Hopper Plus 120-24
Wireless Ethernet Bridge

Installation and Configuration Guide

Version 1.0 Rev B
08/00

Contents

Notices

Copyright Notice

Regulatory Notice

The Hopper Plus 120-24 product presented in this guide complies with the following regulations and/or regulatory bodies:

- RSS-210 and/or RSS-139 of Industry Canada
- FCC Part 15
- CEPT/ERC Recommendations, ETS 300-328, ETS 300-826, and EN 60950

Operation is subject to the following two conditions:

- this device may not cause interference, and
- this device must accept any interference, including interference that may cause undesired operation of the device.

This equipment generates, uses, and radiates radio frequency and, if not installed and used in accordance with this guide, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following methods:

- reorient or relocate the receiving antenna,
- increase the separation between the equipment and receiver.
- connect equipment to an outlet on a circuit different from that to which the receiver is connected.

- consult the dealer or an experienced radio/TV technician for help.
- selecting and testing different channels, if employing 2.4 GHz equipment.

As the Hopper Plus 120-24 is used on a license-exempt, non-frequency coordinated, unprotected spectrum allocation, and thus can be subject to random unidentified interference, applications must not be those of a primary control where a lack of intercommunication could cause danger to property, process, or person. An alternative fail-safe should be designed into any system to ensure safe operation or shut down, should communication be lost for any reason.

Other Notices

- Changes or modifications to the equipment not expressly approved by Wi-LAN, Inc., could void the user s authority to operate the equipment.
- Appropriately shielded remote I/O serial cable with the metal connector shell and cable shield properly connected to chassis ground shall be used to reduce the radio frequency interference.
- FCC radio frequency exposure limits may be exceeded at distances closer than 23 centimeters from the antenna of this device.
- All antenna installation work shall be carried out by a knowledgeable and professional installer.
- Use only a power adapter approved by Wi-LAN.

Contacting Wi-LAN

You can contact Wi-LAN applications engineers to help troubleshoot your Wi-LAN products and to plan your wireless network applications.

Contacting Customer Support

You can contact Wi-LAN customer support at the locations listed below:

Canada and USA	Call toll free: Available from:	1-800-258-6876 8:00 a.m. to 5:00 p.m. (GMT-7:00)
Outside North America	Call: Available from:	+1-403-273-9133 8:00 a.m. to 5:00 p.m. (GMT-7:00)
All locations	Send an e-mail message to: techsupport@wi-lan.com	

You can also contact the Wi-LAN dealer or representative in your region. Phone or email Wi-LAN for information about the dealer in your area.

Mailing Address

Wi-LAN, Inc.
Suite 300, 801 Manning Road N.E.
Calgary, Alberta CANADA
T2E 8J5
Tel: +1-403-273-9133

Description

Hopper Plus 120-24 Wireless Ethernet Bridge

The Hopper Plus 120-24 is a wireless Ethernet bridge that provides high-speed, wireless connectivity at a fraction of the cost of wired solutions. It uses multi-code direct sequence spread spectrum technology over the license-exempt, 2.4 - 2.4835 GHz ISM radio band. The maximum data rate is 12.0 Mbps.

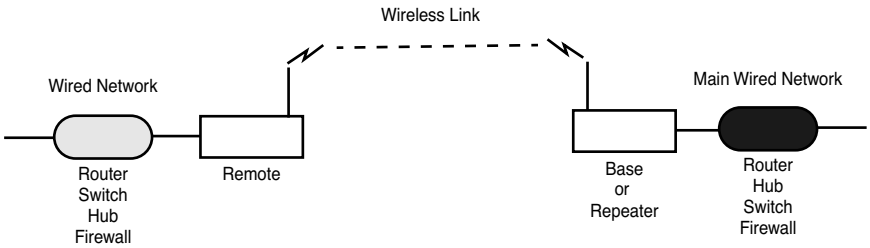
The Hopper Plus 120-24:

- provides wireless connectivity at speeds up to eight times faster than regular T1 lines, making the Hopper Plus ideal for providing high-speed Internet access or for wirelessly extending existing communications infrastructures.
- supports point-to-point and point-to-multipoint networks. Contentionless polling ensures efficient access to remote data networks.
- is self-contained and easy to use. Simply connect a Hopper Plus 120-24 to each LAN segment, and the unit automatically learns where nodes are located on the network and performs dynamic packet filtering to ensure the local LAN traffic does not overload the wireless connection.

Making a Wireless Bridge

The simplest example of using the Hopper Plus 120-24 is a point-to-point wireless bridge, which requires a minimum of two units: a base unit and a remote unit. The units make a high-speed wireless communication link between two wired network segments.

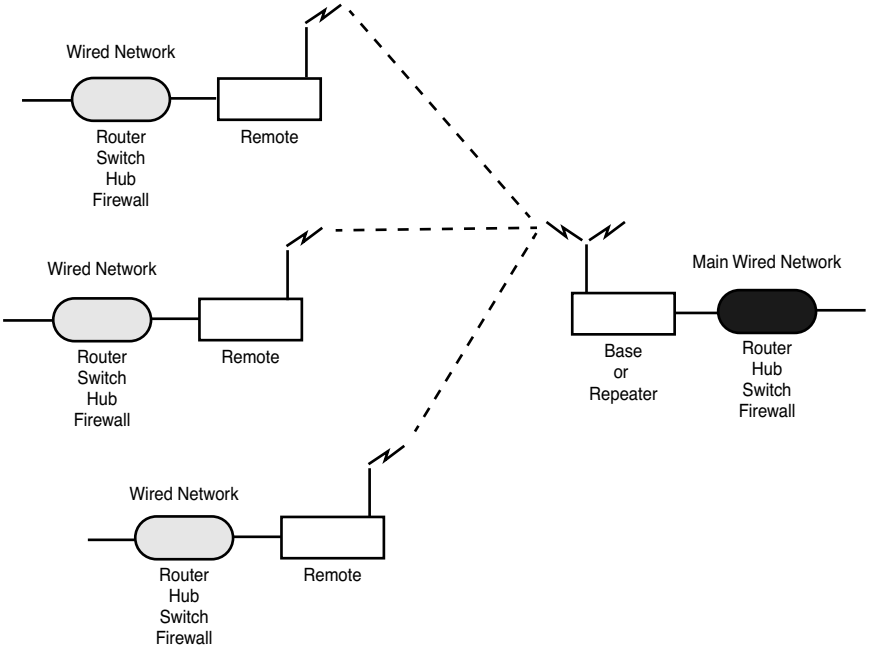
Point-to-Point Wireless Bridge.



Creating a Wireless Network

You can create a wireless network by adding remotes and taking advantage of the point-to-multipoint capabilities of the Hopper Plus 120-24. Up to 255 remote units can be contained in a wireless network.

Point-to-Multipoint Wireless Network



About Hopper Plus Units

Base Station: A Hopper Plus 120-24 can operate as a remote unit or a base station, however, at least one unit in the network *must* be configured as a base. A base station is the central control unit of the wireless network. The base station polls all remote units and controls how traffic is routed to and from remotes. The base usually connects to a major access point of the wired network. The antenna of the base station must be capable of transmitting and receiving radio signals to and from all the remote units in a system. If remotes are spread over a large area, an omni-directional antenna is usually required.

Remote Units: Remote units link wired segments of the network wirelessly to the main network (via the base station). Remotes can limit the amount of data passed by the remote (a function called throttling), and they can filter specific data packets. Because remote units need to communicate only with the base station, their antennas can be more directional and have higher gains than base antennas.

Repeaters: A base unit can also be configured as a repeater. A repeater is needed when remote units cannot communicate directly with each other, but direct transfers of data between them are necessary (as in a true WAN). When configured as a repeater, the base station passes data packets between remote stations based on the remote group status and the MAC (Media Access Control) address filter. Remote stations ignore the packets they hear from other remotes, and listen only to the repeated packets from the base. See *Setting Repeater Mode (Base Station Only)*, page 49 for more information.

Hardware Description

Shipping Package Contents

When you receive a Hopper Plus, the shipping package contains the following items:

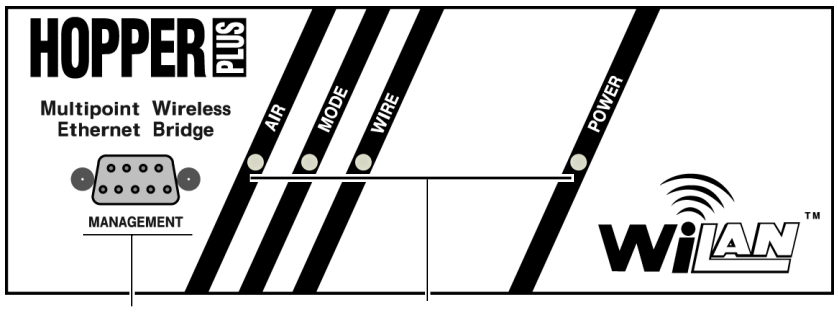
- Hopper Plus 120-24 unit
- indoor antenna
- power supply cord
- AC/DC power adapter
- straight-through ethernet cable (RJ45)
- crossover ethernet cable (RJ45)
- DB9 (M) to DB25 (F) adaptor
- RS-232 DB9 serial cable
- Installation and Configuration Guide
- Warranty Card

If any of the above items are not included in the Hopper Plus 120-24 shipping package, contact Wi-LAN customer support immediately.

Hopper Plus 120-24 Unit

The Hopper Plus 120-24 has connectors and LEDs on the front and back panels.

Front Panel



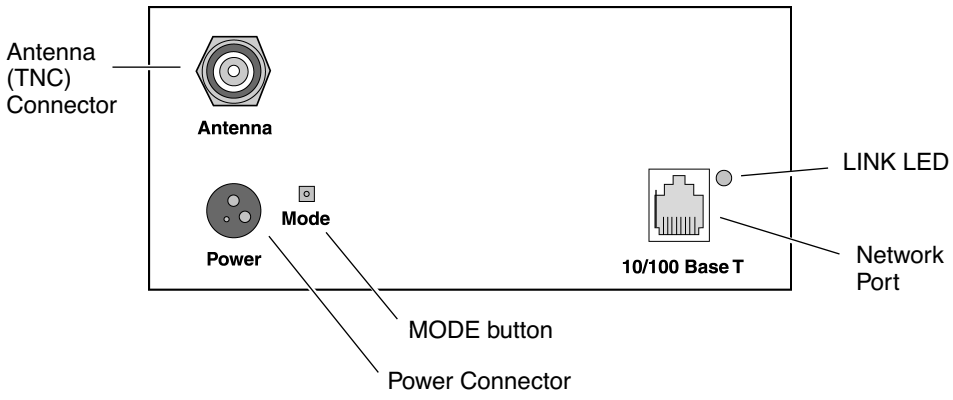
RS-232 Management Port LED Indicators

The the front panel connector and LEDs are described below. The color of a LED indicates its status See *Front Panel LEDs*, page 111 for detailed information.

MANAGEMENT Port	An RS-232, DB9 connector used to communicate with a PC. Use this port to configure, test and set up the Hopper Plus.
AIR LED	Color of LED indicates the status of the wireless link during transmit, receive, or listen. Normal color: Orange.
MODE LED	Color of LED indicates the test status of the unit when unit is in test mode. Normal color: Off.
WIRE LED	Color of LED indicates the status of the wire link during transmit, receive, transmit and receive, or listen. Normal color: Green, Red, Orange or Off.
POWER LED	Shows the status of the unit's power. Normal color: Green.

Connectors for power, antenna and wired network are located on the back panel, as well as a mode button and a link LED.

Rear Panel



Items located on the back panel are described below:

ANTENNA Connector	The antenna connector is located at the top left of the rear panel. It is TNC (Threaded N-type Connector) male or female. This port should always be connected to an antenna directly or through a 50 ohm coaxial cable.
POWER Connector	3-pin power connector. See Power Connector Pinout, page 112 for detailed pinout illustration.
MODE Button	The mode button can be used to set the operating mode of a unit without a terminal. See Setting Operating Mode with the MODE Button, page 68 for information about the mode button.
10/100 BASET	A standard RJ45 female connector. To connect to a PC Ethernet card, you must use the crossover twisted-pair cable (provided). To connect to a hub, use a straight-through twisted-pair cable.
LINK LED	The color of the LED indicates the data rate and status of the twisted-pair connection. Green = 10 BaseT link, functioning properly. Orange = 100 BaseT link, functioning properly. Off = No link.

Hopper Plus 120-24 Specifications

General Specifications	
Modulation Method:	Multi-Code Direct Sequence Spread Spectrum
Wireless Data Rate:	12 Mbps
RF Frequency Range:	2.4 - 2.4835 MHz (unlicensed ISM band)
Number of Center Frequencies:	7 independent, 3 concurrent
Power Requirements:	48W @ 12VDC (via 110/240 VAC 50/60 Hz adaptor)
Physical Dimensions:	24 x 8 x 21 centimeters (9.5 x 3.2 x 8.3 inches)
Radio Specifications	
Antenna Connector:	Reverse TNC TNC
Output Power:	+18.5 dBm
Receiver Sensitivity:	– 83 dBm
Processing Gain:	>10 dB
Network Support	
Packet Format:	IEEE 802.3 and Ethernet II (High-level protocol transparent)
LAN Connection:	10/100 BaseT (autonegotiates)
Bridge Functionality:	Local Packet Filtering (self-learning), Static IP address filtering, throttling capability
Wireless Networking Protocols	
Network Topologies:	Point-to-Point, Point-to-Multipoint, Multipoint-to-Multipoint
Repeater Mode:	User Configurable
RF Collision Management:	Dynamic Polling, with Dynamic Time Allocation
Security	
Data Scrambling:	User Configurable
Data Security Password:	Security password of up to 20 bytes in length (10^{48} combinations)
Configuration, Management, and Diagnostics	
Configuration Methods:	SNMP, Telnet, and RS-232 Management Port

SNMP:	Version I compliant (RFC 1157), MIB standard and enterprise (RFC 1213)
Management Port Functionality:	Supports system configuration, security, access control, wireless LAN diagnostics and management, menu-driven ASCII interface via RS-232 DB-9.

Environment

	Units must be located in a weatherproof environment with an ambient temperature from 0 to 40º Celsius and humidity 0 – 95% non-condensing.

Installation

Basic Installation Steps

The following basic steps are required to successfully install your Hopper Plus 120-24 wireless bridge. For detailed information about performing the steps, see the references provided.

1. Plan your network. Before you install any equipment, you need to determine the physical layout of your wireless link, plan antenna and fade margin requirements, and optimize the wireless link. For help, refer to Appendix A: Planning Your Wireless Link or contact Wi-LAN customer support. You will require a minimum of two Hopper Plus units (one configured as a base, and one configured as a remote) to create a wireless link between two wired network segments.
2. Check the contents of each shipping carton to ensure all the required parts are present. See Hardware Description, page 3 for a list of parts.
3. Configure one Hopper Plus unit as a base station. See Configuring a Unit as a Base, page 10. (Units come from the factory configured as remotes).
4. Test the basic operation of the bridge. See Testing Basic Operation, page 11 for more information.
5. Place the units in their field locations and connect them to antennas, the wired network, and power.

Warning: External antennas must be professionally installed and follow accepted safety, grounding, electrical, and civil engineering standards.

Always connect an antenna to the ANTENNA port before you power up a unit or you can damage a unit.

6. Configure each unit as follows:
   - View and set the Unit Identification. See Viewing Unit Identification, page 20 and Setting Unit Identification, page 21.
   - Set the Station Rank. See Setting the Station Rank, page 43.
   - Set the Center Frequency. See Setting the Center Frequency, page 44.
   - Set the Security Passwords. See Setting Security Passwords, page 45.
   - Set the Acquisition Code. See Setting the Acquisition Code, page 47.
   - Set the Remote Unit RF Group. See Setting Remote Unit RF Group, page 52.
   - Change the default passwords. See Setting Login Passwords, page 59.
7. Test the installed wireless network using ping, ftp, or file transfers.

If you have problems, contact Wi-LAN customer support.

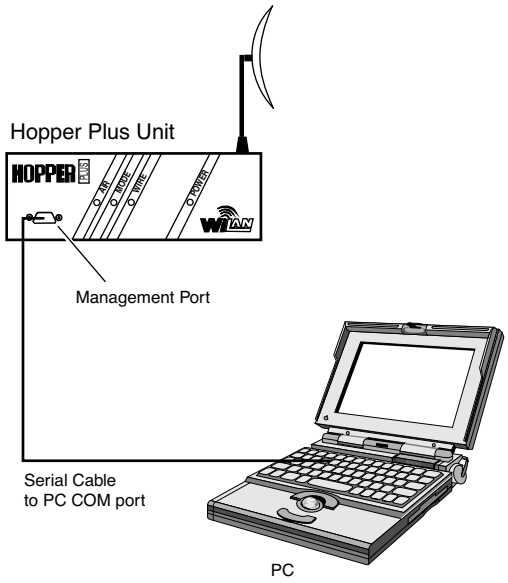
Configuring a Unit as a Base

Hopper Plus 120-24 units are delivered from the factory configured as remote units. To make a wireless bridge, you need to configure one unit as a base unit (base station). All other units in the wireless network can remain configured as remote units (so you do not need to change the "station type" of remotes). No user software is required to install a unit.

To configure one unit as a base unit

1. Connect a PC to the MANGAGEMENT port to the Hopper Plus unit that will be the base unit.

Connecting PC to MANAGEMENT Port



2. Start the terminal emulation program (for example, HyperTerm¤—see*Appendix B: Using HyperTerminal*, page 87).
3. Press **Enter**. Enter the default password (choose `supervisor`). The Main Menu is displayed.

4. Select **Radio Module Configuration**. The Radio Module Configuration window is displayed.

```
                              Radio Module Configuration
                                        New          Current         Flash
Station Type                         -> Remote Unit   Remote Unit   Remote Unit
Station Rank (1-1000)                   1              1             1
Center Frequency                        2.4400 GHz     2.4400 GHz    2.4400 GHz
Security Password 1   (Hex)             1              1             1
Security Password 2   (Hex)             10             10            10
Security Password 3   (Hex)             100            100           100
Security Password 4   (Hex)             1000           1000          1000
Security Password 5   (Hex)             10000          10000         10000
Scrambling Code       (Hex)             0              0             0
Acquisition Code      (0-15)            1              1             1
Config Test Minutes   (1-120)           30             30            30

Base Station Only Parameters
Repeater Mode                           off            off           off
System Symmetry Type                    Asymmetric     Asymmetric    Asymmetric
Dynamic Polling Level (1-100)
Remote Station Only Parameters
Remote Unit RF Group (0-63)             0              0             0

Reboot New RF configuration             Press Enter to Execute
Save Current Config to Flash            Press Enter to Execute
```

5. Select **Station Type**.
6. Select **Base Unit** and press **Enter**.
7. Select **Reboot New RF configuration** and press **Enter**. The unit reboots.
8. Log in to the unit.
9. Select **Save Current Config to Flash** and press **Enter**. The settings are stored in flash memory.
10. Select **Logout** from the Main Menu to exit.

Testing Basic Operation

Wi-LAN recommends that you bench test units before placing them the field. You should first perform a standalone test, then test the bridge as part of a simple network.

Once one unit has been set to a base unit, it can then be used to test all other remote units without making configuration changes to the remotes.(Units are shipped from factory configured as remotes).

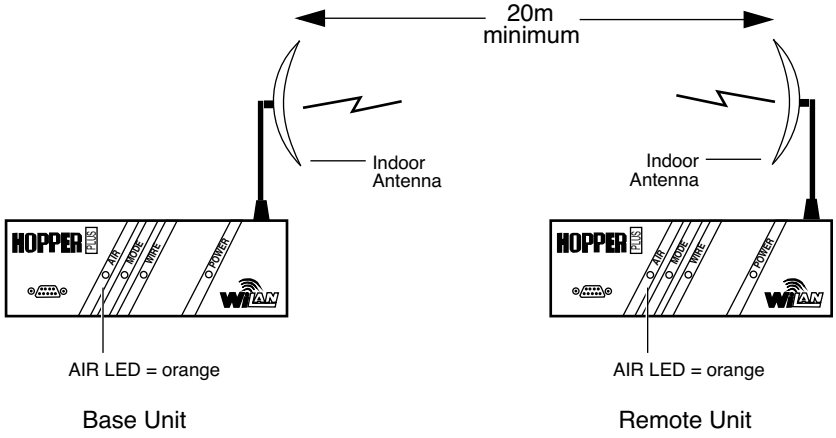
Performing a Bench Test

To perform a bench test of the bridge

1. Ensure that you have configured a unit as a base unit.
2. Ensure that the station type of all other units is **Remote Unit**. See *Setting the Station Type*, page 42.

3. Locate base unit and one remote unit at least twenty meters apart with a clear line of sight between them.
4. Attach the provided indoor antenna to the antenna port of each unit, and orient the antenna vertically.
5. Power up both units.

Basic Test Setup



6. Observe the AIR LED of each unit and look for normal status. A normal status is indicated when the AIR LEDs on the base and the remote unit are both orange. The status of the AIR LED is indicated as follows.

Orange (both stations)	The stations are continuously sending and receiving sync packets.
Red (base station)	The stations are configured incorrectly, and the base station is transmitting without receiving acknowledgment.
Green (remote station)	The stations are configured incorrectly, and the remote station is receiving packets to which it cannot respond.
Off	Nothing is being received (by the remote) or transmitted (from the base).

Note: If antennas are too close together, the strong transmit signal will cause distortion at the receiveing unit. You can fine-tune antennas by physically moving the antenna. When the remote antenna is correctly aligned, the AIR LED is orange, indicating that data from the base station is being received and acknowledged.

7. Run the Link Monitor test on the remote unit. See *Setting Link Monitor Remote Station Rank (Base Station Only)*, page 38. Check for RSSI below 40% and BER = 0. If you have problems ensure that the unit is configured to its basic default settings or contact Wi-LAN customer support.
8. Disable Link Monitor.
9. When both AIR LEDs are orange, power down both units and perform the simple network test. See *Performing a Simple Network Test*, page 13.

