



## ***IP*Series**

# **B64450G25 Base Station Product Owner's Manual**

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The term "IC": before the radio certification number only signifies that Industry of Canada technical specifications were met.

Operation is subject to the following two (2) conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of this device.

The following U.S. Patents apply to this product:


U.S. Patent numbers 5,640,695,6,018,647,6,243,393

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## Product Description

-  The B64450G25 Base Station works within a frequency range of 450-507 MHz and requires 1/4-wavelength antenna.

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 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.



## Product Functionality

The base station utilizes a high-performance DSP to modulate/demodulate 4 to 16-level Frequency-Shift Keying (FSK) modem for 25 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.

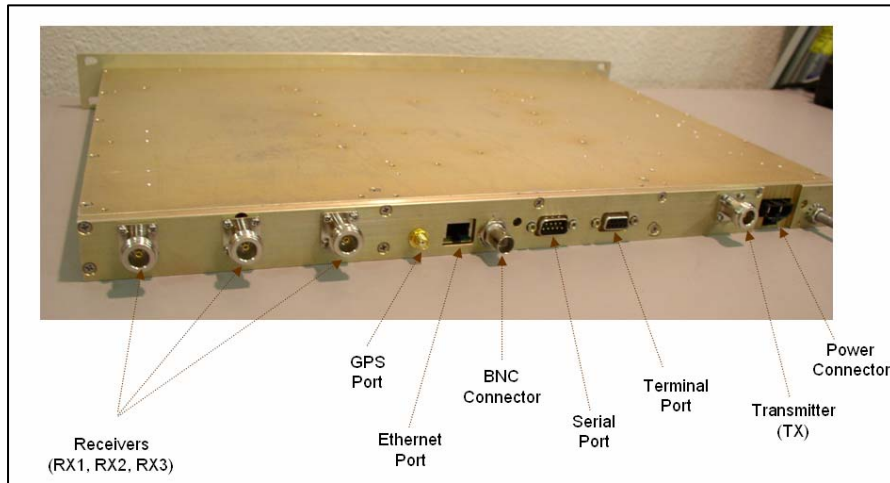
-  Diversity is most effective when the vehicle using an IPSeries Mobile Radio is in motion.

**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.

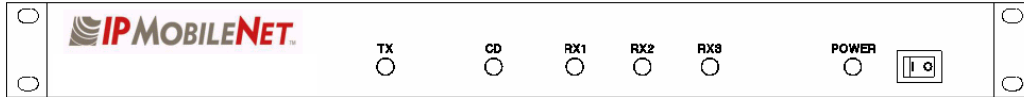


The product warranty becomes void if an uncertified or unauthorized individual removes the base station cover.



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

<b>TABLE 1: EXTERNAL FEATURES (Rear)</b>	
<b>FEATURE</b>	<b>DESCRIPTION</b>
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



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

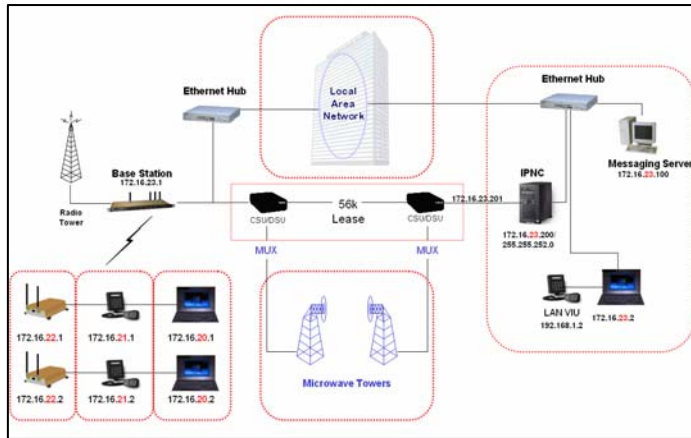
<b>TABLE 2: EXTERNAL FEATURES (Front)</b>	
<b>LED Name</b>	<b>When lit....</b>
TX	Indicates that transmission is in progress
CD	Carrier detect indicates an RF message is detected
RX1	Indicates that receiving is in progress on Receiver 1
RX2	Indicates that receiving is in progress on Receiver 2
RX3	Indicates that receiving is in progress on Receiver 3
POWER	Indicates the base station is powered on

