IP MOBILENET™

Government - Utilities - Transportation

IPSeries High Speed Base Station
User Manual

Released: May 30, 2007
IPMN p/n: 516.80540.UM
Revision: D

16842 Von Karman Avenue, Suite 200 Irvine, CA 92606
Voice: (949) 417-4590 Fax: (949) 417-4591
www.ipmn.com

DOCUMENT REVISION CONTROL

Document Title: IPSeries High Speed Base Station User Manual

New Release Date	Previous Revision	New Revision	Action	Brief Change Description
11/06/05	N/A	A	Release Per ECN-5021	Initial Release
03/27/06	A	B	Release Per ECN-5107	Modified Data Rate Parameter
05/08/07	B	C	Release Per ECN-5290	Delay timer installation changes, and documentation clean-up.
05/30/07	C	D	Release Per ECN-5317	Page 5 – Added FCC 15.21 change / modification statement & 15.105 radio interference statement . Page 23 – Added tuning and adjustment statement

COPYRIGHT STATEMENT

TABLE OF CONTENTS

Manual Purpose

The purpose of the IPSeries High Speed Base Station User Manual is to provide IPMobileNet dealers and customers with the necessary information required to install, operate, and troubleshoot problems with the IPSeries base station.

✎ This manual does not provide information for every possible configuration and should be used as a starting point of reference for general product setup and operation.

Manual Contents

This user manual contains the following sections:

- Chapter 1: Introduction

  The *Introduction* provides a description of the base station as well as a general overview of its functionality, external features, product interfaces, product specifications, and theory of operation with a block diagram and definitions.

- Chapter 2: Basic Network Configurations

  Basic Network Configurations provides a series of network diagrams depicting sample network configurations. Each organization will need to determine their best approach for configuration.

- Chapter 3: Product Setup and Preliminary Testing

  Product Setup and Preliminary Testing provides a diagram and information required for mounting the base station in a rack unit as well as preliminary testing prior to placing the base station into service.

- Chapter 4: Product Installation

  Product Installation provides basic diagrams and instructions for adjusting the base station's power and installing the base station and required components.

- Chapter 5: Programming Instructions

  Programming Instructions provides instructions for setting up and programming the base station and its interfaces.

- Chapter 6: Customer Support

  Customer Support provides instructions for ordering parts, documentation support, and reporting problems.

- Appendix A: Backhaul Requirements
- Appendix B: Base Station IPMessage Parameters
- Figure Listing
- Glossary
- Index

Manual Use

Special icons appear throughout this manual to emphasize important information related to the chapter in which the icons are found. The definitions for these icons are listed below.

It is imperative that the user read this section carefully prior to continuing to the next chapter of this user manual.

TABLE 1: ICON HELPS

ICON	INDICATES	DEFINITION
	**NOTE**	This icon indicates that a comment follows highlighting or stressing a special point.
	**CAUTION**	This icon indicates that a precautionary message follows. Carefully read the message following this icon and proceed with caution.

Audience

This user manual is intended for specific use by IPMobileNet, Inc. staff, dealers, and customers. This user manual is not to be reproduced without expressed written consent of IPMobileNet Management.

In accordance with FCC certification, changes or modification not expresssly approved by IPMN could void the user's authority to operate the equipment.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, 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 measures:

-- Reorient or relocate the receiving antenna.
-- Increase the separation between the equipment and receiver.
-- Connect the equipment into 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"

Product Description

The content of this manual applies to all frequency ranges of the IPSeries Base Stations, unless otherwise specified. This manual will note key differences between frequency ranges when appropriate.

The IPSeries Base Stations are intelligent devices designed for stringent requirements of mobile data communication systems. Intended for mounting in rack units, the base station requires very little room at tower sites and may be connected via Serial Line Internet Protocol (SLIP) or Ethernet ports. At the minimum, the unit requires a 13.8 VDC power supply, an RF Filter Antenna System, and a high-speed data connection to an Internet Protocol Network Controller (IPNC) system to operate. The base station is typically teamed up with a Power Amplifier (PA) and third-party system components such as antennae, preamplifiers, preselectors, filters, and combiners.

Figure 1: Base Station External Illustration (Front View)

Product Functionality

The base station utilizes a high-performance DSP to modulate/demodulate 4 to 16-level Frequency-Shift Keying (FSK) modem for 25 and 50 kHz channel spacing, a multi-layered approach to signaling reliability, including patented multi-receiver Intelligent Diversity Reception™, dynamic scrambling, data interleaving for burst error protection, Forward Error Correction (FEC), and Viterbi soft-decision algorithms.

The IPSeries High Speed Base Station technology includes IPMobileNet's Diversity Reception (DR) capability. Diversity Reception reduces the number of fades and the effects of multi-path reception. With the use of three (3) antennae, mounted as far apart as possible on the base station tower, the Diversity Reception System (DRS) minimizes the effects of fading. One of the antennae is likely to receive a viable signal while the others may not. DRS minimizes fading effects by comparing the signal levels from the three (3) antennae, and selecting the strongest signal.

Diversity is most effective when the vehicle using an IPSeries Mobile Radio is in motion.

External Features

The base station technology is enclosed in a sturdy aluminum case. The external features consist of a series of connectors in the rear of the base station and light emitting diodes in the front of the base station, as described in this section.

The product warranty becomes void if an uncertified or unauthorized individual removes the base station cover.

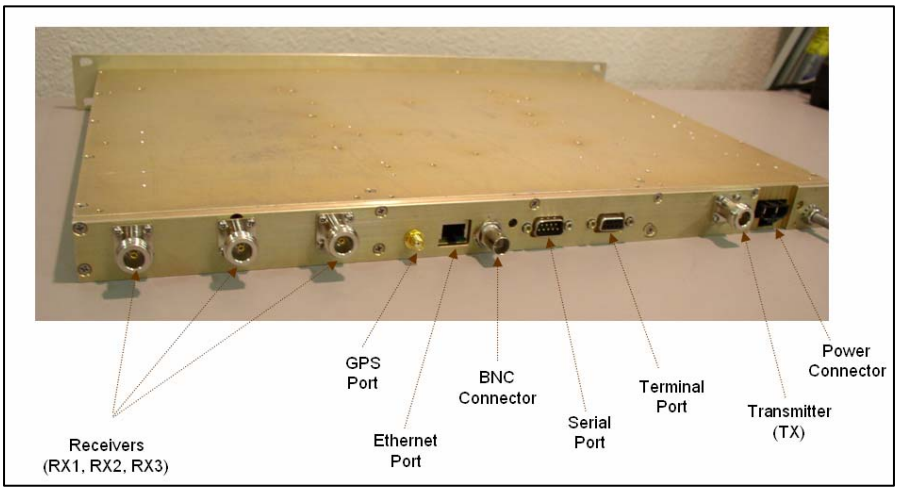


Figure 2: Base Station External Connectors (Rear View)

The base station's rear external features consist of the following connectors and ports:

TABLE 2: EXTERNAL FEATURES (Rear)

FEATURE	DESCRIPTION
TX	Transmitter antenna connection
RX1/RX2/RX3	Receivers 1, 2, and 3 antenna connections
GPS Port	GPS antenna (SMA) connector
BNC	Bayonet Neill Concelman connector used for measuring receiver sensitivity.
Power Connector	13.8 VDC base station power connector
Serial Port 1 (DB9M)	RS232 Serial Line Internet Protocol (SLIP) interface port (115K)
Terminal Connection (DB9F)	ANSI/TTY Terminal Connection (used for programming) (9600 bps, no parity, 8-databits, 1-stop bit)
Ethernet Port	RJ45 Ethernet 10 Base T interface port

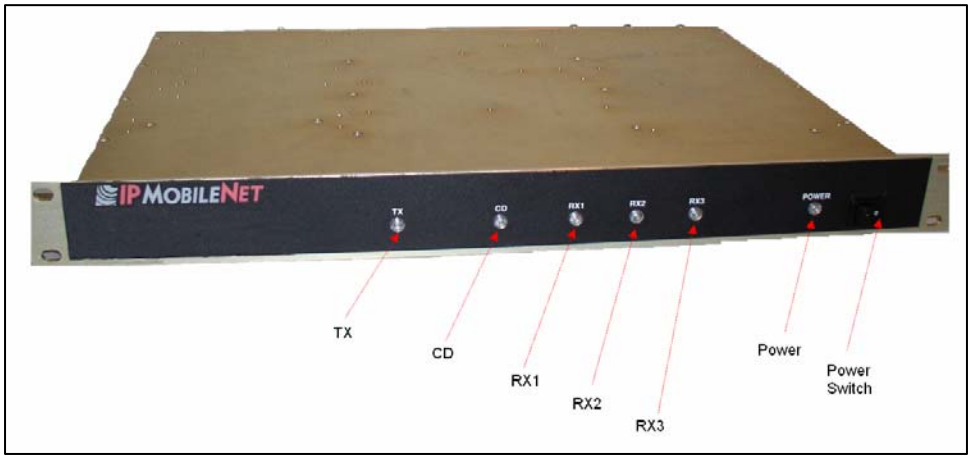


Figure 3: Base Station External Features (Front View)

