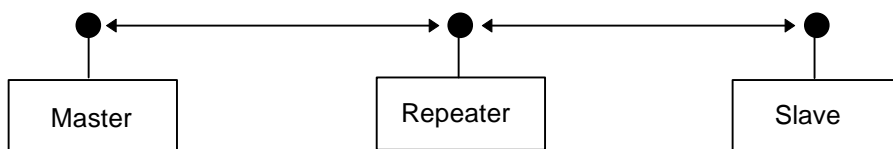
**Figure 9-5 Point to Point System with Repeater - Logical View**
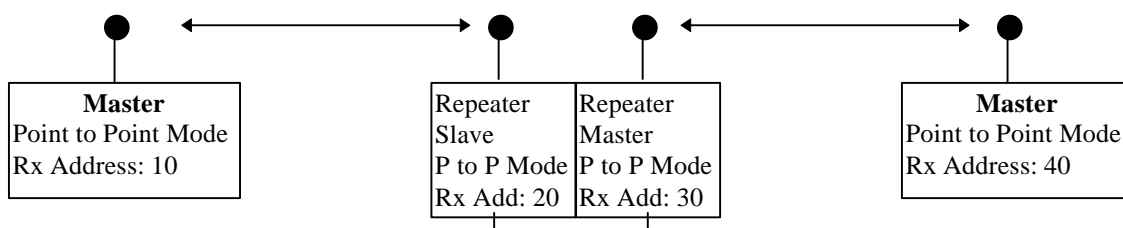
**Figure 9-6 Point to Point System with Repeater - Physical View**

Figure 9-7 shows a link with two repeaters between the master and slave. With two repeaters there is clearly more flexibility in getting around obstacles and greater total range is possible. Once again, it would be desirable to use external omnidirectional antennas with the repeaters, and attaching a Yagi to the master and slave would increase the range of the link. When two repeaters are used there is no further degradation in the RF speed of the link, only the data latency is effected.
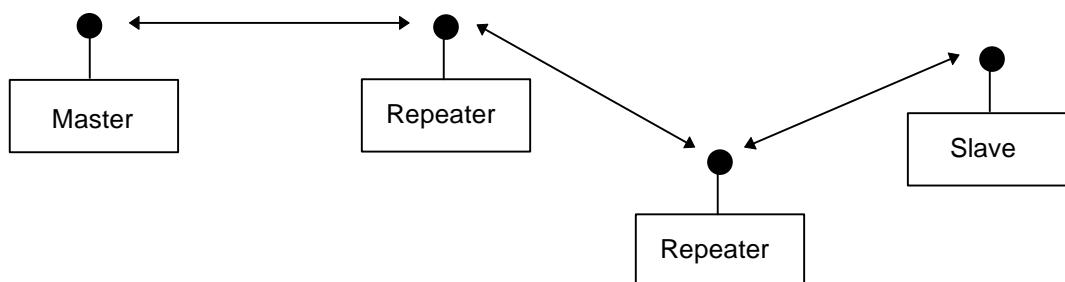
**Figure 9-7 Point to Point System with Multiple Repeaters - Logical View**

## 9.1.4 Point to Multipoint (+Repeater)

In Figure 9-8 a setup is shown where a master routinely calls a number of slaves at different times. The master is communicating with a transceiver designated as a slave/repeater which is connected to a remote instrument in the field. Since this instrument is placed in an elevated location, the transceiver may also be used as a repeater when it is not used as a slave. At any time the master may call any of the slaves, establish a connection, and retrieve and send data. Note, point to multi-point (Dialup) is the only mode available when the radio is configured (using the menu) as a repeater.



**Figure 9-8 Point to Multipoint with Repeater**

## 10. Auxiliary Input/Output Port

The Auxiliary I/O Port has 8 digital I/O lines as depicted in Table 13.2. These pins are not associated with the Main or Auxiliary serial ports, but are used as logical bit inputs or outputs to the modem. These lines are individually configurable as inputs or outputs and their default state can be configured to preset their power-up state.

The I/O ports can be controlled both remotely and locally through software or by following each other as if directly connected by wire.

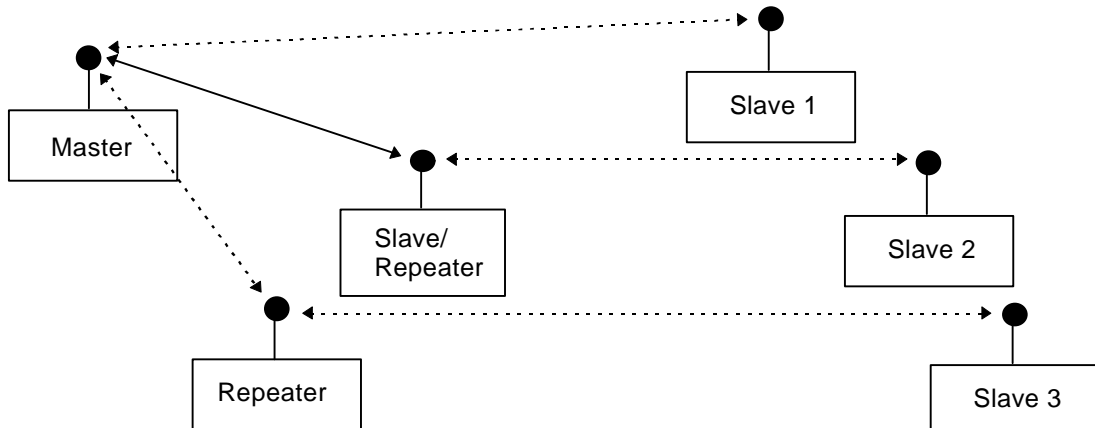- **Software control** works by submitting Hayes **S Register** commands the local radio or dialling a remote radio's virtual Hayes port as described in section on DIALUP NETWORKING on page 52 and submitting the commands to it. The Hayes **S Register** commands allow you full access to configure and control the 8 I/O lines. To software control a Auxiliary port the **Enable/Disable Auxiliary I/O** must be disabled see the **Auxiliary I/O Port** menu on page **29.**

- **Input/Output control** configuration of each of the 8 digital I/O lines as either an input or an output. The configuration may be done by menu as described on page 29 or by Hayes commands.

- **Power-up Output Defaults** allows you to preset the state (High/Low) of an output line when the radio is first powered up. This prevents devices that are attached to the radios I/O from being unintentionally enabled.