**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.

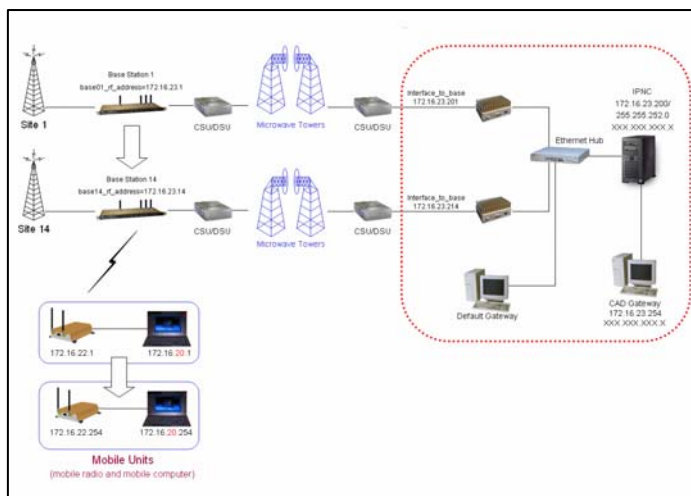
Basic Network Connection to an Existing LAN

The following figure depicts a basic network connection for an existing Local Area Network (LAN) inclusive of one (1) Internet Protocol Network Controller (IPNC), one (1) base station, and multiple mobile radios, voice interface units (VIU), and mobile computers. It also includes other equipment such as a LAN VIU and a messaging server.



Basic Network Connection with a Range of Base Stations

The following figure 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.



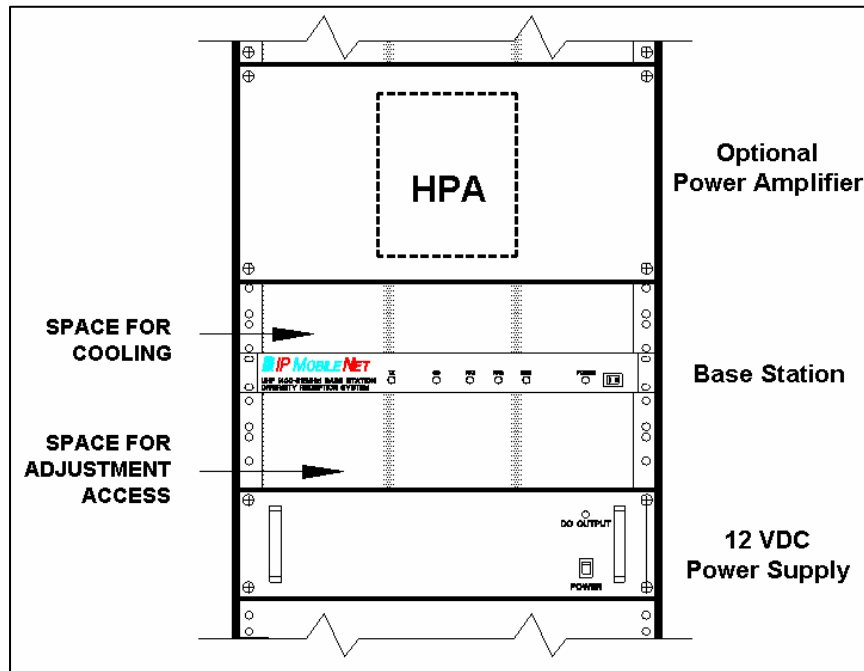
For serial connectivity to Ethernet only systems, please refer to the IPTurbo Converter Quick Reference Guide (IPMN p/n: 516.80496.QR) on the Production Documentation CD (IPMN p/n: 480.0001.001).

## SECTION 3: PRODUCT SETUP AND PRELIMINARY TESTING

### 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



The table below lists the required components for a base station setup.


TABLE 3: BASE STATION COMPONENTS REQUIRED FOR INSTALLATION	
QTY	DESCRIPTION
1	Frequency appropriate IP Series 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)



## SECTION 3: PRODUCT SETUP AND PRELIMINARY TESTING

### 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.

<b>TABLE 4: CHECKLIST OF REQUIRED EQUIPMENT FOR PRELIMINARY TESTING OF A BASE STATION</b>		
<b>1</b>	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	
<b>2</b>	DC power supply with ammeter, with the appropriate volts, see page 7 <i>Current Consumption</i> for each base station (Astron VS12M or equivalent)	
<b>3</b>	Six (6) antennae (generic mag mounts) tuned to frequency of transceiver	
<b>Serial Base Station Interface</b>		
<b>No.</b>	<b>Requirement</b>	<b>✓</b>
<b>1</b>	DB9 RS232 serial cable	
<b>2</b>	IPTurbo Converter (IPMN p/n: 900.00012.01)	
<b>3</b>	IPTurbo Converter Reference Manual (IPMN p/n: 516.80496.REF)	
<b>Ethernet Base Stations Interface</b>		
<b>No.</b>	<b>Requirement</b>	<b>✓</b>
<b>1</b>	Ethernet RJ45 Cable	
<b>2</b>	Ethernet Cable	

## SECTION 3: PRODUCT SETUP AND PRELIMINARY TESTING

### 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 antennae 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 IP Series 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. Adjustment points are available through holes in the base station's bottom cover. Sufficient space below the base station should exist to facilitate adjustments.