The base station's front external features consist of six (6) LED (light emitting diodes) indicators defined as follows:

TABLE 3: EXTERNAL FEATURES (Front)

LED Name	When lit….
TX	Indicates that transmission is in progress
CD	Carrier detect indicates an RF message is detected
RX1	Indicates that receiving is in progress on Receiver 1
RX2	Indicates that receiving is in progress on Receiver 2
RX3	Indicates that receiving is in progress on Receiver 3
POWER	Indicates the base station is powered on

Product Specifications

TABLE 4: PRODUCT SPECIFICATIONS		
PARAMETER	**SPECIFICATION**	
Frequency Range TX	700 MHz (764-776)	800 MHz (851-869)
Frequency Range RX	700 MHz (794-806)	800 MHz (806-823)
TX/RX Frequency Separation	30 MHz @ 700 MHz	45 MHz @ 800 MHz
Channel Spacing	25 or 50 kHz, software controlled	
Receiver Type	Triple receiver, dual conversion superheterodyne architecture for 25 kHz Triple receiver, triple conversion superheterodyne architecture for 50 kHz	
Data Rate	32 kbps, firmware upgradeable to 64 kbps in 25 kHz 64 kbps to 128 kbps in 50 kHz	
Sensitivity	12 dB SINAD @ -116 dBm with a 1 kHz test tone @ +/- 2/3 rated maximum deviation	
Distortion	Less than 3.0% with a 1 kHz test tone @ +/- 2/3 rated maximum deviation	
Operating Temperature	-30 to +60 Degrees Celsius	
Power Supply Voltage	13.6 +/- 15%	
Current Consumption TX	<10 amps, typical	
Current Consumption RX	<1.5 amp, typical	
Number of Channels	1	
Shock / Vibration	Per TIA/EIA-603-A	
RF Output Power	25 Watts (+/- 1 dB) @ 700 MHz	20 Watts (+/- 1 dB) @ 800 MHz
Transmitter Attack Time	Less than 5.0 milliseconds	
Modulation	4 to 16-Level FSK	

** Specifications are subject to change.*

Basic Network Configurations

This section provides basic network connection samples to help the user better understand some of the possibilities in setting up their respective systems. Each organization's configuration will differ based on its own system requirements, equipment, backhaul, etc.

Basic Network Connection

Figure 5 depicts a basic network connection for a network inclusive of one (1) Internet Protocol Network Controller (IPNC) and a range of base stations, mobile radios, mobile computers, and additional components that interface with this sample system setup.

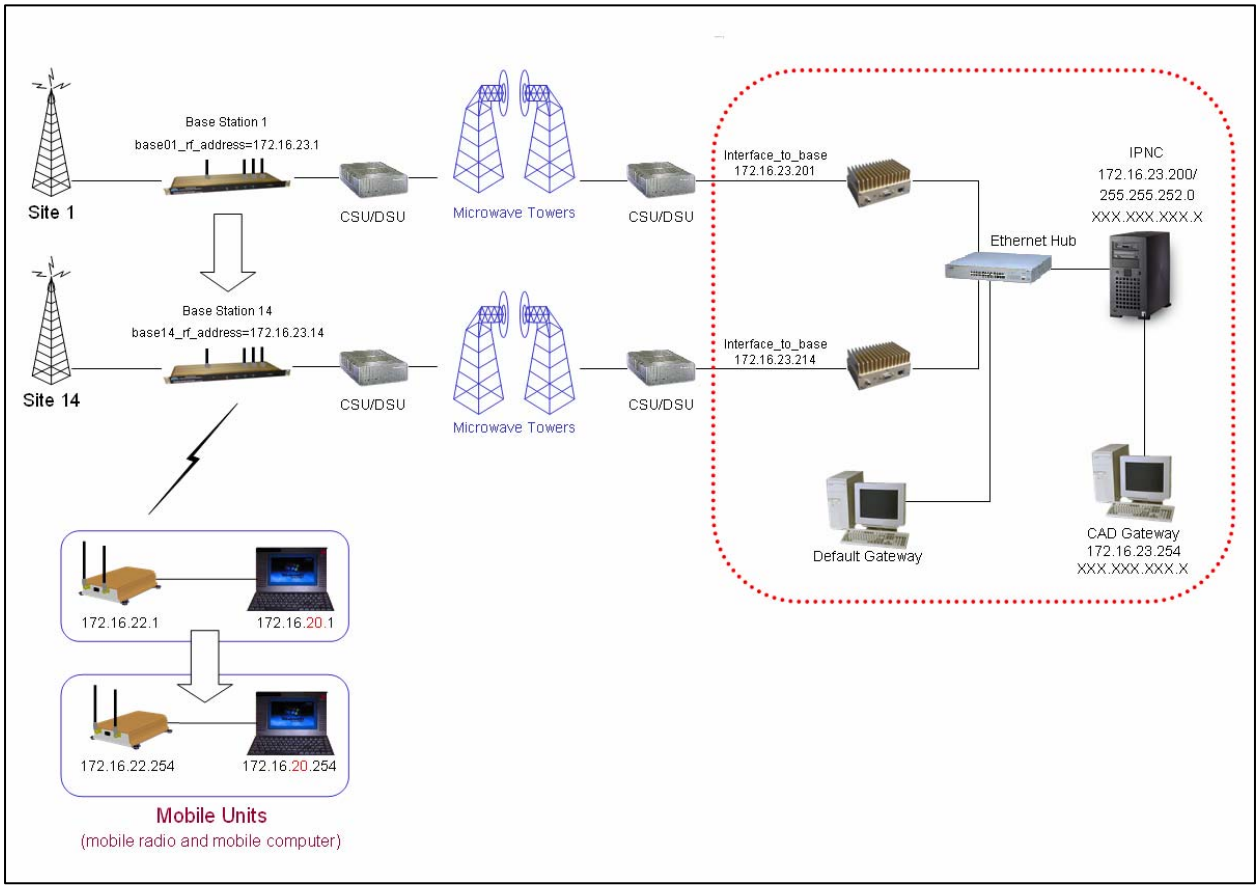


Figure 5: Basic Network Connection

For serial connectivity to Ethernet only systems, please refer to the IPTurbo Converter Quick Reference Guide (IPMN p/n: 516.80496.QR) on the Production Documentation CD (IPMN p/n: 480.0001.001).

Network Connection to an Existing LAN

Figure 6 depicts a network connection to an existing LAN (local area network) inclusive of one (1) IPNC, one (1) base station, and a range of mobile radios, VIUs (voice interface units), mobile computers, and additional components that interface with this sample system setup. This diagram also shows a LAN VIU.

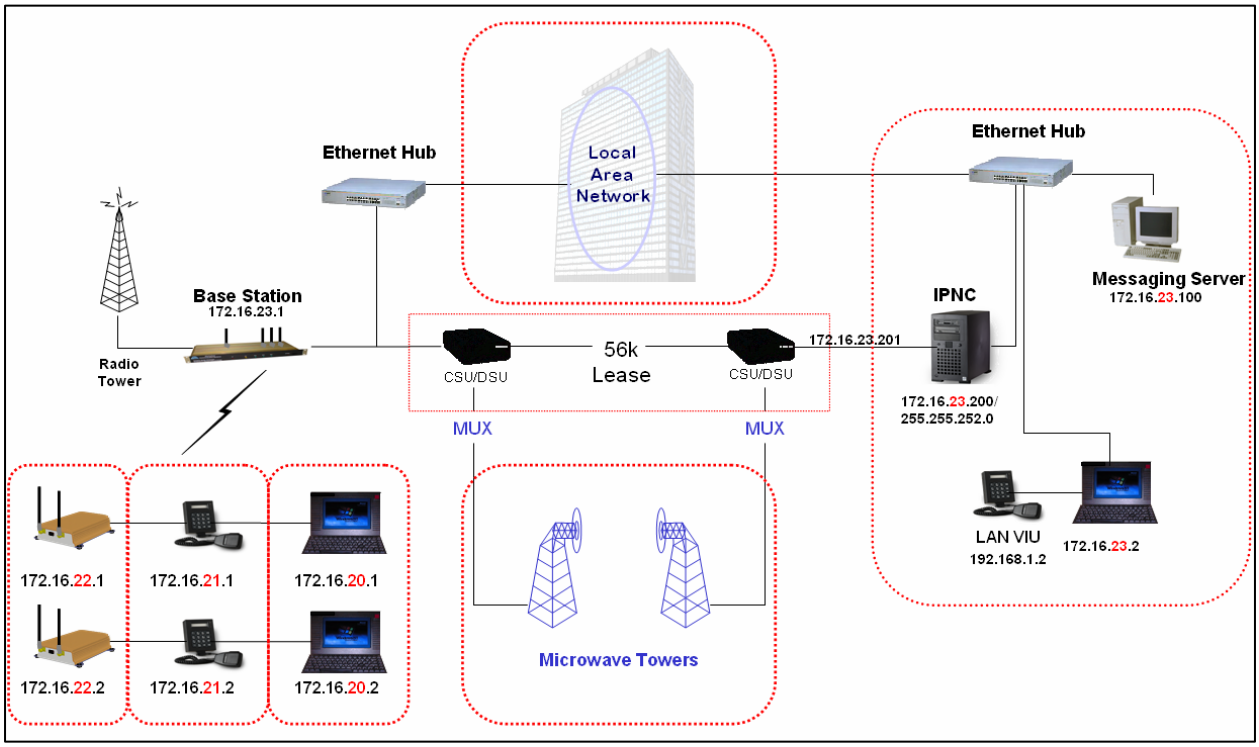


Figure 6: Network Connection to an Existing LAN

For serial connectivity to Ethernet only systems, please refer to the IPTurbo Converter Quick Reference Guide (IPMN p/n: 516.80496.QR) on the Production Documentation CD (IPMN p/n: 480.0001.001).