- **Sample Rate control** to balance the performance of the RFI-9256 between fast updates from the I/O device for one application and fast serial data throughput for another application. Fast sample rates below 15ms may degrade serial data throughput when trying to obtain serial data transfer rates of faster than 50,000 bits per seconds.

- To allow a radio's outputs to follow the inputs of another radio the **Auxiliary I/O Follows Remote** must be enabled. When two radios are connected for communication in either a point to point mode or dialup mode, the may also exchange each others Input information and thus reflect the results on their outputs. They must be configured so that the pins that are the input in one radio are the output on the other. For example, in Figure 10-9, when the modems are connected, flipping the switch connected to pin number 21 in the Remote Modem will activated the output LED connected to pin 21 in the Local modem. Similarly, Flipping the switch connected to pin 7 on the Local Modem will change the status of the relay attached to pin 7 on the remote modem.
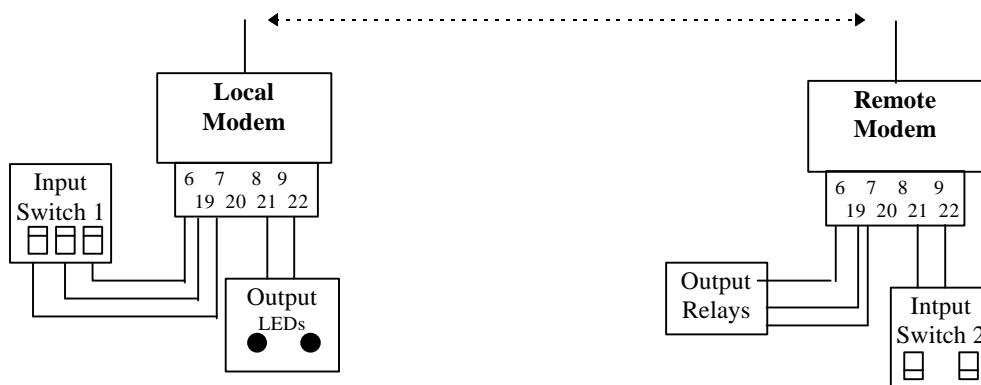
**Figure 10-9 Auxiliary I/O Example**

For menu configuration see **Auxiliary I/O Port** on page **29.**

# 11. Firmware Compatibility

## 11.1 The version numbering scheme.

The RFI-9256 products contain a firmware version string. This version information provides some information regarding compatibility with other firmware versions.

**Product Name:** Identifies the modem hardware type such as RFI-419, RFI-9256 or RFI-156.

**Major and Minor Number:** The major number generally reflects the hardware compatibility of the firmware but may be incremented if the firmware has had a major overhaul. The minor number is incremented as new suites of functionality have been added or when changes have been made which render the firmware incompatible with previous versions. Combined they are the version number.

**Revision:** The revisions reflect bug fixes or minor changes that don't render the system incompatible.

**Country:** Firmware with versions with different country identifiers, are always incompatible with their air interface. This is due to the frequencies and hopping sequences that they use. Each country has its own spectrum allocation and laws governing radio spectrum usage.
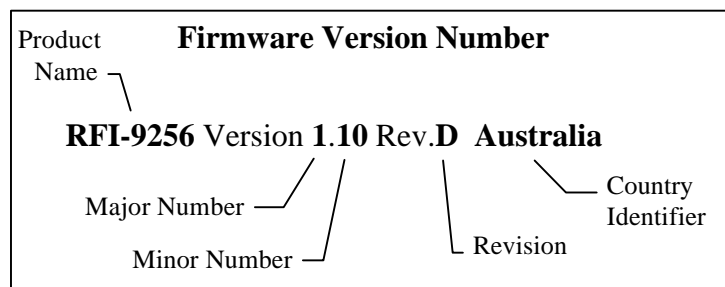


**Figure 11-1 Firmware version**

## 11.2 Compatibility Types

There are several different aspects of compatibility:

### 11.2.1 Hardware compatibility.

The compatibility of the firmware with the radio's hardware, such as processor, transceiver and revisions of the PCB. This is usually indicated by the Major version number or the product name.

### 11.2.2 Air interface compatibility.

The ability for radios of different versions to still communicate. This is related to the air interface protocols, RF frequencies, modulation methods and channels hopping mechanisms. Firmware with the same Major and Minor revision numbers are always Air interface compatible. A difference in the Minor number may indicate some Air interface incompatibility in some modes.

### 11.2.3 Feature Compatibility

Each version of the firmware usually contains additional features such as protocols, enhancements such as security coding and changes to the user interface. Modems with different versions of firmware may be still compatible provided that features of the newest version modem are not utilised.

## 11.3 Version Inter-Compatibility Guide

The following  firmware versions are for the RFI-9256 Data Strike Series 3 Radio.

| Firmware Version | 1.08 | | 1.09 | | 1.10 | | 1.11 | |
|---|---|---|---|---|---|---|---|---|
| | Air Int. | Feature | Air Int. | Feature | Air Int. | Feature | Air Int. | Feature |
| 1.08 | ✓ | ✓ | ✓ | 60% | ✘ | ✘ | ✘ | ✘ |
| 1.09 Rev A - D | ✓ | 60% | ✓ | ✓ | ✘ | 60% | ✘ | 40% |
| 1.10 Rev A - D | ✘ | ✘ | ✘ | ✘ | ✓ | ✓ | 90% | 80% |
| 1.11 Rev A | ✘ | ✘ | ✘ | 40% | 90% | 80% | ✓ | ✓ |
| 1.20 | ✘ | ✘ | ✘ | 40% | ✘ | 80% | ✘ | 80% |