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 substitutions 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 top of the rack. 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 top of the rack. 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 top of the rack. 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 the top of the rack. 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.

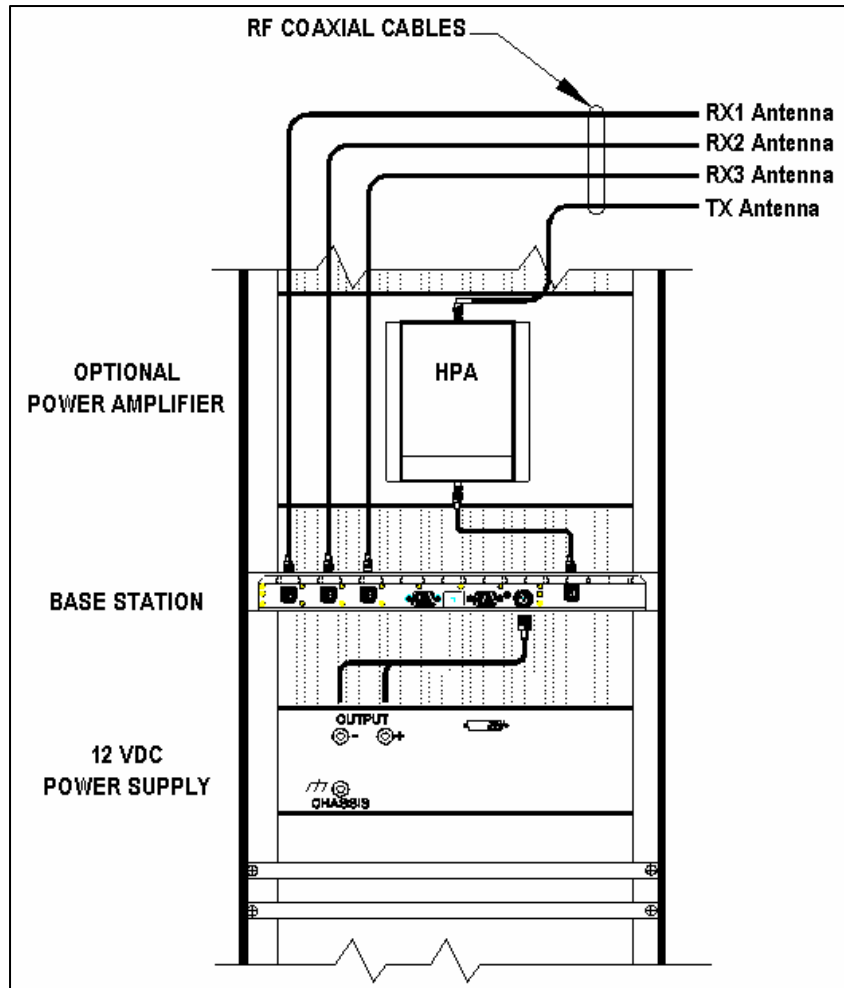


Figure 8: Base Station Mounting and Connection in the Rack Unit (Rear View)