Base Station Setup

Intended for rack unit configuration, the base station can be installed in an existing rack or assembled into a rack of its own.

Rack Unit Mounting

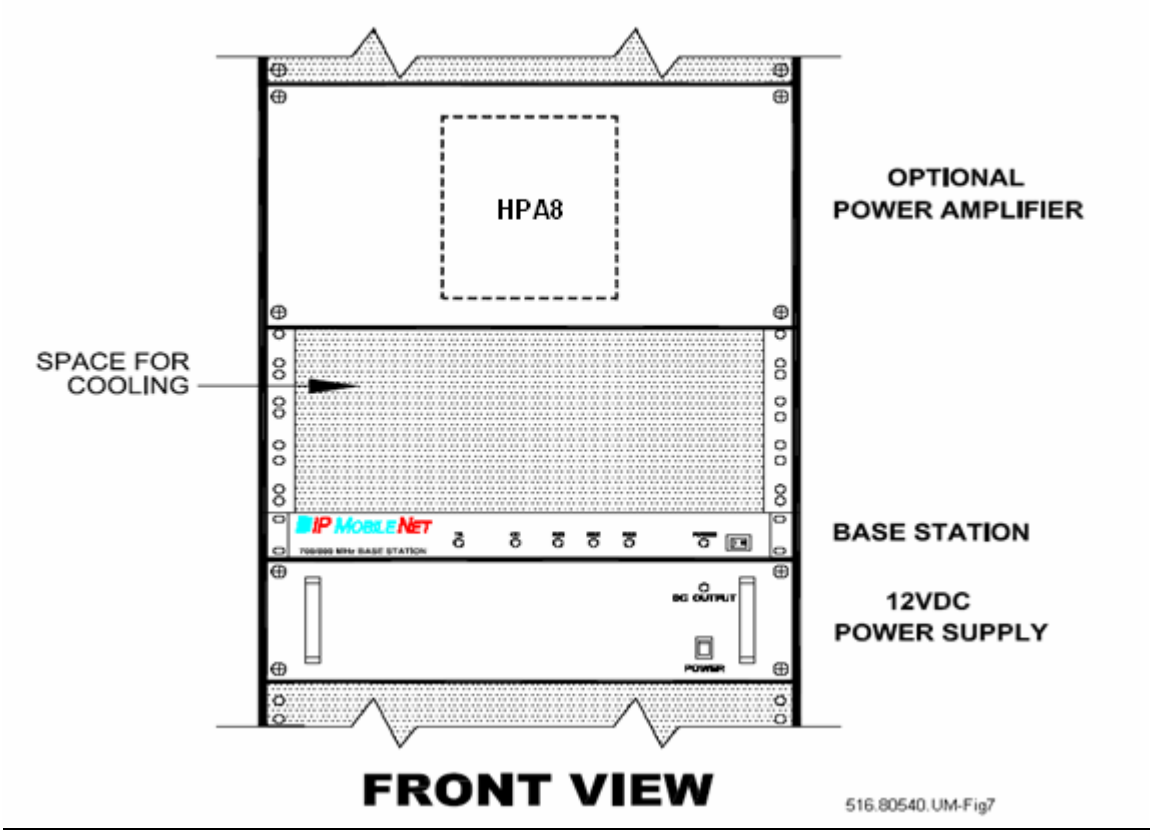


Figure 7: Base Station Mounting in the Rack Unit (Front View)

Table 5 lists the required components for a base station setup.

TABLE 5: BASE STATION COMPONENTS REQUIRED FOR INSTALLATION

QTY	DESCRIPTION
1	Frequency appropriate IPSeries Base Station
1	Ethernet cable
1	5' DC power input cable with connector
4	RF coaxial cables (may require an additional cable if connecting the base station to a power amplifier)
3	RF Filters to protect receivers from excessive RF levels. Typically 2 Band Pass / Band Reject and 1 Band Pass cavities on the receivers and 2 Band Pass / Band Reject cavities and an isolator on the transmitter.

Preliminary Testing

This section provides a functional preliminary test for the base station prior to installation. It is used to determine the condition of the new base station prior to placing into service. If the base station is non-functional after completing this test, refer to Chapter 6: Customer Support.

✎ This section applies to all base station frequency ranges.

Checklist of Required Material

The following checklist provides a list of tools required to perform this preliminary test procedure.

TABLE 6: CHECKLIST OF REQUIRED EQUIPMENT FOR PRELIMINARY TESTING OF A BASE STATION		
1	Calibrated Base Station System – Consisting of the following components: (1) Frequency appropriate IPSeries Base Station (2) Desktop or laptop configured as an Internet Protocol Network Controller (IPNC) (3) Corresponding IPSeries Mobile Radio tuned to Base Station frequencies (i.e.: if an IPB138 base, use IP138 mobile) (4) Desktop or laptop with two (2) available serial ports with Microsoft Windows 98 or higher, IPMobileNet Dial-Up Networking, IPMessage software, and HyperTerminal for base station installed (5) Base Station power cable	
2	DC power supply with ammeter, with the appropriate volts, see page 7 *Current Consumption* for each base station (Astron VS12M or equivalent)	
3	Six (6) antennae (generic mag mounts) tuned to frequency of transceiver	
Serial Base Station Interface		
No.	**Requirement**	✓
1	DB9 RS232 serial cable	
2	IPTurbo Converter (IPMN p/n: 900.00012.01)	
3	IPTurbo Converter Reference Manual (IPMN p/n: 516.80496.REF)	
Ethernet Base Stations Interface		
No.	**Requirement**	✓
1	Ethernet RJ45 Cable	

Preliminary Test Procedure

Perform the following initial setup to prepare the base station for preliminary test:

Step 1 Connect the antenna to the base station's TX port.

Step 2 Connect the base station to the 13.8 VDC power supply.

Step 3 Power on the base station and verify that the LED's illuminate and the power LED on the front panel remains illuminated.

Step 4 Verify that the base station DC-supply current is <1.2 Amps.

Step 5 For the ideal Serial or Ethernet setup please refer to the IPTurbo Converter Reference Manual (IPMN p/n: 516.80496.REF) available on the Product Documentation CD enclosed with this product.

Step 6 Connect the antenna to the mobile radio.

Step 7 Power on the mobile radio.

Step 8 Recycle the base station power.

Step 9 Connect the antenna to the base station's RX1.

Step 10 Verify that the RX1 and CD LED's are illuminated when the mobile radio is attempting to connect. Repeat steps 9 and 10 with RX2 and RX3.

Step 11 From the mobile PC, open the DOS prompt, then ping the IPNC with the following command:

ping 172.16.23.200 (replacing with the appropriate IPNC IP address).

Press **[ENTER]** and verify that the IPNC responds to the ping request. Also verify that the base station carrier detect (CD) LED is lit followed by the TX LED.

Installation Overview

This chapter provides the basic setup involved in the installation process of an IPSeries High Speed Base Station. For backhaul requirements, refer to Appendix A of this document.

Standard considerations such as air flow clearance above the base station for heat dissipation and ensuring adequate space exists behind the base station for the routing of cables are of primary importance.

A minimum clearance of 1 rack space is recommended for natural convection cooling. Coax, power, and interface cabling service lengths with neat routing will make the removal and replacement of the base station easier for functional testing and maintenance purposes.

To prevent injury and damage to the base station, exercise extreme caution throughout the installation process and follow the reminders listed below.

- Follow safety precautions for handling rack unit installations.
- **Do not** alter the components listed in the Installation Requirements section, unless substituions are noted within this chapter.

Installation Instructions

If setting up a new rack unit, make sure to complete the rack unit setup according to the Manufacturers' instructions.