**Table 11.1 Compatibility of Firmware and Versions**

## 12.  DIAGRAMS

The following diagram in Figure 12-1 shows the dimensions of the mounting holes on the RFI-9256 radio.
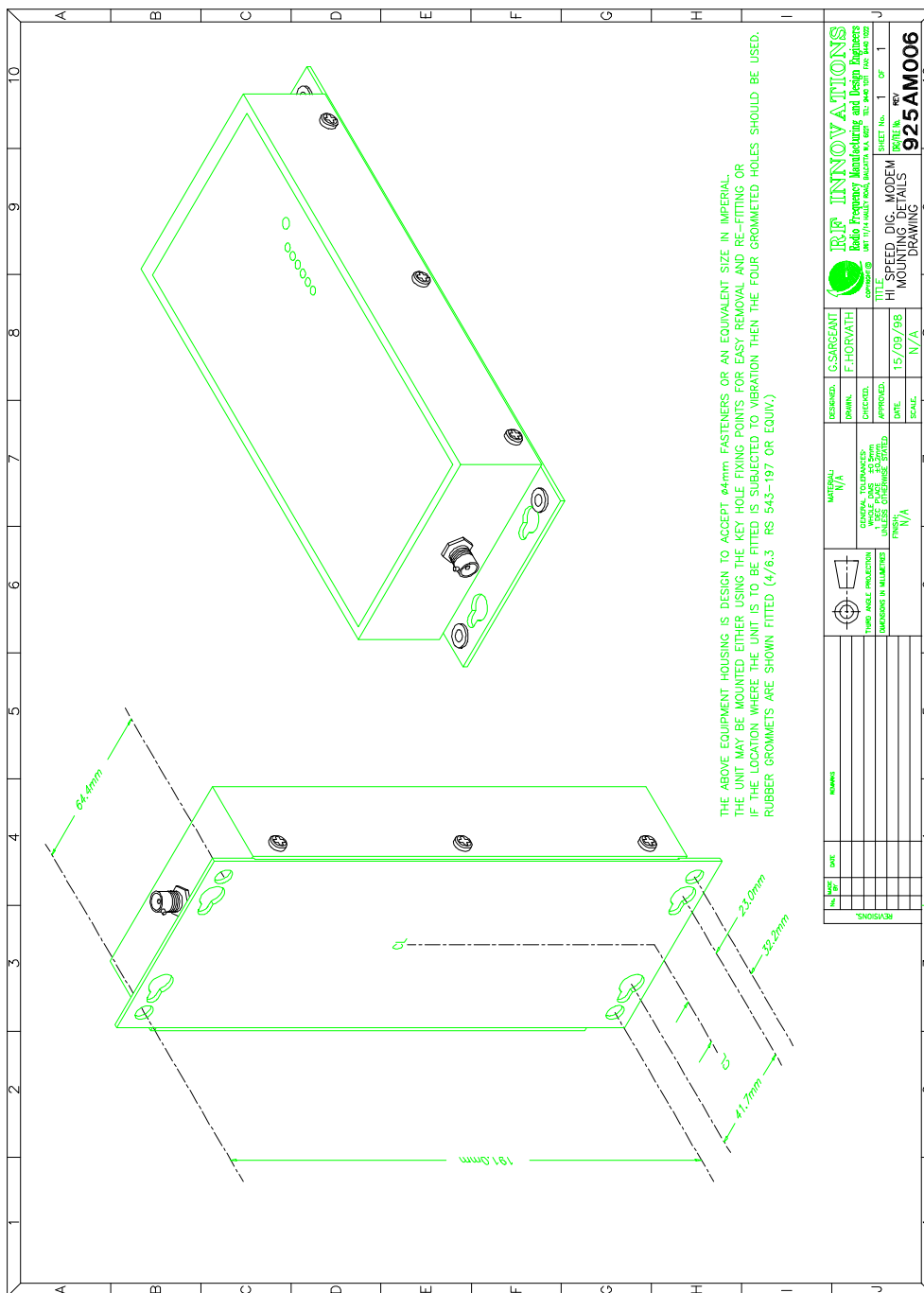


**Figure 12-1 Mounting details of the RFI-9256**

The following diagram in Figure 12-2 is a cable assembly diagram for the RFI-9256. The two communication ports are output via DB9 connectors and a 12V plug pack is also connected to supply power to the radio.
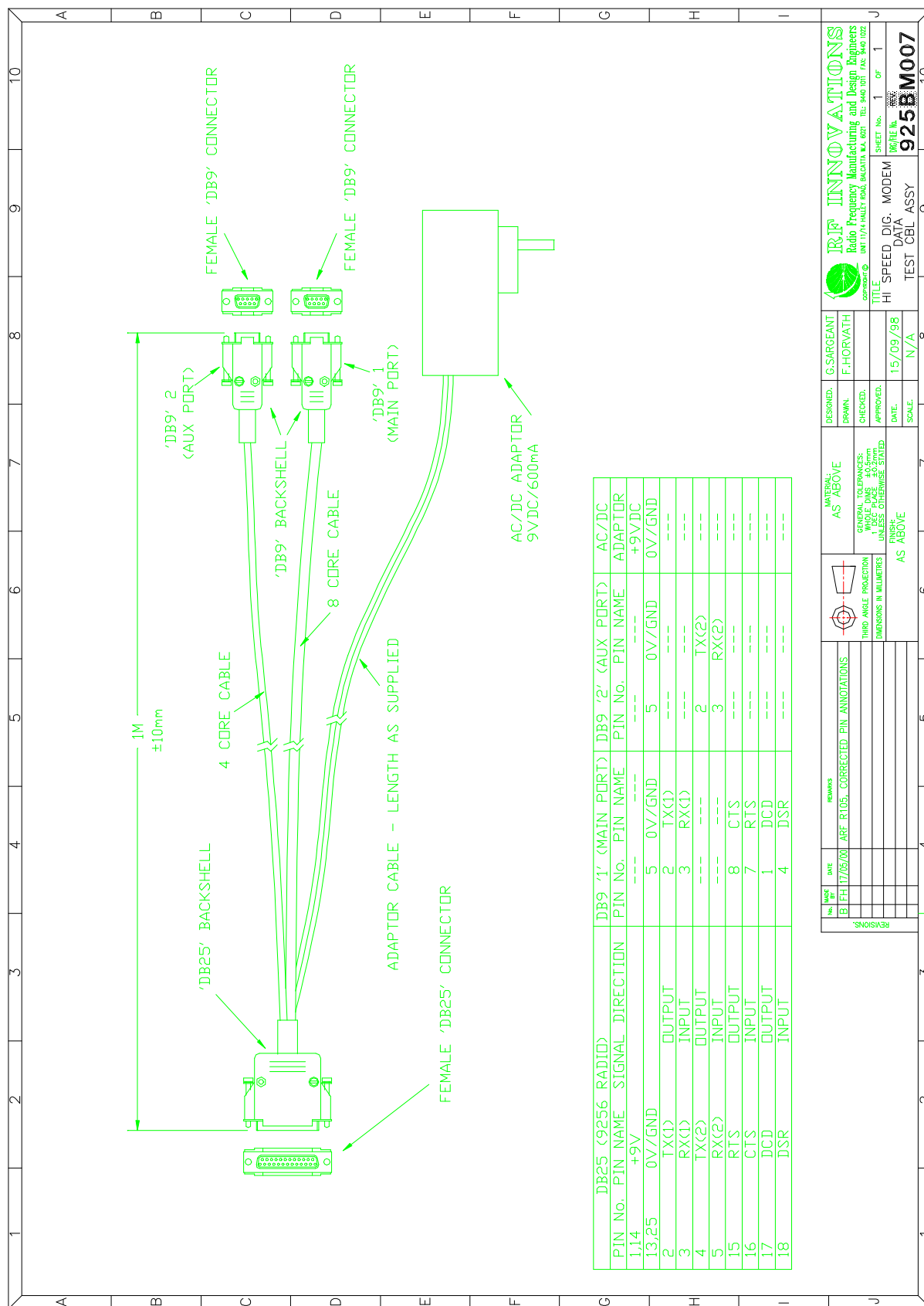
Figure 12-2. Cable assembly details for interfacing to the RFI-9256 radio modem