### Single Base Station Configuration

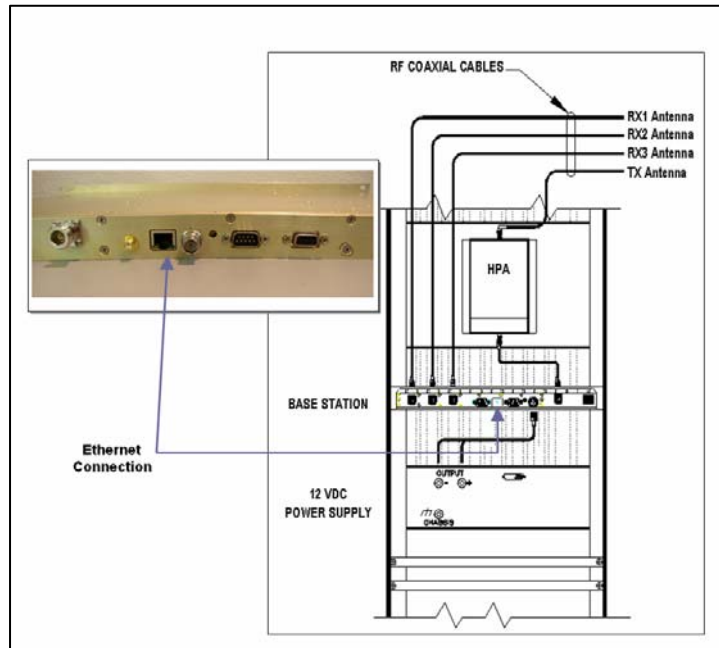


Figure 9: Base Station Ethernet Connection

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.

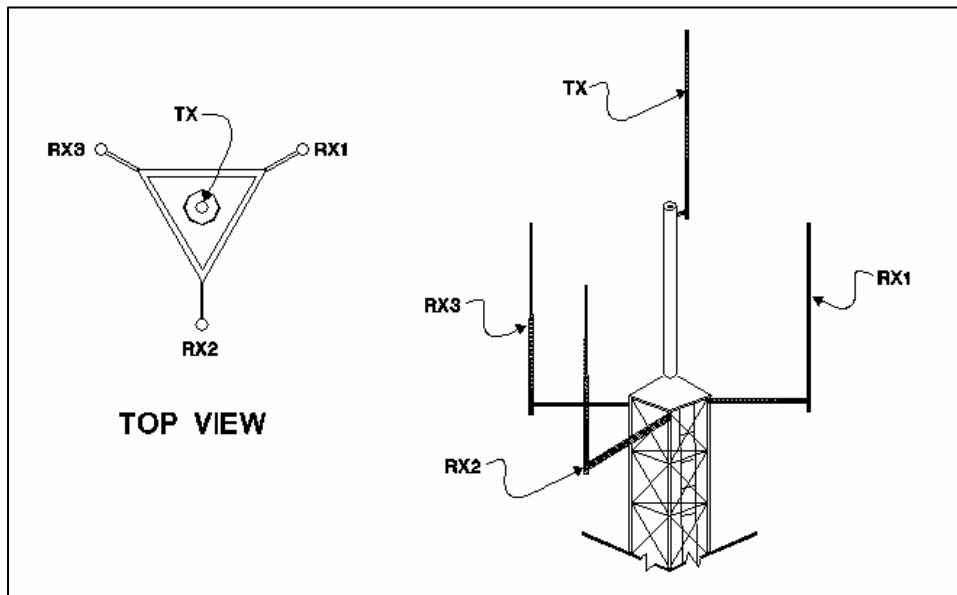


Figure 10: Typical Antenna Configuration

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 distortion 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 builds 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 antenna. 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 relatively 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 transmitted 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 separation 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 antenna's near field boundary
- d is the antenna's longest linear dimension (in the same units as D)
- $\lambda$  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

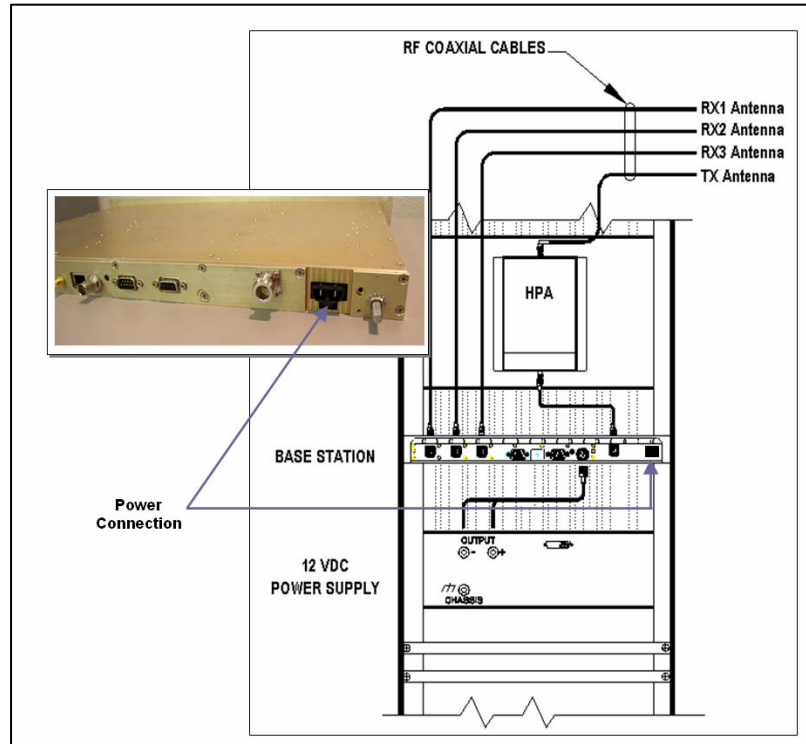


Figure 11: Base Station Power Connection

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.

