PES800 NR

Operations Manual

550-1200-03

Revision 2

March 2005

PENINSULA·ENGINEERING SOLUTIONS Inc

Corporate Headquarters
39 Grand Canyon Ln, San Ramon
California 94582 USA
Telephone: +1 925 901-0103
Facsimile: +1 925 901-0403
www.peninsulaengineering.com

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39 Grand Canyon Lane, San Ramon
California 94582
United States of America
Telephone: +1 925 901-0103
Facsimile: +1 925 901-0403
www.peninsulaengineering.com

PES800 NR Installation Checklist Rev. 1 — Jan 2005

Only qualified personnel trained in the installation of Network Repeaters™ should install the PES800 NR.
*Use this checklist in conjunction with the installation instructions in **Chapter 0**.*
*For detailed instructions on RepeaterNet installation and operation, see **RepeaterNet Craft for the PES800 NR**.*

1. Mount antennas and associated equipment as required—for example, antenna feeders, BUPS (Back-up Power Supply) equipment, and so on.
2. Mount the repeater, leaving room for cable access.
3. Connect the repeater, antennas, and any other equipment to an external ground.
4. Terminate antenna ports with Type N, 50-ohm termination loads.
5. Connect the repeater to its power source, but do not activate power.
6. Check the RSL (Receive Signal Level) from the donor Cell Site antenna feeder with a spectrum analyzer and adjust the donor antenna position for maximum RSL. When finished, record the control channel power level and frequency:

   Power Level ____ dBm Frequency ____ MHz.
7. Aim (by sight) mobile service antenna in accordance with the site plan or network engineering documentation.
8. Measure antenna isolation. Adjust antenna position or add a shield, as necessary.
9. Put on a wrist grounding strap, attach the strap to the system ground lug, and touch the side of the cabinet.
10. Open the repeater cabinet; open the cover door of the bottom of the repeater; then activate system power.
11. Connect the red lead with blue connector (quick disconnect type) to the internal battery backup—located centrally in the cabinet.
12. Close and secure the repeater upper door, and remove the wrist grounding strap.
13. Connect the PC to the repeater and login with RepeaterNet—see “Configuring Ports” in *RepeaterNet Craft for the PES800 NR*.
    - ⇒ Connect the computer to the repeater using the serial cable included with the accessory kit.
    - ⇒ Turn ON the computer.
    - ⇒ Install RepeaterNet, if necessary. To do so, insert the first program disk in the computer’s floppy drive and run the **setup.exe** program.
    - ⇒ Start RepeaterNet™ from the Windows™ desktop by clicking **Start -> Programs -> RepeaterNet -> RepeaterNet.**
    - ⇒ Select the repeater and click on **OK** to open the Main Control screen
14. Check the Power System alarms—see “Power System Properties” in *RepeaterNet Craft for the PES800 NR*.
    - ⇒ From the Main Control screen, click the 2-Prong Plug icon.
    - ⇒ Click the **Status** tab and view the Power System alarms. All alarms should be *inactive.*
    - ⇒ Click **OK** or **Apply**.

15. Confirm that the Forward and Reverse PAs are OFF—see “PA Properties” in *RepeaterNet Craft for the PES800 NR*.
    - ⇒ From the Main Control screen, click the **Forward PA** Triangle icon.
    - ⇒ Click the **Control** tab and view the PA Power switch. The switch reads ON or OFF.
    - ⇒ If the switch reads ON, click it once to turn the PA OFF.
    - ⇒ Repeat for the Reverse PA subsystem.
    - ⇒ Click **OK** or **Apply**.

16. Select the operating channel or band with RepeaterNet, if applicable.
    - ⇒ From the Main Control screen, click the **Channel 1** button.
    - ⇒ Click the **Channel #** tab and enter the appropriate channel or band in the **Channel** field.
    - ⇒ Click **OK** or **Apply**.
    - ⇒ Repeat for Channel 2, if applicable.

17. Set repeater gain according to the site plan or network engineering documentation— see “PA Properties” in *RepeaterNet Craft for the PES800 NR.*

⇒ From the Main Control screen, click the **Forward PA** button.
⇒ Click the **Gain** tab.
⇒ Click-drag the horizontal slider to set antenna gain.
⇒ Click **OK** or **Apply**.
⇒ Repeat for the Reverse PA subsystem.

18. Exit the active session, but do not exit RepeaterNet— see "RepeaterNet Commands," "Exit" in *RepeaterNet Craft for the PES800 NR.*
19. Deactivate repeater power and remove antenna port terminations.
20. Connect antenna feeders (coaxial cables) and activate power.
21. Login with RepeaterNet—see Step 13.
22. Activate Forward and Reverse PAs with RepeaterNet— see "PA Properties" in *RepeaterNet Craft for the PES800 NR.*

⇒ From the Main Control screen, select **Forward PA** from the Configuration menu.
⇒ Click the **Control** tab and click the PA power switch (set to OFF) to turn it ON.
⇒ Click **OK** or **Apply**.
⇒ Repeat for the Reverse PA subsystem.

23. Monitor Forward RF output power with RepeaterNet and carefully adjust the position of the donor antenna to maximize the **Relative Power Out**.

⇒ From the Main Control screen, select **Forward PA** from the Configuration menu.
⇒ Click the Measurements tab and view the Relative Power Out.

24. Compare Forward and Reverse RF output power levels to the listed power guidelines and project engineering documentation and correct any problems—see the table on page 36.
25. Verify coverage area and optimize Forward and Reverse gain for the planned application.
26. Exit the active RepeaterNet session but do not exit RepeaterNet.
27. Turn OFF the repeater and connect any digital outputs, relay outputs, external inputs, the modem land line, and the external modem, if applicable.
28. Turn ON the repeater and monitor external equipment. Correct any problems.
29. Configure alarm severity and other software settings with RepeaterNet (see **Configuring for Alarm Reporting and Systems Operation** on page 49 in *RepeaterNet Craft for the PES800 NR*).

⇒ Open a connection and login with RepeaterNet.
⇒ Configure system properties.
⇒ Configure subsystem properties.
⇒ Configure alarm severity settings

30. Test operation of all inputs and outputs connected to external equipment—see **Testing Inputs and Outputs** on page 51.
31. Back-up system configuration with RepeaterNet user the File>Upload Properties command—see **Backing-Up Repeater Configuration** on page 51.
32. If multiple repeaters are to be installed, create a standard Repeater Configuration (.rcf) file—see **Creating a Standard Software Configuration** on page 52.

See the following table for a quick reference into the *Craft for the PES800 NR* for the task you need to complete.

Installation Task	**Section in Craft for the PES800 NR**
Connect the repeater through a COM port	Configuring Ports
Check Power System alarms	Power System Status
Confirm Forward and Reverse PAs are OFF	PA Properties PA Control Tab
Select an operating channel or band	Channel Properties Channel # Tab
Set repeater gain	PA Properties Gain Tab
Activate Forward and Reverse PAs (ON)	PA Properties PA Control Tab
Monitor Forward RF output power and adjust position of donor antenna to maximize Relative Power Out	PA Status Measurements Tab
Configure Alarm Severity	Configuring PES800 NR Properties
Configure System Properties	System Menu—PES800 NR Craft System Tab
Configure Subsystem Properties	Configuring PES800 NR Properties Channel PA ACU Modem Cell phone Power System
Backup your configuration	File Menu—PES800 NR Download Properties Upload Properties

Contents

Figures

Tables

Chapter 1. Overview

Using This Manual

This manual is divided into the following chapters. Personnel installing this equipment for the first time should read each chapter. Personnel already familiar with this equipment and the RepeaterNet Craft software can begin with **Chapter 2. Installation Instructions**.

The chapters of this manual are organized as follows:

Chapter 1. Overview
Includes a general product description, a functional description, technical specifications, and ordering information.

Chapter 2. Installation Instructions
Includes instructions for the following topics: Repeater and antenna mounting; all necessary wiring; antenna orientation, isolation, and output measurement; optimizing a coverage area.

Chapter 3. Mounting the PES800 NR
Defines the tasks you should complete to mount the repeater.

Chapter 4. Powering the PES800 NR
Includes information for AC and DC wiring of the repeater and modem, as well as connecting alarm and control wiring.

Chapter 5. Orienting and Isolating Antennas
Includes information you need for antenna orientation and isolation.

Chapter 6. Completing Installation
Includes information about activating system power, assigning frequency, adjusting gain, and other tasks you should complete to finish repeater installation.

Chapter 7. Maintenance and Troubleshooting
Includes routine checks required to maintain performance and to address problems, return and repair of the PES800 NR, and the product warranty.

In addition, *RepeaterNet Craft for the PES800 NR* provides information about configuring and monitoring your repeater with RepeaterNet Craft.

General Information

The **Peninsula Engineering Solutions 800 MHz Network Repeater**, hereafter referred to as the PES800 NR (or *the repeater)*, is a bi-directional, on-frequency, over-the-air RF repeater that extends the coverage of cellular base stations.

The repeater receives signals from a Cell Site and retransmits them to a mobile or portable telephone; likewise, the repeater receives signals from a mobile or portable telephone and retransmits them to the Cell Site.

Repeaters significantly improve coverage in areas with weak signal reception or transmission. The power amplifier ratings, the antenna system, and the donor cell channel configuration determine the Effective Radiated Power (ERP) output of the installed repeater.

The PES800 NR is designed for indoor or outdoor installation and can be either wall- or pole-mounted. The unit's compact cabinet simplifies installation, while its aesthetically acceptable design allows it to be easily zoned in many locations.

The repeater only requires initialization of the gain and channel to be on the air. In addition, as a field-replaceable unit, no component-level repair is necessary.

The assembly consists of a transceiver assembly, power amplifier assemblies, diplexers, power supplies and microcontrollers. All assemblies are mounted on a heatsink and enclosed in a sealed, aluminum, weathertight cabinet.

During normal operation, the cabinet housing remains closed. Access to power and data transmission connections is provided through the connection ports located on the bottom of the repeater. Install repeaters and associated hardware in locations suitable for adequate reception of signals from the Donor Cell Site and for effective retransmission of these signals to mobiles and portables.

The following figures show front and bottom views of the PES800 NR.

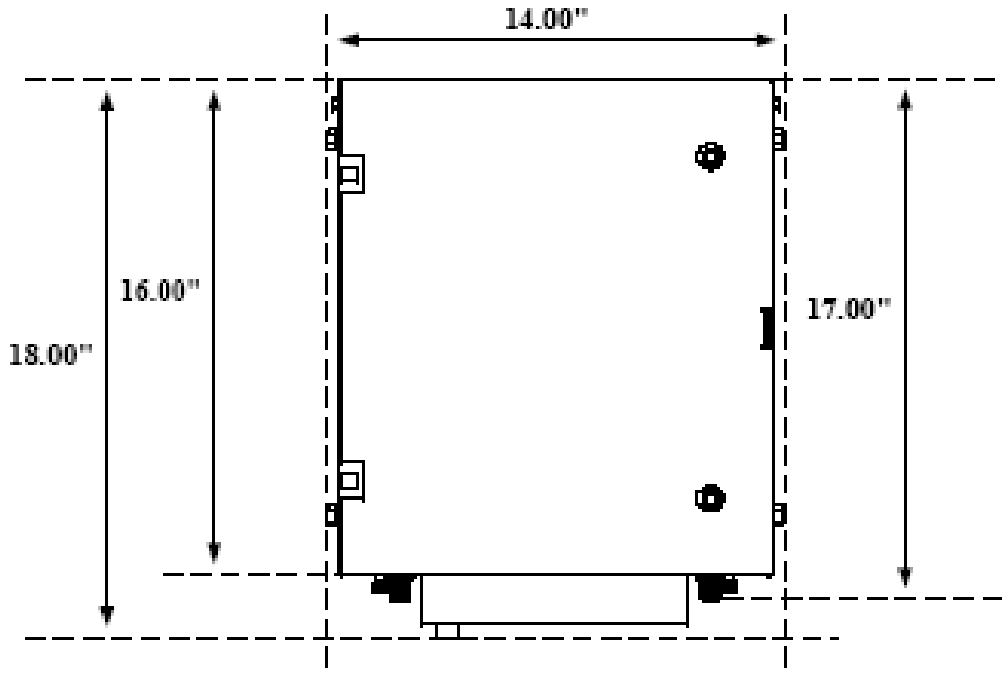

Figure 1. PES800 NR Exterior Front View

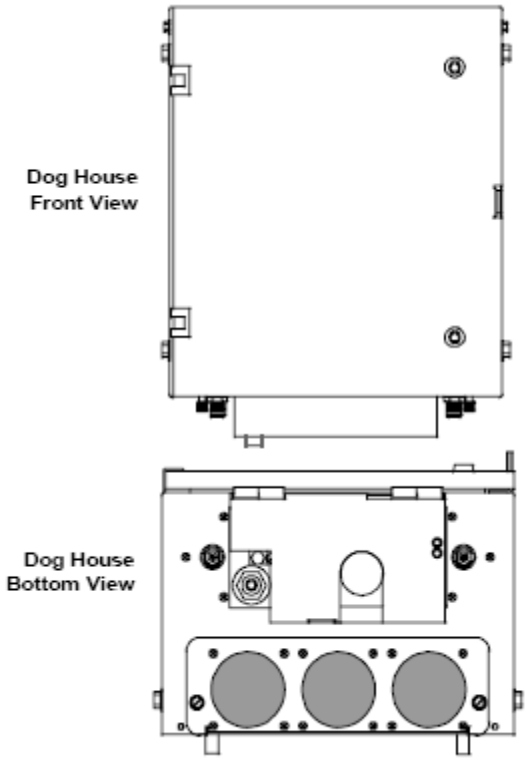

Figure 2. PES800 NR Exterior with Secure Access Panel

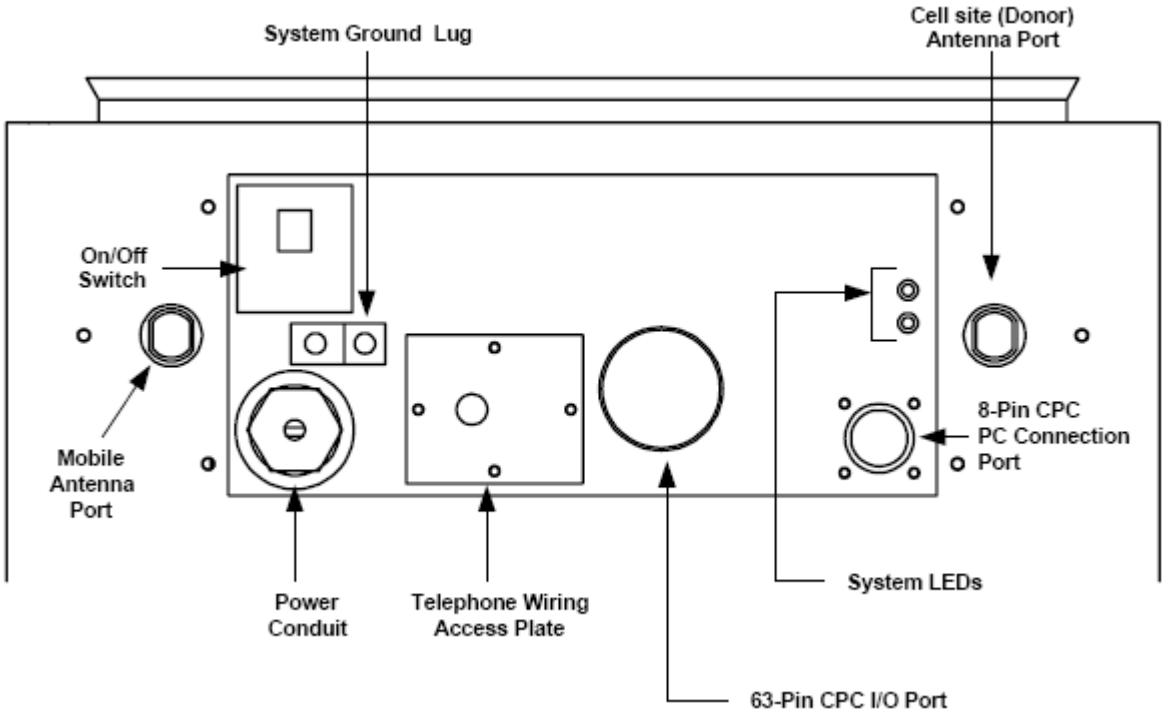

Figure 3. PES800 NR Exterior Bottom View

The Network Management System (NMS) version of the PES800 NR is equipped with an optional cellular telephone, which is mounted on the interior of the cabinet front door, as shown in the following figure. This operates with RepeaterNet NMS for monitoring a network of repeaters. For more information, see RepeaterNet Craft for the PES800 NR.