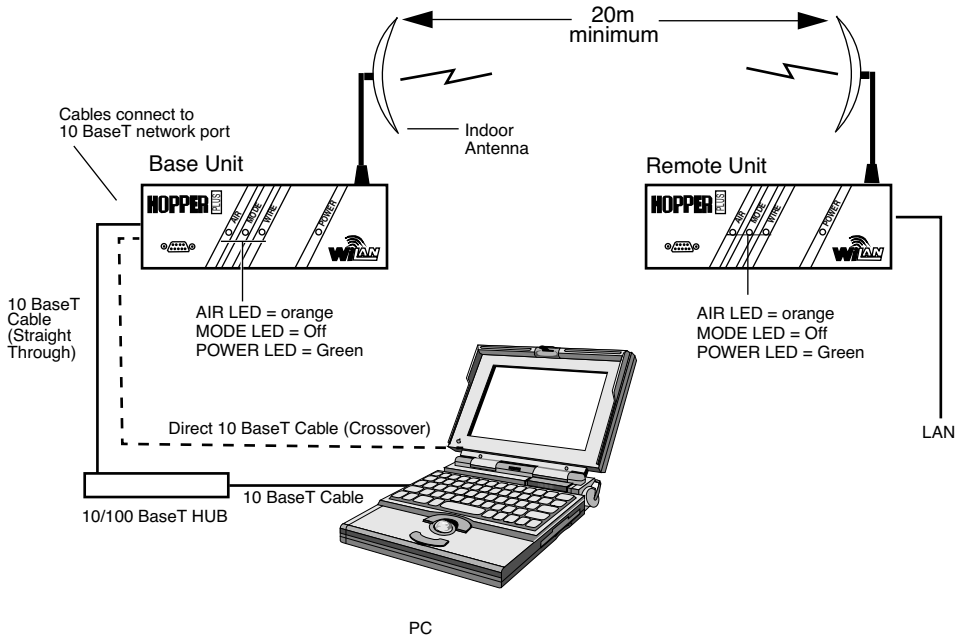
Performing a Simple Network Test

To perform a simple network test

1. Connect one Hopper Plus 120-24 to the LAN.
2. Connect a PC from your network directly to the other Hopper Plus 120-24 (connect with a 10/100 BaseT crossover cable if no hub is used).

   Note: Cabling between 10/100 BaseT nodes is generally done through a network hub. To make a direct 10/100 BaseT connection between a Hopper Plus 120-24 and a PC, you need a standard crossover cable (swap pins 1&3; 2&6).

Simple Network Test Setup



3. Power up each Hopper Plus 120-24 unit. Initially the LEDs should appear as follows:

POWER LED	Green
MODE LED	Off
AIR LED	Orange

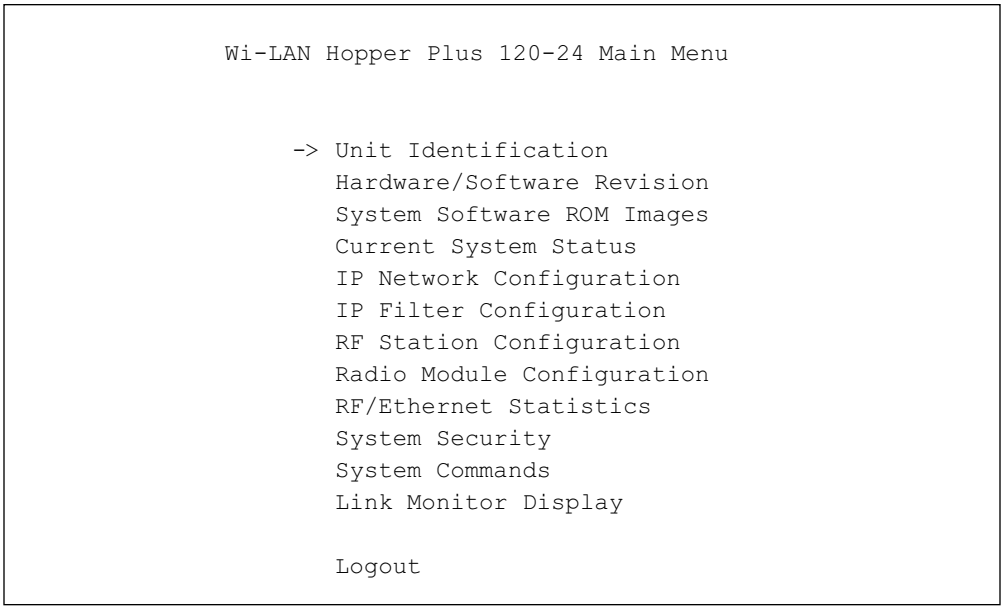
4. Create some network traffic to test the bridge (for example, transfer a file across the bridge). The WIRE LED indicates the activity. See *Appendix C: Configuring a Simple Data Network*, page 93 for more information.
5. Repeat the steps for each remote you install.
6. To test network configuration further, see *Appendix C: Configuring a Simple Data Network*, page 93 for moreinformation about configuring simple peer-to-peer networks.

Configuration

This section explains how to access and use the main configuration menu (called the Wi-LAN Hopper Plus 120-24 Main Menu, and shown below). In this section, each item in the Main Menu is described in the order that it appears in the menu.

Use the Main Menu and your keyboard keys to select, view or change settings. Some items in the menu simply display information, while others ask you to enter data or make a selection from a list.

Main Menu



Accessing the Main Menu

You can access the Main Menu via the MANAGEMENT port or a *telnet* session.

You can also configure the Hopper Plus 120-24 remotely with the SNMP (Simple Network Management Protocol) manager. See *Appendix D: SNMP MIB*, page 99 for information about SNMP.

Accessing Main Menu with MANAGEMENT Port

To access the Main Menu through the MANAGEMENT port

1. Disconnect the power from the Hopper Plus unit.
2. Connect a serial cable from a DB9 serial port on the PC to the MANAGEMENT port on the Hopper Plus (adaptors are shipped with the unit). See *Configuring a Unit as a Base*, page 10.
3. Start a terminal emulation program (such as Hyperterm) on the PC. See *Appendix B: Using HyperTerminal*.
4. Set the terminal emulation program to emulate a VT100 terminal with the following settings:
   - ¥ COM port — PC serial port connected to Hopper Plus unit
   - ¥ Bits per second: 9600
   - ¥ Data bits: 8
   - ¥ Parity: none
   - ¥ Stop bits: 1
   - ¥ Flow control: none
5. Reconnect the power to the Hopper Plus unit.
6. Press **Enter**. The Login menu is displayed.

```
Wi-LAN Hopper Plus 120-24 Login

Software:   Rev 0.0.0 (May 25 2000 10:13:37)
Hardware:   Rev 0.0.0 (4MB SDRAM, 4MB Intel Flash)

Enter Password:
```

7. Type the default password, or type your password.

Login Account	Default Password	Privileges
User	user	Read Only
Supervisor	supervisor	Read and Write

The Main Menu is displayed.

Accessing Units via telnet

To access units via telnet

1. Ensure that the unit s Internet IP address has been configured, the unit has a working Ethernet connection, and wire and remote access has been enabled (see *Setting Remote Access*, page 60).
2. Ensure that the VT100 Arrows feature in your telnet session is enabled. See *Setting VT100 Arrows*, page 18.
3. From a VT100 terminal, or emulation program, type **`telnet <IP address>`** where <IP address> is the address of the unit that you want to configure.
4. Press **Enter**. The Login menu is displayed.

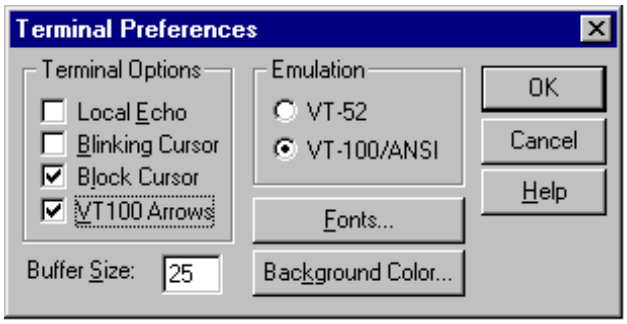
```
Wi-LAN Hopper Plus 120-24 Login

Software:   Rev 0.0.0 (May 25 2000 10:13:37)
Hardware:   Rev 0.0.0 (4MB SDRAM, 4MB Intel Flash)

Enter Password:
```

5. Type the default password (`user` or `supervisor`) or type your personal password. The Main Menu is displayed.

Setting VT100 Arrows

To set the VT100 arrows in Microsoft telnet

1. In the active Microsoft telnet 1.0 session, select **Terminal, Preferences** from the menu bar. The Terminal Preferences window is displayed.



2. Click the **VT100 Arrows** checkbox.
3. Click **OK**. The VT100 arrows are enabled in the telnet session.

You can now use the keyboard arrow keys to navigate the configuration menus.

Configuring with the Main Menu

This section describes how to configure units with the Main Menu. Menu items are presented in the order they appear in the menu shown below.

Main Menu

```
            Wi-LAN Hopper Plus 120-24 Main Menu


                 -> Unit Identification
                    Hardware/Software Revision
                    System Software ROM Images
                    Current System Status
                    IP Network Configuration
                    IP Filter Configuration
                    RF Station Configuration
                    Radio Module Configuration
                    RF/Ethernet Statistics
                    System Security
                    System Commands
                    Link Monitor Display

                    Logout
```

Unit Identification

Viewing Unit Identification

You can view a unit s serial number, production date, and MAC address in the Unit Identification menu. These fields are view only and are set at the factory.

To view unit identification

1. From the Main Menu, select **`Unit Identification`** The Unit Identification window is displayed.

```
                        Unit Identification


  Serial Number                       Serial-Number
  Production Date                     01-01-2000
  Ethernet MAC Address                001030040502

  Unit Name/Description            -> System Name
  Unit Location                       System Location
  Contact Name                        System Manager's Name
```

where

`Serial Number`	Unique serial number of the unit (Read Only).
`Production Date`	Date that the unit was produced (Read Only).
`Ethernet MAC Address`	Unique Internet MAC address for the unit (Read Only).

Setting Unit Identification

You can configure a unit s name, location, and contact name for system management purposes. This information could be used to distinguish remote units by their physical location or by meaningful names rather than the unit s station rank. The unit identification information does not need to be configured for a working system.

To set unit name/description

1. From the Main Menu, select **`Unit Identification`**. The Unit Identification window is displayed.

```
                        Unit Identification


  Serial Number                        Serial-Number
  Production Date                      01-01-2000
  Ethernet MAC Address                 001030040502

  Unit Name/Description           -> System Name
  Unit Location                        System Location
  Contact Name                         System Manager's Name
```

where

`Serial Number`	Unit serial number.
`Production Date`	The production date: MM-DD-YY.
`Ethernet MAC Address`	MAC (Media Access Control) address. The physical Ethernet address.

2. Select **`Unit Name/Description`**.
3. Type in new name or description.
4. Press **Enter**. The new name or description is displayed in the entry field.

To set unit location

1. From the Main Menu, select **Unit Identification**. The Unit Identification window is displayed.

```
                        Unit Identification


Serial Number                        Serial-Number
Production Date                      01-01-2000
Ethernet MAC Address                 001030040502

Unit Name/Description                System Name
Unit Location                     -> System Location
Contact Name                         System Manager's Name
```

2. Select **Unit Location**.
3. Type in the new location.
4. Press **Enter**. The new location appears in the entry field.

To set unit contact name

1. From the Main Menu, select **Unit Identification**. The Unit Identification window is displayed.

```
                        Unit Identification


Serial Number                        Serial-Number
Production Date                      01-01-2000
Ethernet MAC Address                 1030040502

Unit Name/Description                System Name
Unit Location                        System Location
Contact Name                      -> System Manager's Name
```

2. Select **Contact Name.**
3. Type in a contact or manager name.
4. Press **Enter**. The new name appears in the entry field.

Hardware/Software Revision

Viewing System Revision Information

The system revision information shows details about the system including:

- ¥ version of the Hopper Plus 120-24 hardware
- ¥ ROM and RAM size
- ¥ version number of the system image file on the unit
- ¥ version date of the system image file on the unit
- ¥ name of the image file running on the Hopper Plus 120-24

To view system revision information

From the Main Menu, select **Hardware/Software Revision**. The System Revision Information window is displayed. The window is view only.

```
              System Revision Information

Hardware      Rev 0.0.0 (4MB SDRAM, 4MB Intel Flash)
ROM Size      0x400000
RAM Size      0x400000

Software      Rev 0.0.0 (Wi-LAN Hopper Plus 120-24 WEBII)
              June 26 2000 10:13:37
              318452 Bytes
File Name     FACTORY-IMAGE
```

where

Hardware	The revision number of the Hopper Plus 120-24 unit, and the RAM and FLASH installed in the unit.
ROM Size	The amount of read-only memory in the unit.
RAM Size	The amount of random-access memory in the unit. This value also appears in the Hardware field.
Software	The revision number of the system image running on the unit, the date of the revision, and the size of the file (in this case FACTORY-IMAGE).
File Name	The file name of the system image running on the unit.

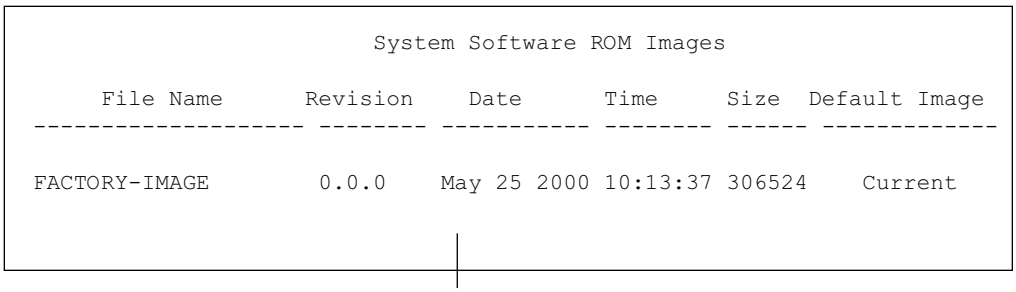
System Software ROM Images

Viewing System Software ROM Images

The System Software ROM Images window shows a list of all images available on the unit. An image is the embedded software stored in Flash ROM that the unit uses to operate. The example lists only the **Factory-Image**, however, several images may be available for use. As new images become available, Wi-LAN will place the images on their web site and make them available for downloading by customers.

To view system software ROM images

From the Main Menu, select **`System Software ROM Images`**. The System Software ROM Images window is displayed. The window is view only.



.

where

`File Name`	The names of all system image files stored in the unit.
`Revision`	The revision number of the system image file. Each time the system image is modified, the revision number increases by 1 unit. For example, the first revision to the file would make the revision number 0.0.1.
`Date`	The date the image file was last revised.
`Time`	The time the image file was last revised.
`Size`	The size of the image file in bytes.
`Default Image`	Indicates which image file is the default. This is the image used at power up. See To set the default image, page 62 to modify default image.

Current System Status

Viewing Current System Status

The Current System Status window shows administration information such as the time a unit has been running, and login statistics.

To view current system status

From the Main Menu, select **`System Current Status`**. The System Current Status window is displayed. The window is view only.

```
                        System Current Status

     Cumulative Run-Time               Days: 0      Hours: 7
     Current Run-Time                  Days: 0  00:38:38
     Successful Logins                 16
     Unsuccessful Logins               1
     Local User Logged In              Supervisor
     Telnet User Logged In             None
     FTP User Logged In                None
```

.

where

`Cumulative Run-Time`	The number of hours the system has been running since it was manufactured. This information is required for maintenance purposes.
`Current Run-Time`	The time duration that has passed since the unit was last reset or power cycled.
`Successful Logins`	The number of times that the configuration menus have been successfully accessed.
`Unsuccessful Logins`	The number of times that access to the configuration menus has failed.
`Local User Logged In`	The access level of the user currently logged into the configuration menus via the RS-232.
`Telnet User Logged In`	The access level of the user currently logged into the configuration menus via a telnet session.
`FTP User Logged In`	The access level of the user currently logged into the host FTP server.

IP Network Configuration

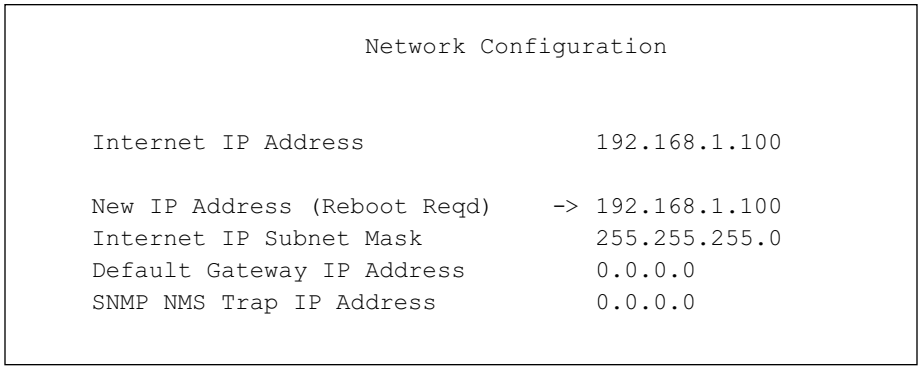
To remotely manage the Hopper Plus 120-24 units, you need to define the Internet IP settings.

Setting the Internet IP Address and Subnet Mask

Each Hopper Plus 120-24 unit in a system must have a valid Internet IP address and subnet mask for communication via TCP/IP.

To set the Internet IP address

1. From the Main Menu, select **`IP Network Configuration`**. The Network Configuration window is displayed.



2. Select **`New IP Address`**.
3. Type the unique Internet IP address for the unit.
4. Press the **Enter** key. The new Internet IP address appears in the **`New IP Address (Reboot Reqd)`** field, but the old address remains in the upper field.
5. Reboot the unit, or power the unit down and up toeffect the changes.

To set the Internet IP subnet mask

1. From the Main Menu, select **IP Network Configuration**. The Network Configuration window is displayed.

```
                    Network Configuration


Internet IP Address                192.168.1.100

New IP Address (Reboot Reqd)       192.168.1.100
Internet IP Subnet Mask         -> 255.255.255.0
Default Gateway IP Address         0.0.0.0
SNMP NMS Trap IP Address           0.0.0.0
```

2. Select **Internet IP Subnet Mask**.
3. Type the Internet IP subnet mask for the unit.
4. Press **Enter**. The Internet IP subnet mask appears in the field and is assigned to the unit.

Setting the Default Gateway IP Address

You need to define the IP address of the system gateway. This address designates the main entry point into the network, and is usually in the same subnet as the unit IP address.

To set the default gateway IP address

1. From the Main Menu, select **IP Network Configuration**. The Network Configuration window is displayed.

```
                    Network Configuration


Internet IP Address                192.168.1.100

New IP Address (Reboot Reqd)       192.168.1.100
Internet IP Subnet Mask            255.255.255.0
Default Gateway IP Address      -> 0.0.0.0
SNMP NMS Trap IP Address           0.0.0.0
```

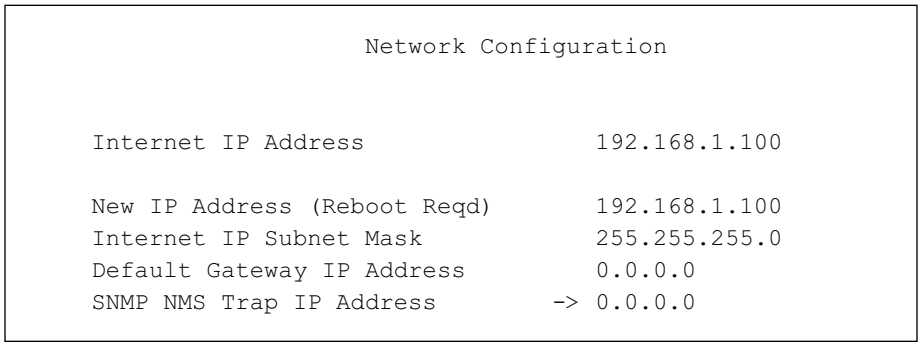
2. Select **Default Gateway IP Address**.
3. Type the default gateway IP address for the unit.
4. Press **Enter**.

Setting the SNMP NMS Trap IP Address

The SNMP (System Network Management Protocol) NMS (Network Management System) Trap IP address identifies the IP address of the network manager. This address communicates all alarms or events to the network manager. The network manager can define the types of traps, or alarms, that will be forwarded to the IP address.

To set the SNMP NMS trap IP address

1. From the Main Menu, select **`IP Network Configuration`**. The Network Configuration window is displayed.



2. Select **`SNMP NMS Trap IP Address`**.
3. Type the SNMP NMS Trap IP address for the unit.
4. Press **Enter**. The SNMP NMS Trap IP address appears in the entry field and is applied to the unit.

IP Filter Configuration

You can define IP address filters to control the data that is transmitted and received through the Hopper Plus unit. The following table describes the IP filters.

Filter	Setting	
IP packet	off (disabled)	All packets are passed.
	on (enabled)	Only IP and ARP packets are passed.
IP address	off (disabled)	All IP packets are passed.
	on (enabled)	Only packets whose IP addresses reside in at least one of the IP filter lists are passed. There are five IP filter lists: each can contain up to 255 IP addresses.

Each IP address list is defined by a range and base value. The range defines how many contiguous IP addresses are in the list, and the base sets the lowest address of the list.

The following is a list of addresses and their capabilities:

Addresses that pass only IP packets and IP Addresses		
192.168.2.10	194.120.3.51	194.120.3.254
192.168.2.11	194.120.3.52	194.120.3.255
192.168.2.11		194.120.4.0
192.168.2.12		194.120.4.1
192.168.2.13		

Configure IP Filtering as:

IP Packet Filtering = on
IP Address Filtering = on
Filter 1 Range (0 - 255) = 4
Filter 1 Base Address = 192.168.2.10
Filter 2 Range (0 - 255) = 2
Filter 2 Base Address = 194.120.3.51
Filter 3 Range (0 - 255) = 4
Filter 3 Base Address =
194.120.3.254

To enable IP packet filtering

1. From the Main Menu, select **`IP Filter Configuration`**. The IF Filter Configuration window is displayed.

```
                  IP Filter Configuration

    IP Packet Filtering             -> off
    IP Address Filtering               off

    Filter 1 Range (0-255)             0
    Filter 1 Base Address              0.0.0.0

    Filter 2 Range (0-255)             0
    Filter 2 Base Address              0.0.0.0

    Filter 3 Range (0-255)             0
    Filter 3 Base Address              0.0.0.0

    Filter 4 Range (0-255)             0
    Filter 4 Base Address              0.0.0.0

    Filter 5 Range (0-255)             0
    Filter 5 Base Address              0.0.0.0
```

2. Select **`IP Packet Filtering`**.
3. Scroll to **`off`** `or` **`on.`** (Initially start with setting to **`off`**).
4. Press **Enter**.

To enable IP address filtering

1. From the Main Menu, select **`IP Filter Configuration`**. The IF Filter Configuration window is displayed.

```
                  IP Filter Configuration

    IP Packet Filtering                off
    IP Address Filtering            -> off

    Filter 1 Range (0-255)             0
    Filter 1 Base Address              0.0.0.0

    Filter 2 Range (0-255)             0
    Filter 2 Base Address              0.0.0.0

    Filter 3 Range (0-255)             0
    Filter 3 Base Address              0.0.0.0

    Filter 4 Range (0-255)             0
    Filter 4 Base Address              0.0.0.0

    Filter 5 Range (0-255)             0
    Filter 5 Base Address              0.0.0.0
```

2. Select **IP Address Filtering**.
3. Scroll to **on**.
4. Press **Enter**.
5. Select **Filter 1 Range (0 - 255)**.
6. Type in the value (0 - 255).
7. Press **Enter**.
8. Select **Filter 1 Base Address**.
9. Type in the value.
10. Press **Enter**.
11. Repeat steps 5-10 for other filter lists.