<b>TABLE 5: POST INSTALLATION CHECKLIST</b>		
NO.	CHECKLIST ITEM	<input checked="" type="checkbox"/>
1	Scope out the entire area setup to locate any obvious problem areas.	<input type="checkbox"/>
2	Check antenna routing for safety concerns and near-field boundary setup.	<input type="checkbox"/>
3	Use tie wraps, where possible to ensure that all cables routed in parallel are bundled together.	<input type="checkbox"/>
4	Perform appropriate testing to ensure base station works properly.	<input type="checkbox"/>



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

## SECTION 5: FACTORY TEST PROCEDURE

### Equipment List

The following table lists the equipment required to perform the B64450G25 Base Station Factory Test Procedure.

<b>TABLE 6: EQUIPMENT REQUIRED TO PERFORM FACTORY TEST PROCEDURE</b>			
<b>QTY</b>	<b>DESCRIPTION</b>	<b>MANUFACTURER</b>	<b>MODEL</b>
2	PC's (one for mobile, one for base)	Windows 9X w/ IPMessage AVR	
1	IPSeries High Speed Base Station	IPMobileNet	B64450G25
1	IPSeries High Speed Mobile Radio	IPMobileNet	M64450G25
1	Service Monitor – Communication Test Set	HP	8920A or B or equivalent
1	High Frequency Probe	HP	85024A
1	Power Supply for 85024A Probe	HP	HP1122A
4	Channel Scope	Tektronix	TDS 460A
1	General Purpose Probe Scope		
1	Digital Multi-Meter Fluke	Tektronix	Dmm91277
1	DC power supply with ammeter, 13.8V, 12 Amps or more	Astron	VS12M or equivalent
1	100 watt dummy load/attenuator	Pasternack	PE7021-40 or equivalent
4	UHF Antennae (generic mag mount)		
1	Serial Cable DB9M – DB9F connectors (generic)	IPMobileNet	156.0245.020
1	Input/Output (I/O) Board	IPMobileNet	502.80081
1	IPSeries High Speed Base Station power cable		
3	Serial DB9F-DB9M Null Modem cables		

### Programming and Configuring the Base Station



This section applies to the 450 to 507 MHz frequency range of the *IP*Series Base Station. **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 client needs.

### Viewing the Base Station's Configuration Data

**Step 1** At the HyperTerminal window, type in the appropriate password and press **[ENTER]**.

**Step 2** Type **?** and press **[ENTER]**. The following example displays in the HyperTerminal window:

```

Host serial = 115200,N,8,1, timeout=200
Host framing = SLIP, no split frames no status messages
tunnel = 0
TX format = new
Injection = LOW SIDE, 45MHz
channel spacing = 25000
Channel = 0
      Channel   Tx freq   Rx freq   Inj freq
Frequency=0, 450.000000, 463.000000, 418.000000
Serial number: yyyyyyyy
RIM address = 1
Frequency group = 1
TX quiet time = 5
Symbol sync time = 12 milliseconds, 0 extra inter-split-frame count
TX tail time = 5
Radio data rate = 19200
Max data tx time = 60 seconds
Carrier detect delay time = 1 millisecond
Station ID = ABC123
Station ID time = 10 minutes
Polarity = TX+, RX+
Allow crc errors = 0
Suppress keep alive = 0
Allow base to base = 0
Timeslot status = 0
Duplicate time = 10 milliseconds
Control head grant delay = 50 milliseconds
RIM DD delay = 0 milliseconds
Retry interval = 0 milliseconds
Retry time limit = 0 milliseconds
RSSI step = 25 (=19dBm)
IPNC = 192.168.3.3
SLIP Address = 192.168.4.6
RF IP Address = 192.168.3.1
SNTP interval = 60 seconds
num timeslots = 16
timeslot period = 992ms
timeslots per voice packet = 4
noise = -128dBm
Fixed TX Delay = 0 milliseconds
Scale TX Delay = 0 microseconds
    
```

**Adjustment / Alignment Procedures**

Make appropriate notations of any items that require attention during this procedure. This information is needed later during the repair process.