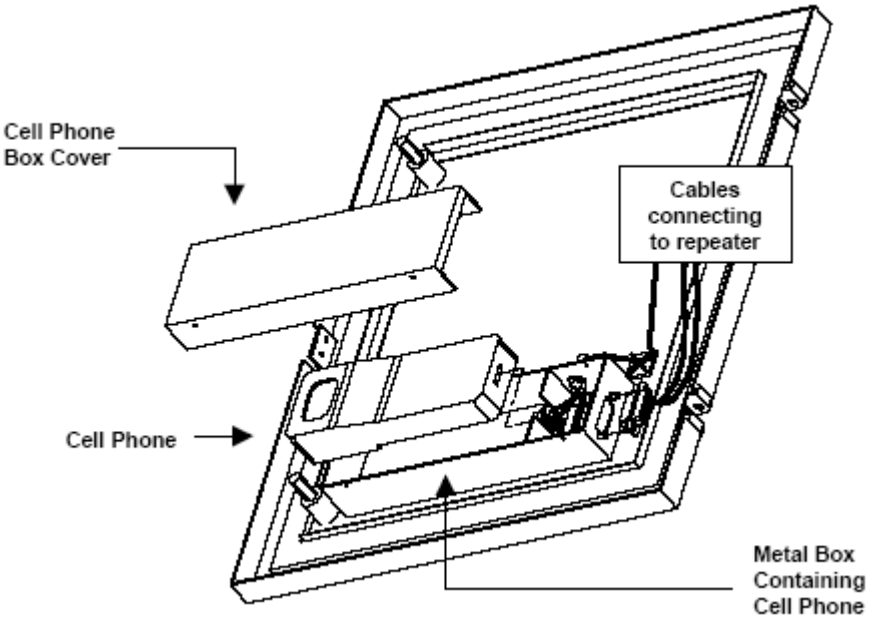

Figure 4. Door Assembly with Cellular Phone

In addition to the PES800 NR assembly, Peninsula Engineering Solutions offers accessory equipment: antennas, mounting hardware, coaxial cable, and BUPS (Back-up Power Systems).

Typical antennas include:

- ⇒ Parabolic reflector
- ⇒ Corner reflector
- ⇒ Circular, linear, directional co-linear
- ⇒ Cross or slant polarization
- ⇒ Log periodic array
- ⇒ Yagi

Antenna usage depends upon the intended coverage area and other project parameters.

Functional Description

The PES800 NR uses an Intermediate Frequency (IF) filtering design to achieve a high degree of selectivity. A common local oscillator is used for up- and down-conversion to prevent frequency conversion error.

The RepeaterNet Craft software is the configuration management and alarm-monitoring interface for the PES800 NR. The Repeater has two COM (communication) ports for RepeaterNet connections—a serial port for direct, laptop connections and a modem port for remote connections.

An ALC (Automatic Level Control) circuit protects the repeater's LNA (Low-Noise Amplifier) from potentially damagingly high input levels and prevents the generation of Intermodulation Distortion (IMD) in the transmit power amplifier. See the following figure for a block diagram of the PES800 NR.

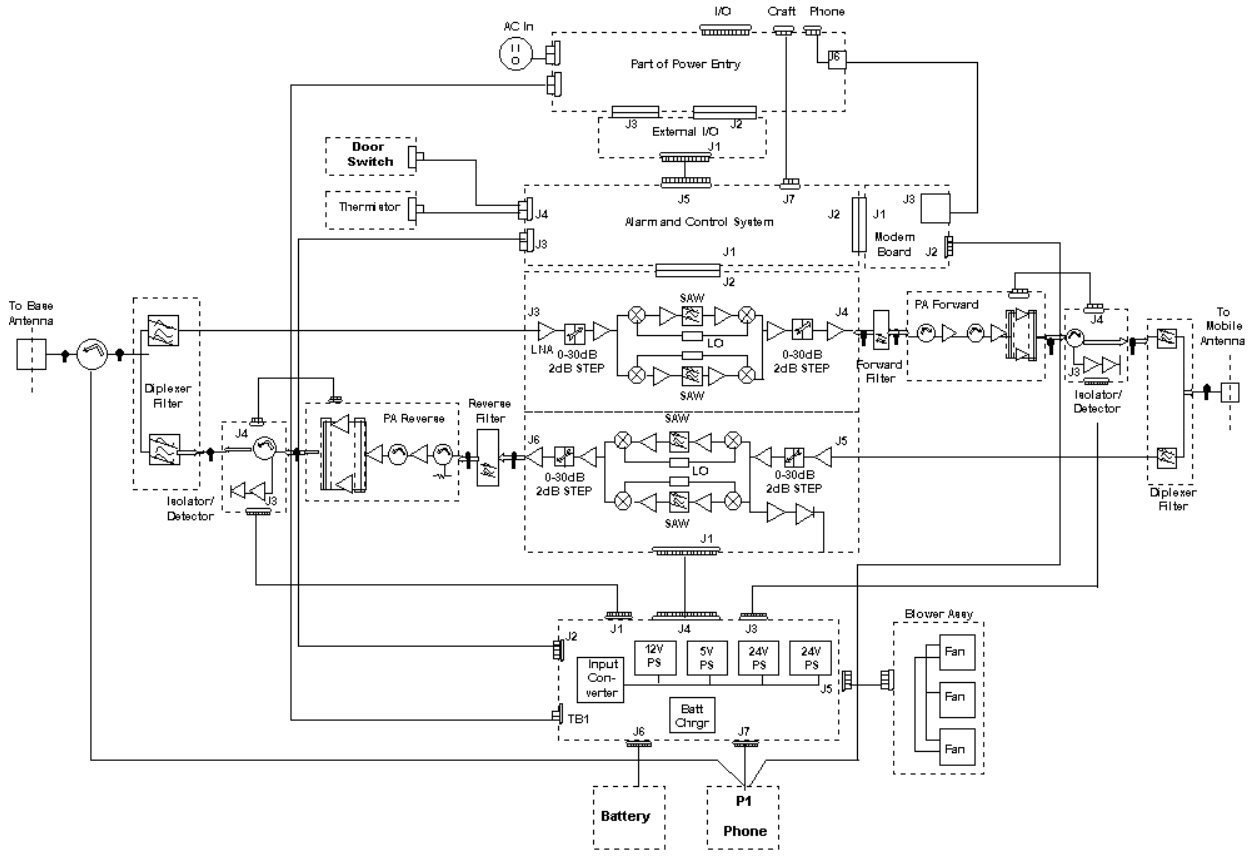

Figure 5. PES800 NR Block Diagram—Signal Flow

The signal processing flow through the repeater in the Forward direction (Donor Cell Site to Mobile) is similar to the flow in the Reverse direction (Mobile to Donor Cell Site).

Signal flow is as follows:

1. The received signal from the Cell Site antenna enters the repeater by way of the cabinet-mounted, Type N(f) connector and feeds to a branching circulator and a diplexer filter.
2. The signal then is amplified by an LNA, and down-converted to an Intermediate Frequency (IF).
3. After being filtered by Surface Acoustic Wave (SAW) filters, the output signal is up-converted, and precisely restored to the original radio frequency by using the same Local Oscillator (LO) as the down-converter.
4. The transmit power amplifier further amplifies the signal to achieve final transmit Radio Frequency power levels.
5. The signal finally routes through the output diplexer to the mobile antenna. (The diplexers permit use of common antennas for both transmit and receive signals while effectively separating the receive band from the transmit band.)

Licensing

All owners of the PES800 NR should consult with the appropriate local and national agencies for information about licensing.

Technical Specifications

Table 1. Models and Frequency Range (MHz)

Model	System	B/W (MHz)	Band	Reverse (MHz)	Forward (MHz)
PES800C	CDMA	1.25	A Extended	824.0 – 835.0 845.0 – 846.5	869.0 – 880.0 890.0 – 891.5
			B Extended	835.0 – 845.0 846.5 – 849.0	869.0 – 880.0 890.0 – 891.5
PES800G	CDMA or GSM-800	4.00	A + A”	824.0 – 835.0	869.0 – 880.0
			B	835.0 – 845.0	869.0 – 880.0
PES800S*	AMPS/NAMPS/TDMA/ CDMA/GSM-800	10.0	A	825.0 – 835.0	870.0 – 880.0
			B	835.0 – 845.0	880.0 – 890.0
PES800SE†	AMPS/NAMPS/TDMA/ CDMA/GSM-800	12.5	A + A" A'	824.0 – 835.0 845.0 – 846.5	869.0 – 880.0 890.0 – 891.5
			B B'	869.0 – 880.0 846.5 – 849.0	890.0 – 891.5 891.5 – 894.0

**Standard spectrum.* *†Extended spectrum.*

Table 2. RF Output Power Per Carrier at the Antenna Port

RF Power Amplifier	AMPS/NAMPS/TDMA/GSM					CDMA			Gain (dB) Adjustable in 2 dB Steps
	Number of Carriers					No. of FA			
	2	4	6	8	16	1	2	3	
Level 4	+33	+30	+28	+27	+24	+35	+32	+30	55–85

Table 3. Selective Filter Bandwidth Specifications

Band	*At -3 dB minimum (MHz)*	*At -50 dB maximum (MHz)*	*Delay, µSec*
AMPS, NAMPS, TDMA, CDMA, GSM-800			
A Band	9.97	10.75	< 6
A' Band	1.5	2.28	< 6
A + A" Band	10.97	11.75	< 6
B Band	9.97	10.75	< 6
B' Band	2.5	3.31	< 6
CDMA Only BW			
A, A', A", B, B'	1.3	2.11	< 12
CDMA, GSM-800; 4.00 MHz BW			
A + A”, B	4.1	6.1	< 3

Table 4. Mechanical/Electrical

Power Consumption	Input Power	Size	Weight	Temp.	Antenna Connector
<250 watts	115/230 (±10%) VAC, 50-60 Hz autodetect +24 (±10%) VDC	16 H x 14 W x 11 D (inches) 406 H x 356 W x 280 D (mm)	45 lbs. 20 kg	-30 to +50° C	Type N(f)

Table 5. Additional Characteristics

Noise Figure	Maximum Input Signal	Spurious Outputs	Image Rejection (out of band)	RL VSWR	Passband Ripple
7 dB maximum @ 85 dB gain	+10 dBm without damage	< -13 dBm	>90 dB	>14 dB <1.5:1	3.0 dB, p-p maximum

Table 6. CDMA Only; Additional Characteristics

Gain Setting	*Forward Link Noise Figure*	*Reverse Link Noise Figure*	*Rho*
Maximum	7 dB	6 dB	ρ > 0.95
Minimum	27 dB	16 dB	

Table 7. Alarm, Monitoring, and Control

Alarm, Monitoring, and Control		
Access Options	**Graphical User Iinterface**	**Functions**
• RS-232 (direct) • POTS (dial-up) • Wireless Modem	• Windows 98 (Craft) • Windows NT (Master) • 32-bit • Point and click • Pull-down menus	• Summary Alarm • Interrupt Reporting • Definable Threshold • Remote Control: gain, channel

Table 8. Power Supply Options

Alternate Power Options	
Type	**Description**
BUPS	2 – 8 hours of battery backup without AC input
Solar Electric Battery	Photovoltaic (PV) with regulated charging to battery
Hybrid Solar and TEG	PV with Propane powered, Thermal Electric Generator and battery
Hybrid Solar and MG	PV with Propane or Diesel powered, Electric Generator and battery

Table 9. Modem Options

Modem Options
• Internal wireless modem
• Internal 14400 bps modem card with an RJ-11 jack for a land-line connection through an Oki 1430 800 MHz Cellular Handset
NOTE: *The repeater can also be ordered without a modem.*

Ordering Information

Consider the following issues before ordering the PES800 NR:

Electrical Supply
The required type and circuit breaker box.

Back-up Power
A power supply in case of interrupted electrical service, note that a BUPS (Back-up Power System) is available from Peninsula Engineering Solutions.

Antennas
What types are required; what is the intended system coverage; note that antennas are available from Peninsula Engineering Solutions.

Coaxial Cabling
Type and length required for antenna connections (including jumper assemblies); note that coaxial cable is available from Peninsula Engineering Solutions.

Mounting
Special requirements for the repeater and antennas.

When ordering, specify a shipping destination and a billing address. Peninsula Engineering Solutions returns an order acknowledgment with the scheduled shipping date. Each shipment includes an equipment list showing the equipment ordered and shipped, including details about system and equipment options.