## 13. TECHNICAL SPECIFICATIONS

### 13.1 RADIO SPECIFICATIONS

**Table 13.1 RFI-9256 Radio Specifications**

| | |
|---|---|
| Range* | >20 KM |
| RS-232 Data Rates | 110 baud - 115.2 K baud |
| RS-232 Interface | Asynchronous, full duplex |
| System Gain | 135dB |
| Minimum Receiver Decode Level | -108 dBm @ 10-4 raw BER |
| | -100 dBm @ 10-6 raw BER |
| Operating Frequency | 915-928 MHz(Australia) |
| Modulation Type | Spread Spectrum, MGFSK |
| Spreading Code | Frequency Hopping |
| Hop Patterns | 32 (user selectable) |
| Output Power | 1 Watt (+30 dBm) |
| Error Detection | 32 Bit CRC with packet retransmit (ARQ) |
| Antenna | BNC to fit required antenna |
| Power Requirements | 9.0-16.0 VDC (negative ground) |
| Power Consumption | 600 mA Transmit |
| | 200 mA Receive |
| | 320 mA Average (normal data loading) |
| Connector | DB25 male (power and data combined) |
| Unit Address (Network ID) | User programmable |
| Operating Modes | • Point-to-Point |
| | • Point to Multipoint Dial (Hayes™) |
| | • Back to Back Repeater |
| | • Protocol Router |
| | • Custom |
| Operating Environment | -10°C - +60°C |
| ACA Identifier | N161 |

NOTE: Solar power supply option is available to lower DC power consumption (consult factory)

*RANGE is dependent upon antenna and environment, a typical range calculator is available to download from the RFI Application notes on the RFI WEB page. (www.rfinnovations.com.au)

## 13.2  PIN ASSIGNMENTS

**Table 13.2 Modem RS-232 Interface Connector Functions**

| PIN NO. & FUNCTION | PIN NO. & FUNCTION |
|---|---|
| 1 +12V input | 14 +12V input |
| 2 Transmit Data Out (TXD)main port | 15 RTS Out (main port) |
| 3 Received Data In (RXD)main port | 16 CTS In (main port) |
| 4 Transmit Data Out (TXD)Aux port | 17 RS232 control Out (DCD)** |
| 5 Received Data In (RXD)Aux port | 18 RS232 control In (DSR)** |
| 6 I/O control 7* | 19 I/O control 6* |
| 7 I/O control 5* | 20 I/O control 4* |
| 8 I/O control 3* | 21 I/O control 2* |
| 9 I/O control 1* | 22 I/O control 0* |
| 10 Analog input 2*(Tx Sync) | 23 Analog input 1* |
| 11 Analog input 0* | 24 I$^2$C Expansion (data)*** |
| 12 I$^2$C Expansion (clock)*** | 25 GND |
| 13 GND | |

*I/O controls and Analogs are 0-5V high impedance (4K7 Ohms) Consult RFI.

**RS232 control line functions are dependant upon device program options and can be used as flow control on the Aux Port.

***Consult RFI for expansion options.
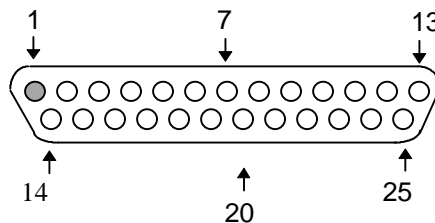


**Figure 13-1. Modem DB-25 (Male) Chassis Connector, Outside View**

*Power supply Notes:*

The power supplies used to power Radio Modems should have sufficient current rating and ripple rejection, typically <500mVRMS of power supply noise can be tolerated. The Modems contain a built in thermal fuse which will open circuit in the advent of any over current conditions, over temperature or reverse polarity. Power supplies used should be capable of at least 1amp continuous current.

# 14. Trouble Shooting

*"I am using the* RFI-9256 *to communicate between two PCs. I am using pcANYWHERE, which is set to direct connection. Both pcANYWHERE and the modem are set to 115.2 KBaud, yet throughput is considerably lower"*

The communication link between two computers may also be slowed considerably by the UART used in the serial port of one or both computers. If you suspect that the serial port on the computer will not support high speed communications, then try reducing the baud rate for that end of the connection (both on the computer and the Transceiver) to see if throughput improves, Also ensure that the Modems are using Flow Control.

*"I have two transceivers, one configured as a master and the other as a slave. When they are plugged in, the POWER LED indicates they are receiving power, and yet they will not LINK. Why not?"*

There are several reasons why this may occur:
- The Transceivers are running at full power and are too close to each other. If the Transceivers are within 1-3 meters of each other and will not link try either reducing the RF power to minimum on each or moving one unit to another room.
- The Transceivers Address do not match. For a Point to Point the Tx and Rx addresses must be correct. ie/ Master Tx Address=1-Slave Rx Address=1 and Master Rx Address=2, Slave Tx Address=2.
- The Units Network ID's do not match, only units on the same network can communicate.
- The Hopping pattern sequence number is not matched in all units.
- The Transmitted signal is not strong enough. Use the **MODE 2** selection from the front panel of the units to check the received signal, for good performance the signal should be > -90dBm.

NOTE: You can also use the diagnostics to check the link performance.

*"I am able to link to a remote unit within line of sight when the Transceiver I have is outside. However, as soon as I walk inside with it I lose the link, even if I place the Transceiver by the window which faces the remote unit."*

Many modern buildings use energy efficient glass which wreaks havoc on RF signals. This glass contains a metal film which is very effective in blocking all radio waves. If your situation is as described above the preferable solution is to install an antenna outdoors.