Startup

- Step 1** Remove the base station cover placing the screws in a location where they will not be misplaced.
- Step 2** Connect the base station to the appropriate components.
- Step 3** Power up the base station and computer. The power supply ammeter must read 1.2 amps or less with a 13.8 VDC input.

Receiver Injection

- Step 1** Using the HP high frequency probe verify that the receiver injection frequency is present at each of the three (3) receivers by monitoring the receivers R24 surface mount pad which lies on the 50 ohm track between P1 and C43.
- Step 2** Adjust R23 on the receiver injection circuit board to set the injection frequency within 10 Hz of the exact injection frequency. The amplitude of the injection frequency should read approximately +5 dBm  $\pm$ 1 dBm.

Receiver

- Step 1** **Using the high frequency probe, monitor the 44.545 MHz second injection frequency** at U6 pin 3, adjust trimmer capacitor (C22) to the center of the oscillator's oscillation range. The amplitude level of pin 3 of U6 should read between +5 and +10 dBm.
- Step 2** Inject an on-frequency signal at a level of -80 dBm, modulated with a 1 KHz test tone at  $\pm$ 5.0 KHz deviation into the receiver under test.
- Step 3** Check the receiver's sensitivity, verifying that the SINAD is 12 dB or better at a maximum level of -119 dBm (-120 is typical).

### Diversity Reception

- Step 1**            Inject an on-frequency signal at a level equal to Receiver 1 12dB SINAD level, modulated with a 1 KHz test tone at  $\pm 5.0$  KHz deviation into Receiver 1.
- Step 2**            While monitoring TP1 with the digital multi-meter, adjust RSSI1 low adjust potentiometer (R12) for a reading of 0.750 VDC  $\pm 10$  mV.
- Step 3**            Increase the amplitude of the signal by 50 dBm.
- Step 4**            While monitoring TP1 with the digital multi-meter, adjust RSSI1 high adjust potentiometer (R11) for a reading of 2.75 VDC  $\pm 10$  mV.



Adjustments R11 and R12 are interactive adjustments, therefore continue adjustments until the DC voltage at TP1 is 0.750 VDC for the receiver's 12 dB SINAD level and 2.75 VDC for a 50 dBm increase from the receiver's 12 dB SINAD level.

- Step 5**            Inject an on-frequency signal at a level equal to Receiver 2 12dB SINAD level, modulated with a 1 KHz test tone at  $\pm 5.0$  KHz deviation into Receiver 2.
- Step 6**            While monitoring TP2 with the digital multi-meter, adjust RSSI1 low adjust potentiometer (R10) for a reading of 0.750 VDC  $\pm 10$  mV.
- Step 7**            Increase the amplitude of the signal by 50 dBm.
- Step 8**            While monitoring TP2 with the digital multi-meter, adjust RSSI1 high adjust potentiometer (R9) for a reading of 2.75 VDC  $\pm 10$  mV.



Adjustments R9 and R10 are interactive adjustments, therefore continue adjustments until the DC voltage at TP2 is 0.750 VDC for the receiver's 12 dB SINAD level and 2.75 VDC for a 50 dBm increase from the receiver's 12 dB SINAD level.

- Step 9**            Inject an on-frequency signal at a level equal to Receiver 3 12dB SINAD level, modulated with a 1 KHz test tone at  $\pm 5.0$  KHz deviation into Receiver 3.
- Step 10**           While monitoring TP3 with the digital multi-meter, adjust RSSI1 low adjust potentiometer (R33) for a reading of 0.750 VDC  $\pm 10$  mV.
- Step 11**           Increase the amplitude of the signal by 50 dBm.
- Step 12**           While monitoring TP3 with the digital multi-meter, adjust RSSI1 high adjust potentiometer (R35) for a reading of 2.75 VDC  $\pm 10$  mV.



Adjustments R33 and R35 are interactive adjustments, therefore continue adjustments until the DC voltage at TP3 is 0.750 VDC for the receiver's 12 dB SINAD level and 2.75 VDC for a 50 dBm increase from the receiver's 12 dB SINAD level.

**Step 13** Inject on-frequency signal at a level of  $-80$  dBm, modulated with a 1 KHz test tone at  $\pm 5.0$  KHz deviation into Receiver 1.

**Step 14** While monitoring the AC voltage at TP6 adjust audio 1 AC adjustment potentiometer (R72) for 350 mVRMS ( $\pm 1$  mV).

**Step 15** While monitoring the DC voltage at TP6 adjust audio 1 DC adjustment potentiometer (R57) for 2.500 VDC ( $\pm 1$  mV).