System Options

The part number for the PES800 NR indicates the system options for that particular unit—see the following two tables. For example, the PES800C, part number 090-1210-17, is configured as follows:

⇒ CDMA
⇒ Single Channel
⇒ A-Band
⇒ Level 4/2 Power Amplifiers
⇒ 115/230 VAC

Table 10. PES800 NR Base Model Numbers and Options

Model	*Service*	*Band**	*Model Number*
PES800S	Multi-Technology	A Standard	090-1200-xx
PES800S	Multi-Technology	B Standard	090-1202-xx
PES800SE	Multi-Technology	A Extended	090-1201-xx
PES800SE	Multi-Technology	B Extended	090-1203-xx
PES800C	CDMA	A	090-1210-xx
PES800C	CDMA	A (2-channel)	090-1211-xx
PES800C	CDMA	B	090-1212-xx
PES800C	CDMA	B (2-channel)	090-1213-xx
PES800G	CDMA/GSM-800	A	090-1210-xxG
PES800G	CDMA/GSM-800	B	090-1212-xxG
**Units single-passband unless otherwise specified.*			

Table 11. PES800 NR Power Amplifier and Electrical Options

Power Level (Forward/ Reverse PAs)	System Power Source	(-xx) Model Number Extension
4/2	115/230 VAC	-17
4/2	24 VDC	-19

Equipment Options

The PES800 NR ships with a standard accessory kit (part number 091-0214-01) and additional equipment options. When ordering, always specify which optional equipment to include with the order. ***See Table 12*** for the contents of the accessory kit. ***See Table 13*** for a list of optional equipment.

Table 12. Accessory Kit Items

Part No.	*Description*	*Use to*
129-0007-02	Wrench, Hex Key 5/32 x 3-1/4 LG Short Arm	Open the door.
129-0008-01	Hex Bit, Pin-in-Socket Driver 7/32" x 1-15/16"	Tighten and loosen security screws.
187-0713-01	A CPC to DB-9 Serial Cable Converter	Connect with a computer.
187-0791-01	DB-9 Conversion Cable	Connect to repeater.
187-0800-02	63-pin CPC to Amphenol Input/Output Ribbon Connector Cable Assembly	Connect external inputs and outputs.
519-1200-03	RepeaterNet Craft Software	Provide user interface for repeater installation and maintenance.
550-1200-02	RepeaterNet Craft Manual	Instructions on how to configure and monitor the repeater
550-1200-03	PES800 NR Operations Manual	Install and maintain the repeater.

Table 13. Optional Equipment

Part No.	*Description*	*Use to*
250-1103-01	BUPS Equipment—BUPS-1 (90 A-H) or BUPS-0 (40 A-H)	Back-up system power.
137-0438-01	Pole Mounting Kit (hardware included)	Mount the repeater to a pole.
McMaster-Carr, 5653K12	¾-inch Band Kit (Band-It)	Attach pole mounting bracket to a pole.
Siemon, VM1-53TP-S66 or S66M2-3W	QCCB (Quick Clip Connecting Block) 25 Pair Pre-Wired with 50-Pin / 25-Pair connector	Connect external inputs and outputs.
Hoffman, A-12R106HCR	QCCB Cabinet	House QCCB for weathertight installation.
Harris Corp. (Dracon Div.), D-714	Punch Down Tool	Connect input and output leads to QCCB.

For information about optional solar shielding for the PES800 NR, contact Peninsula Engineering Solutions.

Table 14. Spare Equipment

Part Number	Description
103–0137–01	Power Cord, AC
126–0002–01 126–0003–01	Power Cable Retainer (Sealtite™ or Liquidtite™)
020–1323–01 024–0281–01 024–1003–01	Input/Output Box (3 pieces)
090–1121–01	Fan Assembly
020–1229–01	Back Plate
020–1330–01	Pole Mounting Channel
149–0841–01	12 Volt, 1.3 Amp-Hr Sealed Rechargeable Lead Acid Internal Battery
091–0215–01	Bracket, Pole Mounting Kit with Hardware
125–0001–13	Hex Bolt 3/8-16X.750 S/S
125–0059–07	Washer Lock 3/8 S/S
125–0068–07	Washer Flat 3/8 S/S

Technical Services

To supplement the manpower resources of service providers, Peninsula Engineering Solutions offers the following technical services:

- ⇒ Site and construction surveys
- ⇒ Network design
- ⇒ Design verification
- ⇒ Training
- ⇒ Project management
- ⇒ Installation
- ⇒ Providing accessories (antennas, coaxial cabling, and so on)

Quotations for technical services are available upon request.

Contacting Peninsula Engineering Solutions

Contact the Peninsula Engineering Solutions corporate headquarters for sales information or technical assistance for the PES800 NR, or any other of our communications or related products.

Corporate Headquarters

39 Grand Canyon Lane
San Ramon, California 94582
United States of America

Telephone: +1 925 901-0103
Facsimile: +1 925 901-0403

Internet: http://www.peninsulaengineering.com/

E-Mail: info@peninsulaengineering.com

Chapter 2. Installation Instructions

Installation Overview

The PES800 NR is designed for indoor or outdoor installation and can be either wall or pole mounted. The unit's compact cabinet simplifies installation, while its aesthetically acceptable design allows it to be easily zoned in many locations.

Use the Installation Checklist (perforated for easy tear-out) at the front of this manual for a reference during installation. The checklist is a master procedure for installing the Repeater and all related hardware, and includes installation procedures for the RepeaterNet software program.

Prior to installing the Repeater, a thorough understanding of RepeaterNet is required—see *RepeaterNet Craft for the PES800 NR*.

NOTE: *Only qualified service or technical personnel should install and service the PES800 NR*.

The following illustrates a typical installation with external equipment.

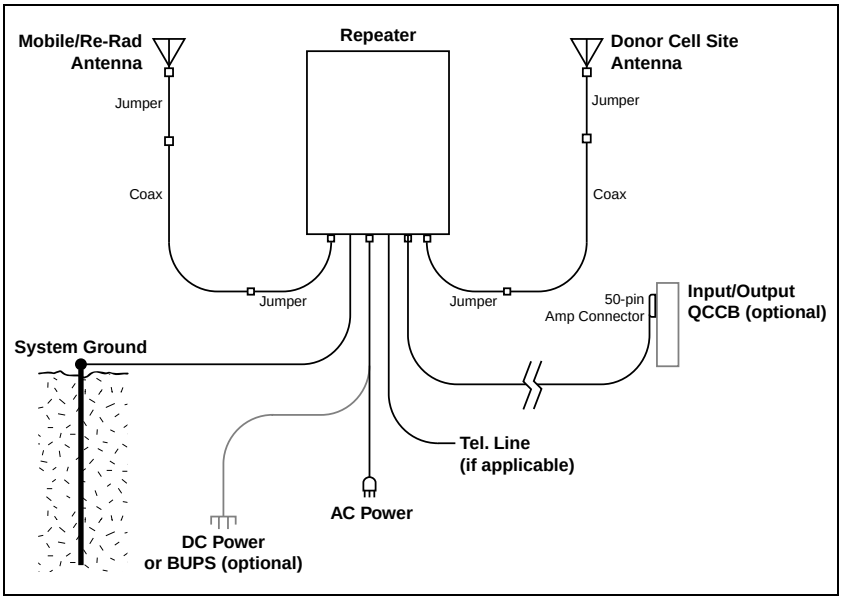

Figure 6. Typical Installation

Receipt and Inspection of the PES800 NR

Immediately upon receipt of the PES800 NR, inspect the unit thoroughly for damage, paying particular attention to the following:

- ⇒ Bent or dented sheet metal
- ⇒ Loose or broken components
- ⇒ Damaged connectors
- ⇒ Damaged or broken wiring or coaxial cables

Note any damage on the waybill and request that the delivery agent sign it for verification. Also, notify the transfer company as soon as possible, submit a damage report to the carrier, and inform the Customer Service Department of Peninsula Engineering Solutions in writing.

NOTE: *Save original shipping carton and packing materials for any future transport of the unit.*

After unpacking the equipment, inventory the contents against the packing lists, including the contents of the accessory kit (part number 091-0214-01) and any optional equipment ordered with the unit—see **Table 12** on page 9. Contact Peninsula Engineering Solutions if any items are missing.

If the PES800 NR is to be stored for later installation or shipment, reseal the packaging of the accessory kit and the repeater.

Installation Equipment

See the following table for a list of required installation equipment. Additional equipment may be needed, depending on specific installation site requirements and optional accessories ordered.

Table 15. Required Installation Equipment

Equipment	Usage
Site Plan and Network Engineering documentation	To correctly configure the repeater to operate in the cellular network.
3/8-inch Ratchet or Screwdriver	To operate pin-in-socket driver.
Voltmeter, Fluke 75*	To test power connections and analog test points.
Power Meter, HP 435B with 8481 Sensor*	To test power output.
Cellular Service Monitor with Signal Generator, IFR-1500, HP-8594A*	To test antenna isolation and system gain.
Type-N (m), 50-Ohm Termination, 20 W, (2 ea.)	To terminate antenna ports during off-air test.
Mounting Hardware	To mount repeater and antennas.
Electrical Wiring Equipment (as needed)	To connect external systems to inputs and outputs.
Wrist Grounding Strap	To protect against static discharge.
Laptop Computer (with RepeaterNet installed)	To control and monitor the repeater.
Accessory Kit	To mount and install repeater.
Pole Mounting Kit†	To mount the repeater to a pole.
Tightening/Crimping Tool†	To secure pole mounting straps.
D-714, Type 66 Punch Down Tool*†	To install optional alarm and control wiring.
**Equivalent substitutes may be used.* *†If necessary.*	

Note that the site plan and network engineering documentation is used during installation to refer to the intended parameters of the project including coverage area, gain settings, and antenna location. If necessary, consult a network administrator for more information.

Chapter 3. Mounting the PES800 NR

Pre-Installation Site Review

Each site should be thoroughly reviewed before antennas or the PES800 NR are mounted. Site review should include, but not necessarily be limited to, the following factors:

Weather
Determine whether environmental conditions necessitate special shielding of the repeater or other equipment.

Security
Determine whether some type of barrier is needed to protect equipment and if a security light is required.

Optional Site Equipment
Determine whether additional site equipment, such as a convenience power outlet, pump, generator, or light is required, and, if so, where equipment is to be located and whether special enclosures for any equipment is required.

Wiring and Wiring Access
Determine any special wiring requirements.

Cabinet Access
Determine whether there is enough room for the repeater door to open, once mounted.

CAUTION: *In an extremely hot environment, such as a desert, shading from direct sunlight may be necessary to prevent the repeater and associated equipment from overheating.*

Mounting Antennas and Associated Equipment

The PES800 NR assembly antennas, antenna coaxial cabling, and BUPS (if used), should be mounted before any wiring is connected.

Coaxial Cable Installation

The size of antenna coaxial cabling for an application depends upon a number of system parameters including, but not limited to, the following:

⇒ Required signal output
⇒ Antenna gain
⇒ Transmission line length

As a signal passes through coaxial cable, the strength of that signal decreases. This loss of signal strength, or *path loss*, decreases as the diameter of the cable increases. However, larger-diameter cabling is more expensive and more difficult to install than smaller-diameter cabling.

The allowable path loss for antenna cabling, and therefore the size of the cabling, is specified in the site plan or network engineering documentation for the project. Do *not* install cabling of a different size than specified.

To install coaxial cabling:

1. Connect the coaxial cable to the antenna.
2. Securely install the cable so that it reaches to the installation site of the PES800 NR, with enough room to connect to the repeater.

3. Terminate the cable with a Type N (m) connector.
4. If the cable is larger than ½-inch (1.3 cm) in diameter, attach a coaxial jumper assembly to the Type N (m) connector on the antenna cable. Make the jumper assembly of ½-inch (1.3 cm) coaxial cabling and Type N connectors, one male and one female.

CAUTION: *If a coaxial cable is larger than ½-inch (1.3 cm) in diameter, do not connect it directly to an antenna port on the repeater, as possible damage could result. The coaxial jumper assembly reduces strain on equipment connectors.*

5. Repeat for the second antenna.

Mounting the Repeater

The PES800 NR can be mounted on a pole or on the wall of a building. Mounting hardware is provided in the accessory kit shipped with the unit.

The PES800 NR is shipped with the rear-mounting bracket attached to the unit. See the following two figures for an illustration of the bracket with dimensions and for a side view of the PES800 NR and the rear-mounting bracket.

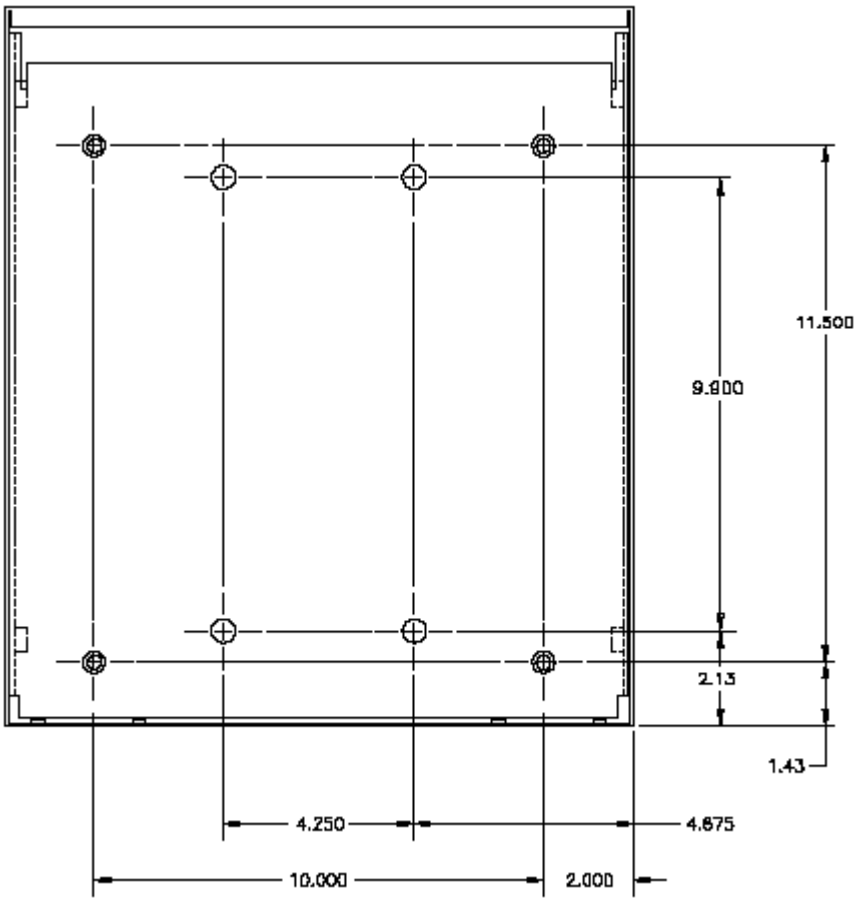

Figure 7. Rear Mounting Bracket

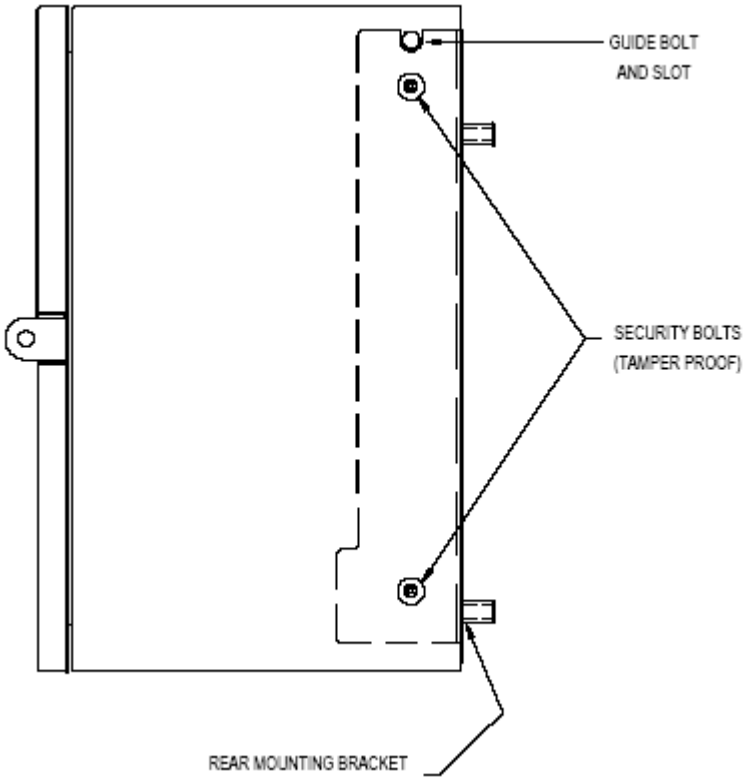

Figure 8. Rear Mounting Bracket with Unit—Side View

Wall Mounting

Appropriate wall mounting hardware depends upon the type of wall to which the repeater is to be mounted. For a typical wall mount installation, recommended equipment is as follows:

- ⇒ Four (4) lag bolts
- ⇒ Four (4) flat washers
- ⇒ Four (4) lock (split) washers

To mount the PES800 NR on a wall:

1. Remove the security screws and washers and separate the rear-mounting bracket from the Repeater.
2. Using the recommended hardware, secure the bracket to the wall—see the following figure.