*"My transceivers have established a solid connection as indicated by the LEDs, yet the application I am running is not transmitting and/or receiving data correctly."*

A quick acid test in a situation like this is to try to get the application up and running using an RS-232 null modem cable before deploying the RFI-9256 in the field. The RFI-9256 essentially functions as a null modem cable. If the application will not work with a hard wire connection then it will not work with the RFI-9256, and the problem lies within the application or other hardware (such as the computer serial ports or flow control).

*"I have used the* RFI-9256 *with several different PC's and portables in very similar settings, yet I have noticed that the Transceivers range is reduced considerably when I am using certain computers. Why is this?"*

It is possible that certain laptop and desktop computers that you are using emit interference which is detrimental to the RFI-9256's operation. Try moving the RFI-9256 as far away from the computer as the connecting cable allows, this should reduce the impact of interference from the computer.

*"I have the* RFI-9256 *set up between two computers and have been unsuccessful in my attempts to establish a link using LapLink."*

At various times difficulty using the RFI-9256 with LapLink has been documented. The cause, while not confirmed, is believed to be due to LapLink changing baud rates, which the RFI-9256 does not support. If you encounter this problem it is recommended that you test the link with a terminal program such as Windows Terminal or Procomm or the RFI UDP program. If either of these applications is used and characters typed on one computer appear on the screen of the other computer in the link, then the transceivers are functioning properly.

*"I have the* RFI-9256 *on Menu Config but I get no menu on my terminal program"*

The largest cause of programming and set up problems with the RFI-9256 is caused by incorrect terminal settings or the wrong hardware set up for the applications. Always ensure that the terminal is at the correct baud rate and the flow control is set correctly. When using the Config menu option ensure the terminal is connected to the Aux port of the RFI-9256. The RFI-9256 contains a modem control line break out box, use this to diagnose cable problems such as RTS / CTS flow control.

*"My Terminal or communications program is losing characters"*

First check that the flow control settings on the terminal or communications program match the settings on the radio. If they both have hardware handshaking enabled then check if you have an S3 based video card. This card often conflicts with your serial ports. To solve this you disable

# 15. Factory Defaults

This section describes the factory defaults for the menu options of the radio.

## 15.1 RADIO CONFIGURATION

- Unit is a Slave

- Network Address = 32

- Rx Address = 20

- Unit is in point to multipoint dialup mode

### Special Controls Menu
- Sync mode = OFF

### Link Control Menu
- ARQ retries = 50

- Network fail timer = 5000ms

- Online request time = 1000ms

- Backoff Retry is disabled

### Radio Personality Menu
- Hopping Pattern = 0

- Power setting = 20 dBm

- RSSI trigger level = -110

- Frame Time = 20 milliseconds

- Directional Bias is disabled.

## 15.2 LINK PROTOCOL MENU

- Hayes Dialup for both ports

## 15.3 SERIAL PORT SELECTION MENU (settings are the same for both ports)

- 19200 Baud

- No Parity

- 8 Data bits

- 1 Stop bit

- No Flow Control

- Packet Timer Disabled

## 15.4  MODEM CONFIGURATION MENU

**HAYES COMMAND CONTROL MENU** (settings are the same for both ports)

- Hangup on DTP dropped.

- Echo is ON

- Response is ON

- Escape character = +

- Escape guard time = 1000 (ms)

- Connect timeout = 10000(ms)

**DCD CONTROLS**
- DCD follows online

**RTD CONTROLS**
- RTS disabled.

**AUXILIARY I/O**
- Auxiliary I/O enabled.

## 15.5  PERSONALITY MENU

- Unit name is blank (unit has no name)

- Menu Password is disabled

- Security code is disabled

- Menu timeout is 15 minutes.

## 15.6  LOG MANAGER MENU

- Log level = General Information

## 16. Glossary

### A

**Alphanumeric**
Roman Letters (alphabetic) and Arabic numbers (numeric).

**ARQ**
Automatic Request Repeat. A form of error correction protocol. That uses retries to correct bad packets of data.

**ARQ Retries**
The number of times the radio modem will try to send a packet of lost information before it gives up.

**ASCII**
American Standard Code for Information Interchange. Pronounced as-kee. A code by which alphanumeric, punctuation and control characters, commonly found on computer keyboards, are each assigned a unique value between 0-127 (decimal).

**Asynchronous**
A data transmission in which the time between characters may vary. Characters are delimited by start and stop bits.

**Attention Commands (AT Commands)**
A group of commands created by Hayes$^{TM}$ that are recognised by the modem and that begin with AT (or at).

**Attenuation**
The loss of power through transmission equipment, lines or other communication devices.

**Auto answer**
A modem capability that allows it to automatically pick-up.

**Auxiliary Port (Aux Port)**
Port connected to 3 wire modem cable. Cable contains Rx, Tx and ground wires. Only able to software flow control (no hardware flow control).

### B

**Bandwidth**
The range of signal frequencies that are accepted or passed by a circuit or network.

**Base Frequency**
The frequency band occupied by a signal in its original or unmodulated form. The base frequency for the RFI-9256 is 915-928MHz (in Australia) and 921-929MHz (in New Zealand).

**Baud**
This term represents the number of discrete signalling events per second. If each signal element has more than one bit associated with it then this will not be the same as BPS. Compare with bit rate. Also called Baud Rate.

**Binary**
A number system with a base of two, using the digits 0 and 1. Commonly used in computers since the values 0 and 1 can easily be represented as OFF and ON in electrical circuits.

**Bit**
The smallest piece of information in a binary number system. The word stands for Binary digit.

**Bit rate**
The speed at which bits are transmitted, usually expressed as bits per second (BPS).

**Block**
Group of characters treated as a unit for the purpose of data transmission.

**BPS**
An acronym for Bits Per Second. Transmission rate of binary numbers (bits).

**Bridge**
Joins dissimilar networks and converts protocols such that data can passed between them. For example, a bridge may allow data to be passed from a TCP/IP network to a ISDN network.

**Buffer**
Temporary storage area used to compensate for a difference in the rate of data flow into and out of a device.

**Byte**
A grouping of bits to specify a single character usually consisting of eight consecutive bits. See also Bit.

## C

**Carrier signal**
The base frequency which is modulated by another signal containing information to be transmitted.

**Carriage Return (CR)**
The enter key on a keyboard. Causes the curser to move to the beginning of the next line.

**Carrier Detect (CD)**
An RS-232 interface signal from the modem to a terminal or personal computer indicating that the modem is receiving a signal from a remote modem. See also DCD.