Base Station Installation into the Rack Unit

Receiver and Transmitter Connections

To connect the base station, perform the following steps:

Step 1 Connect the RF coaxial cable to Receiver 1 (RX1) on the back of the base station.

Step 2 Route the cable neatly toward the receive filter. Allow a little slack in the cable to avoid accidental disconnection.

Step 3 Connect the RF coaxial cable to Receiver 2 (RX2) on the back of the base station.

Step 4 Route the cable neatly toward the receive filter. Allow a little slack in the cable to avoid accidental disconnection.

Step 5 Connect the RF coaxial cable to Receiver 3 (RX3) on the back of the base station.

Step 6 Route the cable neatly toward the receive filter. Allow a little slack in the cable to avoid accidental disconnection.

For clear identification for troubleshooting and/or maintenance activities, avoid crossing the coaxial cables.

Step 7 Connect the RF coaxial cable to the Transmitter (TX) connection on the back of the base station.

Step 8 If connecting to a power amplifier (as shown in the figure below), connect the cable from the base station to the power amplifier via the Transmitter (TX) connection.

If not connecting to a power amplifier, skip to Step 11.

Step 10 If a power amplifier is used, connect an RF coaxial cable to the output port of the power amplifier.

Step 11 Route the cable neatly toward transmit filter. Allow a little slack in the cable to avoid accidental disconnection.

Step 12 To perform the RX1, RX2, RX3, and TX antenna connections, refer to the *Typical Antenna Configuration* section in this chapter.

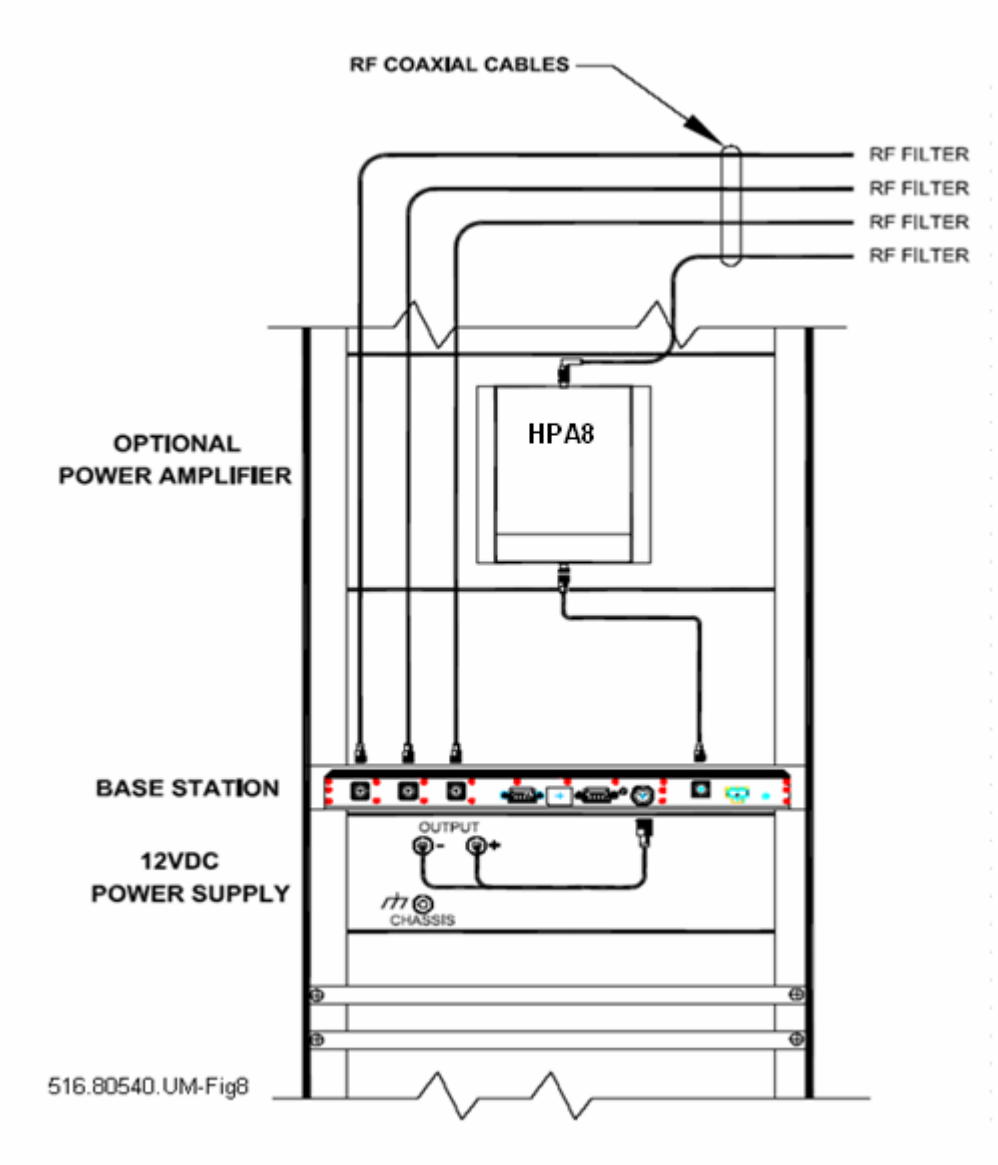
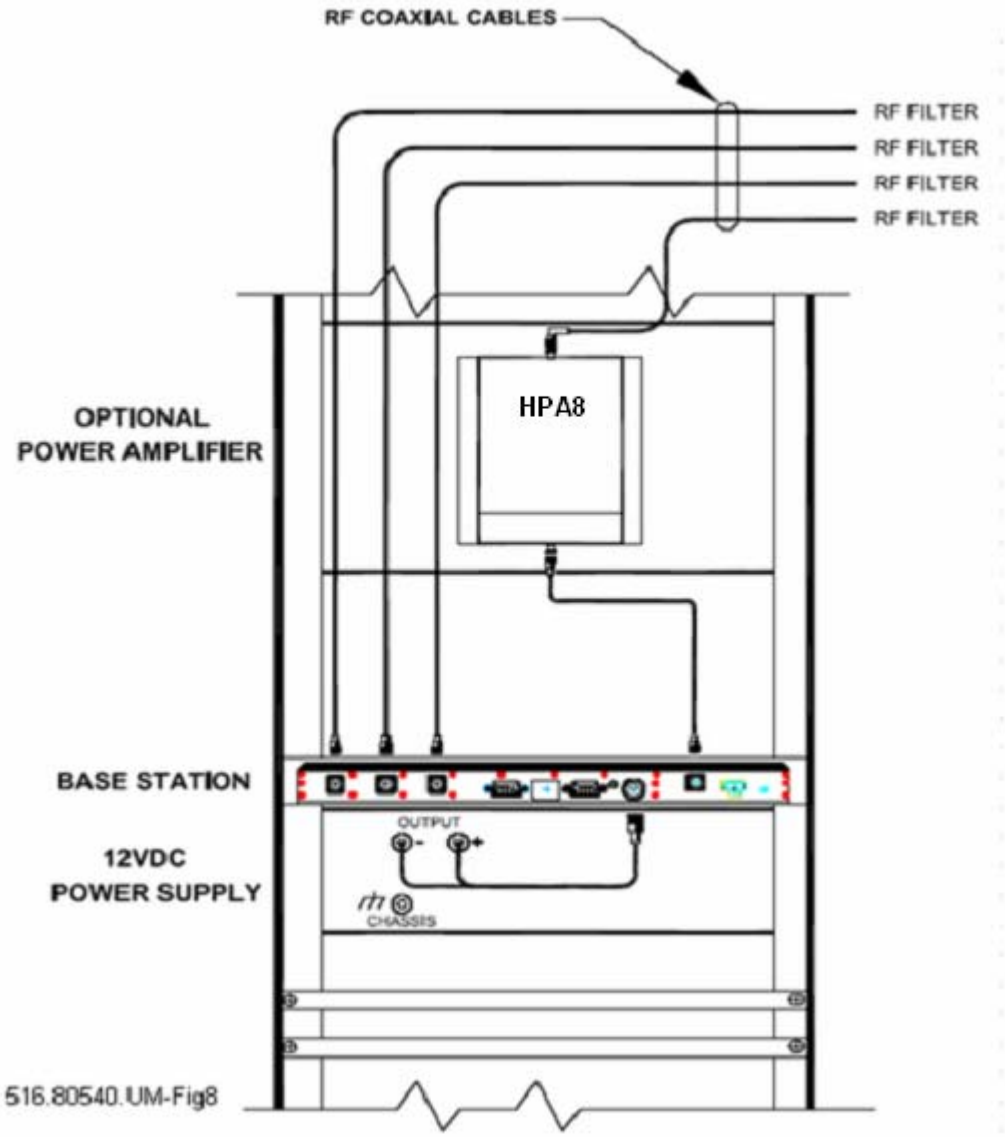