The audio AC and DC adjustments are interactive, therefore continue adjusting R72 for 350 mVRMS and R57 for 2.500 VDC until further adjustments are no longer required.

**Step 16** Inject on-frequency signal at a level of  $-80$  dBm, modulated with a 1 KHz test tone at  $\pm 5.0$  KHz deviation into Receiver 2.

**Step 17** While monitoring the AC voltage at TP6 adjust audio 1 AC adjustment potentiometer (R71) for 350 mVRMS ( $\pm 1$  mV).

**Step 18** While monitoring the DC voltage at TP6 adjust audio 1 DC adjustment potentiometer (R58) for 2.500 VDC ( $\pm 1$  mV).



The audio AC and DC adjustments are interactive, therefore continue adjusting R71 for 350 mVRMS and R58 for 2.500 VDC until further adjustments are no longer required.

**Step 19** Inject on-frequency signal at a level of  $-80$  dBm, modulated with a 1 KHz test tone at  $\pm 5.0$  KHz deviation into Receiver 3.

**Step 20** While monitoring the AC voltage at TP6 adjust audio 1 AC adjustment potentiometer (R53) for 350 mVRMS ( $\pm 1$  mV).

**Step 21** While monitoring the DC voltage at TP6 adjust audio 1 DC adjustment potentiometer (R59) for 2.500 VDC ( $\pm 1$  mV).



The audio AC and DC adjustments are interactive, therefore continue adjusting R53 for 350 mVRMS and R59 for 2.500 VDC until further adjustments are no longer required.

**Step 22** Adjust the carrier detect potentiometer (R74) to illuminate a level of  $-116$  dBm.

### Receive Data

**Step 1** Using a calibrated mobile radio, generate uplink data messages using the **X=1400,19** command in the *IPMessage* Utility program.

**Step 2** Attach an antenna to one of the base station's receiver ports and verify on the base station monitor screen (HyperTerminal) that the received message data quality are consistently 240 and higher for 1400 character messages. Repeat test for each receiver.

### Exciter

- Step 1** Using the **X=1400,19** command, generate data messages so the transmit power and frequency can be checked.
- Step 2** Note the power level and then on the power amplifier circuit board adjust the potentiometer (R3) fully counterclockwise (this will enable low power transmit operation).
- Step 3** Connect the base stations' transmit port to the HP communication test set.
- Step 4** While transmitting data messages using the **X=1400,19** command, adjust the following:
- TCXO Y1 for minimum frequency error
  - R42 for  $\pm 5$  KHz deviation



Transmit output power should be approximately 1mWatt. The REFMOD adjustment needs to be made while the base station is transmitting real data messages to and from a mobile radio. This is most easily done using the ping command to ping the IPNC from a mobile radio. This will cause the base station to repeatedly send data messages and will facilitate the REFMOD adjustment.

- Step 5** Connect the base station to the IPNC.
- Step 6** Using a calibrated mobile radio operating on the base station's channel, adjust R30 for consistent data quality readings of 248 (as observed on the mobile radio's attached PC *IPMessage* window). Access the MSDOS prompt and ping using the following command:

```
>;ping 192.168.3.3 -t -l 500 -w 2000
```



This command will ping the IPNC continuously with a 500-character test message. Press **[Ctrl]+C** to stop the ping.

### Power Amplifier

- Step 1** Connect the base station's transmit port to the communication test set.
- Step 2** Using the **X=1400,19** command, generate data messages.
- Step 3** Slowly increase the base station output power by turning the power control potentiometer clockwise until the power noted in Step 2.

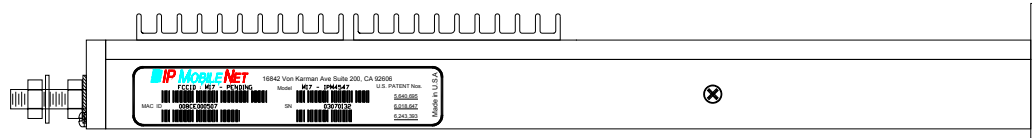


Do not exceed 40 watts output power, as this will reduce the life of the amplifier module. If the base station uses a power amplifier, output power must be set to achieve power output specified for the specific base station installation.