RF Station Configuration

The RF Station Configuration menu contains test and optimization parameters for the Hopper Plus 120-24 unit. You can change the test mode time, operating mode, RF transmit status, and link monitor period. You can also change Base Station Only settings, and Remote Station Only settings.

Setting Test Mode Time

Before you test the unit, you need to set the test mode timer. The test mode timer sets the maximum time that the unit will remain in test mode. If the Hopper Plus is not returned to the normal mode before time runs out, the unit will perform an automatic software reboot and return to normal operating mode.

Note: The timer applies to tests initiated with the configuration menus and the mode button, but the timer can only be configured via the menus

To set test mode timer

. 1. From the Main Menu, select **`RF Station Configuration`**. The RF Station Configuration window is displayed.

```
                  RF Station Configuration

Operating Mode                            Normal Mode
RF Transmit Status                        unblocked
Link Monitor Period (0=OFF, 1-10000)      0
Test Mode Timer Minutes (1-1000)      -> 5

Base Station Only Parameters

Maximum Remote Distance                   5 Km
Link Monitor Remote Station Rank          1

Remote Station Only Parameters
Throttle Enable                           off
Throttle Level (1-50)                     1
```

2. Select **`Test Mode Timer Minutes`**.
3. Type the desired time value in minutes (1-1000).
4. Press **Enter**.

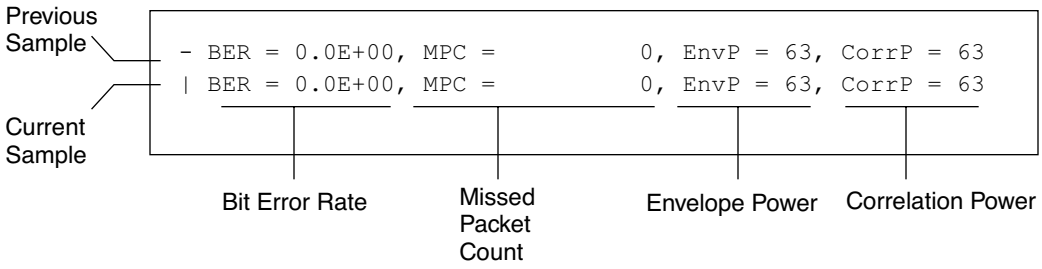
Setting the Operating Mode

The Hopper Plus starts up in Normal mode. Three modes are available for test purposes: Receive, Transmit, and RSSI.

`Receive`	Receives only. Processes expected packet data and displays statistics on RS-232 monitor.
`Transmit`	Transmits only. Sends known packet data to the receiver.
`RSSI`	RSSI (Received Signal Strength Indicator). Unit receives packets and displays fade margin data on Air LED.

When testing a bridge, one unit is placed in Transmit mode and the other unit is placed in Receive mode. The transmitting unit sends packets of known data to the receiving unit. The receiving unit analyzes the data and can display llink statistics on a terminal, as shown below.

Link Statistics



Alternating vertical and horizontal lines indicate that data is incoming.

where

`BER`	Bit Error Rate
`MPC`	Missed Packet Count
`EnvP`	Envelope Power. The power of the received signal inlcuding noise, measured in dB (0–63)
`CorrP`	Correlation Power. The power of the received signal, excluding noise, measured in dB (0–63)

RSSI mode is used to measure the fade margin of a system. The receive unit is put into RSSI mode and its AIR LED indicates the fade margin according to the following table:

AIR LED Color	Signal Strength
Green	Reliable signal - greater than 15 dB fade margin
Orange	Marginal signal - between 11 and 15 dB fade margin
Red	Poor signal - less than 10 dB fade margin
Blank	No signal at all

To set the operating mode

1. From the Main Menu, select **`RF Station Configuration`**. The RF Station Configuration window is displayed.

```
                  RF Station Configuration

Operating Mode                          -> Normal Mode
RF Transmit Status                        unblocked
Link Monitor Period (0=OFF, 1-10000)      0
Test Mode Timer Minutes (1-1000)          5

Base Station Only Parameters

Maximum Remote Distance                   5 Km
Link Monitor Remote Station Rank          1

Remote Station Only Parameters
Throttle Enable                           off
Throttle Level (1-50)                     1
```

2. Select **`Operating Mode`**.
3. Select the desired mode: Normal Mode, Transmit Mode, Receive Mode, or RSSI Mode.
4. Press **Enter**.

Note: The operating mode can also be set with the MODE button on the back of the Hopper Plus. See *Setting Operating Mode with the MODE Button*, page 68 for more information.

Setting the RF Transmit Status

This setting blocks a unit from carrying traffic.

To set RF transmit status

1. From the Main Menu, select **`RF Station Configuration`**. The RF Station Configuration window is displayed.

```
                  RF Station Configuration

    Operating Mode                            Normal Mode
    RF Transmit Status                     -> unblocked
    Link Monitor Period (0=OFF, 1-10000)      0
    Test Mode Timer Minutes (1-1000)          5

    Base Station Only Parameters

    Maximum Remote Distance                   5 Km
    Link Monitor Remote Station Rank          1

    Remote Station Only Parameters
    Throttle Enable                           off
    Throttle Level (1-50)                     1
```

2. Select **`RF Transmit Status`**.
3. Select a setting.

`unblocked`	Transmits and receives. This is the default setting.
`blocked`	Receives only

4. Press **Enter**.

Setting the Link Monitor Period

The Link Monitor Period determines the amount of test data that is sent during a link monitor test. The following table shows how much test data is sent during the link monitor test.

Monitor Setting	Test data (%)	Message data (%)	Notes
0	0	100	link monitor disabled
1	50	50	maximum test data
2	33.3	66.6	
3	25	75	
. . .	. . .	. . .	
10000	0.01	99.99	minimum test data

To set Link Monitor Period

1. From the Main Menu, select **`RF Station Configuration`**. The RF Station Configuration window is displayed.

```
                  RF Station Configuration

Operating Mode                            Normal Mode
RF Transmit Status                      unblocked
Link Monitor Period (0=OFF, 1-10000) ->10
Test Mode Timer Minutes (1-1000)          5

Base Station Only Parameters

Maximum Remote Distance                   5 Km
Link Monitor Remote Station Rank          1

Remote Station Only Parameters
Throttle Enable                           off
Throttle Level (1-50)                     1
```

2. Select **`Link Monitor Period`**.
3. Type the time value in minutes (0=OFF, 1-1000)
4. Press **Enter**.

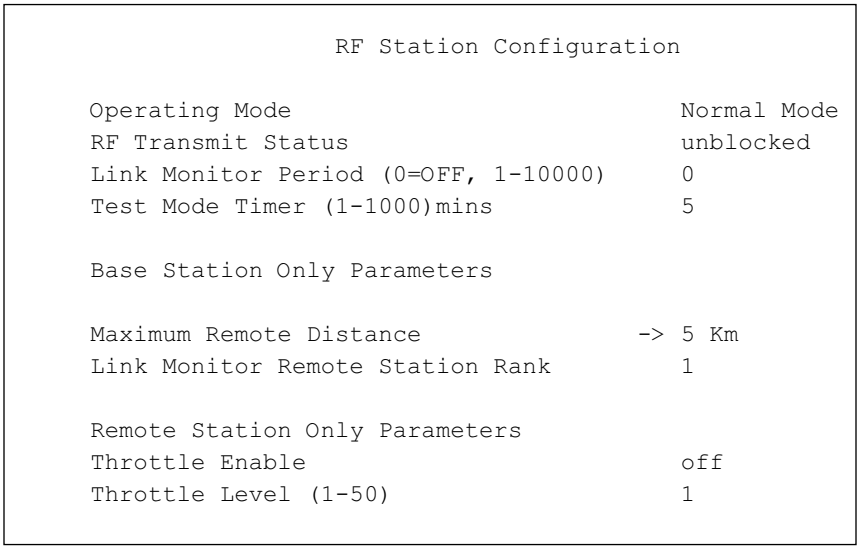
Setting Maximum Remote Distance (Base Station Only)

The Maximum Remote Distance is used to optimize dynamic polling by compensating for polling delay.

Important: In the base unit, the Maximum Remote Distance should always be set to the distance between the base and the farthest remote.

To set the maximum remote distance

1. From the Main Menu, select **`RF Station Configuration`**. The RF Station Configuration window is displayed.



2. Select **`Maximum Remote Distance`**.
3. Scroll to select the distance of the furthest remote unit.
4. Press **Enter**.

Setting Link Monitor Remote Station Rank (Base Station Only)

The Hopper Plus can test the RF link while it carries actual data. Link monitor sends test data along with the message data (the amount of data sent is determined by the setting of the Link Monitor Period). See *Setting the Link Monitor Period*, page 36.) The receiving unit processes statistics and sends the test data and statistics back to the testing unit. The testing unit then processes and displays statistics for both directions on the link monitor display. (See *Viewing Link Monitor Statistics*, page 66 for information about viewing link monitor statistics).

Note: It is possible to run the link monitor twice over one link by enabling it on the base and the remote at the same time. This situation should be avoided as it causes needless overhead.

You can run the link monitor from the base or any remote. When you run the link monitor from the base station, you must enter the station rank of the remote whose link you wish to test (rank represents the number of remotes that the base polls). When you run the link monitor from a remote, the only link that can be tested is to the base, so the station rank is not configured.

To set the link monitor rank from the base unit

1. From the Main Menu, select **`RF Station Configuration`**. The RF Station Configuration window is displayed.

```
                    RF Station Configuration

    Operating Mode                              Normal Mode
    RF Transmit Status                          unblocked
    Link Monitor Period (0-OFF, 1-10000)        0
    Test Mode Timer Minutes (1-1000)            5

    Base Station Only Parameters

    Maximum Remote Distance                     5 Km
    Link Monitor Remote Station Rank       -> 1

    Remote Station Only Parameters
    Throttle Enable                             off
    Throttle Level (1-50)                       1
```

2. Select **`Link Monitor Remote Station Rank`**.
3. Type the station rank of the remote to test.

4. Press **Enter**. The RF Station Configuration window is displayed.

```
                    RF Station Configuration

    Operating Mode                              Normal Mode
    RF Transmit Status                          unblocked
    Link Monitor Period (0-OFF, 1-10000)  -> 0
    Test Mode Timer Minutes (1-1000)            5

    Base Station Only Parameters

    Maximum Remote Distance                     5 Km
    Link Monitor Remote Station Rank            1

    Remote Station Only Parameters
    Throttle Enable                             off
    Throttle Level (1-50)                       1
```

5. Select **Link Monitor Period**.
6. Type in the desired link monitor period (0=OFF, 1-10000).
7. Press **Enter**.

For information about viewing the statistics, see *Viewing Link Monitor Statistics*, page 66.

To set the link monitor rank from a remote unit

1. From the Main Menu, select **RF Station Configuration**. The RF Station Configuration window is displayed.

```
                    RF Station Configuration

    Operating Mode                              Normal Mode
    RF Transmit Status                          unblocked
    Link Monitor Period (0-OFF, 1-10000)  -> 0
    Test Mode Timer Minutes (1-1000)            5

    Base Station Only Parameters

    Maximum Remote Distance                     5 Km
    Link Monitor Remote Station Rank            1

    Remote Station Only Parameters
    Throttle Enable                             off
    Throttle Level (1-50)                       1
```

2. Select **Link Monitor Period**.
3. Type in the desired link monitor value (1-10000).
4. Press **Enter**.

For information about viewing the statistics, see *Viewing Link Monitor Statistics*, page 66.

Setting Throttling (Remote Station Only)

Throttling limits the amount of data that passes though a remote Hopper Plus 120-24 unit. When throttling is enabled, the amount of data passed is equal to the throttling level times 128 kbps, to a maximum of 6.4 Mbps. Throttling applies to both the down link and up link traffic, so a setting of 128 kbps means the unit can pass 128 kbps in each direction. When throttling is disabled, the unit allows up to the maximum available bandwidth. The default setting is to disable throttling.

To enable throttling

1. From the Main Menu, select **`RF Station Configuration`**. The RF Station Configuration window is displayed.

```
                    RF Station Configuration

    Operating Mode                              Normal Mode
    RF Transmit Status                          unblocked
    Link Monitor Period (0=OFF, 1-10000)        0
    Test Mode Timer (1-1000)mins                5

    Base Station Only Parameters

    Maximum Remote Distance                     5 Km
    Link Monitor Remote Station Rank            1

    Remote Station Only Parameters
    Throttle Enable                          -> off
    Throttle Level (1-50)                       1
```

2. Select **`Throttle Enable`**.
3. Scroll to select **`on`**.
4. Press **Enter**.

Radio Module Configuration

Changing the configuration settings of a Hopper Plus while it operates in a system could disrupt service. To prevent disruptions when the configuration is being changed, the Hopper Plus stores configuration information in three different states:

New	The intended configuration changes. Temporary.
Current	The configuration actually running on the unit. Temporary.
Flash	The configuration that was stored last in FLASH memory. Final configuration is saved to FLASH memory.

To change the current configuration of the radio module

1. Set the Config Test Minutes. See *Setting Config Test Minutes*, page 48.
2. Make new configuration changes with the Radio Module Configuration menu. These changes are stored in the `New` state, but the radio uses the Current state configuration until it is rebooted with new configuration.
3. Reboot the unit following the steps in *Rebooting and Saving RF Configurations*, page 53. The unit runs the new configuration, and the old configuration is retained in FLASH.
4. If the new configuration works as intended, then the changes can be saved to FLASH. See *To save current configuration to FLASH*, page 54.

   If the new configuration disrupts communications, then the configuration stored in FLASH is restored after a timeout has elapsed. The unit can be re-configured and tested until the unit works as intended.

Setting the Station Type

Each Hopper Plus 120-24 unit must be defined as a base or a remote unit. In any given system there is only one base unit, but there can be numerous remote units.

To set the station type

1. From the Main Menu, select **`Radio Module Configuration`**. The Radio Module Configuration window is displayed.

```
                          Radio Module Configuration
                                   New         Current        Flash
Station Type                    -> Remote Unit   Remote Unit   Remote Unit
Station Rank (1-1000)              1             1             1
Center Frequency                   2.4400 GHz    2.4400 GHz    2.4400 GHz
Security Password 1  (Hex)         1             1             1
Security Password 2  (Hex)         10            10            10
Security Password 3  (Hex)         100           100           100
Security Password 4  (Hex)         1000          1000          1000
Security Password 5  (Hex)         10000         10000         10000
Scrambling Code      (Hex)         0             0             0
Acquisition Code     (0-15)        1             1             1
Config Test Minutes  (1-120)       30            30            30

Base Station Only Parameters
Repeater Mode                      off           off           off
System Symmetry Type               Asymmetric    Asymmetric    Asymmetric
Dynamic Polling Level (1-100)      1
Remote Station Only Parameters
Remote Unit RF Group (0-63)        0             0             0

Reboot New RF configuration        Press Enter to Execute
Save Current Config to Flash       Press Enter to Execute
```

2. Select **`Station Type`**.
3. Scroll to select the desired station type (base unit or remote unit).
4. Press **Enter**.

Setting the Station Rank

For a base station, rank is the number of remotes that the base polls (regardless of the actual number of remotes in the system). The base station rank should equal the number of remotes so the base does not waste time polling nonexistent remotes.

For a remote unit, rank is a unique number that identifies the remote to the base station.

The base station polls remote units sequentially from rank 1 to the base unit s station rank, then repeats the process.

To set the station rank

1. From the Main Menu, select **Radio Module Configuration.** The Radio Module Configuration window is displayed.

```
                          Radio Module Configuration
                                   New          Current         Flash
Station Type                  Remote Unit    Remote Unit    Remote Unit
Station Rank (1-1000)       -> 1              1              1
Center Frequency              2.4400 GHz     2.4400 GHz     2.4400 GHz
Security Password 1  (Hex)    1              1              1
Security Password 2  (Hex)    10             10             10
Security Password 3  (Hex)    100            100            100
Security Password 4  (Hex)    1000           1000           1000
Security Password 5  (Hex)    10000          10000          10000
Scrambling Code      (Hex)    0              0              0
Acquisition Code     (0-15)   1              1              1
Config Test Minutes  (1-120)  30             30             30

Base Station Only Parameters
Repeater Mode                 off            off            off
System Symmetry Type          Asymmetric     Asymmetric     Asymmetric
Dynamic Polling Level (1-100) 1
Remote Station Only Parameters
Remote Unit RF Group (0-63)   0              0              0

Reboot New RF configuration   Press Enter to Execute
Save Current Config to Flash  Press Enter to Execute
```

2. Select **`Station Rank (1-1000)`**.
3. Type the rank number of the station.
4. Press **Enter**.

Setting the Center Frequency

The center frequency defines the channel the unit uses to transmit and receive RF energy. To ensure communication between units, all units in a system must have the same center frequency value.

To set the center frequency

1. From the Main Menu, select **`Radio Module Configuration`**. The Radio Module Configuration window is displayed.

```
                          Radio Module Configuration
                                   New          Current         Flash
Station Type                    Remote Unit   Remote Unit   Remote Unit
Station Rank (1-1000)           1             1             1
Center Frequency              -> 2.4400 GHz    2.4400 GHz    2.4400 GHz
Security Password 1  (Hex)      1             1             1
Security Password 2  (Hex)      10            10            10
Security Password 3  (Hex)      100           100           100
Security Password 4  (Hex)      1000          1000          1000
Security Password 5  (Hex)      10000         10000         10000
Scrambling Code      (Hex)      0             0             0
Acquisition Code     (0-15)     1             1             1
Config Test Minutes  (1-120)    30            30            30

Base Station Only Parameters
Repeater Mode                   off           off           off
System Symmetry Type            Asymmetric    Asymmetric    Asymmetric
Dynamic Polling Level (1-100)   1
Remote Station Only Parameters
Remote Unit RF Group (0-63)     0             0             0

Reboot New RF configuration     Press Enter to Execute
Save Current Config to Flash    Press Enter to Execute
```

2. Select **`Center Frequency`**.
3. Scroll to select the RF center frequency to apply to all units in the network.
4. Press **Enter**. The center frequency is stored in the **New** state.

Setting Security Passwords

Up to five different passwords can be set for a unit. Only Security Password 1 is required, the other passwords are optional. The higher the number passwords that are used, the higher the level of security for the unit. The set of passwords on the remote unit must match the set of passwords on the base unit. All passwords are exchanged between units, even when l password are not used. Passwords can be set and modified directly with the Radio Module Configuration menu.

Note: All units in the same network must have this setting set to the same value.

To set security passwords

1. From the Main Menu, select **Radio Module Configuration**. The Radio Module Configuration window is displayed.

All units in the same network must have these configurations set the same.

```
                          Radio Module Configuration
                                   New          Current         Flash
Station Type                    Remote Unit   Remote Unit   Remote Unit
Station Rank (1-1000)           1             1             1
Center Frequency              -> 2.4400 GHz    2.4400 GHz    2.4400 GHz
Security Password 1  (Hex)      1             1             1
Security Password 2  (Hex)      10            10            10
Security Password 3  (Hex)      100           100           100
Security Password 4  (Hex)      1000          1000          1000
Security Password 5  (Hex)      10000         10000         10000
Scrambling Code      (Hex)      0             0             0
Acquisition Code     (0-15)     1             1             1
Config Test Minutes  (1-120)    30            30            30

Base Station Only Parameters
Repeater Mode                   off           off           off
System Symmetry Type            Asymmetric    Asymmetric    Asymmetric
Dynamic Polling Level (1-100)   1
Remote Station Only Parameters
Remote Unit RF Group (0-63)     0             0             0

Reboot New RF configuration     Press Enter to Execute
Save Current Config to Flash    Press Enter to Execute
```

2. Select **Security Password 1**.
3. Enter a password in Hex code.
4. Press **Enter**. The password is stored in the **New** state.

   Note: Security Passwords 2 to 5 are optional.
5. If you want to use more than one password, select **Security Password *n*.**
6. Enter a password in Hex code.
7. Select **Reboot New RF configuration**.
8. Press **Enter**. The passwords are put into effect.

Setting the Scrambling Code

The scrambling code is used to scramble messages so only units with the correct scrambling code will be able to read messages. The scrambling code can be 0-32 bits long.

Note: All units in the same network must have this setting set to the same value.

To set scrambling codes

1. From the Main Menu, select **`Radio Module Configuration`**. The Radio Module Configuration window appears.

```
                          Radio Module Configuration
                                   New          Current         Flash
Station Type                     Remote Unit    Remote Unit    Remote Unit
Station Rank (1-1000)            1              1              1
Center Frequency                 2.4400 GHz     2.4400 GHz     2.4400 GHz
Security Password 1  (Hex)       1              1              1
Security Password 2  (Hex)       10             10             10
Security Password 3  (Hex)       100            100            100
Security Password 4  (Hex)       1000           1000           1000
Security Password 5  (Hex)       10000          10000          10000
Scrambling Code      (Hex)    -> 0              0              0
Acquisition Code     (0-15)      1              1              1
Config Test Minutes  (1-120)     30             30             30

Base Station Only Parameters
Repeater Mode                    off            off            off
System Symmetry Type             Asymmetric     Asymmetric     Asymmetric
Dynamic Polling Level (1-100)    1
Remote Station Only Parameters
Remote Unit RF Group (0-63)      0              0              0

Reboot New RF configuration      Press Enter to Execute
Save Current Config to Flash     Press Enter to Execute
```

2. Select **`Scrambling Code`**.
3. Type the code.
4. Press **Enter**.

Setting the Acquisition Code

The acquisition code ensures that the receiver does not process any signals not intended for that receiver. The receiver processes only signals with the correct acquisition code.

Note: All units in the same network must have this setting set to the same value.

To set the acquisition code

1. From the Main Menu, select **`Radio Module Configuration`**. The Radio Module Configuration window is displayed.

```
                          Radio Module Configuration
                                   New          Current         Flash
Station Type                       Remote Unit  Remote Unit     Remote Unit
Station Rank (1-1000)              1            1               1
Center Frequency                   2.4400 GHz   2.4400 GHz      2.4400 GHz
Security Password 1  (Hex)         1            1               1
Security Password 2  (Hex)         10           10              10
Security Password 3  (Hex)         100          100             100
Security Password 4  (Hex)         1000         1000            1000
Security Password 5  (Hex)         10000        10000           10000
Scrambling Code      (Hex)         0            0               0
Acquisition Code     (0-15)    -> 0            0               0
Config Test Minutes  (1-120)       30           30              30

Base Station Only Parameters
Repeater Mode                      off          off             off
System Symmetry Type               Asymmetric   Asymmetric      Asymmetric
Dynamic Polling Level (1-100)      1
Remote Station Only Parameters
Remote Unit RF Group (0-63)        0            0               0

Reboot New RF configuration        Press Enter to Execute
Save Current Config to Flash       Press Enter to Execute
```

2. Select **`Acquisition Code`**.
3. Type the Acquisition code (0-15).
4. Press **Enter**.

Setting Config Test Minutes

Since there is a chance that RF configuration changes will disrupt communications, each unit returns to its pre-configuration state after a timeout (unless the changes are saved to FLASH before the timeout). This timeout is set with the Config Test Minutes parameter, which can be set from 1 to 120 minutes.