Figure 8: Base Station Mounting and Connection in the Rack Unit (Rear View)

Single Base Station Configuration



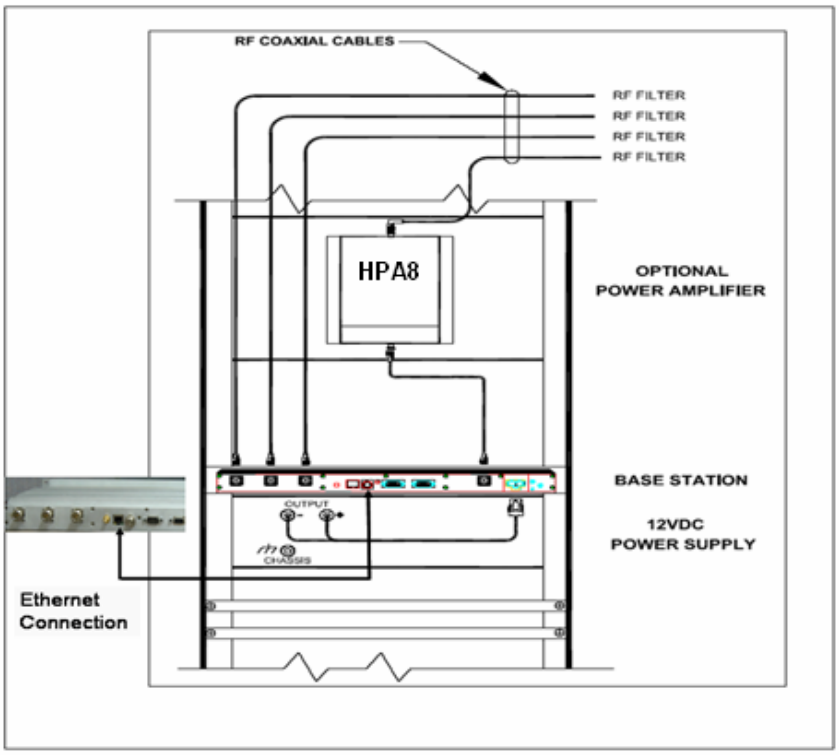


Figure 9: Base Station Ethernet Connection

To connect a single base station, perform the following steps:

Step 1 Plug in the Ethernet cable into the Ethernet port on the base station (as shown in the figure above).

Step 2 Route and plug in the other end of the Ethernet cable to an Ethernet switch or router.

Step 3 Route and plug in another Ethernet cable from the Ethernet switch or router to the Ethernet port of the Internet Protocol Network Controller (IPNC).

If connecting to a Serial backhaul, an IPMobileNet IPTurbo Converter is required. For connection instructions, refer to the IPTurbo Converter Reference Manual (IPMN p/n: 516.80496.REF) available on the Product Documentation CD provided with this product.

Multiple Base Station Configurations

To connect multiple base stations, perform the following steps:

Step 1 Plug in the Ethernet cables to the back of each base station (as shown in the figure above) and route according to selected setup. Refer to the IPTurbo Converter Quick Reference Guide (IPMN p/n: 516.80496.QR) for setup instructions and scenarios.

Step 2 Route and plug in the Ethernet cables to an IPMobileNet's Internet Protocol Network Controller (IPNC) via the hardware as defined by the organization's configuration.

If connecting to a serial backhaul, an IPMobileNet IPTurbo Converter is required. For connection instructions, refer to the IPTurbo Converter Reference Manual (IPMN p/n: 516.80496.REF).

Typical Antenna Configuration

Base station antenna configurations may vary from site to site depending on the type of mounting structure, the presence of existing antennae, mounting structure loading limitations, etc. The following information is provided as a guideline for a typical scenario.

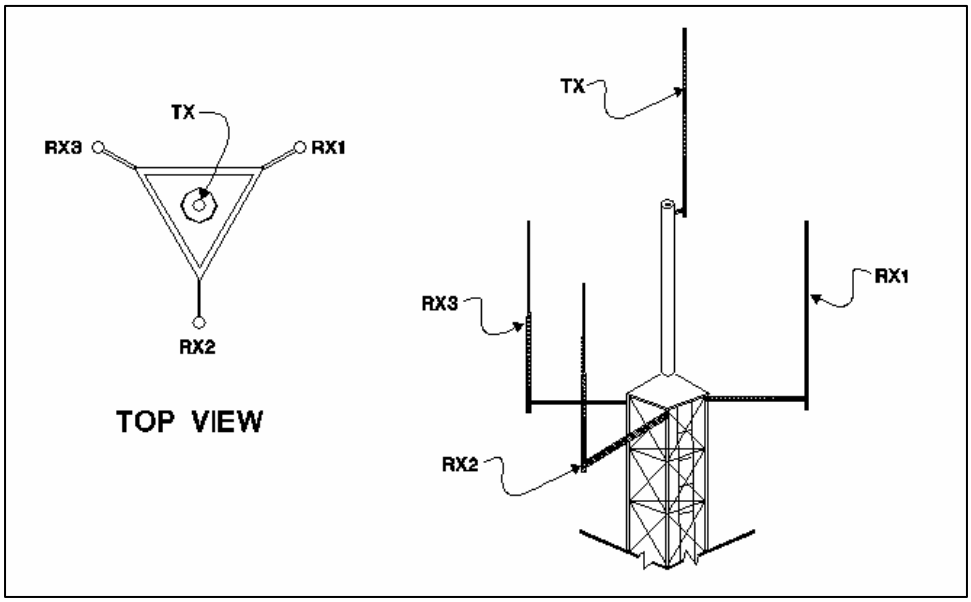


Figure 10: Typical Antenna Configuration

An optimal antenna mounting configuration is shown in the figure above. The transmit antenna and receive antennae are located at different elevations. This vertical separation provides the greatest degree of isolation between transmit and receive antennae. The three (3) receive antennae are mounted at the same elevation and are oriented in a 120 degree triangular pattern. A triangular orientation of the receive antennae provides optimal diversity performance in an omnidirectional pattern.

The greater the separation between receive antennae, the greater the diversity gain; therefore, the distance between antennae should be made as great as is practical.

In the event only two (2) receive antennae are used (i.e. a dual receiver diversity reception system), the receive antennae should be mounted in a broadside orientation with respect to the radio coverage area.

To prevent the antenna's radiation pattern from becoming distorted, the immediate area surrounding each antenna should be kept free from conductive objects (i.e. other antennae, guy wires, or the tower structure itself). The amount of clear area required to prevent pattern distorion is equal to the antenna's near-field exclusion.

Near-Field Exclusion Zone

The near-field exclusion zone (NFEZ) is the required distance between antennae to any other surfaces to improve transmit and receive performance. The large radio frequency field that builts up around the antenna upon transmitting is essential for proper data transmission. It can be severely corrupted by metal objects in the NFEZ. As seen in the previous figure, the transmitting antenna is placed at the very top of the tower especially if the base station will be required to transmit in all directions (omni-directional).

If the transmitting antenna cannot be positioned on the top of the tower and must be placed on a tower arm, then it is important to realize that coverage will be shaded in the area behind the tower from the anetnna. The installer must be certain that the area of desired coverage is away from the tower and not behind it.

Receiving and transmitting antennae should not be on the same plane, especially VHF and UHF systems where the frequency splits are relatiely small. An antenna in the near-field exclusion zone that is tuned for the same frequency as the transmitting antenna will reradiate the signal and create unwanted effects on the transmittal signal. The receivers will be inundated by high levels of radio frequency energy from the transmitting antenna. This is why it is important to include vertical separation in the plan for the base station installation. The isolation provided by 30 feet of vertical spearation can dramatically improve the performance of the base station.

An antenna's NFEZ can be calculated as follows:

$$D = \frac{2d^2}{\lambda}$$

Where: D is the distance to the anenna's near field boundary

d is the antenna's longest linear dimension (in the same units as D)

λ is the wavelength (in the same units as D)

Maximizing the distance between the receive antennae will provide maximum diversity gain and will minimize antenna radiation pattern distortion.