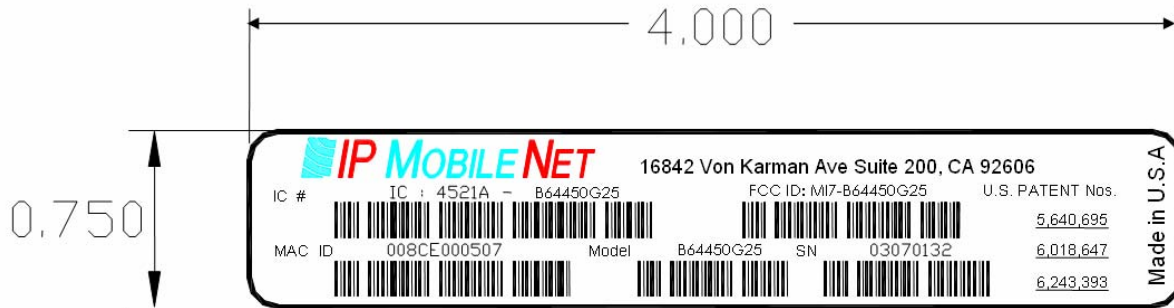
- Step 4** Perform a close visual inspection of the base station paying close attention to manufacturing related problems such as loose screws, solder practices, etc.



B64450G25 Base Station FCC Label Placement



B64450G25 Base Station FCC Label



**Program and Configure the Base Station**

Date \_\_\_\_\_  
 Serial Number \_\_\_\_\_  
 Firmware Revision \_\_\_\_\_  
 End User \_\_\_\_\_  
 Tester \_\_\_\_\_

**Adjustment / Alignment Procedures**

Receiver Injection

<u>Parameter</u>	<u>Spec</u>	<u>Measured</u>
Injection Frequency Error at RXINJ1(within +/- 10 Hz of exact injection frequency)	<b>+/- 100 Hz</b>	_____
P1 & C39	<b>5 +/- 1 dBm</b>	_____

Receiver Diversity Reception Controller 1, 2 & 3

<u>Parameter</u>	<u>Spec</u>	<u>Receiver 1 Measured</u>	<u>Receiver 2 Measured</u>	<u>Receiver 3 Measured</u>
U6 Pin 4	<b>+10 to +5 dBm</b>	_____	_____	_____
RSSI Test Point TB1-4	<b>2.8 to 3.0 VDC</b>	_____	_____	_____
Distortion (1 kHz Test Tone @ 5.0 kHz)	<b>3%&lt;</b>	_____	_____	_____
SINAD 12 dB (1 kHz Test Tone @ 5 kHz)	<b>-119dBm &gt;</b>	_____	_____	_____
SINAD 12 dB TP1	<b>0.75 VDC +/- 1 mV</b>	_____	_____	_____
SINAD +50 dB TP1	<b>2.75 +/- 1 mV</b>	_____	_____	_____
Audio AC Amplitude (1 kHz Test Tone @ 5 kHz Deviation)	<b>350 mVRMS +/- 1mV</b>	_____	_____	_____
Audio DC Amplitude (1 kHz Test Tone @ 5 kHz Deviation)	<b>2.5 VDC +/- 1mV</b>	_____	_____	_____
Carrier Detect Light Set	<b>-116 dBm</b>	_____	_____	_____

Data Quality

<u>Parameter</u>	<u>Spec</u>	<u>Measured</u>
Receiver 1 Data Quality (x=1400, 19 Command <i>IPMessage Utility</i> )	<b>240&gt;</b>	_____
Receiver 2 Data Quality (x=1400, 19 Command <i>IPMessage Utility</i> )	<b>240&gt;</b>	_____
Receiver 3 Data Quality (x=1400, 19 Command <i>IPMessage Utility</i> )	<b>240&gt;</b>	_____

Exciter

<u>Parameter</u>	<u>Spec</u>	<u>Measured</u>
Transmit Frequency Error (Transmitting 1400 character test message)	<b>+/- 500 Hz</b>	_____
Transmit Modulation Deviation (5.3 kHz while transmitting 1400 character test message)	<b>5.1 kHz to 5.3 kHz</b>	_____
Transmit Data Quality (While transmitting 1400 character test message to the base station)	<b>240&gt;</b>	_____

Transmit Power Control

***Warning: Do Not exceed 40 Watts RF output power during this test***

<u>Parameter</u>	<u>Spec</u>	<u>RF Out</u>	<u>RF Out Max</u>	<u>Level set to</u>
Output Power (Use x=1400,19 command)	<b>40 +/- 1 Watt</b>	_____	_____	_____

Test Check List

<u>Test Task</u>	<u>Completed</u>
Attached copy of Base Station's Firmware Settings	<u>(✓)</u>

Visual Inspection

**Copy Base Station Settings Below:**