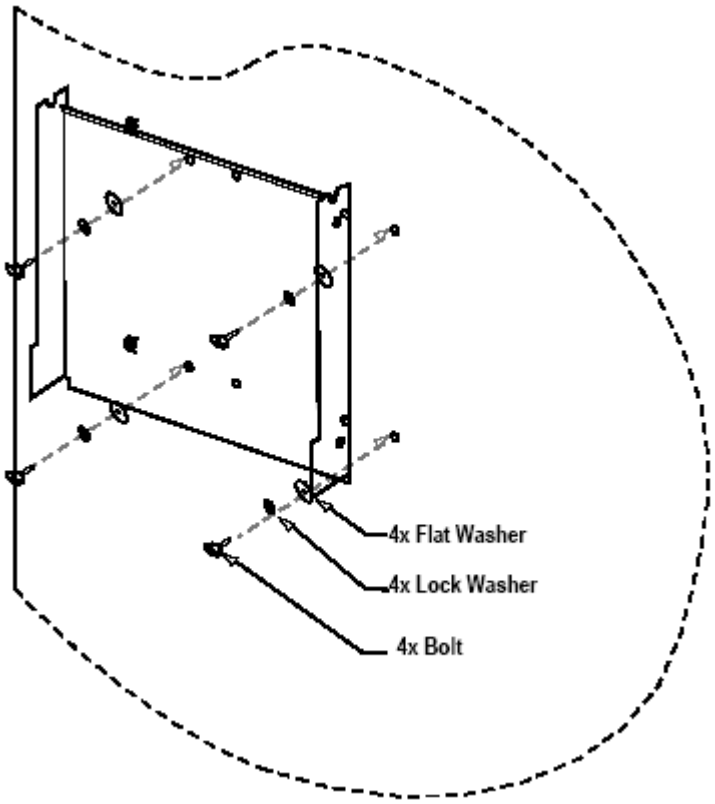

Figure 9. Typical Installation of Rear Mounting Bracket on a Wall

3. Set the Repeater into the bracket by sliding the guide bolt into the guide slot, then replace the security screws and washers removed in Step 1—see the next two figures.

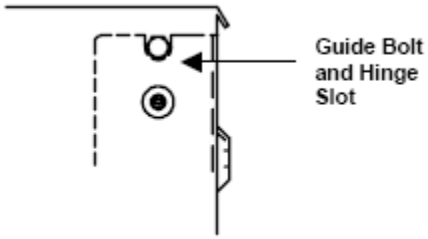

Figure 10. Guide Bolt and Slot

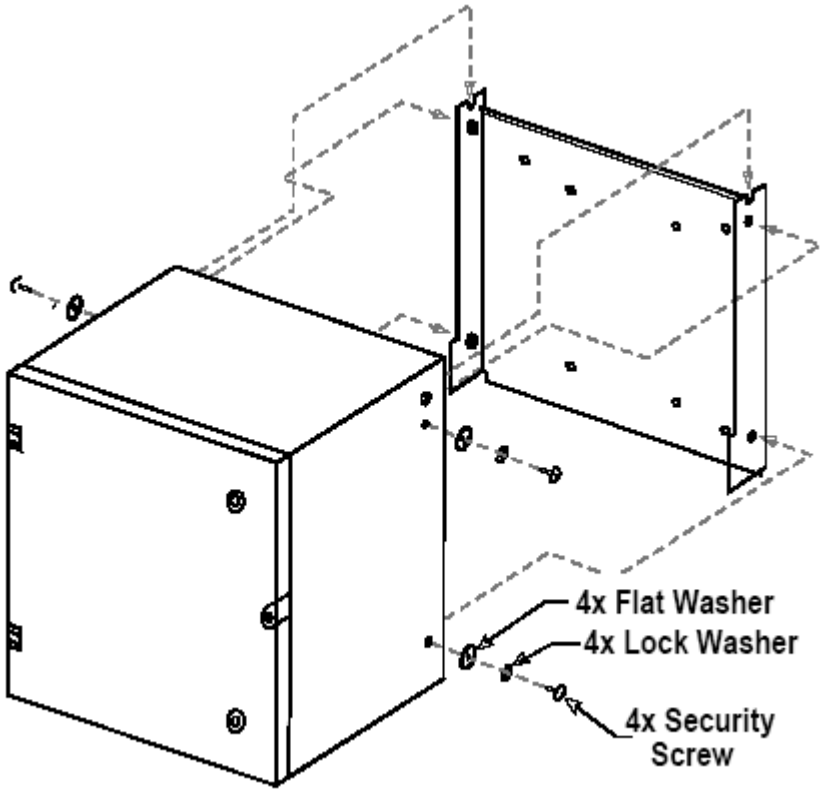

Figure 11. Repeater Mounting and Hardware Placement

Pole Mounting

Peninsula Engineering Solutions offers optional pole mounting equipment for the PES800 NR, available when ordering the PES800 NR—see Ordering Information on page 8.

Pole installation requires the following materials:

- ⇒ Pole mounting kit (available from Peninsula Engineering Solutions)
- ⇒ Banding kit (purchased separately—available from McMaster-Carr)

See the following table for a description of the two kits. Because the Banding Kit comes with 100 feet of band, you need not purchase a kit with every repeater.

Table 16. Optional Pole Mounting Equipment

Quantity	Item
Pole Mounting Kit (091-0215-01)	
2	Pole Mounting Bracket
4	Bolts
4	Lock (Split) Washers
8	Flat Washers
4	Neoprene Gaskets
4	Stainless Steel Gasket Retainers
4	Hex Nuts
¾-Inch Banding Kit (McMaster-Carr Supply Co., Part No. 5653K12 Los Angeles, CA, USA, Tel. # (562) 692-5911)	
1	Tightening-Crimping Tool
100 ft.	¾-inch, Type 201 Stainless Steel Band
100	Stainless Steel Buckles
25	Stainless Steel Scru-Lockt Buckles
1	Carrying Case

NOTE: Two people are required for pole mounting.

To mount the PES800 NR to a pole:

1. Remove the attachment bolts and washers, and then separate the rear-mounting bracket from the repeater.
2. Using the hardware provided with the accessory kit, secure the rear-mounting bracket to the two (2) pole brackets—see the next figure.

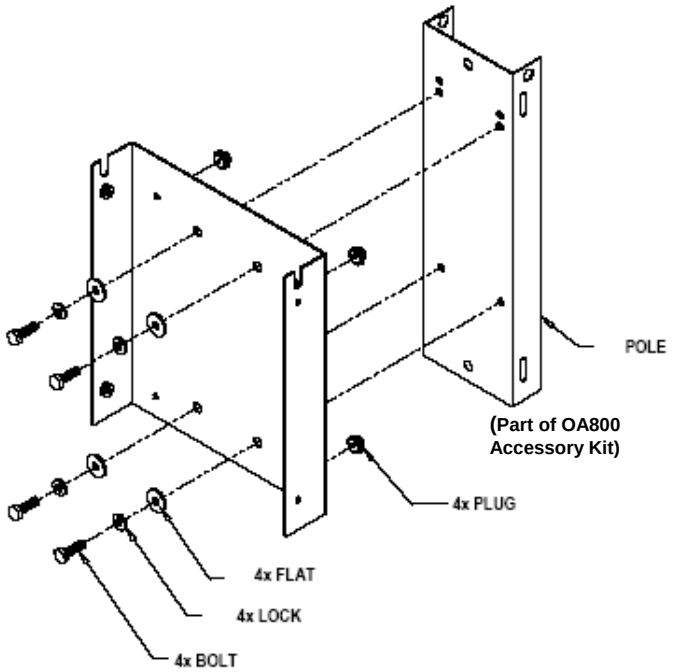

Figure 12. Pole Mounting Hardware

3. Insert the 4 plugs provided into the 4 outer holes in the rear mounting bracket.
4. Position the rear-mounting bracket (with the attached pole bracket) against the pole and hold it in place.
5. While one person holds the rear-mounting bracket in place, the second person installs the steel bands that hold the bracket against the pole. Consult the manufacturer's instructions included with the Banding Kit for this procedure.

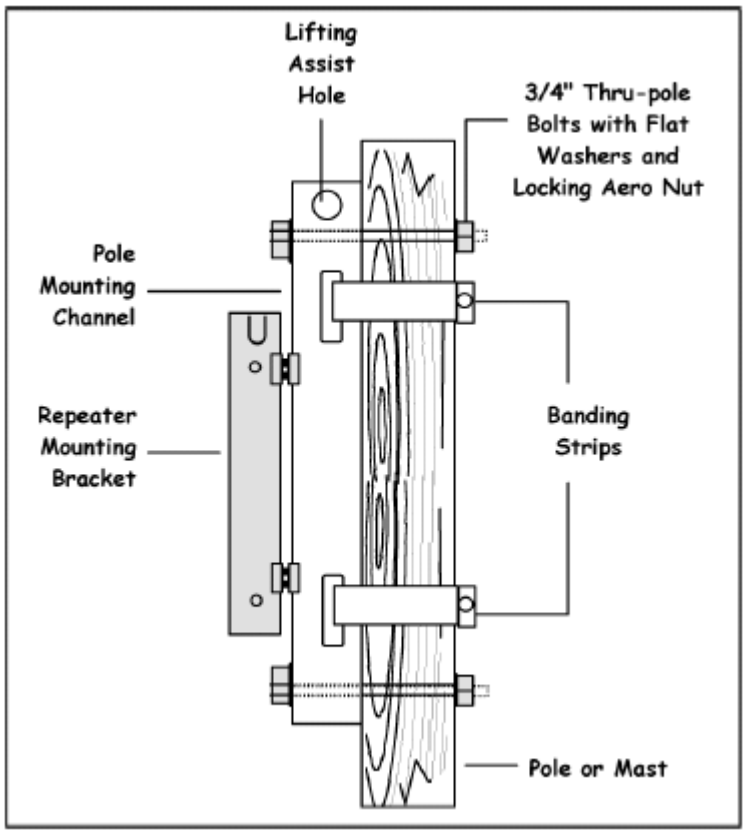

Figure 13. Pole Mount—Side View

6. Set the repeater into the bracket by sliding the guide bolt into the guide slot—see Figure 10 and Figure 11.
7. Secure the repeater to the bracket with the security screws and washers removed in Step 1.

Earth, Ground, and Lightning Protection

When grounding the PES800 NR and associated equipment, follow the general guidelines in the Peninsula Engineering Solutions application note, *Installation Standards for Grounding Requirements*. Connect the screw-compression ground lug located on the bottom of the PES800 NR cabinet to a suitable earth ground—copper ground rod, copper pipe, grounded steel building frame or similar ground point—using 2 to 7 mm, No. 6 to 2 AWG, copper wire—see the following two figures.

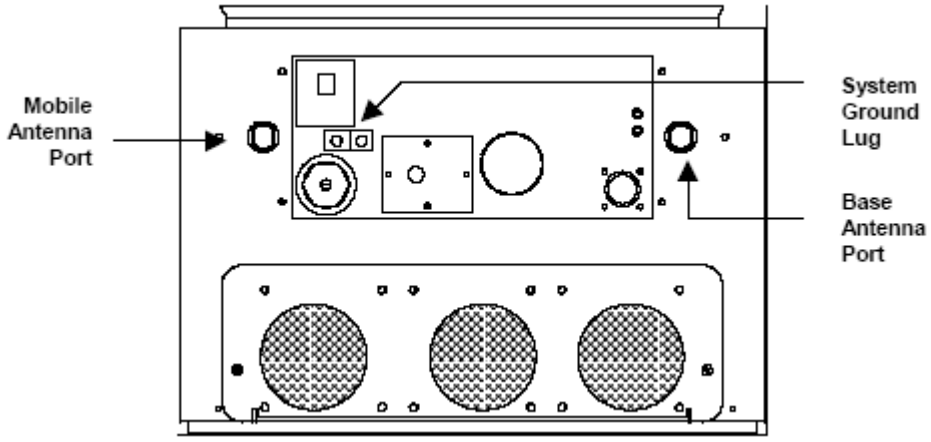

Figure 14. System Ground Lug and Antenna Ports

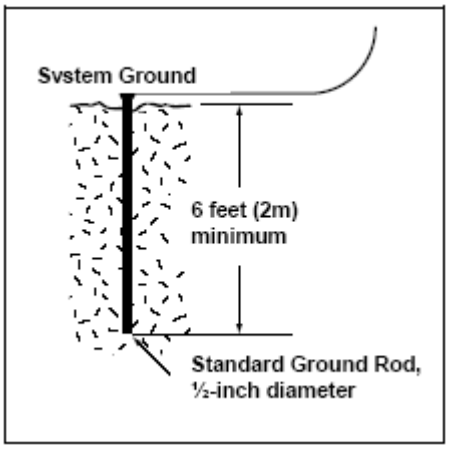

Figure 15. Typical System Ground

CAUTION: *Ground all other cabinets, enclosures, antennas, and coaxial cables used for installation to reduce any damage from a lightning strike or power surge.*

Chapter 4. Powering the PES800 NR

Power the PES800 NR with one of the following AC or DC power supplies:

- ⇒ 115 VAC ±10% 3.0 Amperes nominal
- ⇒ 230 VAC ±10% 1.5 Amperes nominal
- ⇒ 24 VDC ±10% 10.5 Amperes nominal

When wiring power to the repeater, match the voltage of the repeater to the voltage of the power supply.