When testing, the configuration test timeout value should be set before any other radio module changes are made, so that the correct value is used if other changes cause the unit to lock up. If you set the timeout too low, then you may not have time to save the changes to FLASH. If you set it too high, then you will have to wait a long time for the unit to reboot after a change that disrupts service.

Note: All units in the same network must have this setting set to the same value.

To set the test timeout

1. From the Main Menu, select **`Radio Module Configuration`**. The Radio Module Configuration window is displayed.

```
                          Radio Module Configuration
                                   New          Current         Flash
Station Type                     Remote Unit    Remote Unit    Remote Unit
Station Rank (1-1000)            1              1              1
Center Frequency                 2.4400 GHz     2.4400 GHz     2.4400 GHz
Security Password 1  (Hex)       1              1              1
Security Password 2  (Hex)       10             10             10
Security Password 3  (Hex)       100            100            100
Security Password 4  (Hex)       1000           1000           1000
Security Password 5  (Hex)       10000          10000          10000
Scrambling Code      (Hex)       0              0              0
Acquisition Code     (0-15)      0              0              0
Config Test Minutes  (1-120)  -> 30             30             30

Base Station Only Parameters
Repeater Mode                    off            off            off
System Symmetry Type             Asymmetric     Asymmetric     Asymmetric
Dynamic Polling Level (1-100)    1
Remote Station Only Parameters
Remote Unit RF Group (0-63)      0              0              0

Reboot New RF configuration      Press Enter to Execute
Save Current Config to Flash     Press Enter to Execute
```

2. Select **`Config Test Minutes`**.
3. Type the test minutes value (1-120).
4. Press **Enter**.
5. Select **`Reboot New RF configuration`**.
6. Press **Enter**. The unit reboots with the temporary test timeout period in effect.
7. To move the setting to FLASH see *Rebooting and Saving RF Configurations*, page 53.

Setting Repeater Mode (Base Station Only)

When a base unit has repeater mode enabled, it re-transmits messages to all remotes in the same RF group. When repeater mode is disabled, remote-to-remote traffic is allowed if radio communication is possible and remotes are in the same non-zero RF group.

To set the repeater mode

1. From the Main Menu, select **Radio Module Configuration.** The Radio Module Configuration window is displayed.

```
                          Radio Module Configuration
                                   New          Current         Flash
Station Type                    Remote Unit   Remote Unit   Remote Unit
Station Rank (1-1000)           1             1             1
Center Frequency                2.4400 GHz    2.4400 GHz    2.4400 GHz
Security Password 1  (Hex)      1             1             1
Security Password 2  (Hex)      10            10            10
Security Password 3  (Hex)      100           100           100
Security Password 4  (Hex)      1000          1000          1000
Security Password 5  (Hex)      10000         10000         10000
Scrambling Code      (Hex)      0             0             0
Acquisition Code     (0-15)     0             0             0
Config Test Minutes  (1-120)    30            30            30

Base Station Only Parameters
Repeater Mode                -> off           off           off
System Symmetry Type            Asymmetric    Asymmetric    Asymmetric
Dynamic Polling Level (1-100)   1
Remote Station Only Parameters
Remote Unit RF Group (0-63)     0             0             0

Reboot New RF configuration     Press Enter to Execute
Save Current Config to Flash    Press Enter to Execute
```

2. Select **`Repeater Mode`**.
3. In the Repeater Mode entry field, scroll to select the desired setting based on the following table.

`off`	Base unit does not re-transmit messages. This is the default setting.
`on`	Base unit re-transmits messages received from one remote to other remotes in the same RF group.

4. Press **Enter**.

Setting System Symmetry Type (Base Station Only)

System symmetry type defines the amount of priority the base unit has when polling the remotes. The default setting "asymmetric" gives the base unit a time slot after each remote is polled—an asymmetric system is appropriate when the base is the access point to a large network.The "symmetric" setting limits the base unit to one time slot for every polling cycle; a symmetric system is more efficient when the base has data passing requirements that are similar to the remotes.

To set system symmetry type

1. From the Main Menu, select **`Radio Module Configuration`**. The Radio Module Configuration window is displayed.

```
                          Radio Module Configuration
                                   New          Current         Flash
Station Type                     Remote Unit    Remote Unit    Remote Unit
Station Rank (1-1000)            1              1              1
Center Frequency                 2.4400 GHz     2.4400 GHz     2.4400 GHz
Security Password 1  (Hex)       1              1              1
Security Password 2  (Hex)       10             10             10
Security Password 3  (Hex)       100            100            100
Security Password 4  (Hex)       1000           1000           1000
Security Password 5  (Hex)       10000          10000          10000
Scrambling Code      (Hex)       0              0              0
Acquisition Code     (0-15)      0              0              0
Config Test Minutes  (1-120)     30             30             30

Base Station Only Parameters
Repeater Mode                    off            off            off
System Symmetry Type          -> Asymmetric     Asymmetric     Asymmetric
Dynamic Polling Level (1-100)    1
Remote Station Only Parameters
Remote Unit RF Group (0-63)      0              0              0

Reboot New RF configuration      Press Enter to Execute
Save Current Config to Flash     Press Enter to Execute
```

2. Select **`System Symmetry Type`**.
3. Scroll to the desired setting as follows.

`asymmetric`	Base unit higher priority than remotes: the base unit has one time slot after every remote time slot. This is the default setting.
`symmetric`	Base unit the same priority as every remote: the base unit has one time slot for every polling cycle.

4. Press **Enter**.

Setting Dynamic Polling Level (Base Station Only)

The Hopper Plus uses dynamic polling to reduce overhead caused by idle remote units. Every remote unit is polled by the base, and idle units are ignored for the number of polling rounds entered in the Dynamic Polling Level field.

Dynamic Polling is most effective in very large systems, where polling delay can become significant.

Important: Polling level is set only for the base unit.

To set the dynamic polling level

1. From the Main Menu, select **`RF Station Configuration`**. The RF Station Configuration window is displayed..

```
                          Radio Module Configuration
                                   New          Current         Flash
Station Type                  Remote Unit    Remote Unit    Remote Unit
Station Rank (1-1000)         1              1              1
Center Frequency              2.4400 GHz     2.4400 GHz     2.4400 GHz
Security Password 1  (Hex)    1              1              1
Security Password 2  (Hex)    10             10             10
Security Password 3  (Hex)    100            100            100
Security Password 4  (Hex)    1000           1000           1000
Security Password 5  (Hex)    10000          10000          10000
Scrambling Code      (Hex)    0              0              0
Acquisition Code     (0-15)   0              0              0
Config Test Minutes  (1-120)  30             30             30

Base Station Only Parameters
Repeater Mode                 off            off            off
System Symmetry Type       -> Asymmetric     Asymmetric     Asymmetric
Dynamic Polling Level (1-100) 1
Remote Station Only Parameters
Remote Unit RF Group (0-63)   0              0              0

Reboot New RF configuration   Press Enter to Execute
Save Current Config to Flash  Press Enter to Execute
```

1. Select **`Dynamic Polling Level`**.
2. Type the desired polling level (1-60).
3. Press **Enter**.

Setting Remote Unit RF Group

Remote unit RF group controls how remote units communicate with each other. Only remote units in the same non-zero RF group can communicate directly with each other. A remote with a zero RF group can only communicate with the base unit.

To set remote unit RF group

1. From the Main Menu, select **`RF Module Configuration`**. The Radio Module Configuration window is displayed.

```
                          Radio Module Configuration
                                   New          Current         Flash
Station Type                     Remote Unit    Remote Unit    Remote Unit
Station Rank (1-1000)            1              1              1
Center Frequency                 2.4400 GHz     2.4400 GHz     2.4400 GHz
Security Password 1  (Hex)       1              1              1
Security Password 2  (Hex)       10             10             10
Security Password 3  (Hex)       100            100            100
Security Password 4  (Hex)       1000           1000           1000
Security Password 5  (Hex)       10000          10000          10000
Scrambling Code      (Hex)       0              0              0
Acquisition Code     (0-15)      1              1              1
Config Test Minutes  (1-120)     30             30             30

Base Station Only Parameters
Repeater Mode                    off            off            off
System Symmetry Type             Asymmetric     Asymmetric     Asymmetric
Dynamic Polling Level (1-100)    1
Remote Station Only Parameters
Remote Unit RF Group (0-63)   -> 0              0              0

Reboot New RF configuration      Press Enter to Execute
Save Current Config to Flash     Press Enter to Execute
```

2. Select **`Remote Unit RF Group`**.
3. In the Remote Unit RF Group entry field, type the RF group number, using the following table as a guide.

RF Group	Remote Characteristics
0	Closed: remote will only transmit to and receive from the base unit.
1-63	Open: remote will transmit to and receive from the base and all remotes with the same RF group number.

4. Press **Enter**.

Rebooting and Saving RF Configurations

A reboot is required for temporary changes to the RF configuration to take effect. If the changes are valid, they can be saved "permanently" in the FLASH memory. If the changes are not valid, then the old configuration is restored after a programmable time-out.

To reboot new RF configuration

1. From the Main Menu, select **`Radio Module Configuration`**. The Radio Module Configuration window is displayed.

```
                          Radio Module Configuration
                                   New          Current         Flash
Station Type                  Remote Unit    Remote Unit    Remote Unit
Station Rank (1-1000)         1              1              1
Center Frequency              2.4400 GHz     2.4400 GHz     2.4400 GHz
Security Password 1  (Hex)    1              1              1
Security Password 2  (Hex)    10             10             10
Security Password 3  (Hex)    100            100            100
Security Password 4  (Hex)    1000           1000           1000
Security Password 5  (Hex)    10000          10000          10000
Scrambling Code      (Hex)    0              0              0
Acquisition Code     (0-15)   1              1              1
Config Test Minutes  (1-120)  30             30             30

Base Station Only Parameters
Repeater Mode                 off            off            off
System Symmetry Type          Asymmetric     Asymmetric     Asymmetric
Dynamic Polling Level (1-100) 1
Remote Station Only Parameters
Remote Unit RF Group (0-63)   0              0              0

Reboot New RF configuration    -> Press Enter to Execute
Save Current Config to Flash      Press Enter to Execute
```

2. Select **`Reboot New RF Configuration`**.
3. Press **Enter**. The Hopper Plus 120-24 reboots with the new temporary RF configuration. The old configuration is remains stored in FLASH memory. If the RF configuration is valid and the unit operates as intended, you can login again, access the Main Menu, Radio Module Configuration, **`Save Current Config to Flash`** to save changes to FLASH memory.

To save current configuration to FLASH

1. From the Main Menu, select **`Radio Module Configuration`**. The Radio Module Configuration window is displayed.

```
                          Radio Module Configuration
                                   New         Current         Flash
Station Type                     Remote Unit   Remote Unit   Remote Unit
Station Rank (1-1000)            1             1             1
Center Frequency                 2.4400 GHz    2.4400 GHz    2.4400 GHz
Security Password 1  (Hex)       1             1             1
Security Password 2  (Hex)       10            10            10
Security Password 3  (Hex)       100           100           100
Security Password 4  (Hex)       1000          1000          1000
Security Password 5  (Hex)       10000         10000         10000
Scrambling Code      (Hex)       0             0             0
Acquisition Code     (0-15)      1             1             1
Config Test Minutes  (1-120)     30            30            30

Base Station Only Parameters
Repeater Mode                    off           off           off
System Symmetry Type             Asymmetric    Asymmetric    Asymmetric
Dynamic Polling Level (1-100)    1
Remote Station Only Parameters
Remote Unit RF Group (0-63)      0             0             0

Reboot New RF configuration      Press Enter to Execute
Save Current Config to Flash  -> Press Enter to Execute
```

2. Select **`Save Current Config to Flash`**.
3. Press **Enter**. The current configuration is saved to FLASH. No reboot is required.

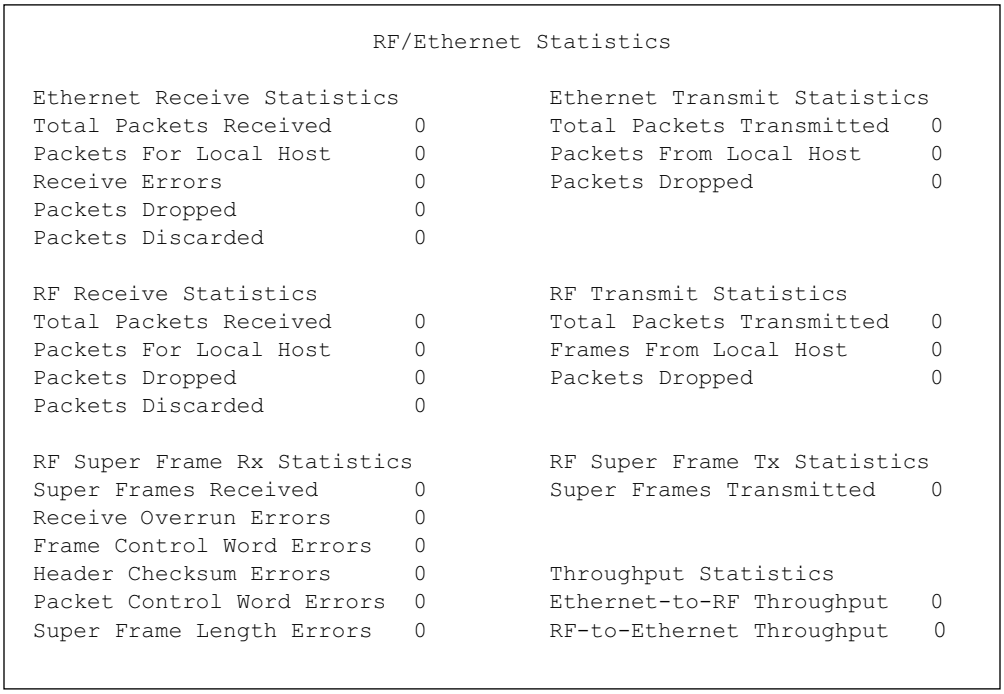
RF/Ethernet Statistics

Ethernet and RF statistics can be viewed for troubleshooting and monitoring link performance. Ethernet and RF statistics are cumulative and increment until reset. The window is view only. See *Resetting the RF/Ethernet Statistics*, page 64 for information about resetting RF/Ethernet statistics.

Viewing RF/Ethernet Statistics

To view RF and Ethernet statistics

1. From the Main Menu, select **`RF/Ethernet Statistics`**. The RF/Ethernet Statistics window is displayed.



```
                        RF/Ethernet Statistics

Ethernet Receive Statistics             Ethernet Transmit Statistics
Total Packets Received      0           Total Packets Transmitted   0
Packets For Local Host      0           Packets From Local Host     0
Receive Errors              0           Packets Dropped             0
Packets Dropped             0
Packets Discarded           0

RF Receive Statistics                   RF Transmit Statistics
Total Packets Received      0           Total Packets Transmitted   0
Packets For Local Host      0           Frames From Local Host      0
Packets Dropped             0           Packets Dropped             0
Packets Discarded           0

RF Super Frame Rx Statistics            RF Super Frame Tx Statistics
Super Frames Received       0           Super Frames Transmitted    0
Receive Overrun Errors      0
Frame Control Word Errors   0
Header Checksum Errors      0           Throughput Statistics
Packet Control Word Errors  0           Ethernet-to-RF Throughput   0
Super Frame Length Errors   0           RF-to-Ethernet Throughput   0
```

.

where

Ethernet Receive	`Total Packets Received`	The number of Ethernet packets from the 10/100 Base-T connection.
	`Packets For Local Host`	The number of Ethernet packets received from the 10/100 Base-T connection which were destined for the Hopper Plus 120-24 unit's TCP/IP stack.
	`Receive Errors`	The number of Ethernet packets received with errors, for example, runt (smaller than 64 bytes), jabber (larger than 1518 bytes), or overflow error.
	`Packets Dropped`	The number of Ethernet packets dropped because the wireless link is at capacity.
	`Packets Discarded`	The number of Ethernet packets discarded as the result of filtering.
RF Receive	`Total Packets Received`	The number of Ethernet packets received over RF.
	`Packets For Local Host`	The number of Ethernet packets received over RF and destined for the local host.
	`Packets Dropped`	The number of Ethernet packets dropped because the wireless link is at capacity.
	`Packets Discarded`	The number of Ethernet packets discarded as the result of filtering.
RF Super Frame Rx	`Super Frames Received`	The number of super frames received.
	`Receive Overrun Errors`	The number of errors caused by receive buffer overrun.
	`Frame Control Word Errors`	The number of errors caused by frame control word problems.
	`Header Checksum Word Errors`	The number of errors caused by receiving an invalid header checksum.
	`Packet Control Word Errors`	The number of errors caused by packet control word problems.
	`Super Frame Length Errors`	The number of errors caused by receiving an invalid super frame length.

where

Ethernet Transmit	`Total Packets Transmitted`	The number of Ethernet packets transmitted onto the 10/100 Base-T connection.
	`Packets From Local Host`	The number of Ethernet packets transmitted onto the 10/100 Base-T connection which originated from the Hopper Plus 120-24 unit's TCP/IP stack.
	`Packets Dropped`	The number of Ethernet packets not transmitted due to some error, for example, unable to transmit within 15 retries, or underflow error.
RF Transmit	`Total Packets Transmitted`	The number of Ethernet packets transmitted over RF.
	`Frames From Local Host`	The number of Ethernet packets transmitted to RF from the local host.
	`Packets Dropped`	The number of packets dropped because of RF problems.
RF S. F. Tx	`Super Frames Transmitted`	The number of super frames transmitted.
Throughput	`Ethernet-to-RF Throughput`	Current data rate measured from wire to air, resolution = 1 second.
	`RF-to-Ethernet Throughput`	Current data rate measured from air to wire, resolution = 1 second.

System Security

You can control access to the Hopper Plus 120-24 unit with the System Security menu.

Setting Community Names

Community names are used to control SNMP access to the Hopper Plus. Community Name 1 has read only access, and Community Name 2 has read and write access. Any SNMP manager can access and configure any Hopper Plus unit on the network as long as the unit has the correct community names and Ethernet access is enabled (see *Setting Remote Access*, page 60).

Warning: Default community names are presented in all Installation and Configuration guides distributed by Wi-LAN. It is the responsibility of the customer to ensure that default community names are changed to unique names at installation. Record all community name changes.

Community name	Privileges	Default value
SNMP Community Name 1	Read	public
SNMP Community Name 2	Read and Write	netman

To set community names

1. From the Main Menu, select **`System Security`**. The System Security window is displayed.

```
                          System Security


SNMP Community Name 1          -> public
SNMP Community Name 2             netman

Change User Password              Press Enter to change password
Confirm User Password             Press Enter to confirm password

Change Supervisor Password        Press Enter to change password
Confirm Supervisor Password       Press Enter to confirm password

Ethernet Access to Local Host     on
Wireless Access to Local Host     on

Auto Logout Minutes (1-120)       10
```

2. Select **`SNMP Community Name 1`**.
3. Type in new name.
4. Press **Enter**. The new name appears in the entry field.
5. Select **`SNMP Community Name 2`**.
6. Type in new name.
7. Press **Enter**. The new name appears in the entry field.

Setting Login Passwords

You can control access to the configuration menus by setting passwords for the user and supervisor logins. The user login has read-only access, while the supervisor login can modify configuration settings. The default passwords match the login names.

Warning: Default passwords are listed in all Installation and Configuration guides distributed by Wi-LAN. It is the responsibility of the customer to ensure that default passwords are changed to unique passwords during installation. Record all password changes.

Note: When you restore factory configurations, the login passwords revert to the defaults.

To set user password

1. From the Main Menu, select **`System Security`**. The System Security window is displayed.

```
                          System Security


SNMP Community Name 1             public
SNMP Community Name 2             netman

Change User Password           -> Press Enter to change password
Confirm User Password              Press Enter to confirm password

Change Supervisor Password         Press Enter to change password
Confirm Supervisor Password        Press Enter to confirm password

Ethernet Access to Local Host      on
Wireless Access to Local Host      on

Auto Logout Minutes (1-120)        10
```

2. Select **`Change User Password`**.
3. Type the new password.
4. Press **Enter**.
5. Select **`Confirm User Password`** entry field.
6. Re-type the password from step 3.
7. Press **Enter**. The change is saved when `Success` appears beside the confirmation field.

To set supervisor password

1. From the Main Menu, select **`System Security`**. The System Security window appears (see above).
2. Select **`Change Supervisor Password`**.
3. Type the new password.
4. Press **Enter**.
5. Select **`Confirm Supervisor Password`** entry field.
6. Re-type the password from step 3.

7. Press **Enter**. The change is saved when `Success` appears beside the confirmation field.

Setting Remote Access

The Hopper Plus can be accessed and configured via the Ethernet and over the RF link. The default setting is to allow both forms of remote access, but they can be disabled if required (as a security measure, for example).

To set Ethernet and wireless access

1. From the Main Menu, select **`System Security`**. The System Security window is displayed.

```
                          System Security


SNMP Community Name 1             public
SNMP Community Name 2             netman

Change User Password              Press Enter to change password
Confirm User Password             Press Enter to confirm password

Change Supervisor Password        Press Enter to change password
Confirm Supervisor Password       Press Enter to confirm password

Ethernet Access to Local Host  -> on
Wireless Access to Local Host     on

Auto Logout Minutes (1-120)       10
```

2. Select **`Ethernet Access to Local Host`**.
3. In the Ethernet Access to Local Host field, select the desired setting.

`on`	Enable access to the unit via the Ethernet.
`off`	Disable access to the unit via the Ethernet.

4. Press **Enter**.
5. Select **`Wireless Access to Local Host`**.
6. Select the desired setting.

`on`	Enable access to the unit via the air.
`off`	Disable access to the unit via the air.

7. Press **Enter**.

Setting the Automatic Timeout

You can specify the maximum time the system can remain idle before the configuration menus close and the Login menu reappears. This ensures that the configuration menus close if a user forgets to exit.

Note: When the menus automatically timeout, the system appears frozen. Press **Enter** to view the Login window, where you can login to the menus.

To set the automatic timeout period

1. From the Main Menu, select **`System Security`**. The System Security window is displayed.

```
                          System Security


SNMP Community Name 1             public
SNMP Community Name 2             netman

Change User Password              Press Enter to change password
Confirm User Password             Press Enter to confirm password

Change Supervisor Password        Press Enter to change password
Confirm Supervisor Password       Press Enter to confirm password

Ethernet Access to Local Host     on
Wireless Access to Local Host     on

Auto Logout Minutes (1-120)    -> 10
```

2. Select **`Auto Logout Minutes`**.
3. Type the maximum idle time period in minutes that can pass before the configuration menus close.
4. Press **Enter**. The new value appears in the entry field.