Power Connection

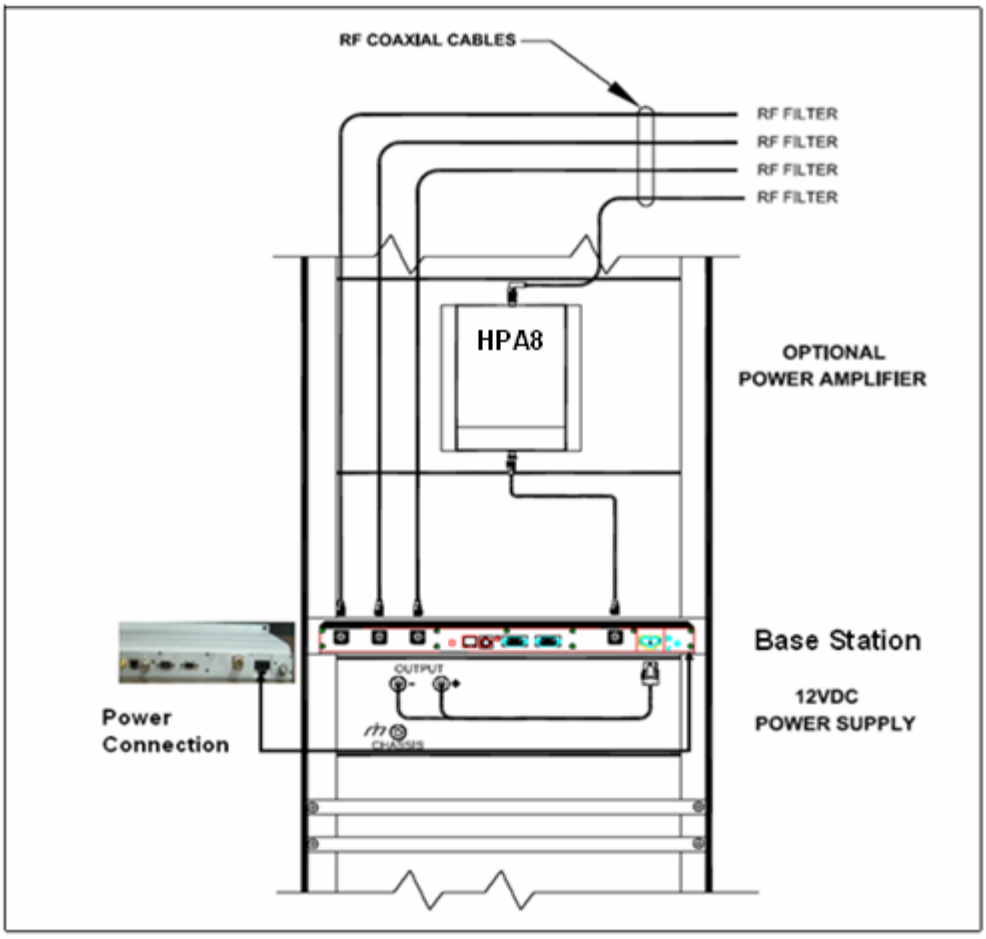


Figure 11: Base Station Power Connection

To connect the base station power connector, perform the following steps:

Step 1 Connect the power cable to the base station power supply connection (as shown in the figure above).

Step 2 Connect the wires to the appropriate output (+ and -) output posts on the power supply (as shown in the figure above).

Post Installation Checklist

The following table lists the tasks that should be performed upon completing installation.

TABLE 4: POST INSTALLATION CHECKLIST

NO.	CHECKLIST ITEM	☑
1	Scope out the entire area setup to locate any obvious problem areas.	☐
2	Check antenna routing for safety concerns and near-field boundary setup.	☐
3	Use tie wraps, where possible to ensure that all cables routed in parallel are bundled together.	☐
4	Perform appropriate testing to ensure base station works properly.	☐

Once installation is complete, make sure the area is clear of debris that would prevent proper airflow and ventilation.

No transmitter tuning or adjustments are to be performed in the field. The base station is factory set to meet all FCC requirements as required by the base station certification.

Overview

This section applies to all frequency ranges of the IPSeries Base Stations. **Important!** The base station's IP address must be known prior to performing the procedures in this section.

The programming procedure should be performed when it is necessary to upgrade a base station's Firmware or to change the operating parameters to suit the customer's needs before putting into complete operation.

HyperTerminal Setup

To communicate and access parameters from the base station, the base station must be connected to a HyperTerminal session setup on a personal computer.

Perform the following steps to setup the base station for communication with HyperTerminal:

Step 1 Connect the base station and the PC as shown in the figure below.

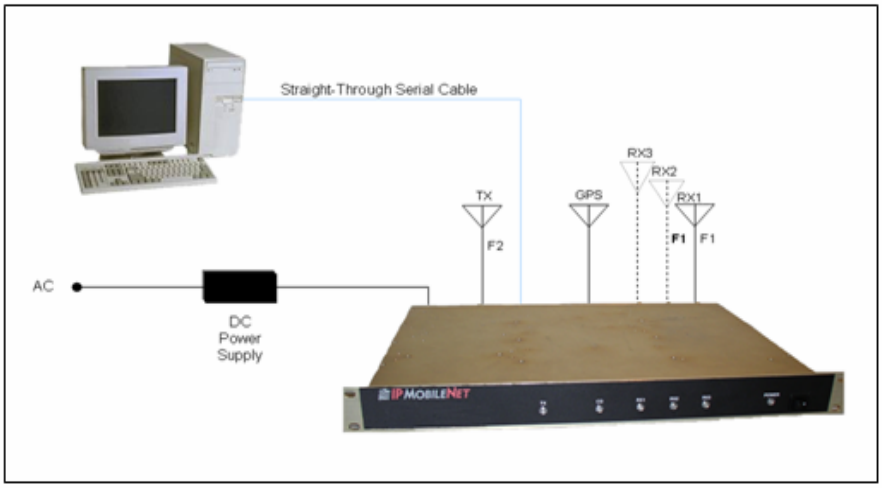


Figure 12: Base Station-to-HyperTerminal Connection Diagram

Step 2 Power on the PC.

Step 3 Power on the base station using the front panel power switch.

Step 4 On the PC desktop, click on the **Start** button and select **Accessories**, **Communications**, and **HyperTerminal**.

Step 5 At the *Connection Description* window enter **IPMNBS** and click on the **OK** button.

Step 6 At the *Connect To* window, under **Connect using:** select the appropriate COM port and click on the **OK** button.

Step 7 At the *COM Properties* window make sure the properties selected are as follows:

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

Step 8 Click on the **OK** button.

Step 9 Open **HyperTerminal**.

Step 10 Recycle the base power and HyperTerminal displays the base's Firmware revision.

Step 11 Type in a **?** in the HyperTerminal screen and press **[ENTER]**. This will list the Base Station parameters, as shown in the sample below. If the cursor is not responsive, check the cables for proper connection.

```
[From: 172.16.23.1] Host serial = 115200,N,8,1, timeout=200
[From: 172.16.23.1] Terminal serial = 9600,N,8,1, timeout=200
[From: 172.16.23.1] IPNC = 172.16.23.200
[From: 172.16.23.1] RF IP Address = 172.16.23.1
[From: 172.16.23.1] Tunnel Address = 172.16.23.2, Netmask = 255.255.0.0
[From: 172.16.23.1] Host interface = SLIP, no split frames, with status messages
[From: 172.16.23.1] tunnel = 0
[From: 172.16.23.1] Injection = LOW SIDE,    45.0000 MHz
[From: 172.16.23.1] channel spacing = 25000
[From: 172.16.23.1] Reference Frequency =    16.800000 MHz
[From: 172.16.23.1]          Channel      Tx freq            Rx freq            Inj freq
[From: 172.16.23.1] Frequency=0,        775.000000      805.000000      760.000000
[From: 172.16.23.1] Channel = 0
[From: 172.16.23.1] Serial number: undefined
[From: 172.16.23.1] TX Power = 0
[From: 172.16.23.1] TX quiet time = 5
[From: 172.16.23.1] Symbol sync time = 10 milliseconds, 0 extra inter-split-frame count
[From: 172.16.23.1] TX tail time = 5
[From: 172.16.23.1] Radio data rate = 32000
[From: 172.16.23.1] Carrier detect delay time = 5 milliseconds
[From: 172.16.23.1] Station ID = ABC123
[From: 172.16.23.1] Station ID time = 10 minutes
[From: 172.16.23.1] Polarity = TX-, RX+
[From: 172.16.23.1] allow crc errors = 0
[From: 172.16.23.1] RSSI step = 25   (=8dBm)
[From: 172.16.23.1] default gateway = 0.0.0.0
[From: 172.16.23.1] Ethernet address = 00:08:ce:00:00:00
[From: 172.16.23.1] Base station number = 27
[From: 172.16.23.1] SNTP interval = 60 seconds
[From: 172.16.23.1] num timeslots = 16
[From: 172.16.23.1] timeslot period = 992ms
[From: 172.16.23.1] timeslots per voice packet = 4
[From: 172.16.23.1] noise = -117dBm, -118dBm, -116dBm
[From: 172.16.23.1] DHCP Relay Agent = disable
[From: 172.16.23.1] 12dB SINAD = -113dBm (85 on RX0)
[From: 172.16.23.1] 12dB SINAD = -108dBm (61 on RX1)
[From: 172.16.23.1] 12dB SINAD = -112dBm (90 on RX2)
[From: 172.16.23.1] 30dB S/N = -106dBm (104 on RX0)
[From: 172.16.23.1] 30dB S/N = -102dBm (73 on RX1)
[From: 172.16.23.1] 30dB S/N = -105dBm (111 on RX2)
[From: 172.16.23.1] 40dB S/N = -90dBm (141 on RX0)
[From: 172.16.23.1] 40dB S/N = -87dBm (11
[From: 172.16.23.1] 40dB S/N = -89dBm (145 on RX2)
[From: 172.16.23.1] -40dBm = (229 on RX0)
[From: 172.16.23.1] -40dBm = (203 on RX1)
[From: 172.16.23.1] -40dBm = (228 on RX2)
[From: 172.16.23.1] -120dBm = (0)
[From: 172.16.23.1] -110dBm = (85)
[From: 172.16.23.1] -100dBm = (104)
[From: 172.16.23.1] -90dBm = (141)
[From: 172.16.23.1] -80dBm = (229)
[From: 172.16.23.1] -70dBm = (255)
[From: 172.16.23.1] Modem FEC = on
[From: 172.16.23.1] RX in progress message = 1
[From: 172.16.23.1] MTU = 1500
[From: 172.16.23.1] IPNC query period = 0 secs
[From: 172.16.23.1] Symbol sync time = 10 milliseconds, 0 extra inter-split-frame count
[From: 172.16.23.1] 02Sep2004 10:33:06.309 (PST), calibration=357
[From: 172.16.23.1] uptime = 0h:03m:30s
[From: 172.16.23.1] Firmware Rev. 34-01.0.001 x8,  Aug 31 2004 - 16:01:44
[From: 172.16.23.1] Test Mode = 0
[From: 172.16.23.1] Temp period = 2s
[From: 172.16.23.1] Temp Maximum = 80C
[From: 172.16.23.1] CRC EEProm = 3736
[From: 172.16.23.1] diversity speed = 3
[From: 172.16.23.1] receiver = auto
[From: 172.16.23.1] Receiver Hysteresis = 0
```