AC Power Wiring

The conduit for AC power wiring is located on the bottom of the cabinet—see the following figure. The PES800 NR is shipped with a cord installed in this conduit. No internal connections are necessary. The power cord comes equipped with a 3-prong plug at the free end.

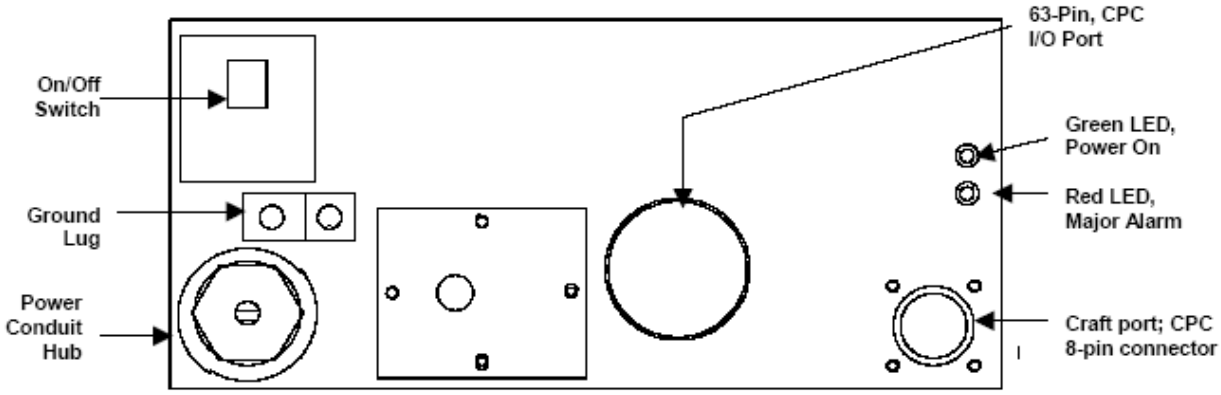

Figure 16. Power and I/O Wiring Access

The PES800 Network Repeater is shipped with a factory wired UL & CSA listed 8-foot power cord. This cord is to be used when the repeater is installed in a building or in a protected environment.

If the repeater is to be installed outdoors, the following procedure must be followed to meet national and local electrical code requirements. See the following figure.

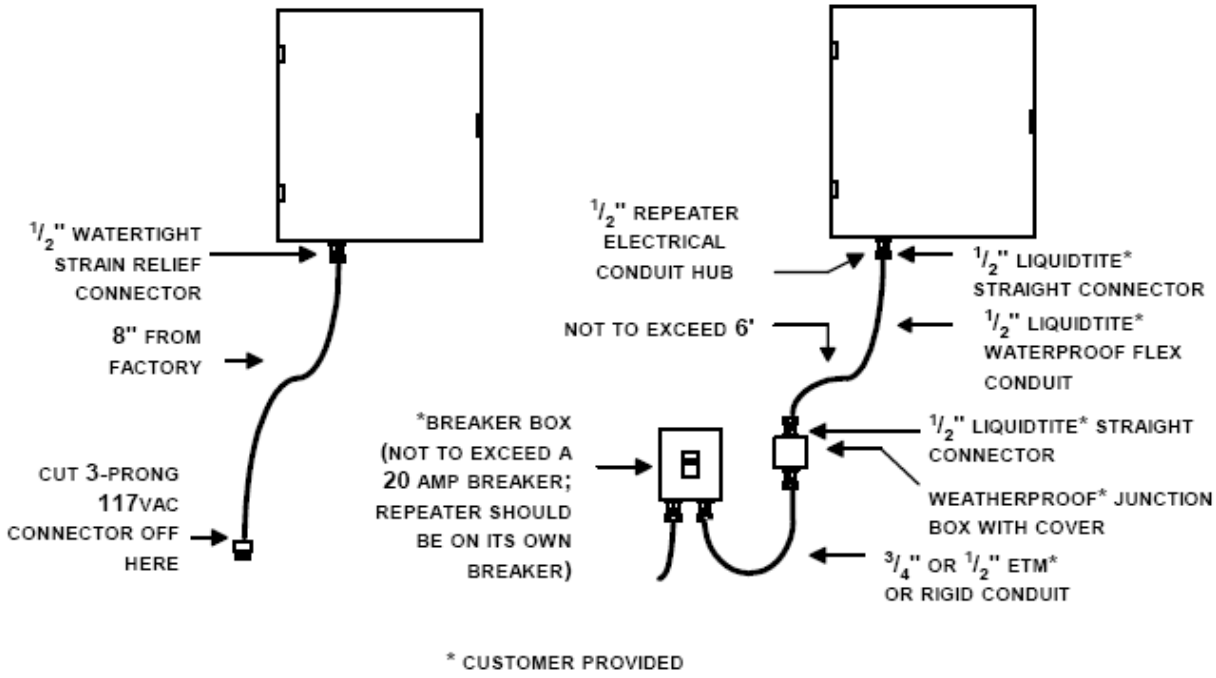

Figure 17. Outdoor Wiring Procedure

NOTE: *Additional information is supplied with the Back-Up Power Supply (BUPS).*

To connect AC power:

1. Turn OFF the external power source (the circuit breaker). The power supply should be a fuse or circuit breaker rated at 10 A for 115 VAC or 7.5 A for 230 VAC mains.
2. Plug the cord from the conduit into the circuit breaker box (if there is an appropriate outlet).
3. If there is no outlet:
   - ❑ Cut off the plug from the power cord just above the plug)
   - ❑ Expose the three (3) colored leads, then strip about ¼ inch (6 mm) from the end of each wire.
   - ❑ If the leads do not reach to the circuit breaker box, measure and cut wiring to make up the difference. Use #14 AWG wire for live and neutral lines, and #10 AWG for the ground line.
4. Connect the ends of the leads to the appropriate terminals in the circuit breaker box. *Match live, neutral, and ground lines to the correct connections.* The color coding of the wires is as follows:
   - ⇒ Black = Live/Hot
   - ⇒ White = Neutral
   - ⇒ Yellow/Green = Ground
5. Wrap any exposed connections with electrical tape to avoid shorts.
6. Neatly arrange or secure and, if necessary, environmentally protect power wiring.

CAUTION: *Do not activate AC power at this time—see* Chapter 6. Completing Installation *on page 39.*

DC Power Wiring

The conduit for DC power wiring is located on the bottom of the cabinet, as shown in Figure 16 on page 21. The PES800 NR is shipped with a cord installed in this conduit. No internal connections are necessary. The power cord comes equipped with a 3-prong plug at the free end.

To connect power:

1. Turn OFF the external power source (the circuit breaker). The power supply should be a fuse or circuit breaker rated at 35 A for a 24 VDC battery.
2. If the leads do not reach to the circuit breaker box, measure and cut wiring to make up the difference. Use #14 AWG wire for positive and negative lines, and #10 AWG for the chassis ground line.

NOTE: *The length of DC power leads should be as short as possible to minimize voltage drop. If line length must exceed 50 feet (12.5 m), contact Peninsula Engineering Solutions for information about appropriate wiring.*

3. Connect the two colored leads to the circuit breaker. *Match positive and negative lines to the correct connections.* The color coding of the wires is as follows:

   ⇒ **Red = Positive**
   ⇒ **Black = Negative**
   ⇒ **Green = Ground Chassis**

   NOTE: Check polarity with a voltmeter before wiring.

4. Neatly arrange or secure and, if necessary, environmentally protect power wiring.

CAUTION: *Do not activate DC power at this time—see* Chapter 6. Completing Installation *on page 39.*

Modem Options and Wiring

The PES800 NR can be ordered with one of three modem options:

⇒ Internal AMPS cellular modem (does *not* need wiring)
⇒ Internal land-line modem (needs wiring)

A repeater can also be ordered without the modem option.

Internal Land-Line Modem Wiring

Land-line modem wiring requires a twisted-pair phone line for proper installation. If an RJ-11 line is present, an adapter is needed to complete installation.

To connect a phone line to the internal land-line modem:

1. Confirm that the repeater is OFF.
2. Using a Phillips head screwdriver, remove the modem wiring access plate—see the following figure. Once removed, the 3-position terminal block is visible.

WARNING: *If the PES800 NR power is ON, the open circuit traces on the board near the modem terminal block carry the full voltage of the system. If necessary, turn OFF system power before continuing with modem wiring.*

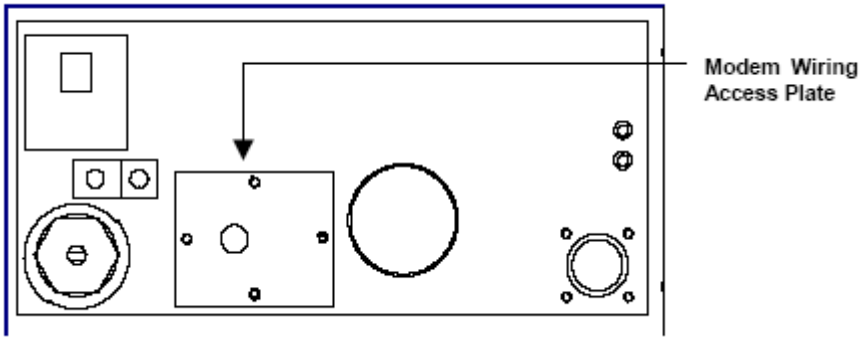

Figure 18. *Internal Land-Line Modem Wiring Access*

1. If necessary, install the adapter to convert the RJ-11 phone line to a twisted pair line.
2. Thread the phone line through the center opening of the access plate just removed.
3. Split the line at the end, then strip approximately ¼-inch (6 mm) of insulation from each wire.

WARNING: ***Do not handle the exposed wiring of a live phone line. Electric shock could result.***

4. Insert one end of wire into the Line 1 terminal, then tighten the screw to close the clamp—see the following figure. Screw clamps are visible from the side of the terminal block. If a clamp is closed, loosen the screw to open it.

NOTE: *Phone line wires are interchangeable. Either line can be inserted at the Line 1 terminal.*

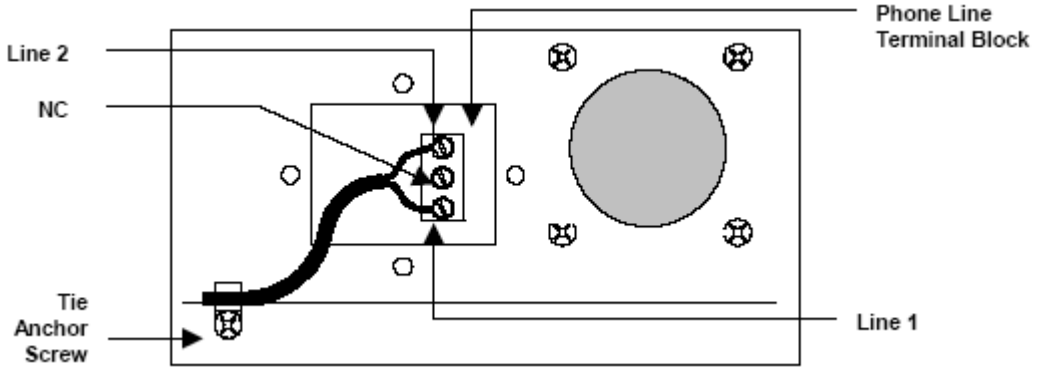

Figure 19. *Internal Land-Line Modem Wiring*

1. Repeat step 4 at the Line 2 terminal. Note that the terminal labeled NC is not used.
2. Replace the modem wiring access plate.

CAUTION: *Do not store any excess phone line inside the repeater cabinet.*

3. Secure the tie anchor (provided with the accessory kit) to the specified screw.
4. Thread the tie cord (also provided with the accessory kit) through the anchor and use it to secure the phone line to the cabinet.
5. Seal the gap between the phone line and the edge of the access plate opening with a silicone-based sealant for optimum environmental protection.

Connecting Alarm and Control Wiring

All PES800 NR input and output wiring connections are made through the 63-pin, CPC port located on the bottom of the repeater cabinet—see **Figure 16** on page 21. The CPC port links to a Quick Clip Connecting Block (QCCB) through an Amphenol cable assembly—see the following figure.

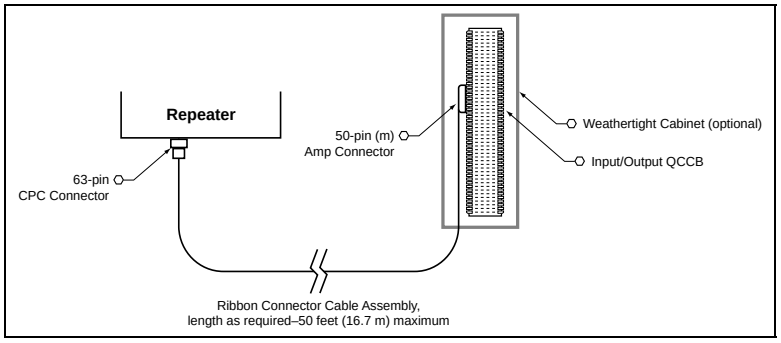

Figure 20. Typical Alarm and Control Wiring Installation

Alarm and control wiring equipment is as follows:

- ⇒ Ribbon Connector Cable Assembly—63-pin CPC to Amphenol 50-pin (m), provided in accessory kit.
- ⇒ Siemon QCCB—part number VM2-53TP-S66 or S66M2-3W, purchased separately
- ⇒ Cabinet for QCCB—for example, Hoffman NEMA 3R Cabinet, part number A-12R106HCR (weathertight installation), purchased separately
- ⇒ D-714 Punch-Down Tool (type 66), purchased separately

The accessory kit does not include all of the required alarm and control wiring equipment; therefore, some equipment must be ordered separately from other companies—see **Ordering Information** on page 8. To connect alarm and control wiring for external equipment:

- ⇒ Install the QCCB
- ⇒ Make wiring connections to the block

Installing the QCCB

To install the QCCB:

1. Exit the active RepeaterNet session (if applicable) and turn OFF the PES800 NR. Do not reactivate the repeater until all wiring is complete.
2. Insert the 63-pin CPC plug of the ribbon connector cable assembly into the 63-pin CPC port on the bottom of the Repeater cabinet—see the following figure. Securely tighten the collar on the CPC.
3. Install the QCCB inside the Hoffman cabinet (weathertight installation only).
4. Mount the QCCB (or the QCCB and cabinet) in a secure location.