System Commands

System image files contain the software that runs the unit. When you first power up the Hopper Plus unit, it runs from the factory-image. With the System Commands menu you can choose the image file that a unit uses to power up, and the image file that a unit uses to reboot.

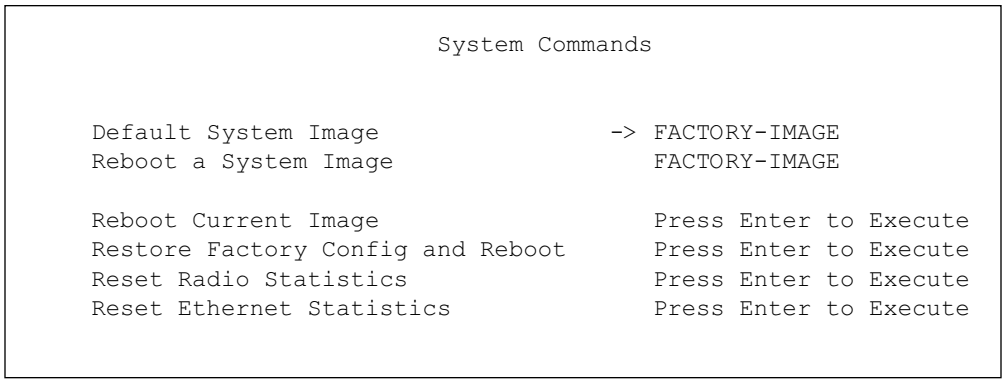
Note: As new images are developed, Wi-LAN plans to place the images on their web site so that you can download them to the unit.

Setting Default System Image

The default image is the image file used at power up. If you have more than one image saved on a unit, you can choose the default power up file.

To set the default image

1. From the Main Menu, select **`System Commands`**. The System Commands window is displayed.



2. Select **`Default System Image`**.
3. Scroll to select the image to use as the default.
4. Press **Enter**. The new image file appears in the field. This image will be used each time the Hopper Plus is powered up.

Setting the Reboot System Image

To set the reboot image

1. From the Main Menu, select **System Commands**. The System Commands window is displayed.

```
                          System Commands


    Default System Image                    FACTORY-IMAGE
    Reboot a System Image                -> FACTORY-IMAGE

    Reboot Current Image                    Press Enter to Execute
    Restore Factory Config and Reboot       Press Enter to Execute
    Reset Radio Statistics                  Press Enter to Execute
    Reset Ethernet Statistics               Press Enter to Execute
```

2. Select **Reboot a System Image**.
3. Scroll to select the image to use when rebooting.
4. Press **Enter**. The new image file appears in the field. This image will be used when the Hopper Plus is rebooted.

Rebooting the Current Image

The Reboot Current Image command must be used when the IP address is changed. See *Setting the Internet IP Address and Subnet Mask*, page 26.

To reboot the current image

1. From the Main Menu, select **System Commands.** The System Commands window is displayed.

```
                          System Commands


    Default System Image                    FACTORY-IMAGE
    Reboot a System Image                   FACTORY-IMAGE

    Reboot Current Image                 -> Press Enter to Execute
    Restore Factory Config and Reboot       Press Enter to Execute
    Reset Radio Statistics                  Press Enter to Execute
    Reset Ethernet Statistics               Press Enter to Execute
```

2. Select **Reboot Current Image**.
3. Press **Enter**. The Hopper Plus reboots using the current image.

You must log in again to make further changes.

Restoring Configurations

After making configuration changes you can return the unit to its original state by restoring factory configuration settings. This command can be used put the unit into a known state to aid troubleshooting, or to ensure that company configurations are removed when decommissioning the unit.

To restore the factory configuration

1. From the Main Menu, select **`System Commands`**. The System Commands window is displayed.

```
                          System Commands


    Default System Image                    FACTORY-IMAGE
    Reboot a System Image                   FACTORY-IMAGE

    Reboot Current Image                    Press Enter to Execute
    Restore Factory Config and Reboot   ->  Press Enter to Execute
    Reset Radio Statistics                  Press Enter to Execute
    Reset Ethernet Statistics               Press Enter to Execute
```

2. Select **`Restore Factory Configuration and Reboot`**.
3. Press **Enter**. The factory configuration settings are restored.

Warning: When you restore factory configurations, the login passwords are automatically set to default values.

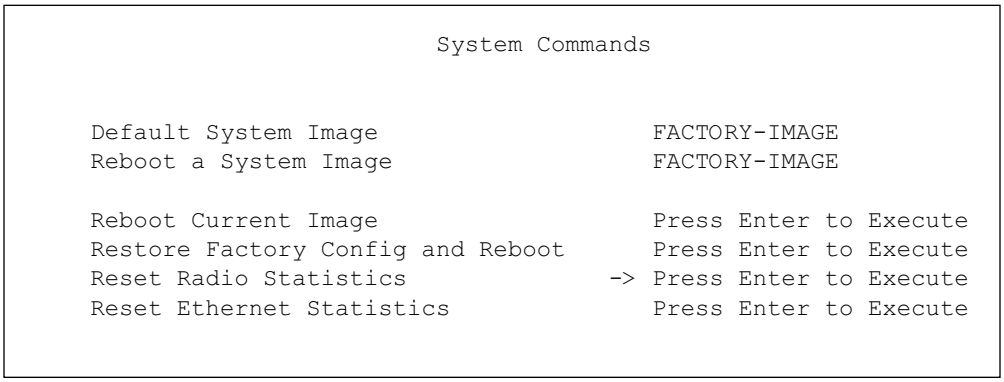
You must log in again to make further changes.

Resetting the RF/Ethernet Statistics

The statistics displayed in the RF/Ethernet Statistics window are cumulative, but can be reset to track events and for troubleshooting. For example, a suspected RF problem can be diagnosed by resetting the radio statistics and simulating the situation suspected of causing the problem.

To reset radio statistics

1. From the Main Menu, select **System Commands**.The System Commands window is displayed.

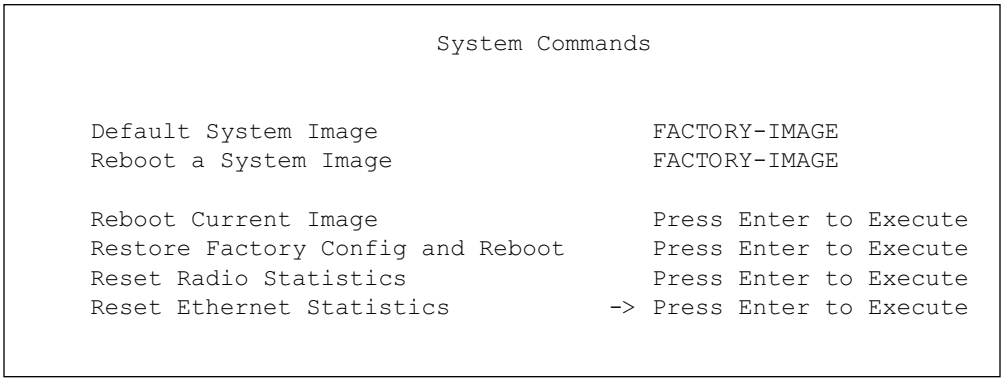


2. Select **Reset Radio Statistics**.
3. Press **Enter**. The radio statistics in the RF/Ethernet Statistics window are reset to 0 when Success appears beside the enter field.

See *Viewing RF/Ethernet Statistics*, page 55.

To reset Ethernet statistics

1. From the Main Menu, select **System Commands**. The System Commands window is displayed.



2. Select **Reset Ethernet Statistics**.
3. Press **Enter**. The Ethernet statistics in the RF/Ethernet Statistics window are reset to 0 when Success appears beside the enter field.

See *Viewing RF/Ethernet Statistics*, page 55.

Link Monitor Display

Viewing Link Monitor Statistics

Link performance statistics such as power and bit error rate can be viewed while the link monitor is running. Statistics are only available on the unit running the link monitor. The window is view only.

To view link monitor statistics

1. From the Main Menu, select **`Link Monitor Display`**. The RF Background Link Monitor Statistics window is displayed.

```
                    RF Background Link Monitor Statistics

    Link Monitor Rank                    0
    Base to Remote BER                     N/A
    Remote to Base BER                     N/A
    Missed Packet Count                  0
    Base to Remote Env Power             0
    Base to Remote Corr Power            0
    Remote to Base Env Power             0
    Remote to Base Corr Power            0
```

where

`Link Monitor Rank`	When viewed on the base unit, the rank of the remote unit whose link is being tested. When viewed on the remote unit, this field is zero.
`Base to Remote BER`	The bit error rate from the base to the remote. Displays “N/A” when the link monitor is not running.
`Remote to Base BER`	The bit error rate from the remote to the base. Displays “N/A” when the link monitor is not running.
`Missed Packet Count`	The number of missed packets.
`Base to Remote Env Power`	Envelope power received at the remote.
`Base to Remote Corr Power`	Correlation power received at the remote.
`Remote to Base Env Power`	Envelope power received at the base.
`Remote to Base Corr Power`	Correlation power received at the base.

Logout

Logging Out

To log out of the Main Menu

1. From the Main Menu, select **Logout**.
2. Press **Enter**.
3. Power down the computer.

or

1. Press the **Esc** key on the keyboard until you reach the `wilan` command line.

```
Enter ESC to return to Main Menu

wilan> logout
```

2. At the prompt, type **logout.**
3. Press **Enter**.

Setting Operating Mode with the MODE Button

The operating mode of a unit is usually set with the RF Station Configuration menu (see *Setting the Operating Mode*, page 33). However, operating mode can also be set using the MODE button located on the back panel of the Hopper Plus 120-24. No tools or equipment are required to use this method, however, a good understanding of the operating modes and LEDs is required.

The Hopper Plus starts up in Normal operating mode with the MODE LED off.. Three test modes are available.

Mode	Function	MODE LED
Transmit	Transmit only. Sends known packet data to the receiver.	Red
Receive	Receive only. Processes received packet data and displays statistics on RS-232 monitor.	Green
RSSI	Received Signal Strength Indicator. Unit receives packets and displays fade margin data on AIR LED.	Orange

You can change the operating mode by pressing the MODE button, as explained below.

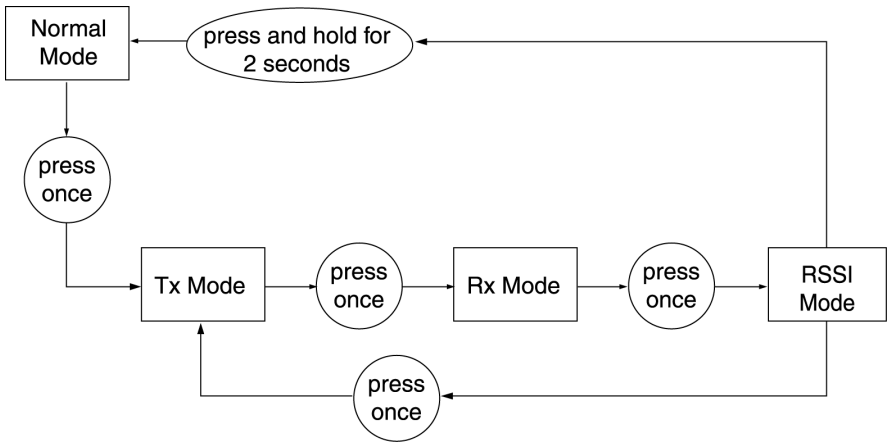
Using the MODE Button

To change the operating mode

1. Press the MODE button once and release it quickly. The unit goes into **Transmit** mode.
2. Press the MODE button once and the unit goes into **Receive** mode.
3. Press the MODE button once and the unit goes into **RSSI** mode.
4. Press the MODE button once and the unit returns to **Transmit** mode.
5. To return to **Normal** mode, press the MODE button and hold it down for at least two seconds. The AIR LED and MODE LED flash orange when the button has been held long enough.

Note: If you do not manually return the unit to normal mode, the unit automatically reboots and returns to normal mode when end of the test time period time is reached. The test time period cannot be set with the mode button—you must use the Main Menu to set the test mode timer (see *Setting Config Test Minutes*, page 48).

MODE Button Operation



See *Setting the Operating Mode*, page 33 for more information about operating modes.

Command Line Interface

The Hopper Plus 120-24 has a command line interface you can use to perform basic commands. The commands are a quick way to perform basic tasks while you remain logged into the configuration menus.

Using Basic Commands

While you are logged into the configuration menus, you can press the **Esc** key until you exit out of the menus to the command line prompt. The **`wilan>`** command line prompt appears.

You can execute all of the Hopper Plus 120-24 commands from this prompt.

The following are some of the commands you can execute at the prompt.

Command	Action	Example
`help`	show the following command summary list: `menu cls dir del ping logout exit quit`	`wilan>help menu`
`menu`	return to the configuration menus	`wilan>menu`
`cls`	clear the terminal screen	`wilan>cls`
`dir`	show a file directory	`wilan>dir`
`del`	delete a file	`wilan>del sample.txt`
`ping`	ping a remote IP address	`wilan>ping 198.168.200.5`
`logout`	log out of the command line interface or terminate a remote telnet session	`wilan>logout`
`exit`	log out of the command line interface or terminate a remote telnet session	`wilan>exit`
`quit`	log out of the command line interface or terminate a remote telnet session	`wilan>quit`

You can contact Wi-LAN customer support for additional information about the command line interface.

Appendix A: Planning Your Wireless Link

To ensure an effective and reliable wireless link, you need to perform some preliminary network planning *before* you install any hardware.

These steps include:

- ¥ determining the physical layout of your planned link
- ¥ planning your antenna and fade margin requirements
- ¥ configuring your RF link.

Planning the Physical Layout

Before you install the units, you must determine the physical locations for each component of the Hopper Plus 120-24 wireless system.

When you plan the physical layout, you need to:

- ¥ measure the physical distance between each pair of units using GPS, a map, or other distance measurement method
- ¥ determine antenna mast height requirements and fade margins
- ¥ determine cable requirements, including routing, between antenna and unit
- ¥ calculate the fade margin to determine the reliability of your wireless link
- ¥ determine environmental requirements

Measuring the Physical Distance Between Units

Use a mapping method to determine the distance between sites, and check the radio path to identify any obstructions in the site path between the two antennas. Due to the high frequency and low output power permitted in the ISM bands, no obstructions may exist between two antennas.

Determining Antenna Requirements

If you plan to install the unit indoors, the rubber duck antenna shipped with the unit may be adequate. The signal from this antenna can penetrate several walls, although metal obstructions or building features such as elevator shafts can deflect or inhibit radio waves. Empirical testing is advised in this case because all interiors are unique.

If you plan to install the antennas outdoors you will need to consider

- ¥ obtaining permission from building owners if you intend to install your antenna on a rooftop
- ¥ the height of the antenna required to ensure a radio Line of Sight between two antennas that define the RF link

- potential wind load and ice loading impact on the antenna
- regulatory restrictions, such as height, on antenna mast usage in the identified location
- grounding requirements. You must ensure that your antenna is properly grounded for lightning and installed according to the relevant electrical code for the location.

Determining Cable Requirements

If you are installing the antenna in an outdoor location, you will require 50 ohm coaxial cable to connect the unit to the antenna. You should minimize the length of the coaxial cable because the longer the cable is, the greater the cable losses are. You need to know the required cable lengths before you install the unit.

Note: You should use surge suppressors at the point of cable entry into the building.

Calculating Fade Margins

You can calculate the fade margin of your wireless link after you ve identified the antenna requirements. The fade margin enables you to predict the reliability of your wireless link. See *Calculating Path Loss* on page 78 for more information about fade margins.

Determining Environmental Requirements

Hopper Plus 120-24 units must be located in a weatherproof environment with an ambient temperature between 0… and 40… Celsius, and humidity from 0 to 95% non-condensing. Consider the building, heating, and air conditioning required to ensure that the unit operates within these conditions.

Optimizing the RF Link

Overview

This section explains how to obtain optimal performance from your RF link. Proper path planning ensures that each end of the RF link receives sufficient signal power to maintain a desired Bit Error Rate (BER). The effectiveness and reliability of your RF link depends on the following:

- antenna gain, beamwidth, F/B ratio, and cross-polarization discrimination
- distance between antennas and obstructions in the RF path
- above-ground height of the antennas
- length and type of coaxial cable connecting the Hopper Plus 120-24 and the antenna

The above factors will be used to calculate your link budget. The calculation indicates if your radio link is feasible over a given distance and path and if your RF link meets regulatory requirements. Link budgets are typically expressed in decibels (dB).

The following dB terms are used in this section:

Term	Description
dB	Decibel. A relative measure of power used to specify power gains and losses. The difference in power P1 and P2 expressed in dB is: $dB = 10 \times \log\left(\frac{P1}{P2}\right)$
dBd	The gain or loss of an antenna reference to a standard dipole. Gain of a Standard Dipole (dBd) = 2.14 dBi.
dBi	The gain or loss of an antenna referenced to an isotropic (theoretical point source) radiator. This measure is used with only antennas, as it quantifies gain or loss of a physical radiator with respect to a theoretical one.
dBm	A power measurement referenced to one milliwatt. This is an absolute measure of power rather than a relative measure such as a gain or a loss.

The following variables are used to calculate the link budget:

Variable	Description
System Gain	The maximum path loss that the system can support for usable data transmission.
EIRP (Effective Isotropically Radiated Power)	The power radiating from an antenna taking into account the output power from the transmitter, connector losses, cable losses, and the antenna gain.
Receiver Sensitivity	The minimum signal strength required for usable performance. Expressed in dBm.
Antenna Gain	Gain of the antenna over a dipole (dBd) or theoretical (dBi).
Propagation Loss	The signal loss experienced as it travels through the air. Expressed in dB.
Cable Loss	The signal loss experienced as it passes through the coaxial cable. Expressed in dB.
Path Loss	The total loss from one end of the path to the other. This includes propagation losses, cable losses, and any other losses that impact the system performance.

Working with System Gain

The system gain of a radio system is the difference between the transmitted power and a receiver s sensitivity threshold. The system gain of the Hopper Plus 120-24 is:

Formula:	System Gain = Transmission Power - Receiver Sensitivity @ 10^{-6} BER
Variables:	**Hopper Plus 120-24** Tx Power = 18.5 dBm Receiver Sensitivity = - 83 dBm (receiver sensitivity @ 10^{-6} BER)
Calculation:	**Hopper Plus 120-24** 18.5 dBm - (-83) dBm = - 101.5 dB
More info:	To ensure reliable communications, the system gain plus all antenna gains must be greater than the sum of all losses. For a reliable link, Wi-LAN recommends that the system gain plus all antenna gains be greater than the sum of all losses by a factor of 15 dB. This factor is known as the fade margin.

Calculating EIRP (Effective Isotropically Radiated Power)

EIRP is the power radiating from an antenna, taking into account the output power from the transmitter, the connector and cable losses, and the antenna gain. Unlike the Tx output power of the devices, EIRP is subject to both antenna gain and cable losses. Many antennas provide a directional gain, which can increase the effective radiated power. Losses such as cable losses subtract from this amount. You calculate the EIRP as follows:

Formula:	EIRP = Tx Power (dBm) - Cable Losses (dB) - Connector Losses (dB) + Antenna Gain (dBi)
Note:	The FCC regulatory body has set the EIRP limit to +36 dBm for point-to-multipoint applications per FCC 15.247(b)(3)(i). For point-to-point applications, the FCC EIRP can be 3 dB higher than +36 dBm for every 1 dB less Tx power below 30 dBm. Industry Canada specifies the EIRP limit to ≤+36 dBm as per RSS-210, 6.2.2(p). In accordance with ETS 300-328 for 2.4 GHz RLANs, the maximum EIRP shall not exceed +20 dBm, with a maximum SPD (Spectral Power Density) not exceeding +10 dBm/MHz. Confirmation is required with the relevant European national radio communications local authority for deviations from this specification.

Optimizing Antenna Gain

To ensure the best range and interference suppression, the external antenna should be directional, focusing the radio energy in one direction (toward the other end of the link). A directional antenna focuses the RF energy to the intended station rather than omni-directionally. This reduces interference from other systems operating at the same frequency.

Note: In some situations, you may want to use an omni-directional antenna in your system design. For example, you would use an omni-directional antenna for a base station with remote sites situated in a 360… path around it.

When you select an antenna, pay particular attention to the gain specification. When you select an antenna for a remote station, select an antenna with a gain that provides at least 15 dB fade margin.

Antenna gain is specified in either dBi or dBd. When an antenna is specified in dBd, add 2.14 dB to the value to convert it to dBi.

Calculating Propagation Loss

The propagation loss is the attenuation (reduction) in RF signal energy as it travels through space. In most wireless systems, losses through space are the major contributor to signal attenuation. When you know the intended installation locations of the base and remote stations, determine the physical line of sight distance and then calculate the RF attenuation as follows:

Formula: Attenuation (dB) for 2.4 GHz band = 100 dB + 20log(d_{km})

where:

d_{km} = Distance in Kilometers

100 dB = Pathloss Constant in the 2.4 GHz band

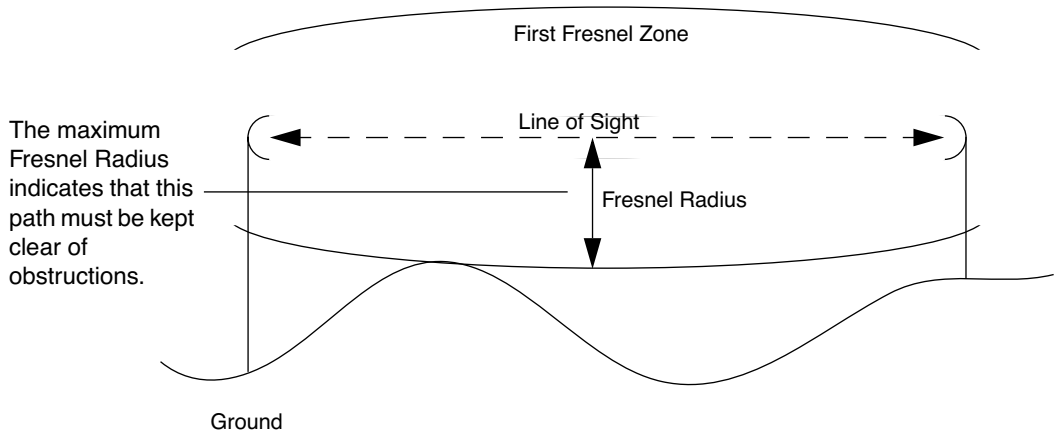
Working with the Fresnel Zone

It is essential that you locate your antennas at maximum above-ground height to ensure that

1. all ground-based obstructions are cleared from the Line of Sight path
2. the Fresnel Zone is clear of obstructions

The Fresnel Zone is the expansion of the RF signal radio angles in the vertical plane near the middle of the RF path. Following diagram shows a Fresnel Zone:

Fresnel Zone



For the 2.4 GHz band, the approximate Fresnel Radius calculated as follows:

Formula: $$\text{Fresnel Radius (meters)} = 3.4\sqrt{d_{km}} + \left(\frac{d_{km}}{8.12}\right)^2$$

Calculating Cable Loss

Cable and connector losses affect the operation of the wireless link and therfore should be kept to a minimum. The two primary coaxial cable specifications for the Hopper Plus 120-24 are:

- cable must be 50 ohms nominal impedance
- cable must be of a low loss type

Generally, cable losses are specified in dB/foot or dB/meter. Following is an example of cable loss ratings:

	Cable Type (loss in dB/meter)					
Frequency	LMR400	LMR600	LDF2-50	LDF4-50A	LDF5-50A	LDF6-50
2.4 GHz	0.22	0.144	0.190	0.128	0.073	0.053

Note: When you calculate path loss, you should add 1dB at each end of the link to compensate for connector losses in addition to the cable loss value.