Ensure that the calibrated base station and the mobile radio antennae are separated by at least 10 feet. If the antennae are too close, the mobile radio receivers are overloaded by the transmitters resulting in intermittent communication and high data errors.

Additional Programming Needs

Refer to the following technical notes and programming instructions and select the appropriate document for additional functionality, programming, and setup information.

TABLE 5: ADDITIONAL PROGRAMMING DOCUMENTS	
TN01-0020	**Remote Firmware Updates for the IPNC and Base Station** This technical note provides instructions on how to perform remote Firmware updates for the Internet Protocol Network Controller and IPSeries base stations.
516.80489.UM	**Internet Protocol Network Controller** Refer to the section on Fault-Tolerance for information on how the base station operates within a fault-tolerant setup.

Ordering Parts

Replacement parts may be ordered from the following address:

Attn: Small Parts Sales
IPMobileNet, Inc.
16842 Von Karman Avenue, Suite 200
Irvine, CA 92606

Voice: (949) 417-4590
Fax: (949) 417-4591

Customer Support

To obtain assistance in troubleshooting problems with a product, please contact IPMobileNet's Customer Service Staff at (800) 348-1477.

Reporting Problems with the Documentation

To report problems or question concerning the documentation included in the shipment, please send an e-mail to dcage@ipmn.com explaining the problem and the Publications Department will respond as soon as possible.

Please ensure to include the following information with the e-mail message:

- Your company name
- Your name or other contact name
- Return e-mail address
- Manual name
- Manual part number
- Page number(s)
- Description of the problem

Backhaul Systems

Considering the backhaul system between the base station location and the Internet Protocol Network Controller location is one of the most critical elements of data transmission. Once data has been received at the base station, it must be relayed to the IPNC at the user's location quickly, accurately, and reliably.

Industry standard backhauls are appropriate for IPMobileNet data transmission as long as data is transmitted cleanly and dependably. Depending upon conditions and accessibility, the preferred method of data transmission to the remote site is through a wired backhaul.

Wired Backhaul

The Ethernet backhaul is preferred as it uses a T1 (or fractional T1) line or equivalent, which handles larger volumes of digital data. If the backhaul will be via SLIP connection, then four (4) wire DDS telephone lines capable of 56 kbps is recommended.

✎ **Do not** order a 64 kbps line as it is incompatible with IPMobileNet's equipment data transmission speed.

One disadvantage of using wired lines is that the system is under the control of an outside agency and telephone line faults or system outages impose potential loss of radio communication through the site affected.

Microwave Transmission Link

Using a microwave transmission link is another option, which is often used when wire cannot be brought into remote locations. Data transmission is generally very reliable, but adverse conditions can degrade the quality of the data. High winds, ice on the microwave dish, and other environmental variables can cause problems and prevent data or voice from completing transmitting.

Newest Backhaul

The 802.11 range of products for wireless data transmission. Several models of 802.11 have been used successfully.

✎ Be aware of the possibility of interference on the 2.4 GHz frequency range. The 802.11 product should only be used for short hops with clear line-of-sight in an environment where minimal radio interference will exist.

Serial Backhaul Capacity

The backhaul with the fastest speed that can provide clean, reliable, and dependable transmission should be considered when dealing with backhaul capacity. IPMobileNet's base stations operate at four (4) data transmission rates, which include the following:

- 115,200 bps
- 57,600 bps
- 38,400 bps
- 19,200 bps

The optimal goal is to select a backhaul data rate that remains ahead of the base station's data transmittal. For example:

BASE STATION	BACKHAUL	RESULTS
19,200 bps or 32,000 bps	Anything less than 38,400 bps	Backhaul does not have the opportunity to remain ahead of the base station's transmittals if data packets are dropped or need to be rebroadcast from the IPNC to the base station.
19,200 bps or 32,000 bps	Anything higher than 38,400 bps	System will be more efficient and always operate at the base station's peak performance never waiting for data to arrive from the IPNC.
64,000 bps	57,600 bps	Backhaul does not have the opportunity to remain ahead of the base station's transmittals if data packets are dropped or need to be rebroadcast from the IPNC to the base station.
64,000 bps	128,000 bps	Ideal rate and system will be more efficient requiring less time and operating at the base station's optimal performance never waiting for data to arrive from the IPNC.
128,000 bps	256,000 bps	Ideal rate and system will be more efficient requiring less time and operating at the base station's optimal performance never waiting for data to arrive from the IPNC.

The 56 kbps DDS line is typically used to create the 57,600 bps asynchronous data line for the serial line Internet protocol (SLIP) connection between the Internet Protocol Network Controller location and the base station site.

BASE STATION PARAMETERS

PARAMETER	DESCRIPTION / VALID VALUES	DEFAULT
?	Displays base station settings.	
12dB SINAD	Valid Values: 0 to -135 (Calibrate RSSI @ 12 db SINAD)	
30dB S/N	Valid Values: 0 to 135 (Calibrate RSSI @ 30 db S/N)	
40dB S/N	Valid Values: 0 to 135 (Calibrate RSSI @ 40 db S/N)	
-40dBm	Valid Values: 40 (Calibrate RSSI @ -40 dBm)	
base station number	Unique number assigned to the base station. Valid Values: 0 to 999	0
carrier detect delay time	Valid Values: 1 to 20 (unit in ms)	5
channel	Selects the operating frequency channel, where “x” is the channel number. Valid Values: 0 to 49	0,voice,data
comparison frequency		400000
default gateway	Default gateway address only needed if the base station is not on the same subnet as the IPNC. Valid Values: xxx.xxx.xxx.xxx (xxx=0 to 255)	0.0.0.0
Ethernet address	Valid Values: 00:08:CE:XX:XX:XX (XX=hexadecimal byte value)	00:00:00:00:00:00
frequency	Sets transmit and receive frequency for the channel. A maximum of 50 channel frequency combinations may be entered. These settings will change depending on the frequency range of the base. Valid Values: n, tx, rx (n=0 to 49, tx=100.0 to 999.0, rx=100.0 to 999.0)	

BASE STATION PARAMETERS

PARAMETER	DESCRIPTION / VALID VALUES	DEFAULT
host interface	Valid Values: ethernet, status/no status; slip, status/no status	ETHERNET, status
host serial	Sets the baud rate o the serial connection. “Timeout” specifies, in milliseconds, the time to end the frame if the end of frame character is not received. Valid Values: Baud, parity, data bits, stop bits, timeout=xxx Baud: 9600/19200/38400/57600/115200; Parity: N, O, E (None, Odd, or Even); Data bits: 7, 9; Stop bits: 1, 2	115200, n, 8, 1, 200
IPNC	Valid Values: xxx.xxx.xxx.xxx (xxx=0 to 255)	172.16.23.191
IPNC query period	Valid Values: 0 to 32767 (unit in seconds)	0
Model	Base station model name.	B64850D25
Modem FEC	Valid Values: On/Off	On
MTU	Used to set the MTU (maximum transmission unit). Where “n” is the desired mtu decimal value, 1500 maximum. Unlock the base prior to changing this parameter. The parameter change takes effect immediately. When the base receives a packet with a sizer greater than the set mtu, it returns an ICMP packet (type=3, code=4) to the source. The original received packet is discarded. Recommended Values: 576/1500	1500
noise	Show noise floor in dBm for each Receiver.	
num timeslots	Valid Values: 1 to 64	20
polarity	Valid Values: RX+, RX-, TX+, TX-	RX+, TX-
reference frequency	Valid Values: 1 to 100 MHz	16.800000 MHz
rf ip address	Base station’s virtual hardware IP address. Set this to an available IP address that is within the IPNC’s network. Valid Values: xxx.xxx.xxx.xxx (xxx = 0 TO 255)	192.168.3.1