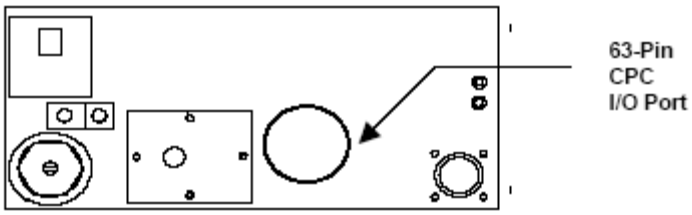

Figure 21. 63-Pin, Input/Output CPC Port

5. Thread the free end of the cable assembly into the cabinet (weathertight installation only).
6. Connect the free (50-pin) end of the cable assembly to the QCCB. You can use an extension cable with 50-pin amp connectors (m-f) if the cable assembly does not reach the QCCB. However, total length of input/output cabling from the repeater to the QCCB must not exceed 50 feet (16.7 m).

Connecting Wiring

When connecting wiring to the QCCB, use the punch-down tool to secure and trim the wires. For weathertight installations, protect all wiring and equipment from the environment.

To connect wiring:

1. Read the following parts of this section for information about the type of connection to be made:
   - ⇒ Digital Control Outputs
   - ⇒ Alarm and Control Relay Outputs
   - ⇒ Digital Inputs
   - ⇒ External DC Input Voltage
2. Confirm that the repeater is OFF.
3. Determine the correct terminal connections for equipment wiring—see Table 17. For example, equipment connected to digital control output #1 has two terminal connections on the QCCB: connector #36 (positive), and connector #11 (negative).
4. Thread the wires into the QCCB cabinet (weathertight installation only).
5. Insert a wire into its correct position.
6. Using the cutting side of the punch-down tool, push the wire down into its position until the loose end of the wire is cut off. Repeat steps 2 and 3 as necessary.

Table 17. Input/Output Descriptions

Function	63-pin CPC Connector		QCCB		
	Pin Number	***Color***	***Connector Number***	***Solid Color***	***Stripe Color***
Major Alarm Summary, Common	1	BLK (Black)	26	White	Blue
Major Alarm Summary, Normally Closed	2	WHT (White)	1	Blue	White
Major Alarm Summary, Normally Open	3	RED	27	White	Orange
Reserved			2	Orange	White
Relay #1, Common	4	GRN (Green)	28	White	Green
Relay #1, Normally Closed	5	ORG (Orange)	3	Green	White
Relay #1, Normally Open	6	BLU (Blue)	29	White	Brown
Reserved			4	Brown	White
Relay #2, Common	7	WHT/BLK	30	White	Slate
Relay #2, Normally Closed	8	RED/BLK	5	Slate	White
Relay #2, Normally Open	9	GRN/BLK	31	Red	Blue
Reserved	10		6	Blue	Red
Forward PA Power, disable	11	ORG/BLK	32	Red	Orange
Spare	12	BLU/BLK	7	Orange	Red
Reverse PA Power, disable	13	BLK/WHT	33	Red	Green
Reserved			8	Green	Red
Digital Input #1	14	RED/WHT	34	Red	Brown
Digital Input #2	16	GRN/WHT	9	Brown	Red
Reserved	17	BLU/WHT	35	Red	Slate
Reserved	18		10	Slate	Red
Digital Output #1, Positive	19	BLK/RED	36	Black	Blue
Digital Output #1, Negative	20	WHT/RED	11	Blue	Black
Digital Output #2, Positive	21	ORG/RED	37	Black	Orange
Digital Output #2, Negative	22	BLU/RED	12	Orange	Black
External DC Battery Monitor	23	RED/GRN	38	Black	Green
Reserved	24 - 37		13	Green	Black
Ground	38	ORG/GRN	39	Black	Brown
Ground	39	BLK/WHT/RED	14	Brown	Black
Ground	40	WHT/RED/BLU	40	Black	Slate
Ground	41	BLK/WHT/GRN	15	Slate	Black
Ground	42	WHT/BLK/GRN	41	Yellow	Blue
Ground	43	RED/WHT/GRN	16	Blue	Yellow
Ground	44	WHT/RED/ORG	42	Yellow	Orange
Reserved	45 - 49		17	Orange	Yellow
Reserved	50	WHT/BLK/RED	43	Yellow	Green

Function	63-pin CPC Connector		QCCB		
	Pin Number	***Color***	***Connector Number***	***Solid Color***	***Stripe Color***
Reserved	51	RED/BLK/WHT	18	Green	Yellow
Reserved	52	GRN/BLK/WHT	44	Yellow	Brown
Reserved	53	ORG/BLK/WHT	19	Brown	Yellow
Reserved	54	BLU/BLK/WHT	45	Yellow	Slate
Reserved	55	BLK/RED/GRN	20	Slate	Yellow
Reserved	56	WHT/RED/GRN	46	Violet	Blue
Reserved	57		21	Blue	Violet
Reserved	58	RED/BLK/GRN	47	Violet	Orange
Reserved	59	GRN/BLK/ORG	22	Orange	Violet
Reserved	60	ORG/BLK/GRN	48	Violet	Green
Reserved	61	BLU/WHT/ORG	23	Green	Violet
Reserved	62	BLK/WHT/ORG	49	Violet	Brown
Reserved	63	ORG/WHT/BLU	24	Brown	Violet
Reserved			50	Violet	Slate
Reserved			25	Slate	Violet

Digital Control Outputs

The PES800 NR has two digital outputs, each with a positive and negative lead. When the output switch is ON, current flows through a circuit, which includes the positive and negative leads for that output—see the following figure.

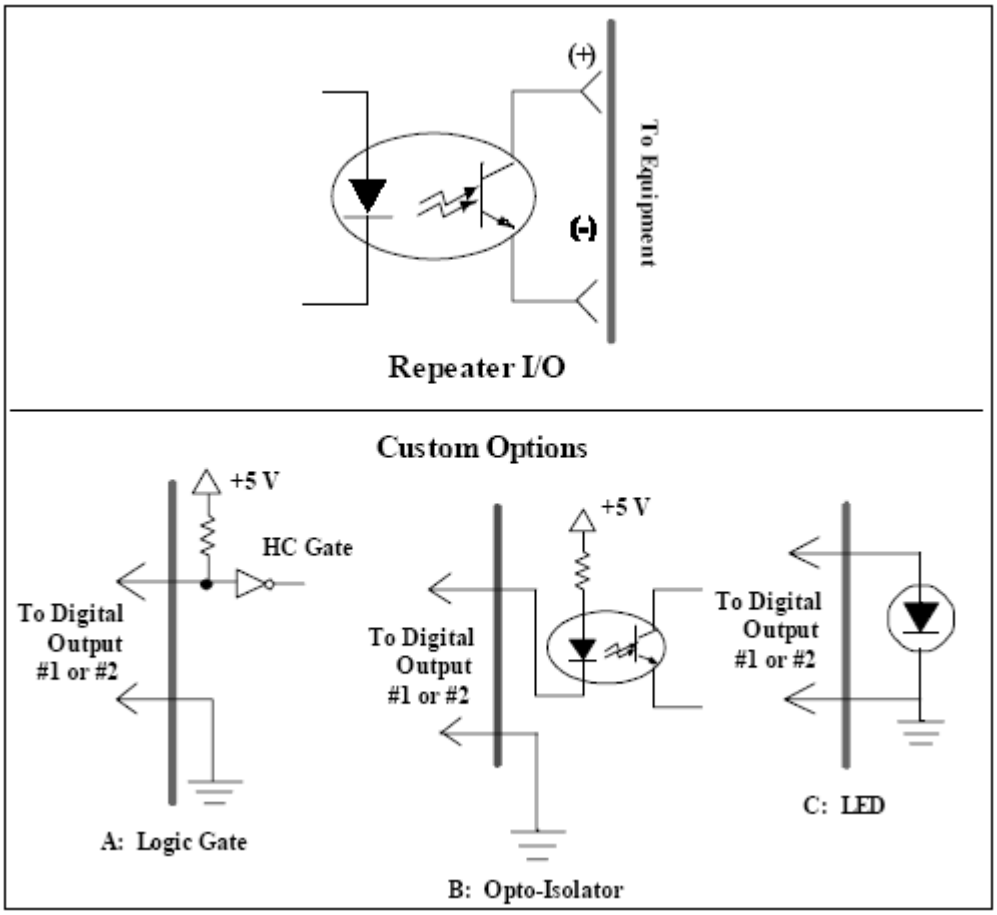

Figure 22. Typical Digital Output Applications

Outputs are isolated from the repeater's power subsystem. Provide a current source on the positive lead that does *not* exceed the following specifications:

Forward Current–Continuous ..... 10 mA

Maximum Positive
to Negative Lead Voltage..... 24 V

Maximum Negative
to Positive Lead Voltage ..... 0 V

Leakage Current in OFF State..... 1 μA

Isolation ..... 1500 V

Alarm and Control Relay Outputs

The PES800 NR has both alarm and control relay outputs (Form C) with common, normally open, and normally closed connections. When attached to the normally open and common leads, an alarm relay *closes* a circuit when a critical alarm activates, and *opens* the circuit when the condition clears.

Relay Outputs #1 and #2 open and close circuits according to the relay output controls in RepeaterNet. For example, to activate an external light when the Relay Control switch is ON, the wiring loop includes the common connector, the normally open connector, a power source for the light, and the light—see the following figure.

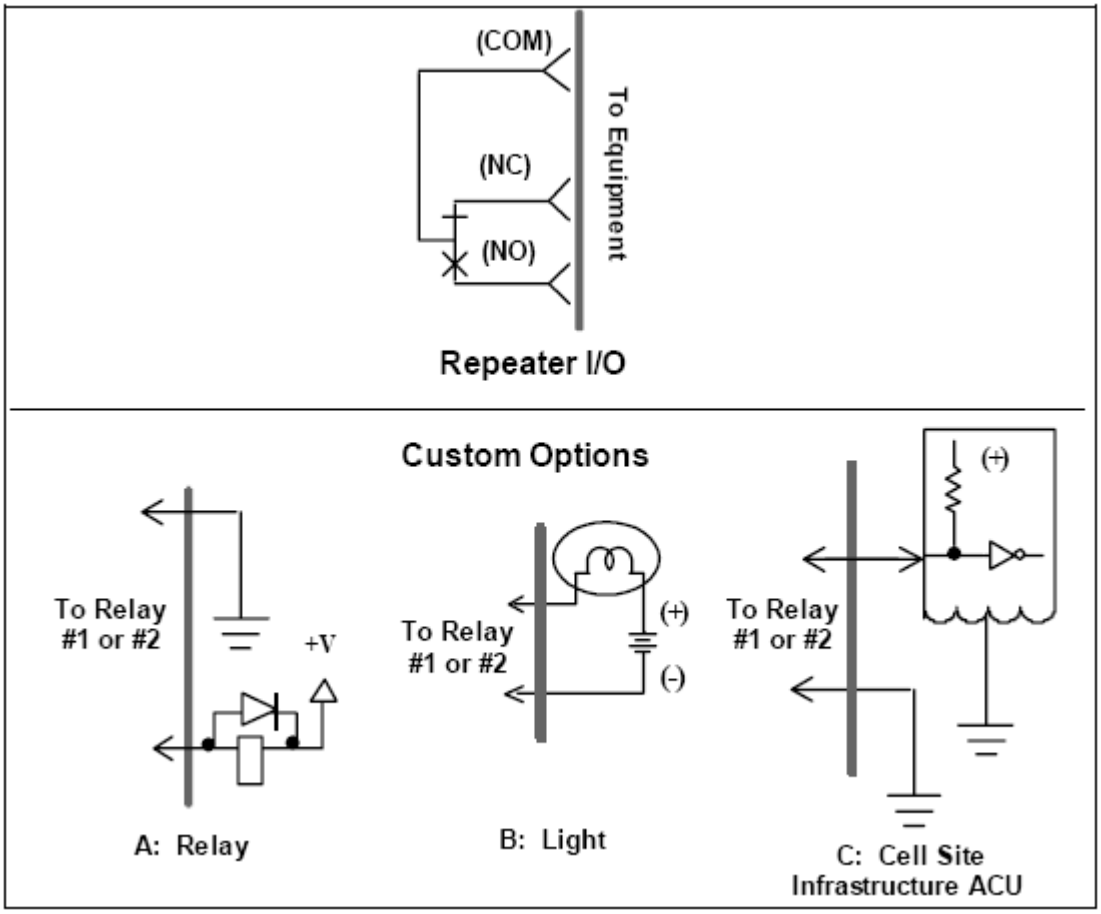

Figure 23. Typical Relay Applications

Do not exceed the following specifications with relay connections:

Maximum Switching Voltage and Current..... 30 VDC/200 mA
125 VAC/100 mA

Digital Inputs

The PES800 NR has digital inputs for external alarm monitoring and for disabling the Forward and Reverse PAs. Each input triggers an alarm (or disables the PA) if the leads form a low impedance circuit (a contact closing), and clears an alarm if the leads form a high impedance circuit (an open contact).

NOTE: *If a PA is disabled using the digital inputs, the PA Alarm is triggered. To avoid triggering a PA Alarm in this manner, set the PA Alarm severity to disabled.*

Connect digital inputs with two leads: the digital input lead and any ground lead. See the next two figures.