Calculating Path Loss

Path loss describes the total RF attenuation throughout the system from Tx antenna to Rx antenna. This includes the losses as the RF signal travels through space plus Tx and Rx cable loss, and Tx and Rx connector loss. Use the following formula to calculate path loss:

Formula: Path Loss = Tx and Rx Cable Loss + Tx and Rx Connector Loss + Propagation Loss

Once you know the path loss, you can compare the value to the system gain value. If the system gain value is greater than the path loss, the link is feasible. See *Working with System Gain* on page 74 for more information about system gain.

Working with the Fade Margin

Total antenna gain is:
Tx Antenna Gain + Rx Antenna Gain

The amount by which the system gain plus the total antenna gain exceeds the path loss is called the fade margin. As calculated, the fade margin is the number of dB that the received signal strength exceeds the minimum receiver sensitivity. You require some level of fade margin for any wireless system. The fade margin compensates for RF path fading due to weather conditions or objects that induce multipath interference.

The Wi-LAN recommended fade margin for the Hopper Plus 120-24 is a minimum of 15 dB. The sum of the cable losses, connector losses, propagation losses, and the 15 dB required fade margin should be less than the sum of the system gain and antenna gain.

Link Budget Example

The values for cable and connector losses in this example are only for illustration. You will need to work these out for your specific installations.

Putting everything together, you must satisfy the following equations to have a successful link:

Formulas:

System Gain + Antenna Gain ≥ Propagation Loss + Desired Fade Margin + Cable Losses + Connector Losses

or

Actual Fade Margin ≥ System Gain + Antenna Gain - Propagation Loss - Cable Losses - Connector Losses

and

Actual Fade Margin ≥ Desired Fade Margin

where:

System Gain = Tx Power - Rx Sensitivity
Antenna Gains = Tx Antenna Gain + Rx Antenna Gain
Cable Losses = Base Cable Losses + Remote Cable Losses
Connector Losses = Base System Connector Losses + Remote System Connector Losses

Variables:

Desired Fade Margin	=	15 dB
Tx Power	=	18.5 dBm
Rx Sensitivity	=	-83 dBm
Tx Antenna Gain	=	11 dBi
Rx Antenna Gain	=	9 dBi
Propagation Loss for desired range of 1km	=	100 + 20 x log(1) = 100 dB
Tx Cable Losses (2m LMR400)	=	2 * 0.22 = 0.44 dB
Rx Cable Losses (2m LMR 400)	=	2 * 0.22 = 0.44 dB
Tx Connector Losses	=	1 dB
Rx Connector Losses	=	1 dB

Variable Calculations:

System Gain = 21 - (-79) = 100 dB
Antenna Gains = 11 + 9 = 20 dBi
Cable Losses = 0.44 + 0.44 = 0.88 dB
Connector Losses = 1 + 1 = 2 dB

Actual Fade Margin Calculation:

Actual Fade Margin = 100 + 20 - 100 - .88 - 2 = 17.12 dB

Analysis:

We have achieved the goal of Actual Fade Margin ≥ 15 dB.

Antenna Basics

Antennas focus and absorb radio energy in specific directions, depending on their design. They can be tuned to certain frequency ranges; the Hopper Plus 120-24 antennas must be tuned to 2.4 - 2.5 GHz.

This section contains some basic information about antenna parameters and how to select and install antennas for use in your wireless system.

Antenna Parameters

Parameter	Description
Gain	• Antennas have a gain associated with them, which is a measure of their ability to amplify signals in their tuned band. • Antenna gain is achieved by focusing the signal. A higher gain antenna has more compressed signal.
dBd vs. dBi	• Antenna gain must be measured over a known reference and is often expressed as either dBd or dBi. • dBd is antenna gain referenced over a half-wave dipole which is an antenna that has a donut shaped radiation pattern. • dBi is antenna gain referenced over an isotropic radiator which is a theoretical antenna that radiates equally in all directions (e.g. the sun). • Wi-LAN references antenna gain in dBi. The conversion factor is: 0 dBd = 2.14 dBi
Beamwidth	• The beamwidth of an antenna describes how a signal spreads out from the antenna, and the range of the reception area. • Beamwidth is measured between the points on the beam pattern at which the power density is half of the maximum power. This is often referred to as the -3 dB points. • A high gain antenna has a very narrow beamwidth and may be more difficult to align.
Downtilt or uptilt	• Some antennas have either an associated downtilt or an uptilt. The tilt further focuses the signal downward or upward with respect to the horizon. • A tilt may be either electrically built into the antenna or achieved mechanically with the mounting gear. • A downtilt or uptilt may be required when there is a significant deviation between the elevation of the remote site(s) and the base site.
F/B	• Front-to-back ratio. • Directional antennas focus the signal in a forward path. This is achieved by directing the signal in one direction that reduces the signal in the opposite direction. • A higher gain antenna typically has a greater F/B ratio.

Parameter	Description
XPD	• Polarity and Cross-Polarization Discrimination (XPD). • Antennas have an associated polarity, which is the orientation of the radiating element with respect to earth. • Antennas are usually described as vertical, horizontal, or circularly polarized. The polarity of all antennas used in a system must be the same. • Cross-Polarization Discrimination specifies the signal isolation achieved when the receiving element is perpendicular to the radiating element. This can be advantageous when co-locating radio systems.
VSWR	• Voltage standing wave ratio. • VSWR is the voltage ratio of minimum to maximum across a transmission line. • A VSWR of 2.0:1 or less in an antenna is considered effective. Most antennas have a VSWR of 1.5:1. • For example, when using a radio with a 4 watt output with an antenna VSWR of 1.5:1, the reflected power will be 160 milliwatts.

Implementation Considerations

Following are some key items to consider when selecting and installing antennas for your wireless network:

Item	Description
Absorption	• Antennas mounted too close to “soft” objects, such as trees, may experience a reduction in signal strength due to absorption. • Absorption is most often encountered in applications installed during the fall or winter months, and the problem does not become evident until the spring.
Diffraction	• Diffraction occurs when a radio signal reflects or bounces off of a solid object. • The level of diffraction could lead to connectivity problems if the remaining signal level is too low. • Two types of diffraction are shadowing and multipath.
Shadowing	• Shadowing is a form of diffraction that is typically caused when antennas are mounted too close to a structure and they lose a portion of the signal lobe due to reflection. The receive antenna is in a shadowed area. • To minimize shadowing, ensure that there is adequate height above structures when mounting antenna equipment.
Multipath Interference	• Multipath is a form of diffraction in which the reflected signal arrives at the receiver at different times which confuses the receiver. • Multipath may be interpreted as interference by the receive antenna, and can result in bit errors and processing delays.

Selecting Antennas

There are several factors to consider when selecting the right antenna for a wireless application. Following are some initial questions you should ask before selecting an antenna:

- What is the operating frequency range?
- Will this be a point-to-point or point-to-multipoint application? Ensure that you consider if the application will change in the future.
- What are the coverage requirements?
- How far is the remote site(s)?
- What is the gain requirement?
- What is the elevation of the remote site(s) with respect to the base station and will additional downtilt/uptilt be necessary at either the base or remote site to compensate?
- Will there be any obstructions in the path?
- Will systems be co-located? What polarity will be used?
- What are the regional environmental conditions? For example, is there windloading, salt air, excessive moisture, ice buildup?
- What is the antenna lifetime expectation?
- What are the site and mounting options?
- What are the restrictions in the locale regarding the effective radiated power permitted from the antenna?
- Will antenna appearance be a factor?

Wi-LAN's Antenna Selection

Following are some antenna selections for the Wi-LAN Hopper Plus 120-24 product:

Antenna Type	Frequency	Gain
Omni	2.4 GHz	6, 9, 12
Dish	2.4 GHz	18, 19, 21, 24, 27
Planar	2.4 GHz	11, 13, 16

Antenna Installation Factors

Following are some installation factors you should consider when installing antennas into your wireless system:

Factor	Description
Maximizing the Hopper Plus 120-24's Capabilities	• Minimize obstructions in the radio path. • Line Of Sight (LOS) is crucial for reliability. • Ensure that equipment is installed correctly. • Ensure proper grounding, testing, and alignment of antennas. • Install in environmental conditions that are suitable for the Hopper Plus 120-24. • Select proper antennas and cable for the application. • Ensure sufficient gain for the intended application.
Safety	• Proper grounding of antenna apparatus in accordance with respective Electrical Code(s) is crucial. • Wi-LAN recommends using a surge arrestor where the antenna cable enters the building. • All installations should be completed by a qualified and competent RF technician.
EIRP	• Effective Isotropically Radiated Power (EIRP) • EIRP is the amount of power that is transmitted to the air from the antenna. • EIRP levels depend on the power of the radio transmitter, the size of the antenna, and the losses incurred in the antenna cable. • To remain license-exempt the EIRP must remain under 4 watts or 36 dBm in Canada and the United States for point-to-multipoint applications. In Europe, this value is reduced to 100 mW or 20 dBm. **Note:** EIRP = Power out of unit – Power lost in cable + Gain in power from Antenna
Fade Margin	See Calculating Fade Margins on page 72.
LOS	• Line of Sight (LOS) • LOS is a football shaped pattern known as the Fresnel Zone, which must be kept clear of obstructions. See Working with the Fresnel Zone on page 76 for more information. • Visual line of sight must be achieved. When standing at the antenna position, you must be able to see the remote antenna.

Minimal Clearance Above Obstructions

For the Hopper Plus 120-24, the absolute minimum clearance above obstructions requirements are as follows (in meters):

- $3.4m \times \sqrt{d_{km}}$ @ 2.4 GHz

Following are some example clearance requirements:

Metric		Imperial	
Distance (km)	2.4 GHz Clearance (m)	Distance (miles)	2.4 GHz Clearance (ft)
0.5	2.4	0.5	10.0
1	3.4	1	14.3
2	4.9	2	20.5
3	6.0	3	25.7
5	8.0	5	34.9
8	10.6	8	48.3
10	12.3	10	57.6
15	16.6	15	83.8

Note: There is also a correction factor added to compensate for curvature of the earth. This correction factor is not required when the correction value is negligible < 10 km. Wi-LAN s Link Analysis Spreadsheet takes this variable into account automatically.

Installing Antennas

If your antennas will be located on a support structure, or on top of a tower, you should have the antenna installed professionally.

Ensure the following:

- dipole antennas are oriented vertically (point up).
- antennas for the system have the same polarity (vertical, horizontal, or circular).
- connectors attaching the coaxial cable to the antenna are properly weatherproofed.
- a drip loop is formed at the building entrance, to prevent water flowing down the coaxial cable and entering the installation building.
- the coaxial cable is secured to the supporting structure at one meter intervals. This prevents wind damage and frost loading problems.
- the antenna is firmly attached to the mast to prevent it from falling, yet has some flexibility so you can move the antenna to fine-tune its position.
- the coaxial cable is connected to the antenna and to the antenna port on both sides of the link (base and remote stations).
- the antennas are grounded properly.

Fine-tuning Antennas

You can fine-tune the antennas by physically moving the antenna. When the remote antenna is correctly aligned, the AIR LED is orange, indicating appropriate reception and acknowledgment of sync tokens from the base station. You can use the Receive and Transmit operating modes to test the link while adjusting the antennas to minimize BER and lost packets, and maximize received power. You can use the RSSI operating mode to maximize RSSI.

Once the antennas are adjusted to maximize performance, secure them properly to the support structures.

Co-locating Units

When Hopper Plus antennas are located on the same mast, you must take care to ensure the output power from one radio does not overpower another co-located bridge, even if the units are operating on different channels. Contact Wi-LAN technical support for antenna and installation assistance when co-locating units.

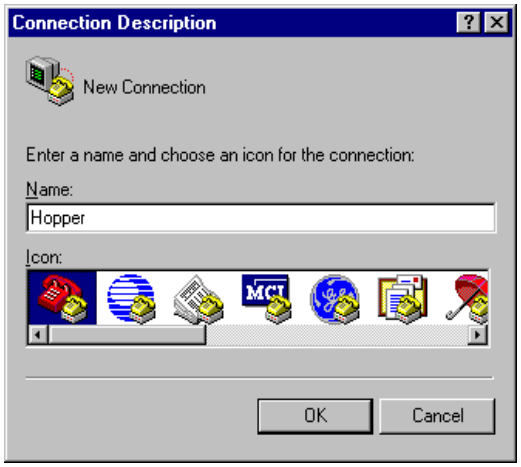
Appendix B: Using HyperTerminal

The Windows 95/98 operating system includes a terminal emulation program called HyperTerminal¤. You can use this program to access the Hopper Plus 120-24 configuration menus through the MANAGEMENT port on the front of the unit.

Starting HyperTerminal

To start HyperTerminal

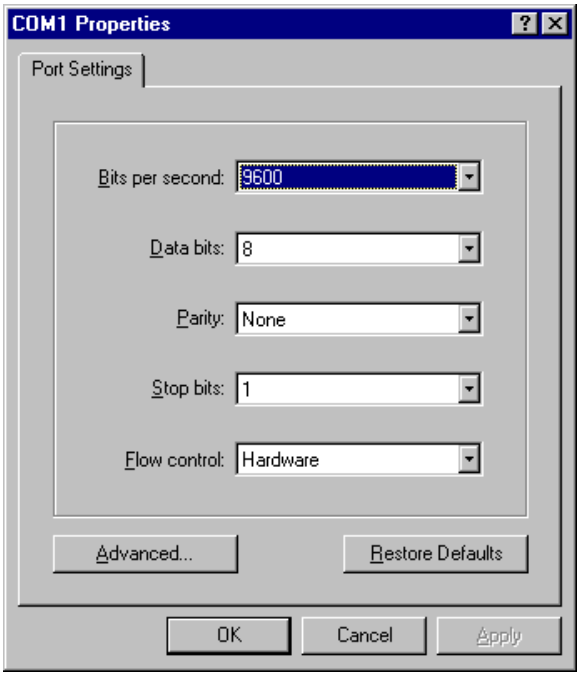
1. In Windows 95 or 98, from the **Start** menu, select **Programs**, **Accessories**, **Communications**, **HyperTerminal.** The Connection Description window is displayed:



2. Select an icon for the HyperTerminal session and type a connection name.

3. Click **OK**. The Connect To window is displayed:

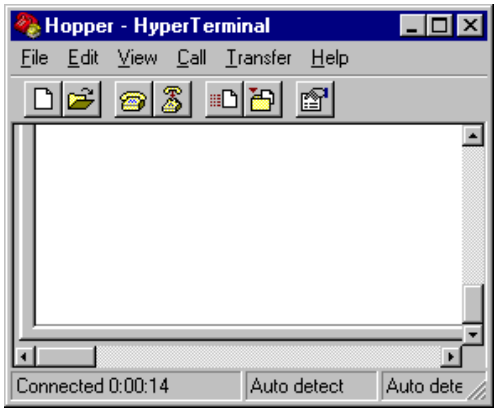
4. In the Connect using field, select the appropriate COM port.
5. Click **OK**. The COM Properties window is displayed:



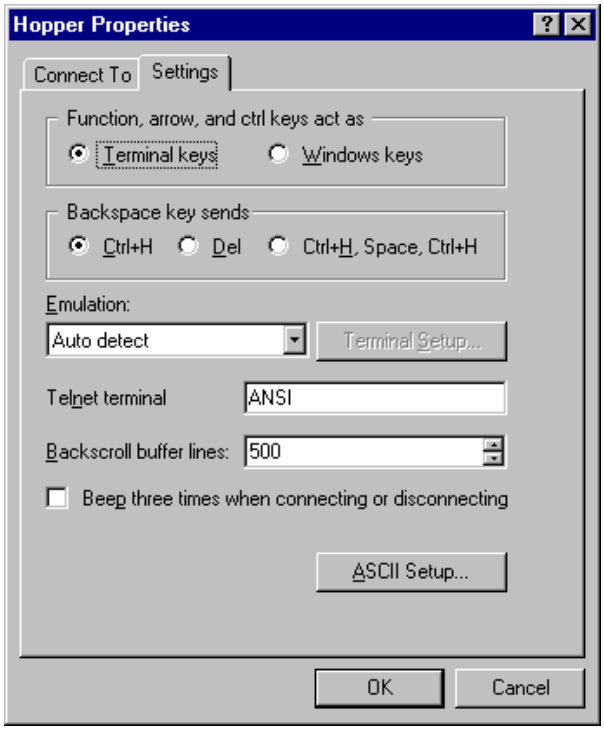
6. Enter the following settings:

Bits per second	9600
Data bits	8
Parity	None
Stop bits	1
Flow control	None

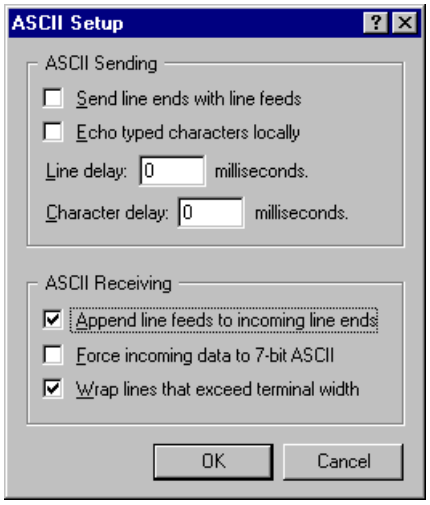
7. Click **OK**. The Hopper - HyperTerminal window is displayed:



8. From the File menu, select **Properties**. The Hopper Properties window is displayed:



9. Click the **Settings** tab and then click **ASCII Setup**. The ASCII Setup window is displayed:



10. In the ASCII Sending area, choose the following settings:

Send line ends with line feeds	Clear the checkbox.
Echo typed characters locally	Clear the checkbox.
Line delay	Type 0.
Character delay	Type 0.

11. In the ASCII Receiving area, do the following:

Append line feeds to incoming line ends	Click to select the checkbox.
Force incoming data to 7-bit ASCII	Clear the checkbox.
Wrap lines that exceed terminal width	Click to select the checkbox.

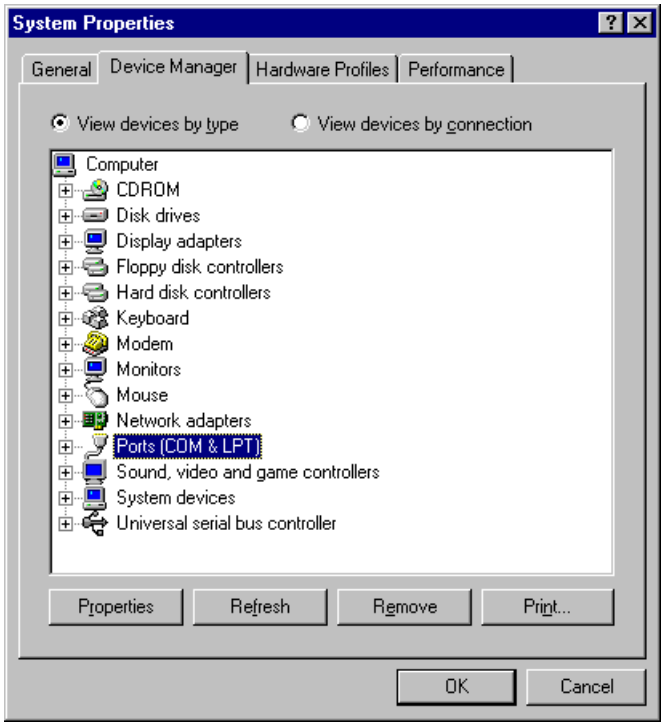
12. Click **OK**. The ASCII Setup window closes.
13. Click **OK**. The Hopper Properties window closes.
14. Use a cross-connect RS-232 serial cable to connect the communications port of the PC to the DB9 connector on the Hopper Plus 120-24.
15. Power up the Hopper Plus 120-24 unit.
16. Press **Enter**. The Hopper Plus 120-24 Configuration menu is displayed in the HyperTerminal window.

Determining the Communications Port

To set the communications port in the HyperTerminal session, you need to know which communications port you are using on your computer. Most laptops are connected through COM 1, but PCs can use COM 1 through 3.

To determine the communications port

1. Right-click the **My Computer** icon on your desktop and from the shortcut menu, select **Properties**. The System Properties window is displayed:



2. Click the **Device Manager** tab and click **Ports (COM & LPT)**. A list of the available communications ports appears.
3. Select the appropriate port for your HyperTerminal session.

Note: A connection to the Hopper Plus 120-24 Configuration menus will not be established if the wrong port is selected. If this occurs, reconfigure the HyperTerminal to connect using another available communications port.

Appendix C: Configuring a Simple Data Network

A simple peer-to-peer network can be configured to perform file transfers between two computers. This section describes the following:

- Checking the Network Adaptor Installation
- Configuring the Network
- Enabling the Sharing Feature on the Hard Disk Drive

Checking the Network Adaptor Installation

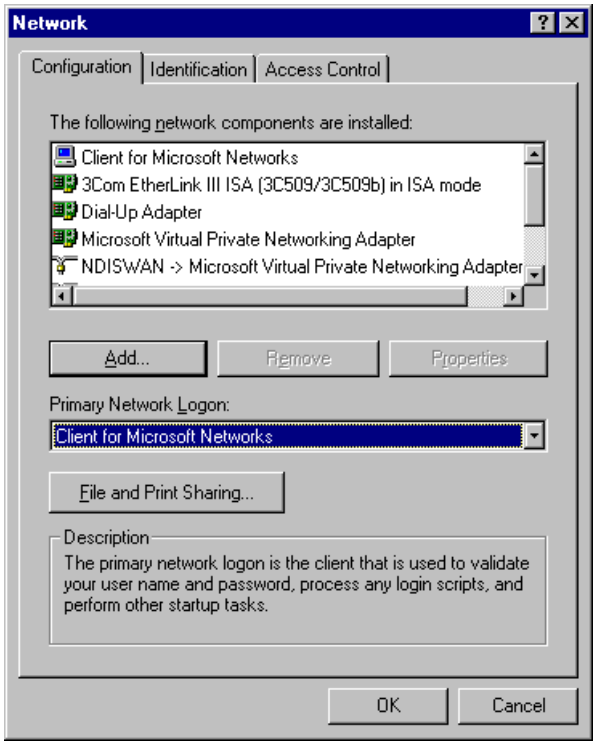
To check the network adaptor installation

1. From the **Start** menu, select **Settings**, **Control Panel**. The Control Panel window appears.
2. Double-click the **System** icon. The System Properties window appears.
3. Click the **Device Manager** tab.
4. Double-click **Network Adapters**. A list of installed devices appears.
5. Check for trouble indicators with the previously installed network adaptor(s).
6. Click **OK**. The Control Panel window appears.