BASE STATION PARAMETERS

PARAMETER	DESCRIPTION / VALID VALUES	DEFAULT
rssi step	Valid Values: 1 to 255	25
RX in progress message	Enable/disables receiving packet look-ahead, where "x" is either 1 or 0 (1=enable; 0=disable). Use to enable/disable the "receiving packet look ahead" feature. If enabled, as soon as the base receives a packet header, it sends a short packet to inform the IPNC of the length, source, address, and arrival time of the packet being received. IPNC Scheduler uses this information to decide the appropriate time to send the next packet to the mobile radio. Unlock base before changing. The parameter change is effective immediately. Valid Values: 0/1 (when set, packets cannot be sent because the mobile is busy will be returned to IPNC)	1
serial number	Valid Values: xxxxxx (x is an alphanumeric character, maximum 20)	undefined
sntp interval	Valid Values: 0 to 3600 (unit in seconds)	60
station ID	Valid Values: xxxxxxx (x is any alphanumeric character, maximum of 11 characters)	ABC123
station id time	Valid Values: 0 to 3600 (units in seconds) 0 = OFF	0
symbol sync time	Length of time that synchronization is transmitted before data is sent and is otherwise known as "TX Sync Time".	12
TFTP options	Valid Values: size, t (size=128/256/512 bytes, t=0 to 10 seconds) "T" specified delay in time in ms between each block	256, 3
time	Base station's concept of current time, NTP calibration value	
timeslot period	Valid Values: 1 to 1000	1000
timeslots per voice packet	Valid Values: 1 to 16	4

BASE STATION PARAMETERS		
PARAMETER	**DESCRIPTION / VALID VALUES**	**DEFAULT**
tunnel address	This is the slip or Ethernet IP Address Valid Values: xxx.xxx.xxx.xxx/mm (xxx=0 to 255), mm=netmask in bits)	172.16.23.5/24
tx quiet time	Valid Values: 1 to 20 (unit in ms)	5
tx sync time	Valid Values: 1 to 20 (unit in ms)	12
tx tail time	Valid Values: 1 to 20 (unit in ms)	5
unlock	Valid Values: xxxx (xxxx is the OEM password)	
uptime	Shows time in seconds since last reboot/reset	
version	Displays the base station's firmware version.	

✎ Use the command **unlock=password** entering the appropriate password to enable programming before issuing any commands above. Also, the base station should be reset by the "reboot" command when no more commands will be issued.

For changes to parameters not listed in this Appendix, please contact Customer Support.

4-Level FSK — A form of digital modulation in which four (4) discrete levels of carrier frequency displacement are employed to convey information.

16-Level FSK — A form of digital modulation in which 16 discrete levels of carrier frequency displacement are employed to convey information.

802.11 — Wireless LAN technology specifications, which specifies an over-the-air interface between a wireless client and a base station or between two wireless clients. 802.11 provide 1 or 2 Mbps transmission in the 2.4 GHz band using either frequency hopping spread spectrum (FHSS) or direct sequence spread spectrum (DSSS).

Analog — A classification of signal in which the amplitude of the signal may take on an infinite number of values.

Backhaul — To transmit voice and data traffic from a cell site to a switch, i.e., from a remote site to a central site.

Bessel Filter — A filter with a linear phase response.

Broadband — A term, which implies that the equipment can be operated over a wide (broad) band of frequencies.

bps — bits per second

CMOS — Complementary Metal Oxide Semiconductor – A type of integrated circuit with low power consumption.

Collision Tolerant Modem — A specially designed modem, which can tolerate transmissions that overlap in time.

Continuous Duty — Indicates that the equipment can be operated 100% of the time.

CRC — Cyclic Redundancy Checksum – An error detection scheme in which a known algorithm is used to operate on a message both prior to transmission and after reception. The output of the operation (the checksum) is compared on both sides of the link to validate the integrity of the received message.

CSU/DSU — Channel Service Unit/Data Service Unit. CSU connects a terminal to a digital line while the DSU performs protective and diagnostic functions for the telecommunication line.

Data Interleaving	A technique in which the order of the individual data bits within the data to be transmitted is shifted and interleaved so as to disassociate adjacent data bits in a message. This scheme is complementary to forward error correction (FEC) algorithms.
Data Scrambling	A technique used to ensure no repeating patterns exist in the transmitted data stream, a method of ensuring the data is reasonable random in nature.
Digital	A classification of signal in which the amplitude of the signal may take a discrete number of values.
Diversity Reception	A reception system using multiple antennae and/or multiple receivers to combat multi-path fading.
Dynamic Range	The range of amplitudes over which a receiver or amplifier will operate within specifications.
EIA	Electronic Industries Association
EMI	Electromagnetic Interference
Ethernet	A local area network (LAN) architecture, which uses a bus or star topology and supports data transfer rates of 10 Mbps.
Exciter	An exciter is that part of a radio, which creates the transmit RF carrier and performs the process of modulation.
FEC	Forward Error Correction – A methodology used to correct errors, which may occur in wireless transmission systems. With FEC, additional data is added to each message prior to transmission, at the receiving end, this additional information can be used to correct errors in the received message.
FM	Frequency Modulation – A form of modulation where the carrier is shifted an amount proportional to the modulating signal's amplitude at a rate proportional to the modulating signal's frequency.
Frequency Stability	A measure of the stability of a frequency with respect to temperature, usually expressed in ppm (parts per million) over a specified temperature range.

FSK	Frequency Shift Keying – Digital modulation (a form of FM) where the carrier frequency is shifted above and below the operating frequency (in discrete steps) in response to a digital data input.
Full Duplex	A dual frequency mode of operation in which transmission and reception occur simultaneously.
GFSK	Gaussian Filtered Frequency Shift Keying – A form of digital modulation in which the baseband modulation signal is filtered by a low-pass filter with a Guassian response prior to modulating the carrier signal.
GPS	Global Positioning System
Half Duplex	A dual frequency mode of operation, which inhibits simultaneous transmission and reception.
Image Frequency	An unwanted frequency, which will produce an on-frequency IF (Intermediate Frequency) signal.
Injection	An injection signal is a signal used in frequency conversion circuits, it is normally mixed with another signal to produce a third signal (which is a sum or difference or the original signal and the injection signal).
kbps	kilobits per second (1 kbps=1000 bps)
LO	Local Oscillator – An on-board oscillator used in frequency conversion circuits.
Modular Design	A design in which the major functional components are separated into distinct modules.
MTU	Maximum Transmission Unit. The largest number of bytes of payload data a frame can carry not counting the frames in the header and trailer.
Multi-path	A radio propagation situation in which multiple RF (radio frequency) signal paths exists between a transmitter and receiver. These multiple paths or multi-path situations can create significant distortion in the received signal.
NFEZ	Near-Field Exclusion Zone
Noise Figure	The “Figure of Merit” of an amplifier. Specifically, noise figure is a measure of the degradation in SNR (signal-to-noise ratio) between the input and output ports of a network.

PCB	Printed Circuit Board
Phase Linearity	Implies a linear relationship between the phase of a signal and the frequency of that signal. A linear phase response ensures constant input to output delays regardless of frequency, import for wireless communication systems.
Phase Noise	A measure of the purity of a discrete frequency (expressed in –dBc/Hz at some offset frequency).
PLL	Phase Locked Loop - A circuit configuration used to lock the frequency of a VCO (voltage controlled oscillator) to a high stability reference oscillator.
ppm	Parts Per Million
RF	Radio Frequency
RFI	Radio Frequency Interference
SINAD	The ratio of Signal + Noise + Distortion to Noise + Distortion.
Sensitivity	The measure of a receiver's ability to capture and faithfully reproduce weak signals.
SLIP	Serial Line Internet Protocol. Protocol that allows connection to the Internet via a dial-up connection.
SMT	Surface Mount Technology – electronic components, which makes electrical contact on the surface layer of a PCB (as opposed to thru-hole components). SMT devices provide reduced size and increase performance.
SNR	Signal-to-Noise Ratio
TCVCXO	Temperature Compensated Voltage Controlled Crystal Oscillator
TIA	Telecommunications Industry Association
Transmit Attack Time	The elapsed time from transmit key assertion to 90% rated RF power is achieved.
VCO	Voltage Controlled Oscillator – An oscillator whose frequency can be adjusted by a DC control voltage.