**Character**
A letter, number or other symbol contained in a message or used in a control function. See Byte and ASCII.

**Clear to Send (CTS)**
Control signal sent by the DCE to indicate that the DTE may begin a transmission.

**Communications Link**
When communication is established between modems, information can be passed between them. Signified on the RFI-9256 by both modems having Network Link, Carrier Detect and On-Line LEDs activated and the receive and transmit LEDs flash as data is sent.

**Competing System**
A Leased Line. For example X25, QPSX, ISPN.

**Connection Commands**
Commands that enable information to be passed between two modems, after a communications link has been established.

**Connector**
A physical devices, such as a plug, socket or jack, used to connect one hardware component of a system to another. A connector may also be called a port.

**Console**
Part of a computer system, usually a video display terminal, used by the operator to communicate with the computer. See terminal.

**Contention**
Condition arising when two or more devices try to transmit at the same time using the same channel.

**Control Character**
Any character assigned as ASCII numeric code less than the SPACE character. These characters are used to initiate a control function on the receiving device. Also a symbol you can create by pressing one of your computer's keys while holding down the Control key. These symbols are not usually printed, and are generally used to control screen formatting and cursor positioning.

**Clear to Sent (CTS)**
This signal is generated by a modem in response to RTS to indicate that a communications channel has been established and that data can be sent.

**Cyclic Redundancy Check (CRC)**
An error-detection technique in which a data validation value is mathematically derived from a block of data and transmitted at the end of the block. The receiving end recomputes the value and if it matches the value sent, the data is assumed to be valid (error-free). If not, the receiver notifies the transmitter that an error has occurred and the block is retransmitted.

# D

**Data**
Any type of information, such as numbers, letters and symbols, that can be processed by a computer.

**Data Bits**
The actual characters being transmitted between two computers when asynchronous communications is being used. Usually 7 or 8 data bits are used. A normal byte has 8 bits. 7 data bits are used for ASCII/alphanumeric data.

**Data Communications Equipment (DCE)**
Equipment that is used to access a communications network. The DCE provides all the functions required to establish, maintain and terminate a connection, and provides the signal conversion required for communications between the Data Terminal Equipment (DTE) and the telephone network. With RS-232 connections, the modem is generally the DCE device while the computer or terminal connected to a modem is generally the DTE device. See also Data Terminal Equipment.

**Data Compression**
An encoding technique which provides for the transmission of fewer data bits without the loss of information. The receiving end expands the data received to its original form. For example, a ZIP file/drive, ARJ file formats, MPEG/JPEG and GIF formats.

**Data Latency**
Time delay between input stream and output data.

**Data Set Ready (DSR)**
An RS-232 control signal used to indicate the readiness of the DCE (Usually a modem) to accept data from the DTE (usually a terminal or computer).

**Data Terminal Equipment (DTE)**
The equipment which provides the data source and/or receiving end of a data transmission link. The DTE may be a personal computer, a printer, a front-end processor to a large mainframe computer or any other device which can transmit or receive data. With RS-232 connections the designation of DTE or DCE determines which device is responsible for generating certain control signals. See also Data Communications Equipment.

**Data Terminal Ready (DTR)**
An RS-232 control signal used to indicate the readiness of the DTE for data transmission.

**DB9**
A port connection used in RS-232 convention with 8 pins.

**DB25**
A port connection used in RS-232 convention with 28 pins.

**DCD**
An acronym for Data Carrier Detect. See also Carrier Detect.

**Dedicated Line**
A communications line which is not dialled. Also known as a leased or private line.

**Decibel (dB/dBm)**
Unit of measure indicating the logarithmic ratio of output signal power to input signal power. dB is relative to Watts while dBm is scaled so that is relative to milli-Watts.

**Default**
A value, action or setting that is automatically used by a computer system when no other explicit information has been given.

**Demodulate**
To recover the information being transmitted by a modulated signal. For example, a conventional radio receiver demodulates an incoming broadcast signal to convert it into sound emitted by a speaker. See also Modulate and Modem.

**Dial Tone**
A call progress signal returned by a telephone switching machine to indicate that it is ready to accept a telephone number. ATDT (Hayes$^{TM}$ commands) supported for compatibility.

**Dial-up**
Establishing a temporary connection to a remote system or computer.

**Digital Signal**
A signal composed of discrete signal levels as opposed to the continuous signal levels of an analog signal.

**DIP Switch**
Acronym for Dual In-line Package. Options chosen by pushing a switch to one of two positions.

**Distortion**
Undesired change in a signal's original waveform resulting from the characteristics of the transmission circuits or other external influences.

**Downloading**
Refers to the transferring of software from a remote system to your computer.

**DTE**
An acronym of Data Terminal Equipment. See Data Terminal Equipment.

**Dual Port Control**
The ability of the RFI-9256 modems to communicate out of both the Aux and Main ports to either the Aux or Main port of the receiving modem.

**Dumb Terminal**
Terminals that do not contain an intelligent microprocessor and usually send data one character at a time.

**Duplex Transmission**
Independent, simultaneous, two-way transmission.

## E

**Echo**
The re-transmission of characters received by either the modem or remote system back to the DTE.

**EIRP**
Effective Isotropic Radiated Power.

**End Point Radio**
Radios that are connected to the data device, such as SCADA/Acquisition/PC. As opposed to a repeater.

**Escape Guard Time**
The amount of time for which no activity is allowed on the data line before and after the sequence is entered, otherwise the escape sequence will be ignored.

**Even Parity**
Even parity refers to the addition of a 0 value or 1 value bit to the data bits which form a character to cause an even number of 1 value data bits to be sent. See also Parity.

**Extension Numbers**
The numbers that must be placed after the destination radio's number, to access the required port (internal or external). Only available in Point to Multipoint mode.

# F

**Fault Log**
Contains a list of modem faults since the log was last cleared.

**Firmware**
Computer program stored permanently in Flash Memory.

**Flash Memory**
Non-volatile memory for storing programs and configuration data.

**Flow Control**
Controls the flow according to the readiness of the associated terminals to receive and transmit data. May be controlled with hardware or software.

**Frame**
See Block.

**Frame Time**
Specifies the maximum length of each packet frame (larger the time, the more information that can be contained within the frame).

**Forward Error Correction (FEC)**
Technique of transmitting additional information with the original data so that if small errors are detected the correct information can be recreated by the receiving end without requiring a retransmission.