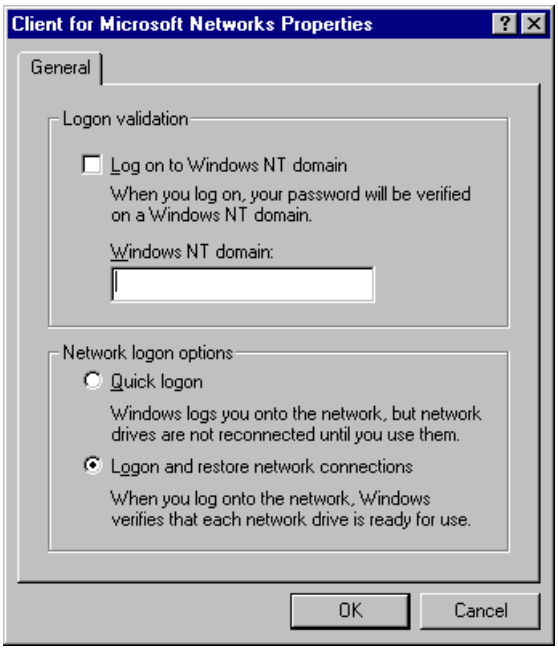
Configuring the Network

To configure the network

1. In the Control Panel window, double-click the **Network** icon. The Network window is displayed:



2. In the list of network components area, double-click **Client for Microsoft Networks**. The Client for Microsoft Networks Properties window is displayed:



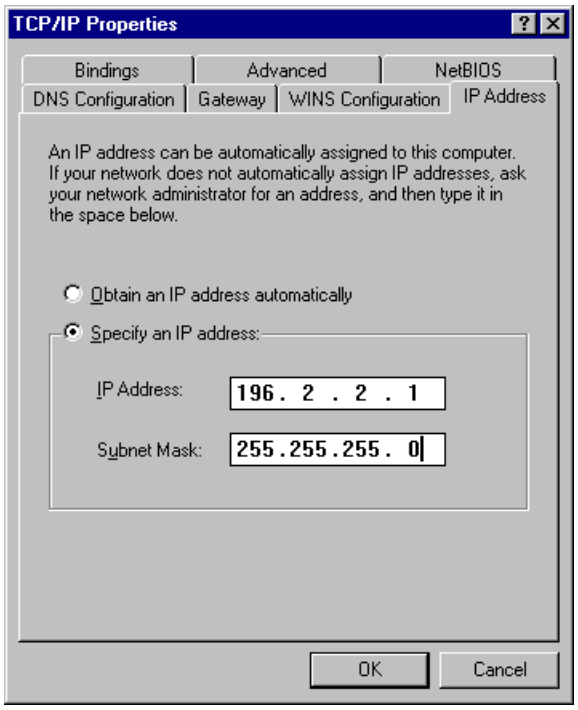
Note: If Client for Microsoft Networks is not listed, click **Add** and select **Client, Add, Microsoft, Client for Microsoft Networks**, and then click **OK**.

3. In the Client for Microsoft Networks Properties window, do the following:

Log on to Windows NT domain	Clear the checkbox.
Windows NT domain	Clear the field.
Logon and restore network connections.	Click the button.

4. Click **OK**. The Client for Microsoft Networks Properties window closes.

5. In the *Network* window, double-click **TCP/IP**. The TCP/IP Properties window is displayed:



Note: If TCP/IP is not listed in the Network window, click Add and select **Protocol, Add, Microsoft, TCP/IP**, and then click **OK**.

6. Click the **IP Address** tab.
7. Click **Specify an IP Address**, and type the following:

IP Address	196.2.2.1 **Note:** Increment the last digit by 1 (i.e. type 196.2.2.2) when configuring the second computer.
Subnet Mask	255.255.255.0 **Note:** This number is the same for both computers.

8. Click **OK.**
9. Click **File and Print Sharing**. The File and Print Sharing window appears.
10. Click to select the **I want to be able to give others access to my files** checkbox.
11. Click **OK**.
12. In the Network window, click the **Identification** tab and type the following:

Computer Name	A unique name for each computer. For example, computer 1 and computer 2.
Workgroup	A workgroup name. For example, Test. **Note:** All computers in the network must have the same workgroup name.

Computer Description	A description of the type of computer used. For example, laptop or desktop.

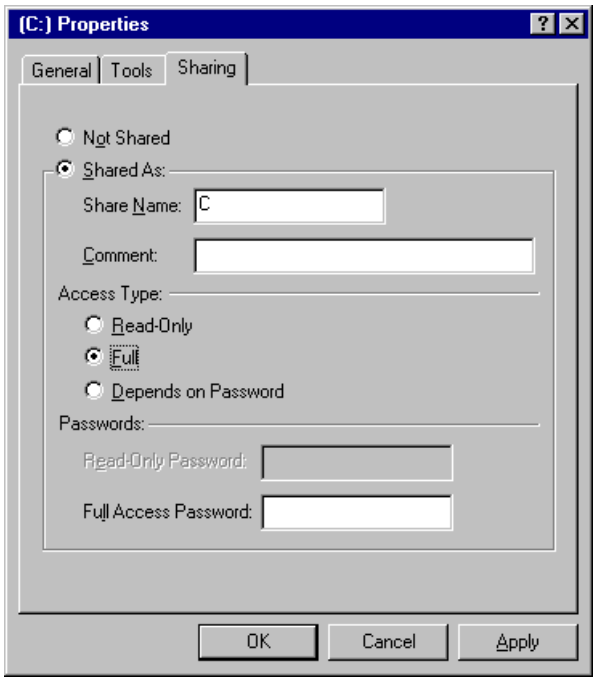
13. In the Network window, click the **Access Control** tab.
14. Click **Share Level Access Control**.
15. Click **OK**.
16. You are prompted to restart your computer.
17. Click **Yes**.
    Wait for your computer to restart, then proceed with Enabling the Sharing Feature on the Hard Disk Drive.

Enabling the Sharing Feature on the Hard Disk Drive

To enable the sharing feature on the hard disk drive

1. On the desktop, double-click **My Computer**. The My Computer window is displayed:

2. Right-click the hard disk drive icon (typically drive C:), and select **Open**. The Properties window is displayed:



3. Click the **Sharing** tab, and choose the following:

Shared As	Click the radio button.
Share Name	Type C.
Comment	Leave this field blank.
Access Type	Click to select Full.
Passwords	Leave these fields blank.

4. Click **OK**.
5. Repeat this procedure for all PCs in the network.

Once all PCs in the network have been shared, you can view the network by double clicking the **Network Neighborhood** icon that appears on each PC desktop.

Appendix D: SNMP MIB

About SNMP MIB

Simple Network Management Protocol (SNMP) Management Information Block (MIB) software is included with each Hopper Plus unit. It enables you to configure, monitor, and control units via the Ethernet or air. (SNMP-compatible network management software is available commercially and as shareware.)

Units in remote and hard-to-reach locations can be easily configured, and network managers can avoid or reduce downtime by monitoring network throughput, packet collision rates, and interference.

SNMP is a protocol used to remotely manage network elements by polling, setting terminal values, and monitoring network statistics and events. It provides a mechanism for the exchange of management information in a TCP/IP-based Internet environment.

Community names are used by the SNMP manager to determine access privileges (see *Setting Community Names* on page 58).

SNMP consists of three elements.

SNMP Element	Description
Manager	Is installed on the network's host computer and is controlled by the network administrator. From the host, the Manager configures Agents, or polls Agents for information.
Agent	Runs on each unit. An Agent accepts configuration commands from the Manager and collects network and terminal information specified in the MIB.
Management Information Block (MIB)	Is a database that is accessed by a specific set of commands that you execute using the SNMP manager. There is a standard MIB and a Wi-LAN customized MIB that stores information relevant to the operation of a wireless network.

Wi-LAN Object Identifier Nodes

The Hopper Plus 120-24 uses SNMP version 1, which is MIB 2 compliant. All OID (Object Identifier) nodes in the 120-24 private Wi-LAN MIB are numbered 1.3.6.1.4.1.2686.2.**n** where **n** is a private Wi-LAN MIB node number or branch of nodes.

All nodes containing statistical information are cleared on power up and reset.

Values in all writeable nodes are stored in FLASH and are retained until overwritten by the administrator, even following power down or reset.

From	To	Classification
1.3.6.1.4.1.2686.2.1.1	1.3.6.1.4.1.2686.2.1.104	Configuration
1.3.6.1.4.1.2686.2.1.100.1	1.3.6.1.4.1.2686.2.1.100.7	Configuration: System Image List
1.3.6.1.4.1.2686.2.2.1	1.3.6.1.4.1.2686.2.2.7	System Status
1.3.6.1.4.1.2686.2.3.1	1.3.6.1.4.1.2686.2.3.32	Statistics
1.3.6.1.4.1.2686.2.4.1	1.3.6.1.4.1.2686.2.4.7	System Commands

Using Object Identifier Nodes

Following are descriptions of the nodes in the Hopper Plus 120-24 MIB:

Group	Node Label	Address/Node	Syntax	Access	Description
Configuration	serialNumber	1.3.6.1.4.1.2686.2.1.1	DisplayString (0..15)	Read Only	The Hopper Plus 120-24 unit Serial Number.
Configuration	productionDate	1.3.6.1.4.1.2686.2.1.2	DisplayString (0..15)	Read Only	The Hopper Plus 120-24 unit Date of Manufacture.
Configuration	macAddress	1.3.6.1.4.1.2686.2.1.3	PhysAddress	Read Only	Ethernet MAC Address.
Configuration	systemName	1.3.6.1.4.1.2686.2.1.4	DisplayString (0..31)	Read/Write	The Hopper Plus 120-24 unit System Name.
Configuration	unitLocation	1.3.6.1.4.1.2686.2.1.5	DisplayString (0..31)	Read/Write	User configurable Unit Location.
Configuration	contactName	1.3.6.1.4.1.2686.2.1.6	DisplayString (0..31)	Read/Write	User configurable Contact Name.
Configuration	config7	1.3.6.1.4.1.2686.2.1.7	INTEGER		Spare.
Configuration	config8	1.3.6.1.4.1.2686.2.1.8	INTEGER		Spare.
Configuration	config9	1.3.6.1.4.1.2686.2.1.9	INTEGER		Spare.
Configuration	ipAddress	1.3.6.1.4.1.2686.2.1.10	IpAddress	Read Only	Internet IP Address: default = 192.168.1.100.
Configuration	ipNewAddress	1.3.6.1.4.1.2686.2.1.11	IpAddress	Read/Write	New Internet IP Address.
Configuration	ipSubnetMask	1.3.6.1.4.1.2686.2.1.12	IpAddress	Read/Write	IP Subnet Mask: default = 255.255.255.0.
Configuration	ipGatewayAddr	1.3.6.1.4.1.2686.2.1.13	IpAddress	Read/Write	IP default gateway address (currently not used).
Configuration	ipNetmanAddr	1.3.6.1.4.1.2686.2.1.14	IpAddress	Read/Write	SNMP network management station IP address.
Configuration	ipPacketFiltering	1.3.6.1.4.1.2686.2.1.15	INTEGER	Read/Write	IP packet filtering: 0 = disabled, 1 = enabled.
Configuration	ipAddressFiltering	1.3.6.1.4.1.2686.2.1.16	INTEGER	Read/Write	IP address filtering: 0 = disabled, 1 = enabled.

Group	Node Label	Address/Node	Syntax	Access	Description
Configuration	ipFilter1Range	1.3.6.1.4.1.2686.2.1.17	INTEGER	Read/Write	IP address filter 1 range: (0-255).
Configuration	ipFilter1Base	1.3.6.1.4.1.2686.2.1.18	IpAddress	Read/Write	IP filter 1 base address.
Configuration	ipFilter2Range	1.3.6.1.4.1.2686.2.1.19	INTEGER	Read/Write	IP address filter 2 range: (0-255).
Configuration	ipFilter2Base	1.3.6.1.4.1.2686.2.1.20	IpAddress	Read/Write	IP filter 2 base address.
Configuration	ipFilter3Range	1.3.6.1.4.1.2686.2.1.21	INTEGER	Read/Write	IP address filter 3 range: (0-255).
Configuration	ipFilter3Base	1.3.6.1.4.1.2686.2.1.22	IpAddress	Read/Write	IP filter 3 base address.
Configuration	ipFilter4Range	1.3.6.1.4.1.2686.2.1.23	INTEGER	Read/Write	IP address filter 4 range: (0-255).
Configuration	ipFilter4Base	1.3.6.1.4.1.2686.2.1.24	IpAddress	Read/Write	IP filter 4 base address.
Configuration	ipFilter5Range	1.3.6.1.4.1.2686.2.1.25	INTEGER	Read/Write	IP address filter 5 range: (0-255).
Configuration	ipFilter5Base	1.3.6.1.4.1.2686.2.1.26	IpAddress	Read/Write	IP filter 5 base address.
Configuration	config27	1.3.6.1.4.1.2686.2.1.27	INTEGER		Spare.
Configuration	config28	1.3.6.1.4.1.2686.2.1.28	INTEGER		Spare.
Configuration	config29	1.3.6.1.4.1.2686.2.1.29	INTEGER		Spare.
Configuration	stationType	1.3.6.1.4.1.2686.2.1.30	INTEGER	Read Only	Current station type: 0 = remote, 1 = base.
Configuration	stationRank	1.3.6.1.4.1.2686.2.1.31	INTEGER	Read Only	Current station RF rank: 1 to 1000.
Configuration	centerFreq	1.3.6.1.4.1.2686.2.1.32	INTEGER	Read Only	Current RF center frequency (GHz)
Configuration	securityWord1	1.3.6.1.4.1.2686.2.1.33	INTEGER	Read Only	Current RF security password 1.

Channel	Frequency	Channel	Frequency
1	2.4258	5	2.4455
2	2.4302	6	2.4498
3	2.4345	7	2.4542
4	2.4400		

Group	Node Label	Address/Node	Syntax	Access	Description
Configuration	securityWord2	1.3.6.1.4.1.2686.2.1.34	INTEGER	Read Only	Current RF security password 2.
Configuration	securityWord3	1.3.6.1.4.1.2686.2.1.35	INTEGER	Read Only	Current RF security password 3.
Configuration	securityWord4	1.3.6.1.4.1.2686.2.1.36	INTEGER	Read Only	Current RF security password 4.
Configuration	securityWord5	1.3.6.1.4.1.2686.2.1.37	INTEGER	Read Only	Current RF security password 5.
Configuration	scramblingCode	1.3.6.1.4.1.2686.2.1.38	INTEGER	Read Only	Current RF scrambling code word.
Configuration	acquisitionCode	1.3.6.1.4.1.2686.2.1.39	INTEGER	Read Only	Current RF acquisition code (0-15).
Configuration	configMinutes	1.3.6.1.4.1.2686.2.1.40	INTEGER	Read Only	Current RF configuration test minutes (1-120).
Configuration	repeaterMode	1.3.6.1.4.1.2686.2.1.41	INTEGER	Read Only	Current base station repeater mode: 0 = disabled, 1 = enabled.
Configuration	systemType	1.3.6.1.4.1.2686.2.1.42	INTEGER	Read Only	Current base station symmetry: 0 = asymmetric, 1 = symmetric.
Configuration	remoteGroup	1.3.6.1.4.1.2686.2.1.43	INTEGER	Read Only	Current RF group identifier: 0 = closed, 1 - 63 = special group.
Configuration	config44	1.3.6.1.4.1.2686.2.1.44	INTEGER		Spare.
Configuration	config45	1.3.6.1.4.1.2686.2.1.45	INTEGER		Spare.
Configuration	defStationType	1.3.6.1.4.1.2686.2.1.46	INTEGER	Read Only	Default Station type: 0 = remote, 1 = base.
Configuration	defStationRank	1.3.6.1.4.1.2686.2.1.47	INTEGER	Read Only	Default Station RF Rank.

Group	Node Label	Address/Node	Syntax	Access	Description
Configuration	defCenterFreq	1.3.6.1.4.1.2686.2.1.48	INTEGER	Read Only	FLASH RF center frequency (GHz)

Channel	Frequency	Channel	Frequency
1	2.4258	5	2.4455
2	2.4302	6	2.4498
3	2.4345	7	2.4542
4	2.4400		

Configuration	defSecurityWord1	1.3.6.1.4.1.2686.2.1.49	INTEGER	Read Only	Default RF security password 1.
Configuration	defSecurityWord2	1.3.6.1.4.1.2686.2.1.50	INTEGER	Read Only	Default RF security password 2.
Configuration	defSecurityWord3	1.3.6.1.4.1.2686.2.1.51	INTEGER	Read Only	Default RF security password 3.
Configuration	defSecurityWord4	1.3.6.1.4.1.2686.2.1.52	INTEGER	Read Only	Default RF security password 4.
Configuration	defSecurityWord5	1.3.6.1.4.1.2686.2.1.53	INTEGER	Read Only	Default RF security password 5.
Configuration	defScramblingCode	1.3.6.1.4.1.2686.2.1.54	INTEGER	Read Only	Default RF scrambling code word.
Configuration	defAcquisitionCode	1.3.6.1.4.1.2686.2.1.55	INTEGER	Read Only	Default RF acquisition code (0-15).
Configuration	defConfigMinutes	1.3.6.1.4.1.2686.2.1.56	INTEGER	Read Only	Default RF configuration test minutes (1-120).
Configuration	deRepeaterMode	1.3.6.1.4.1.2686.2.1.57	INTEGER	Read Only	Default base station repeater mode: 0 = disabled, 1 = enabled.
Configuration	defSystemType	1.3.6.1.4.1.2686.2.1.58	INTEGER	Read Only	Default base station symmetry type: 0 = asymmetric, 1 = symmetric.
Configuration	defRemoteGroup	1.3.6.1.4.1.2686.2.1.59	INTEGER	Read Only	Default RF group identifier: 0 = closed, 1 - 63 = special group.
Configuration	config60	1.3.6.1.4.1.2686.2.1.60	INTEGER		Spare.
Configuration	config61	1.3.6.1.4.1.2686.2.1.61	INTEGER		Spare.
Configuration	newStationType	1.3.6.1.4.1.2686.2.1.62	INTEGER	Read/Write	New station type: 0 = remote, 1 = base.

Group	Node Label	Address/Node	Syntax	Access	Description
Configuration	newStationRank	1.3.6.1.4.1.2686.2.1.63	INTEGER	Read/Write	New station RF rank (1-1000).
Configuration	newCenterFreq	1.3.6.1.4.1.2686.2.1.64	INTEGER	Read/Write	New RF center frequency (GHz)
Configuration	newSecurityWord1	1.3.6.1.4.1.2686.2.1.65	INTEGER	Read/Write	New RF security password 1.
Configuration	newSecurityWord2	1.3.6.1.4.1.2686.2.1.66	INTEGER	Read/Write	New RF security password 2.
Configuration	newSecurityWord3	1.3.6.1.4.1.2686.2.1.67	INTEGER	Read/Write	New RF security password 3.
Configuration	newSecurityWord4	1.3.6.1.4.1.2686.2.1.68	INTEGER	Read/Write	New RF security password 4.
Configuration	newSecurityWord5	1.3.6.1.4.1.2686.2.1.69	INTEGER	Read/Write	New RF security password 5.
Configuration	newScramblingCode	1.3.6.1.4.1.2686.2.1.70	INTEGER	Read/Write	New RF scrambling code word.
Configuration	newAcquisitionCode	1.3.6.1.4.1.2686.2.1.71	INTEGER	Read/Write	New RF acquisition code (0-15).
Configuration	newConfigMinutes	1.3.6.1.4.1.2686.2.1.72	INTEGER	Read/Write	New RF configuration test minutes (1-120).
Configuration	newRepeaterMode	1.3.6.1.4.1.2686.2.1.73	INTEGER	Read/Write	New base station repeater mode: 0 = disabled, 1 = enabled.
Configuration	newSystemType	1.3.6.1.4.1.2686.2.1.74	INTEGER	Read/Write	New base station symmetry type: 0 = asymmetric, 1 = symmetric.
Configuration	newRemoteGroup	1.3.6.1.4.1.2686.2.1.75	INTEGER	Read/Write	New RF group identifier: 0 = closed, 1 - 63 = special group.
Configuration	config76	1.3.6.1.4.1.2686.2.1.76	INTEGER		Spare.
Configuration	config77	1.3.6.1.4.1.2686.2.1.77	INTEGER		Spare.

Channel	Frequency	Channel	Frequency
1	2.4258	5	2.4455
2	2.4302	6	2.4498
3	2.4345	7	2.4542
4	2.4400		

Group	Node Label	Address/Node	Syntax	Access	Description
Configuration	stationMode	1.3.6.1.4.1.2686.2.1.78	INTEGER	Read/Write	Operating mode: 0 = normal, 1 = Rx Test, 2 = Tx Test, 3 = RSSI Test.
Configuration	rfTransmitStatus	1.3.6.1.4.1.2686.2.1.79	INTEGER	Read/Write	RF transmit status: 0 = blocked, 1 = unblocked.
Configuration	linkMonitorPeriod	1.3.6.1.4.1.2686.2.1.80	INTEGER	Read/Write	Link monitor period (0-10000): 0 = disabled, 1 - 10,000 = number of data superframes per single test superframe.
Configuration	testModeTimer	1.3.6.1.4.1.2686.2.1.81	INTEGER	Read/Write	Test mode timer minutes (1-1000).
Configuration	dynamicPolling	1.3.6.1.4.1.2686.2.1.82	INTEGER	Read/Write	Dynamic polling level (1-60).
Configuration	remoteDistance	1.3.6.1.4.1.2686.2.1.83	INTEGER	Read/Write	Maximum remote unit distance (km)
Configuration	linkMonitorRank	1.3.6.1.4.1.2686.2.1.84	INTEGER	Read/Write	Link monitor remote station rank (1-1000).
Configuration	throttleEnable	1.3.6.1.4.1.2686.2.1.85	INTEGER	Read/Write	Throttling enable: 0 = disabled, 1 = enabled.
Configuration	throttleLevel	1.3.6.1.4.1.2686.2.1.86	INTEGER	Read/Write	RF throttle level (1-50).
Configuration	config87	1.3.6.1.4.1.2686.2.1.87	INTEGER		Spare.
Configuration	config88	1.3.6.1.4.1.2686.2.1.88	INTEGER		Spare.
Configuration	config89	1.3.6.1.4.1.2686.2.1.89	INTEGER		Spare.
Configuration	communityName1	1.3.6.1.4.1.2686.2.1.90	DisplayString (0..15)	Read/Write	Read-only access community name.