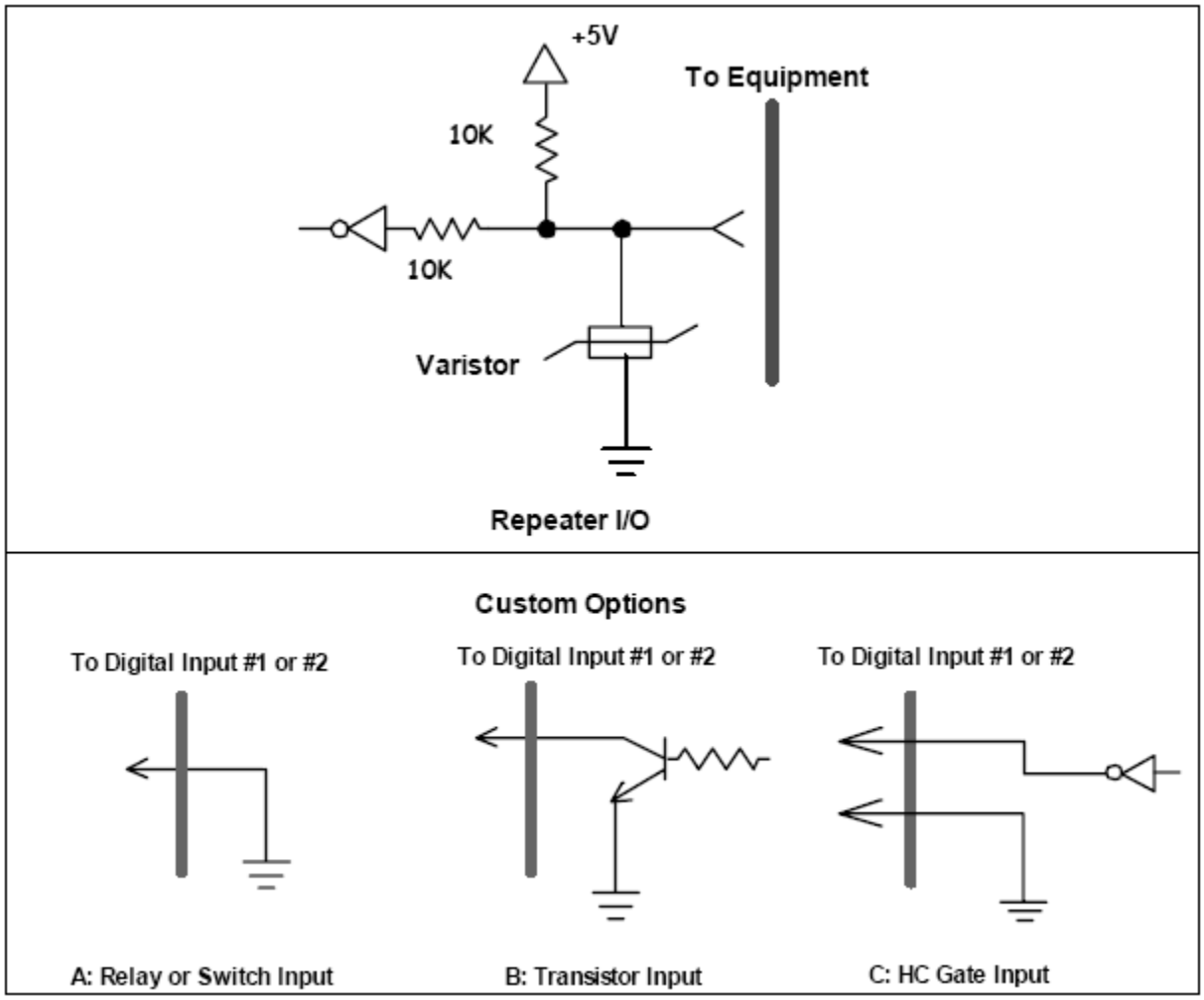

Figure 24. Typical Digital Input Applications

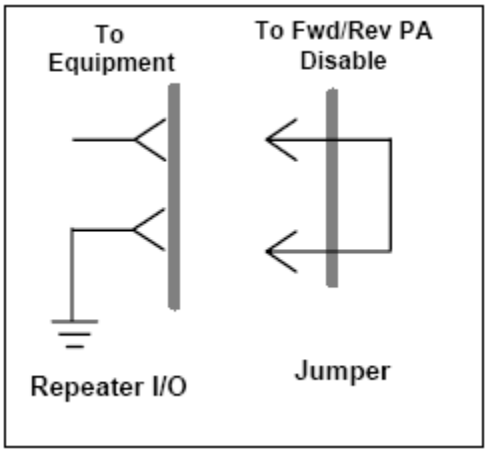

Figure 25. Typical PA Disable Input

Do not exceed the following specifications when connecting digital inputs:

Input Voltage for Logic 0
(active alarm/disable PA)..... < 0.5 V

Input Voltage for Logic 1
(normal/enable PA)..... ..... > 4.0 V

Maximum Input Voltage.... ..... 5.0 V

Minimum Input Voltage..... ..... 0.0 V

Maximum Input Current.... ..... 2 mA

External DC Input Voltage

The PES800 NR has one analog input to monitor an external DC power source. The monitoring range is from 0 to 60 V, with a resolution of 250 mV.

Connect an external DC power source to the repeater with a single lead from the positive line/terminal of the battery—see the following figure.

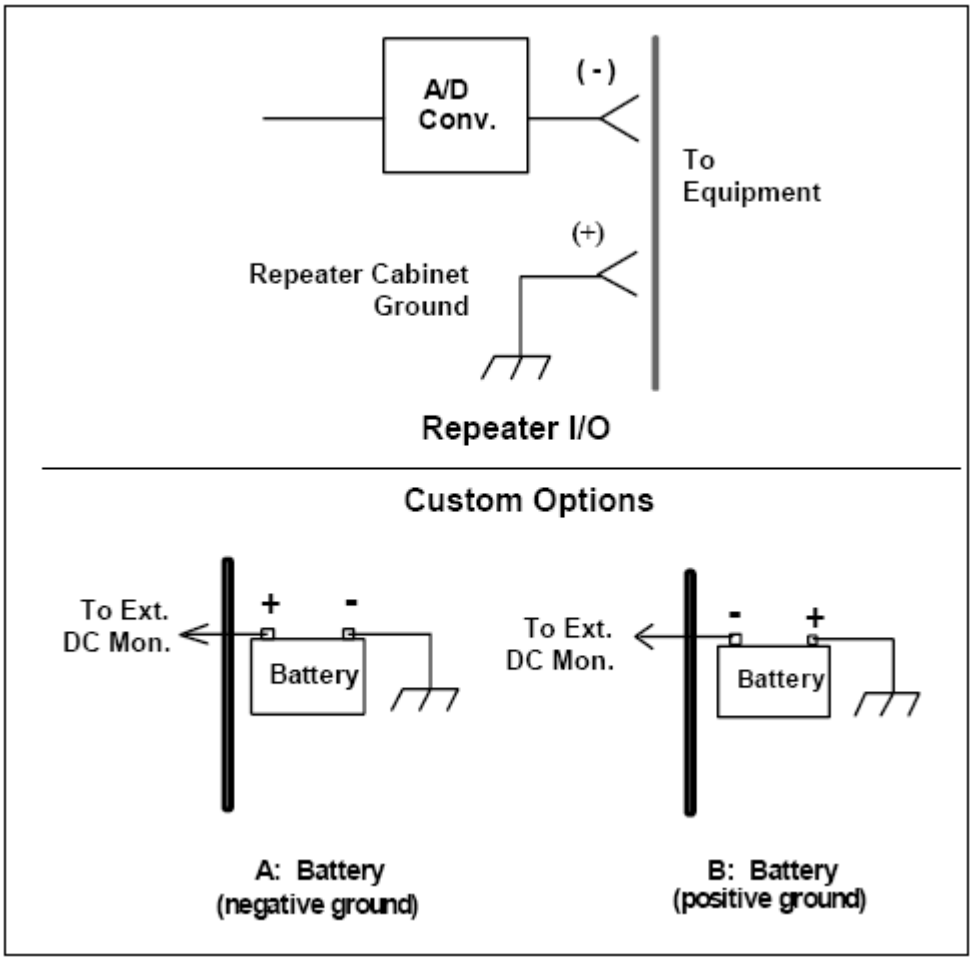

Figure 26. Typical DC Monitoring Applications

CAUTION: *Do not allow any input to exceed the 60 V limit.*

Chapter 5. Orienting and Isolating Antennas

Orienting Antennas and Measuring Output Power

With the antennas mounted, coaxial cables installed, and the repeater OFF, antenna orientation can begin.

To orient antennas and measure output power:

1. Turn OFF system power (using the switch on the bottom of the repeater).
2. Remove the 50-ohm terminations from the repeater antenna ports.
3. Connect the cell site (base) and mobile antenna feeders to the proper antenna ports.
4. Open a session with RepeaterNet and login—see *RepeaterNet Craft for the PES800 NR*.
5. Activate the Forward and Reverse Power Amplifiers using RepeaterNet—see *RepeaterNet Craft for the PES800 NR*.
6. Monitor the Forward RF output power on the Measurements tab of the Forward PA Status screen. The Forward transmit power increases as the orientation of the Donor antenna is optimized. Make *minor* adjustments to the Donor antenna facing the Cell Site to maximize Forward power output.
7. Monitor the Reverse RF output power on the Measurements tab of the Reverse PA Status screen.
8. Compare the Forward and Reverse RF output power levels to the intended RF output power levels for the system (defined in the site plan or network engineering documentation) and the maximum output power of the Repeater.
9. If the RF output power levels exceed the planned limits for this application, reduce RF power output by adjusting repeater gain.

Cell Site Antenna – toward Donor Cell Site

To initially orient the Cell Site (RBS) antenna:

1. Connect the spectrum analyzer to the coaxial cable from the donor cell site antenna.
2. Monitoring the control channel assigned to the cell site, position the cell site antenna to maximize the RSL (Received Signal Level).
3. Analyze the signal to ensure that it conforms to project design specifications. Consult your site plan or network administrator for more information.
4. Record the power level and frequency of the control channel and other active carriers from the cell site for later reference:

   Power Level _____ dBm

   Frequency _____ MHz

   If the RSL is less than *Maximum RF Output Power Level* minus *Maximum Gain*, then full repeater output power may *not* be reached when installed. See the following table for RF output and maximum gain levels. To correct the problem, reposition the antenna, change the mounting height of the antenna, or use an antenna with greater gain to reach the required RSL.

Table 18. PES800S/SE Maximum RF Output Power Levels; Power per Equal Level Carrier; AMPS, NAMPS, TDMA, GSM-800

Number of Carriers*	PES800S/SE Forward Power	PES800S/SE Reverse Power
2	33.0 dBm	26.0 dBm
4	30.0	23.0
6	28.0	21.5
8	27.0	20.0
10	26.0	19.0
12	25.5	18.0
14	24.5	17.5
16	24.0	17.0
20	23.0	16.0
25	22.0	15.0
30	21.0	14.0
35	20.5	13.5
40	20.0	13.0
45	19.5	12.5
50	19.0	12.0
60	18.0	11.0
70	17.5	10.5
80	17.0	10.0
90	16.5	9.5
100	16.0	9.0
*Carrier count includes the Control or Setup channel.		

Table 19. PES800S/SE Maximum RF Output Power Levels; Power per CDMA 1x FA

Number of FA	PES800S/SE Forward Power	PES800S/SE Reverse Power
1	35.0 dBm	28.0 dBm
2	32.0	25.0
3	30.0	23.0
4	29.0	22.0
5	28.0	21.0
6	27.0	20.0
7	26.5	19.5
8	26.0	19.0
9	25.5	18.5
10	25.0	18.0

Table 20. PES800C Maximum RF Output Power Levels; Power per CDMA 1x FA

Number of FA	PES800C Forward Power	PES800C Reverse Power
1	35.0 dBm	28.0 dBm
2	32.0	25.0

Table 21. PES800G Maximum RF Output Power Levels; Power per Equal Level Carrier, GSM-800

Number of Carriers	PES800G Forward Power	PES800G Reverse Power
1	37.0 dBm	30.0 dBm
2	33.0	26.0
3	31.0	24.0
4	30.0	23.0
5	29.0	22.0
6	28.0	21.0
7	27.5	20.5
8	27.0	20.0
10	26.0	19.0

Table 22. PES800G Maximum RF Output Power Levels; Power per CDMA 1x FA

Number of FA	PES800G Forward Power	PES800G Reverse Power
1	35.0 dBm	28.0 dBm
2	32.0	25.0
3	30.0	23.0

Mobile Antenna

The Mobile service antenna can only be *boresighted*, or aimed by eye, at this time. Aim the antenna as closely as possible to its final position. Accuracy is important because the antenna position affects antenna isolation.

Antenna Isolation

In order to prevent oscillation or severe passband distortion, *the antennas must have a port-to-port isolation equal to 15 dB plus the PES800 NR active gain.* For example, a PES800 NR set for a maximum available gain of 85 dB requires a minimum antenna isolation of 100 dB (85 dB + 15 dB) for proper operation.

Be aware that the motion of objects near the antennas can cause near-field reflections, which affect antenna isolation. If possible, tests should be made with expected objects present to ensure that the isolation does not drop below minimum levels.

To measure the isolation:

1. Disconnect both antenna signal cables at the antenna ports on the repeater.
2. Inject a signal into one of the antenna ports and measure the power level of that signal at the other antenna port. The difference in power levels (measured in dBs) between the injected signal and the measured signal is the isolation of the antennas.

   NOTE: *The antennas are not connected to the repeater at this time. Isolation is obtained through the air.*

3. Repeat the test at several frequencies across the Forward and Reverse passband, confirming that minimum antenna isolation is met at *all* frequencies.
4. If isolation is not met, try repositioning the antennas or adding intervening shielding and measure again.

The following method can be used to *estimate* antenna isolation (referenced to dBd, i.e. dB gain or loss relative to a dipole). During installation, always rely upon actual measurements, not estimated data.

Equation 1. Antenna Isolation

$$\mathbf{Isol = L_s + L_f + L_o - G_d + AD_d - G_r + AD_r + XPD}$$

English or Imperial

$L_s = -42.2 + 20*\text{Log}_{10}(F \times D)$

F in MHz,
D in feet,
L_s in dBd

Metric

$L_s = -31.8 + 20*\text{Log}_{10}(F \times D)$

F in MHz,
D in meters,
L_s in dBd.

Where:

Isol = Antenna isolation in dB.

L_s = Antenna separation loss in dB.

L_f = Total feedline loss in dB.

L_o = Obstruction Loss from structure or shield in dB.

G_d = Gain of antenna toward donor Cell Site in dBd.

AD_d = Angular Discrimination of donor antenna toward re-radiation antenna in dB.

G_r = Gain of re-radiation antenna toward Mobile in dBd.

AD_r = Angular Discrimination of re-radiation antenna toward donor antenna in dB.

XPD = Cross polarization discrimination between antennas (if applicable) in dB

Chapter 6. Completing Installation

Activating System Power

While activating system power, RepeaterNet Craft—the software program that configures, controls, and monitors the PES800 NR—is used. Detailed instructions on the operation of RepeaterNet Craft are located in *RepeaterNet Craft for the PES800 NR*.

To activate system power:

1. Terminate the PES800 NR antenna ports with Type N (m) Power Loads.
2. Put on a wrist grounding strap and attach the other end of the strap to the system ground lug, located on the bottom of the cabinet.
3. Touch the side of the cabinet to dissipate any static charge.
4. Open the door of the repeater and find the internal battery backup, located centrally in the cabinet. See **Backing Up the Internal Battery** on page 55 for information about the operation of the internal battery backup.
5. Activate the power source to the repeater, then turn on the repeater's power switch— see **Figure 14** on page 20.
6. Connect the red lead (quick disconnect type) of the internal battery backup.
7. Close and secure the repeater door, and remove the grounding strap.
8. Check the repeater for an Input Power Alarm to confirm proper system voltage. This includes the following steps:

   ⇒ Connect to the repeater.
   ⇒ Install RepeaterNet, if necessary.
   ⇒ Start RepeaterNet.
   ⇒ Define a new connection and login—see *RepeaterNet Craft for the PES800 NR*.
   ⇒ From the Main Control screen, click on the 2-Prong Plug icon to open the Power System Status screen.
   ⇒ Click on the **Status** tab and view the Power System alarms— see *RepeaterNet Craft for the PES800 NR*.
   ⇒ Click **OK** when finished.