**Full Duplex**
Data transmission which allows data to flow in two directions at the same time.

# G

**Gateway**
An electronic connection that joins similar networks together, for example IP to IP. Generally transparent to the user.

# H

**Half Duplex**
Data transmission in which data may flow in either direction at one time, but not both directions simultaneously. Transmission direction is alternatively switched to allow two way flow of data.

**Handshake**
A predetermined interchange of signals between two devices to establish conditions for a transfer of data.

**Hang-up**
Termination of the Communications Link. As with a normal phone call, the phone must be hung-up so that you can call and receive other calls.

**Hang-up on DTR**
Only available with the Main Port. If activated, will terminate the Communication Link when the Data Terminal Ready pin is low.

**Hardware**

The electronic or electro-mechanical devices in a computer system as opposed to the programs or software.

**Hardware Handshaking**

The use of special RS-232 signals to halt or commence the flow of data between two computers or terminals, between computers and modems or between facsimile machines. See also Software Handshaking, RTS and CTS.

**Hayes™**

Company that designed the AT commands.

**Hertz (Hz)**

Unit of frequency, one cycle per second.

**Hopping Pattern**

Pattern to which the modem jumps through the frequency spectrum as it transmits and receives information. There are 32 hopping patterns available, all modems that are to communicate with each other must have the same hopping pattern.

**Host Computer**

A computer that manages information for many terminals. A host computer may be mainframe, minicomputer or a microcomputer.

## I

**Input**

Information transferred into a computer from some external source, such as the keyboard, a disk drive, a modem or a scanner. Also, the act or process of transferring such information.

**Input/Output Device**

A device that transfers information into or out of a computer.

**Interface**

A physical point of interconnection between two devices where electrical signal levels, timing, handshaking and pin numbers are defined. The devices, rules or convention by which one component of a system communicates with another.

**Interference**

Undesirable disturbances or distortions in a data transmission signal.

**I/O**

Input/Output. The transfer of information into and out of a computer.

## K

**Kermit**

Kermit is a file transfer protocol developed for operating systems which could not support the XModem protocol.

## L

**Light Emitting Diode (LED)**

A diode which glows when a current flows through it. Often used as an indicator light.

**Link**

A circuit or transmission path, including all equipment, between a sender and a receiver.

**Local Echo**

A method of communication in which your modem or software displays data locally on your screen, without relying on the host computer to echo the characters back.

**Local Command State**
Also called Terminal Command State. When a computer is communicating with a local modem. The local mode, assumes all commands are for it and acts on the AT commands. As opposed to being connected to a remote modem (see On-Line State).

**Local Rx Address**
4 digit phone number/address of the modem that you are dialling. Each modem, within a point to multipoint network, must have a unique Rx address, otherwise more than one modem will be dialled. Used when dialling a remote modem. In point to point communication, there is no dialling so it does not matter if both modems have the same Rx Address.

**Log**
List of information concerning the modem. See Fault Log, Physical Layer Log, and Serial Layer Log.

**Loop-back**
Directing signals back toward the source at some point in the communications path. Used in testing RFI-9256.

# M

**Main Port**
Port connected to full RS-232 (7 wire) cable. Cable contains Tx, Rx, DCD, RTS, CTS, DTR, and ground. Allows hardware flow control (hardware handshaking).

**Master**
Active Modem that synchronises the slave modems to enable the transmission of information. Can communicate with all slaves in its network.

**Modem**
Modulator/Demodulator. A device to convert data from a computer or terminal into a form suitable for transmission across a telephone system.

**Modem Returns Response Codes**
Suppresses (when activated) the Response Codes, so that they are not displayed on the terminal.

**Modem Eliminator**
A usually passive device which takes the place of a modem between a local terminal which requires a modem and a computer. Also called Null Modem.

**Modulate**
To modify or alter a signal so as to transmit information. For example, conventional broadcast radio transmits sound by modulating the amplitude or the frequency of a carrier signal. See also Demodulate and Modem.

**Multiplex**
To interleave or simultaneously transmit two or more messages on a single channel.

# N

**NAK**
Negative Acknowledgment. This control character indicates that the last block transmitted was in error and that the receiver is expecting a re-transmission.

**Network Address**
If the modem is a master, then this is the network identification number. Slaves are synchronised by the master that has the same network address. A radio will ignore messages originating from radios with differing addresses. Must be the same for all radios within a network.

**Network Fail Timeout**
The length of time that the system will wait after a signal is lost before trying to re-synchronise.

**Network Identification Number**
See Network Address

**Node**
A point of interconnection on a circuit.

**Noise**
Random electrical signals introduced by components of the circuit or natural disturbances which can produce errors in transmission.

**Non-Volatile Memory**
Stores data/programs/configurations without the need for a battery backup. Will not be erased if there is a power failure. Nearly permanent.

**Null Modem**
See Modem Eliminator.

# O

**Odd Parity**
Odd parity refers to the appending of a 0 or 1 value bit to the data bits of a character to ensure that an odd number of 1 value bits are sent. See also Even Parity and Parity.

**Off-line**
Describes to state of a connection as not in session or not currently connected. There is no communications link between the modems, system has not dialled.

**On-line**
Describes to state of a connection as in session and currently connected. The system has dialled and a communications link has been formed allowing the transfer of data. On-line LED on front of RFI-9256 is activated.

**On-line Requests Timer**
Controls the time between slave integrity checks by the master.

**On-line State**
When a Communications Link is established and dialogue is between your computer and a remote system. The local modem assumes that all information from your computer is to be sent on to the remote modem. All AT commands are ignored by the local modem but are acted upon by the remote modem. See also Local Command State.

**On-line Time**
The amount of time spent on-line with an information service.

# P

**PABX**
Private Automatic Branch Exchange. An automatic switchboard for handling large concentrations of telephones (extensions).

**Packet**
Group of bits including data and control elements that are transmitted as a whole.

**Packet Switched Network**
System where messages are transmitted in packets, each individually addressed and routed through the network.

**Packet Timer**
Sends the packet of information when no information has been received for the specified length of time.

**Parity**
A simple method of error checking by which the number of data bits received are added together to ensure that the correct number have been received.

**Password**
Password protection for the menu to prohibit unauthorised menu access and the ability to alter the radio's settings. Consists of 12 to 18 Alpha-numeric characters.

**Peripheral (Peripheral Device)**
A device, such as a video monitor, disk drive, printer or modem, used in conjunction with a computer. Often (but not necessarily) physically separate from the computer and connected to it by wires, cables or some other form of interface.