Channel	Frequency	Channel	Frequency
1	2.4258	5	2.4455
2	2.4302	6	2.4498
3	2.4345	7	2.4542
4	2.4400		

Group	Node Label	Address/Node	Syntax	Access	Description
Configuration	communityName2	1.3.6.1.4.1.2686.2.1.91	DisplayString (0..15)	Read/Write	Read-Write access community name.
Configuration	ethernetAccess	1.3.6.1.4.1.2686.2.1.92	INTEGER	Read Only	Ethernet access to local host: 0 = disabled, 1 = enabled.
Configuration	wirelessAccess	1.3.6.1.4.1.2686.2.1.93	INTEGER	Read Only	Wireless access to local host: 0 = disabled, 1 = enabled.
Configuration	config94	1.3.6.1.4.1.2686.2.1.94	INTEGER		Spare.
Configuration	currentImage	1.3.6.1.4.1.2686.2.1.95	DisplayString (0..15)	Read Only	Current system image file name.
Configuration	defaultImage	1.3.6.1.4.1.2686.2.1.96	DisplayString (0..15)	Read/Write	Selects specified system image file as default.
Configuration	prevDefaultImage	1.3.6.1.4.1.2686.2.1.97	DisplayString (0..15)	Read Only	Previous default system image file name.
Configuration	config98	1.3.6.1.4.1.2686.2.1.98	INTEGER		Spare.
Configuration	config99	1.3.6.1.4.1.2686.2.1.99	INTEGER		Spare.
Configuration	systemImageList	1.3.6.1.4.1.2686.2.1.100	SEQUENCE OF SystemImage Entry	N/A	System Image List Branch.
Configuration: System Image List	systemImageNumber	1.3.6.1.4.1.2686.2.1.100.1	INTEGER	Read Only	System image number.
Configuration: System Image List	systemImageName	1.3.6.1.4.1.2686.2.1.100.2	DisplayString (0..15)	Read Only	System image file name.
Configuration: System Image List	systemImageRevn	1.3.6.1.4.1.2686.2.1.100.3	DisplayString (0..15)	Read Only	System image revision identifier.

Group	Node Label	Address/Node	Syntax	Access	Description
Configuration: System Image List	systemImageDate	1.3.6.1.4.1.2686.2.1.100.4	DisplayString (0..15)	Read Only	System image file date.
Configuration: System Image List	systemImageTime	1.3.6.1.4.1.2686.2.1.100.5	DisplayString (0..15)	Read Only	Time system image file was last changed.
Configuration: System Image List	systemImageSize	1.3.6.1.4.1.2686.2.1.100.6	INTEGER	Read Only	System image file size.
Configuration: System Image List	systemImageText	1.3.6.1.4.1.2686.2.1.100.7	DisplayString (0..15)	Read Only	System image descriptive text.
Configuration	config101	1.3.6.1.4.1.2686.2.1.101	INTEGER		Spare.
Configuration	config102	1.3.6.1.4.1.2686.2.1.102	INTEGER		Spare.
Configuration	config103	1.3.6.1.4.1.2686.2.1.103	INTEGER		Spare.
Configuration	config104	1.3.6.1.4.1.2686.2.1.104	INTEGER		Spare.
System Status	totalHours	1.3.6.1.4.1.2686.2.2.1	Counter	Read Only	Cumulative run-time hours.
System Status	systemHours	1.3.6.1.4.1.2686.2.2.2	Counter	Read Only	Current run-time hours since powerup.
System Status	loginOkays	1.3.6.1.4.1.2686.2.2.3	Counter	Read Only	Number of successful logins.
System Status	loginFails	1.3.6.1.4.1.2686.2.2.4	Counter	Read Only	Number of unsuccessful login attempts.
System Status	localUser	1.3.6.1.4.1.2686.2.2.5	INTEGER	Read Only	Local user login status: 0 = none, 1 = user, 2 = supervisor.
System Status	telnetUser	1.3.6.1.4.1.2686.2.2.6	INTEGER	Read Only	Telnet user login status: 0 = none, 1 = user, 2 = supervisor.
System Status	ftpUser	1.3.6.1.4.1.2686.2.2.7	INTEGER	Read Only	FTP user login status: 0 = none, 1 = user, 2 = supervisor.
Statistics	etherRxTotalPkts	1.3.6.1.4.1.2686.2.3.1	Counter	Read Only	Total Ethernet packets received.
Statistics	etherRxLocalPkts	1.3.6.1.4.1.2686.2.3.2	Counter	Read Only	Ethernet packets received for local host.

Group	Node Label	Address/Node	Syntax	Access	Description
Statistics	etherRxErrorPkts	1.3.6.1.4.1.2686.2.3.3	Counter	Read Only	Ethernet packets received in error.
Statistics	etherRxDroppedPkts	1.3.6.1.4.1.2686.2.3.4	Counter	Read Only	Number of received Ethernet packets dropped.
Statistics	etherRxDiscardPkts	1.3.6.1.4.1.2686.2.3.5	Counter	Read Only	Number of received Ethernet packets discarded.
Statistics	etherTxTotalPkts	1.3.6.1.4.1.2686.2.3.6	Counter	Read Only	Total Ethernet packets transmitted.
Statistics	etherTxDroppedPkts	1.3.6.1.4.1.2686.2.3.7	Counter	Read Only	Number of transmitted Ethernet packets dropped.
Statistics	rfRxTotalPkts	1.3.6.1.4.1.2686.2.3.8	Counter	Read Only	Total received RF packets.
Statistics	rfRxLocalPkts	1.3.6.1.4.1.2686.2.3.9	Counter	Read Only	Total received RF packets for local host.
Statistics	rfRxDroppedPkts	1.3.6.1.4.1.2686.2.3.10	Counter	Read Only	Number of received RF packets dropped.
Statistics	rfRxDiscardedPkts	1.3.6.1.4.1.2686.2.3.11	Counter	Read Only	Number of received RF packets discarded.
Statistics	rfTxTotalPkts	1.3.6.1.4.1.2686.2.3.12	Counter	Read Only	Total transmitted RF packets.
Statistics	rfTxLocalPkts	1.3.6.1.4.1.2686.2.3.13	Counter	Read Only	Number of transmitted local RF packets.
Statistics	rfTxDroppedPkts	1.3.6.1.4.1.2686.2.3.14	Counter	Read Only	Number of transmitted RF packets dropped.
Statistics	rfRxSframeCount	1.3.6.1.4.1.2686.2.3.15	Counter	Read Only	Total RF super frames received.
Statistics	rfRxOverrunErrors	1.3.6.1.4.1.2686.2.3.16	Counter	Read Only	Number of RF overrun errors.
Statistics	rfRxSFrameErrors	1.3.6.1.4.1.2686.2.3.17	Counter	Read Only	Number of RF super frame control word errors.
Statistics	rfRxChecksumErrors	1.3.6.1.4.1.2686.2.3.18	Counter	Read Only	Number of RF super frame header checksum errors.
Statistics	rfRxPacketErrors	1.3.6.1.4.1.2686.2.3.19	Counter	Read Only	Number of RF packet control work errors.
Statistics	rfRxLengthErrors	1.3.6.1.4.1.2686.2.3.20	Counter	Read Only	Number of RF super frame length errors.
Statistics	rfTxSuperFrameCnt	1.3.6.1.4.1.2686.2.3.21	Counter	Read Only	Number of RF super frames transmitted.
Statistics	rfEtoIThroughput	1.3.6.1.4.1.2686.2.3.22	Counter	Read Only	Ethernet to RF throughput.

Group	Node Label	Address/Node	Syntax	Access	Description
Statistics	rfItoEThroughput	1.3.6.1.4.1.2686.2.3.23	Counter	Read Only	RF to Ethernet throughput.
Statistics	statistics24	1.3.6.1.4.1.2686.2.3.24	Counter		Spare.
Statistics	linkMonitorRank1	1.3.6.1.4.1.2686.2.3.25	INTEGER	Read Only	Link monitor remote station rank.
Statistics	linkMonRtoBber	1.3.6.1.4.1.2686.2.3.26	DisplayString (0..8)	Read Only	Link monitor remote to base bit error rate.
Statistics	linkMonBtoRber	1.3.6.1.4.1.2686.2.3.27	DisplayString (0..8)	Read Only	Link monitor base to remote bit error rate.
Statistics	linkMonMissPktCnt	1.3.6.1.4.1.2686.2.3.28	Counter	Read Only	Link monitor missed packet count.
Statistics	linMonEnvPBtoR	1.3.6.1.4.1.2686.2.3.29	INTEGER	Read Only	Link monitor base to remote envelope power.
Statistics	linkMonEnvPRtoB	1.3.6.1.4.1.2686.2.3.30	INTEGER	Read Only	Link monitor remote to base envelope power.
Statistics	linkMonCorrPBtoR	1.3.6.1.4.1.2686.2.3.31	INTEGER	Read Only	Link monitor base to remote correlation power.
Statistics	linkMonCorrPRtoB	1.3.6.1.4.1.2686.2.3.32	INTEGER	Read Only	Link monitor remote to base correlation power.
System Commands	rebootCurrent	1.3.6.1.4.1.2686.2.4.1	INTEGER	Read/Write	Reboot current system image: 1 = reboot.
System Commands	rebootImage	1.3.6.1.4.1.2686.2.4.2	DisplayString (0..15)	Read/Write	Reboot specified system image: system image file name.
System Commands	rebootnewRFConfig	1.3.6.1.4.1.2686.2.4.3	INTEGER	Read/Write	Reboot new RF configuration: 1 = reboot.
System Commands	restFactConfReboot	1.3.6.1.4.1.2686.2.4.4	INTEGER	Read/Write	Restore factory configuration and reboot: 1 = restore.
System Commands	saveConfToFlash	1.3.6.1.4.1.2686.2.4.5	INTEGER	Read/Write	Save current configuration to flash: 1 = save.
System Commands	resetRadioStats	1.3.6.1.4.1.2686.2.4.6	INTEGER	Read/Write	Reset radio statistics: 1 = reset.
System Commands	resetEthernetStats	1.3.6.1.4.1.2686.2.4.7	INTEGER	Read/Write	Reset Ethernet statistics: 1 = reset.

Appendix E: Technical Reference Information

Front Panel LEDs

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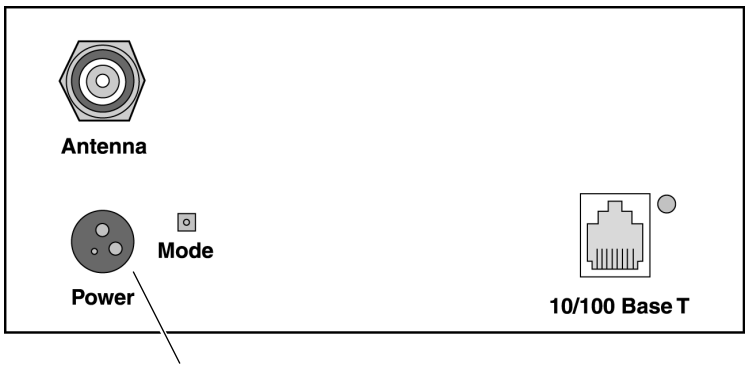
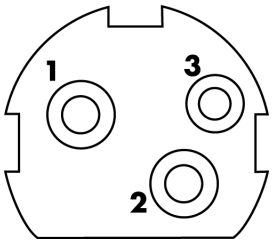
LED Type	Color	Status
AIR	Orange (both units)	The units are configured correctly: the base and remote units are transmitting and receiving data.
	Green (remote)	The units are configured incorrectly: the remote unit is receiving data from the air but can not respond.
	Red (base)	The units are configured incorrectly: the base unit is transmitting without receiving acknowledgment.
	Off	Listening to the air
MODE	Green	Receive test mode - RS-232 displays statistics
	Red	Continuous Transmit test mode
	Orange	RSSI test mode - measures fade margin
	Off	Normal transceiver mode
WIRE	Green	Receiving data from the wire
	Red	Transmitting data to the wire
	Orange	Transmitting and receiving data on the wire
	Off	Listening to the wire
POWER	Green	Power is connected to the transceiver
	Off	No power is connected to the transceiver

Power Connector Pinout

Hopper PLUS 120-24, Rear View



Power Connector Pinout



Pin 1	+12 VDC
Pin 2	GND
Pin 3	N/C

Glossary

A

absorption

Antennas mounted too close to soft objects, such as trees, may experience a reduction in signal strength due to absorption. Absorption is most often encountered in applications installed during the fall or winter months. The problem does not become evident until the spring.

acquisition code

To minimize the effects of interference, all units in a system use the same acquisition code so the receivers can distinguish the desired signal from interfering signals.

agent

In an SNMP context, the agent runs on each unit. An agent accepts configuration commands from the manager and collects network and terminal information specified in the MIB.

antenna

A device which accepts electromagnetic energy from a circuit or wire and radiates it into space rather than confining it.

antenna gain

Gain of the antenna over a dipole (dBd) or isotropic (dBi).

- Antennas have a gain associated with them, which is a measure of their ability to amplify signals in their tuned band.
- Antenna gain is achieved by focusing the signal. A higher gain antenna has more compressed signal.

attenuation

Any loss in signal strength, due to resistance, absorption, capacitance, or any characteristic of the medium or design of the system.

B

beamwidth

The beamwidth of an antenna describes how a signal spreads out from the antenna as well as the range of the reception area. Beamwidth is measured between the points on the beam pattern at which the power density is half of the maximum power. This is often referred to

as the -3 dB points. A high gain antenna has a very narrow beamwidth and may be more difficult to align.

BER

Bit Error Rate. A percentage of bits per million, showing the number of bits in error compared to the data bits actually sent.

blocking

Blocking is an operating mode where the radio receives only. Unblocked is the normal operating mode.

C

cable loss

The signal loss experienced as it passes through the coax cable. Expressed in dB.

channel

The width of the spectrum band taken by a radio signal, usually measured in kilohertz (kHz).

coaxial cable

A type of wire where the inner conductor is surrounded by an outer conductor. The outer conductor serves as an electrical shield.

collision

The situation that exists when two users try to send a signal over the same medium at the same time, and the signal uses the same frequencies.

configuration menus

The menu based user interface on the Hopper Plus 120-24 that allows the viewing and configuration of Hopper Plus 120-24 parameters.

contentionless polling

The Hopper Plus 120-24 uses a form of dynamic polling that ignores idle remote stations. The number of polls that an idle remote is ignored can be set to maximize polling to active stations.

Cross-Polarization Discrimination

See *XPD*.

D

dB

Decibel. A relative measure of power used to specify power gains and losses. The difference in power P1 and P2 expressed in dB is:

$$dB = 10 \times \log\left(\frac{P1}{P2}\right)$$

DB9

A D-shaped connector with 9 pins.

dBd

dBd is antenna gain referenced over a half-wave dipole which is an antenna that has a donut shaped radiation pattern.

Gain of a Standard Dipole = 2.14 dBi.

dBi

dBi is antenna gain referenced over an isotropic radiator which is a theoretical antenna that radiates equally in all directions (e.g. the sun).

Wi-LAN references antenna gain in dBi. The conversion factor is:
0 dBd = 2.14 dBi

dBm

A power measurement referenced to one milliwatt. This is an absolute measure of power rather than a relative measure such as a gain or a loss.

diffraction

Diffraction occurs when a radio signal reflects or bounces off of a solid object. The level of diffraction could lead to connectivity problems if the remaining signal level is too low. Two types of diffraction are *shadowing* and *multipath*.

downtilt

Some antennas have either an associated downtilt or an uptilt. The tilt further focuses the signal either downward or upward with respect to the horizon. A tilt may be either electrically built into the antenna or achieved mechanically with the mounting gear. An downtilt or uptilt may be required when there is a significant deviation between the elevation of the remote site(s) and the base site.

dynamic polling

A polling protocol in which idle units are not polled as frequently as active units. Since less time is spent polling idle remotes, there are more available resources for active units and overhead is reduced.

E

EEPROM

Electrically Erasable, Programable Read Only Memory: Non-volatile memory, but must be removed from board to be erased.

EIRP

Effective Isotropically Radiated Power. EIRP is the amount of power that is transmitted to the air from the antenna. EIRP levels depend on the power of the radio transmitter, the size of the antenna, and the losses incurred in the antenna cable. To remain license exempt the EIRP must remain under 4 watts or 36 dBm in Canada and the United States for point-to-multipoint applications. In Europe, this value is reduced to 100 mW or to 20 dBm.

Note: *EIRP = Power out of unit — Power lost in cable + Gain in power from Antenna*

ERP

Effective Radiated Power. The power radiating from an antenna taking into account the output power from the transmitter, connector losses, cable losses, and the antenna gain.

ETSI

European Telecommunications Standards Institute.

F

fade margin

The amount that the system gain plus the total antenna gain exceeds the path loss is called the fade margin. The fade margin is calculated as the number of dB that the received signal strength exceeds the minimum receiver sensitivity.

filtering

Filtering in remote stations limits certain data packets.

FLASH

A type of electrically erasable non-volatile memory that can easily be erased without removal from the board. Using FLASH, Hopper Plus 120-24 units can be upgraded in the field.

Fresnel zone

One of a (theoretically infinite) number of a concentric ellipsoids of revolution which define volumes in the radiation pattern of a (usually) circular aperture.

Notes:

- The cross-section of the first Fresnel zone is circular. Subsequent Fresnel zones are annular in cross-section, and concentric with the first.
- Odd-numbered Fresnel zones have relatively intense field strengths, whereas even-numbered Fresnel zones are nulls.
- Fresnel zones result from diffraction by the circular aperture.

front to back ratio (F/B)

Directional antennas focus the signal in a forward path. This is achieved by directing the signal in one direction that reduces the signal in the opposite direction. A higher gain antenna typically has a greater F/B ratio.

I

IEEE

Institute of Electrical and Electronics Engineers.

image

An image is a collection of configurations or settings for a particular device. With the Hopper Plus 120-24, the System Image File contains a collection of configurations that are used when the unit is rebooted.

interference

Any signal that tends to hamper the normal reception of a desired signal. Equivalent to jamming except considered non-hostile in origin.

ISM

Industrial, Scientific, and Medical. It is the family of license-exempt radio bands in North America and some European countries. It is also referred to as part 15.247 in the FCC regulation that defines the parameters for use of the ISM band in the U.S., including power outputs, spread-spectrum, and noninterference.

L

link monitor

A Hopper Plus 120-24 utility that sends known data over an active system to test the reliability of the RF link. The link monitor information is overhead, that is, it reduces the amount of available payload for message data.

LOS (Line of Sight)

LOS is a elliptical pattern known as the Fresnel Zone, which must be kept clear of obstructions. Visual line of sight must be achieved. When standing at the antenna position, you must be able to see the remote antenna.

M

MAC address

Media Access Control address. Alphanumeric characters that uniquely identify a network-connected device.

Management Information Block

See MIB.

manager

When used in SNMP, this element is installed on the network s host computer and is controlled by the network administrator. From the host, the manager configures agents, or polls agents for information.

MIB

Management Information Block. The MIB is a database which is accessed by a specific set of commands that you can execute using the SNMP Manager. There is a standard MIB and a Wi-LAN customized MIB that stores information relevant to the operation of a wireless network.

multipath interference

Multipath is a form of diffraction in which the reflected signal arrives at the receiver at different times which confuses the receiver. Multipath may be interpreted as interference by the receive antenna, and can result in bit errors and processing delays.

O

OID nodes

Object Identifier Nodes. These are the individual nodes in a MIB. See SNMP and MIB.

overhead

Anything that reduces the payload capacity of a system is overhead, even if serves a useful function. The link monitor data is used to determine transmission statistics, but it reduces the message carrying capacity of the Hopper 120-24 system and is considered overhead.

P

path loss

The total loss from one end of the path to the other. This includes propagation losses, cable losses, and any other losses that impact the system performance.

point-to-multipoint

A wireless system where one base unit communicates with many remote units. The base unit polls all the remotes, and data passes between units to complete the network.

point-to-point

The simplest wireless system consisting of a base and one remote.

polling

The base unit in a Hopper Plus 120-24 point-to-multipoint system handles multiple remotes by polling each one sequentially. When a base polls a remote, data exchange between that remote and the base takes place. The remote cannot exchange information with the base until it is polled again.

propagation loss

The signal loss experienced as it travels through the air. Expressed in dB.

R

RF

Radio Frequency. A system of communication using electromagnetic waves propagated through space. Because of varying characteristics, radio waves of different lengths are used for different purposes and are usually identified by their frequency.

RS-232

Standards for serial communications, which define the voltages, currents, data rates, and other factors about the signals to be used, as well as single-ended, differential, multi-drop operation.

RSSI

Received Signal Strength Indicator. Strength of received signal expressed in dB. The Hopper Plus 120-24 measures RSSI as a fade margin value.

S

sensitivity

The minimum signal strength required for usable performance. Expressed in dBm.

shadowing

Shadowing is a form of diffraction that is typically caused when antennas are mounted too close to a structure, and they lose a portion of the signal lobe due to reflection. The receive antenna is in a *shadowed* area. To minimize shadowing, ensure that there is adequate height above when mounting antenna equipment to a structure.

SNMP

Simple Network Management Protocol. A protocol you can use to remotely manage a network element by polling, setting terminal values, and monitoring network statistics and events. It is the de-facto internet work management standard, designed to provide a mechanism for the exchange of management information in a TCP/IP-based Internet environment.

spread spectrum

Any of a group of modulation formats in which an RF bandwidth much wider than signal bandwidth is used to transmit information, resulting in a greater immunity to noise interference.

system gain

The maximum path loss that the system can support for usable data transmission.

system image file

The Hopper Plus 120-24 uses system image files to store system configuration settings. The default system image file is called factory-image and is when the Hopper Plus is first powered up.

T

telnet

An Internet communications protocol that enables a computer to function as a terminal working on a remote computer. A computer with a network connection to a Hopper Plus 120-24 system can Telnet to any of the (configured) Hopper Plus 120-24 units and access their configuration menus.

throttling

Throttling limits the amount of data that a remote station passes.

U

uptilt

See downtilt.

X

XPD (Cross-Polarization Discrimination)

Refers to polarity and Cross-Polarization Discrimination. Antennas have an associated polarity, which is the orientation of the radiating element with respect to earth. Antennas are usually described as being vertical, horizontal, or circularly polarized. The polarity of all antennas used in a system must be the same. XPD specifies the amount of signal

isolation achieved when the receiving element is perpendicular to the radiating element. This can be advantageous when co-locating radio systems.

V

VSWR (Voltage Standing Wave Ratio)

VSWR is the voltage ratio of minimum to maximum across a transmission line. A VSWR of 2.0:1 or less in an antenna is considered effective. Most antennas have a VSWR of 1.5:1. For example, when using a radio with a 4 watt output with an antenna VSWR of 1.5:1, the reflected power will be 160 milliwatts.

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