**Physical Layer Logging**
Shows the modem statistics relating to the quantity of data throughput.

**Point-to-Multipoint Communication**
One radio (the master) communicates with more that one slave, while each slave can only talk to the master. As opposed to Point to Point Communication.

**Point-to-Point Communication**
A connection between two points only. Communications established automatically with the RFI-9256 and is not controlled by the AT commands. As opposed to Point to Multipoint Communication..

**Port**
The point of connection, usually a physical connector, between a computer and a peripheral device, another computer or a network.

**Propagation Delay**
The time required for a signal to travel from one end of a circuit to another.

**Protocol**
A set of conventions controlling the timing and format of data communications between two pieces of communications equipment.

**Public Switched Telephone Network (PSTN)**
Telephone system providing circuit switching to many customers.

**Pulse**
An abrupt and relatively short change in voltage, either positive or negative, resulting in the conveyance of data in a circuit.

# R

**RAM**
Random Access Memory. RFI-9256 has 64k on board. See technical specifications page 64.

**Received Line Signal Detector**
See Carrier Detect.

**Redundancy Check**
Technique of error detection involving the transmission of additional data related to the message so that the receiving device can determine if the data transmitted is valid (error-free).

**% Registers**
Registers inside the modem that usually contain string values. Can be read and altered on a remote modem using a Communications Link. Examples include Unit Name, Security Code and Local Address.

**Remote Configuration**
The accessing of information from a remote radio and the ability to change the remote radio's attributes via a Communications Link.

**Remote System**
A another PC or network that can be communicated with via modem.

**Repeater**
Radio that receives and repeats the signal in a communications path, to extend the range between the End Point Radios. They do not act on the information, only pass it on.

**Request to Send (RTS)**
Control signal by the DTE to inform the DCE that it is ready to transmit data. When used for flow control between the DTE and the modem, this signal indicates to the modem that the DTE is ready to accept data. Used mainly in half-duplex communications.

**Response Codes**
Also called Result Codes. Screen messages that indicate what the modem is doing. For example, OK will appear when a command has been executed successfully.

**RF Channels**
Steps or intervals of frequency divisions in the 915-928MHz spectrum. 51 channels available.

**Routing Table**
A table that is used by the radios to convert packet addresses into radio addresses.

**Router**
Guides data through a network by the address of the data.

**RS-232C**
Frequently shortened to RS-232. A standard which defines the physical and electrical interface between Data Communications Equipment and Data Terminal Equipment. The most commonly used interface between modems and computers. Also known as ITU-T V24.

**RSSI Trigger Level**
Signal threshold/trigger level in dBm. This is the level at which the radio decides what it is hearing is no longer noise.

**RTS/CTS**
Control characters for hardware handshaking.

**RTU**
Acronym for Remote Terminal Unit. Device attached to remote radio.

**Rx**
Abbreviation for Receive.

# S

**Security Code**
4 digits, same as a PIN number. The code is known only to the user and protects the user from interference from other networks using RFI-9256 modems.

**Serial Data**
Data transmission in which each bit of information is sent sequentially through a single data path.

**Serial Logging**
Shows information regarding the performance of both serial ports.

**Serial Port**
Port that receives/transmits serial data. The RFI-9256 has two serial ports, the Main and Auxiliary (Aux) ports.

**Simplex**
Data communications in one direction only.

**Slave**
Passive modem. Requires a Master to synchronise timing to enable successful transmission. May initiate communication, but can only communicate with the Master.

**Software**

Computer program or set of computer programs held in storage, and loaded into RAM for execution.

**Software Handshaking**

A method of controlling the flow of data between two computers or terminals. Special control characters are sent from one terminal to the other in order to halt or recommence the flow of data. See also Hardware Handshaking.

**Spread Spectrum Modem**

Modem that operates within a frequency band (as opposed to operating at a single, fixed frequency), jumping through the frequencies according to the Hopping Pattern.

**Spread Spectrum Standard**

Standard that specifies the way in which the frequencies of the spread spectrum are to be utilised.

**S Registers**

Registers, inside the modem, that contain whole number values. These can be read and obtained from remote modems by using a communications link. Examples include Escape Sequence Guard Time, Number of Retries for ARQ.

**Start Bit**

When a character is transmitted asynchronously to another computer, a start bit always precedes the actual data. Seven or eight data bits, an optional parity bit and a stop bit will follow.

**Stop Bit**

The last bit or element transmitted in asynchronous transmission of a character to return the circuit to an idle state. One or two stop bits are sent at the end of each character of data.

**Synchronous**

A data transmission in which the time between characters is fixed by synchronising the transmitting and receiving communications equipment. The clock signal is typically derived from the data stream in order to maintain synchronisation.

## T

**Telecommunications**

The transmission of information across long distances, such as over telephone lines.

**Terminal**

An input/output device consisting of a typewriter-like keyboard and a display device, used for communicating with a large computer. Any device capable of sending and/or receiving data over a communications channel.

**Terminal Emulation**

Refers to the type of ASCII terminal your software will imitate (the control characters used to perform certain screen and cursor movement tasks vary from one terminal to another).

**Terminal Program**

Also called Terminal Software, terminal package, emulator. Computer program that deciphers the information received from the modem and send information to the modem as required.

**Test Link Margin**

Displays the average signal and noise the modem is measuring.

**Text**

The message portion of a data block in synchronous data transmissions.

**Transmit Power**

Power of signal emanating from the antenna. This should be the minimum required to maintain a solid data link.

**Turnaround Time**

The time required to reverse the direction of transmission when operating in half duplex mode.

**Tx**
Abbreviation for Transmit.

# U

**UNIMODEM PnP Response**
The unit response to a PnP (Plug and Play) query.

**Unit Name**
User defined name for radio. May be used to indicate radio position or other identifying feature.

**Upload**
Refers to sending files or text from the user's computer to another user.

# V

**Virtual Hayes Connection**
Interface for communication with and management of a remote radio.

# W

**Wait Time for Connect**
Time the radio will wait for valid connection, before indicating communication unsuccessful.

**Whip Antenna**
Small antenna (usually approx. 15 cm)

# X

**XModem**
A communications protocol developed in the late '70s by Ward Christensen to perform error checking on data being sent between two computers. See Kermit.

**XON/XOFF**
Special control characters used to control the flow of data between your computer and a remote system. See Software Handshaking.

# Y

**Yagi Antenna**
Directional antenna.

# Z

**ZModem**
Designed to rectify limitations of previous models as well as providing support for high speed, packet and network communications environments.