9. If any power alarms are active, check external power wiring and equipment. If all external power wiring and equipment is without fault, contact Peninsula Engineering Solutions.

   ⇒ Confirm that the Forward and Reverse PAs are OFF— see *RepeaterNet Craft for the PES800 NR*.

NOTE: *The PES800 NR is factory configured with the PA switches turned OFF.*

10. When finished, do not end the active session or exit RepeaterNet. Proceed with installation.

Assigning Frequency

Some versions of the PES800 NR must be configured to operate at the desired frequency by setting the operating channel or band with RepeaterNet. Other versions of the PES800 NR do not require channel or band adjustment for proper operation.

The following models require software configuration:

⇒ PES800C NR (channel-selective CDMA Repeater)
⇒ PES800G NR (block-selective CDMA/GSM Repeater)

Determining the Operating Frequency

Consult the Site Plan or network engineering documentation for the proper channel or band setting for the application.

CDMA Applications with the PES800C repeater

In CDMA applications, primary and secondary channel assignments depend upon geographic location. See the following table for a listing of CDMA channel assignments. Note that CDMA channel assignments are different in Korea and Japan.

Table 23. 800 MHz CDMA Channel Assignments

Cellular Band	Channel #	Forward Tx (MHz)	Reverse Tx (MHz)
Primary Channels			
A-Band (standard spectrum)	283	878.490	833.490
B-Band (standard spectrum)	384	881.520	836.520
Secondary Channels			
A-Band (extended spectrum)	691	890.730	845.730
B-Band (extended spectrum)	777	893.310	848.310

NOTE: Any valid CDMA channel can be assigned per TIA-97-E, Band Class 0 and Spreading Rate 1.

Two-Channel CDMA Repeater Configurations

Two-Channel Assignment Preference

The 2-channel OA800C Network Repeater is designed optimally to have the higher frequency CDMA Channel assigned to Channel 1. The higher frequency CDMA Channel Number should always be assigned to repeater Channel 1 and the lower frequency to repeater Channel 2 (for example, for a B-CDMA repeater in a standard configuration, Channel 777 should be entered on repeater Channel 1 and Channel 384 should be entered on repeater Channel 2).

Special Single-Channel Operation, Two-Channel CDMA Repeater

If only one repeater channel is to be “Active” on the 2-channel repeater, the second repeater channel can be “overlaid” on the same channel assignment as repeater channel 1. This increases the gain by typically 5 dB on the overlaid signal. This gain increase requires the operator to decrease the forward and reverse repeater gain by 6 dB, using RepeaterNet™. RepeaterNet™ now always displays the gain 5 dB lower than actuality while the repeater is in this overlaid configuration. Make a note of this special channel assignment when in this configuration.

GSM Applications with the PES800G repeater

In GSM multi-carrier applications using the PES800G, 4.0 MHz bandwidth block repeater, a maximum of 21 contiguous carrier frequencies are supported with one passband center frequency setting. This bandwidth will normally serve RBS with up to 4 or 5 assigned carriers using a 4 channel spacing.

The passband is set by center frequency and corresponding channel assignment. RepeaterNet Craft is programmed to use AMPS and CDMA channel plan numbers. Correspondence tables from GSM-800 channel plan numbers to AMPS/CDMA are shown below.

Lookup the range of GSM channels to be repeated, then find the corresponding AMPS/CDMA channel for the passband center. Assign that AMPS/CDMA channel number to the repeater using RepeaterNet Craft. AMPS/CDMA channels can be set in 1-channel; 30 kHz increments.

Table 24. GSM-800 Channels, A-Band, PES800G – 4.0 MHz BW

GSM-800 Channels A-Band Extended			***AMPS, CDMA Channels***	***Passband Frequencies, MHz Forward Direction***		
Low	**Center**	**High**	**Center**	**Low**	**Center**	**High**
128	138	148	**40**	869.20	871.20	873.20
129	139	149	**47**	869.41	871.41	873.41
130	140	150	**53**	869.59	871.59	873.59
131	141	151	**60**	896.80	871.80	873.80
132	142	152	**67**	870.01	872.01	874.01
133	143	153	**73**	870.19	872.19	874.19
134	144	154	**80**	870.40	872.40	874.40
135	145	155	**87**	870.61	872.61	874.61
136	146	156	**93**	870.79	872.79	874.79
137	147	157	**100**	871.00	873.00	875.00
138	148	158	**107**	871.21	873.21	875.21
139	149	159	**113**	871.39	873.39	875.39
140	150	160	**120**	871.60	873.60	875.60
141	151	161	**127**	871.81	873.81	875.81
142	152	162	**133**	871.99	873.99	875.99
143	153	163	**140**	872.20	874.20	876.20
144	154	164	**147**	872.41	874.41	876.41
145	155	165	**153**	872.59	874.59	876.59
146	156	166	**160**	872.80	874.80	876.80
147	157	167	**167**	873.01	875.01	877.01
148	158	168	**173**	873.19	875.19	877.19
149	159	169	**180**	873.40	875.40	877.40
150	160	170	**187**	873.61	875.61	877.61
151	161	171	**193**	873.79	875.79	877.79
152	162	172	**200**	874.00	876.00	878.00
153	163	173	**207**	874.21	876.21	878.21
154	164	174	**213**	874.39	876.39	878.39
155	165	175	**220**	874.60	876.60	878.60
156	166	176	**227**	874.81	876.81	878.81
157	167	177	**233**	874.99	876.99	878.99
158	168	178	**240**	875.20	877.20	879.20
159	169	179	**247**	875.41	877.41	879.41
160	170	180	**253**	875.59	877.59	879.59
161	171	181	**260**	875.80	877.80	879.80

Lookup the range of GSM channels to be repeated, then find the corresponding AMPS/CDMA channel for the passband center. Assign that AMPS/CDMA channel number to the repeater using RepeaterNet Craft. AMPS/CDMA channels can be set in 1-channel; 30 kHz increments.

Table 25. GSM-800 Channels, B-Band, PES800G – 4.0 MHz BW

GSM-800 Channels B-Band			AMPS, CDMA Channels	Passband Frequencies, MHz Forward Direction		
Low	**Center**	**High**	**Center**	**Low**	**Center**	**High**
183	193	203	**407**	880.21	882.21	884.21
184	194	204	**413**	880.39	882.39	884.39
185	195	205	**420**	880.60	882.60	884.60
186	196	206	**427**	880.81	882.81	884.81
187	197	207	**433**	880.99	882.99	884.99
188	198	208	**440**	881.20	883.20	885.20
189	199	209	**447**	881.41	883.41	885.41
190	200	210	**453**	881.59	883.59	885.59
191	201	211	**460**	881.80	883.80	885.80
192	202	212	**467**	882.01	884.01	886.01
193	203	213	**473**	882.19	884.19	886.19
194	204	214	**480**	882.40	884.40	886.40
195	205	215	**487**	882.61	884.61	886.61
196	206	216	**493**	882.79	884.79	886.79
197	207	217	**500**	883.00	885.00	887.00
198	208	218	**507**	883.21	885.21	887.21
199	209	219	**513**	883.39	885.39	887.39
200	210	220	**520**	883.60	885.60	887.60
201	211	221	**527**	883.81	885.81	887.81
202	212	222	**533**	883.99	885.99	887.99
203	213	223	**540**	884.20	886.20	888.20
204	214	224	**547**	884.41	886.41	888.41
205	215	225	**553**	884.59	886.59	888.59
206	216	226	**560**	884.80	886.80	888.80
207	217	227	**567**	885.01	887.01	889.01
208	218	228	**573**	885.19	887.19	889.19
209	219	229	**580**	885.40	887.40	889.40
210	220	230	**587**	885.61	887.61	889.61
211	221	231	**593**	885.79	887.79	889.79

Lookup the range of GSM channels to be repeated, then find the corresponding AMPS/CDMA channel for the passband center. Assign that AMPS/CDMA channel number to the repeater using RepeaterNet Craft. AMPS/CDMA channels can be set in 1-channel; 30 kHz increments.

CDMA Applications with the PES800G repeater

In CDMA multicarrier applications using the PES800G, 4.0 MHz bandwidth block repeater, a maximum of 3 CDMA 1x frequency assignments (FA) are supported with one passband center frequency setting. The following tables show the permissible CDMA channel settings for the Americas following TIA-97-E, Band Class 0 and Spreading Rate 1.

Table 26. CDMA Channels, A-Band, PES800G – 4.0 MHz BW, Maximum Spacing

CDMA FA, A-Band Valid Channel Limits, maximum spacing			***Passband Frequencies, MHz Forward Direction***		
Low	**Center**	**High**	**Low**	**Center**	**High**
1013	**34**	78	869.70	871.02	872.34
223	**267**	311	876.69	878.01	879.33

Table 27. CDMA Channels, B-Band, PES800G – 4.0 MHz BW, Maximum Spacing

CDMA FA, B-Band Valid Channel Limits, maximum spacing			***Passband Frequencies, MHz Forward Direction***		
Low	**Center**	**High**	**Low**	**Center**	**High**
356	**400**	444	880.68	882.00	883.32
556	**600**	644	886.68	888.00	889.32

Table 28. CDMA Channels, A-Band, PES800G – 4.0 MHz BW, Recommended Spacing

CDMA FA, A-Band Valid Channel Limits, 1.230 MHz spacing			***Passband Frequencies, MHz Forward Direction***		
Low	**Center**	**High**	**Low**	**Center**	**High**
1013	**31**	72	869.70	870.93	872.16
229	**270**	311	876.87	878.10	879.33

Table 29. CDMA Channels, B-Band, PES800G – 4.0 MHz BW, Recommended Spacing

CDMA FA, B-Band Valid Channel Limits, 1.230 MHz spacing			***Passband Frequencies, MHz Forward Direction***		
Low	**Center**	**High**	**Low**	**Center**	**High**
356	**397**	438	880.68	881.91	883.14
562	**603**	644	886.86	888.09	889.32

Setting the Channel or Band

To set the operating channel or band:

1. Confirm that RepeaterNet is ON and a connection is established with the repeater.
2. From the Main Control screen, click the Channel 1 button.
3. Click the Channel Number tab and set the operating channel or band—see *RepeaterNet Craft for the PES800 NR*.
4. Click **OK** or **Apply**.
5. Repeater for the Channel 2 subsystem, if necessary.
6. When finished, do not end the active session or exit RepeaterNet. Proceed with installation.

Configuring Initial Gain

When initially setting Forward and Reverse Gain, use the gain settings defined on the project site plan or in network engineering documentation (if necessary, contact a network administrator). Final adjustments to gain settings are made during system optimization.

To initially set gain:

1. Confirm that RepeaterNet is ON and a connection is established with the repeater.
2. From the Main Control screen, click the **Forward PA** button.
3. Click on the **Gain** tab, and set FORWARD gain by click-dragging the horizontal slider—see *RepeaterNet Craft for the PES800 NR*.
4. Click **OK** or **Apply**.
5. Repeat for the Reverse PA subsystem.
6. Exit the session but do not exit RepeaterNet—see *RepeaterNet Craft for the PES800 NR*.

The PES800 NR has an adjustable gain range of 30 dB, with upper and lower limits defined by the PA level of the repeater. In some rare cases, it may be necessary to set antenna gain below the lower limit of this range.

In case gain must be set below the lowest limit, or hot input levels are present:

1. Choose a fixed attenuator pad that sets the gain to a level about 5 dB lower than what is required.
2. Install the attenuator pad at the antenna port.
3. Make the final *upward* gain adjustment with RepeaterNet.

NOTE: *If an attenuator pad is inserted in this manner, RepeaterNet does not show the correct antenna gain. For example, if the Attenuator pad reduces gain by 5 dB, the system gain is 5 dB lower than the setting shown on the PA Properties screen.*

Verifying and Optimizing Coverage Area

NOTE: *This information is valid for AMPS systems only. For information on CDMA, GSM, TDMA (IS-136), or other systems, contact Peninsula Engineering Solutions for appropriate application engineering guides.*

After initially setting repeater gain, carefully check the service area to ensure that the system is in balance with the entire network of coverage. If the system and the network are in balance, calls hand off smoothly between the Donor Cell Site and the repeater, and between the repeater and any adjacent cell sites.

During verification, monitor coverage using a Mobile unit with RSSI (Receive Signal Strength Indicator) output, or a service monitor and a recorder.

To verify and optimize system coverage:

1. Deactivate the PES800 NR, then measure the RSL for Forward, and Reverse transmissions at various locations within the area of service to be affected by the repeater. This requires RSL monitoring at the Cell Site and at the Mobile transmission site.
2. Reactivate the repeater and return to the same locations where measurements were taken in step 1 and measure Forward and Reverse RSL for confirmation of coverage.
3. Measure the Forward RSL with the Mobile monitor. Make *minor* adjustments to the orientation of the mobile service antenna to optimize coverage.
4. Check Forward and Reverse RSL at points where service should hand-off from the repeater's donor Cell Site to the Repeater. Note any problems with service.
5. Check Forward and Reverse RSL at points where service should hand-off from the repeater to any adjacent cell sites. Note any problems with service.
6. Adjust repeater gain to optimize system coverage and ensure smooth hand-off.
7. Repeat steps 4 through 6 to verify coverage and correct problems with service.

Balancing Gain

A brief explanation of gain balancing in cellular systems follows. For a more complete description, consult the *MicroCells and System Balance* application note.

The process of transferring an active call from one cell to another is called hand-off. Hand-off is controlled by the RSL of the mobile or hand-held unit—units *stay* in the service of the Cell Site from which they receive the strongest signal. When the signal from another Cell Site grows stronger than the signal of the Cell Site currently servicing the mobile, the control of the call is transferred to the Cell Site with the stronger signal. In other words, a hand-off is made from one cell to another.

What makes gain balancing so important is the fact that the hand-off process does *not* monitor the Reverse (mobile to the Cell Site) signal transmission. If the Forward (Cell Site to mobile) gain of an Cell Site (or repeater) is set too high, the mobile unit continues to receive the strongest signal from that Cell Site and stay in its service—even to the point at which it does not have the power to transmit to that Cell Site. When the mobile unit's transmissions are not powerful enough to reach the Cell Site, the call is dropped (disconnected).

The goal in gain balancing is to set gains so that control passes from Cell Site to Cell Site, or Cell Site to repeater, with no loss of service. A well-balanced network of cell sites can also reduce the number of hand-offs, improving service.

For example, a typical cellular situation might place a cell site transmitting at 100 W ERP (+ 50 dBm) and receiving through 10 dB gain diversity antennas. A typical mobile unit transmits up to 4 W ERP (+36 dBm), but often transmits at lower levels. Transmission power varies with the type of modulation (TDMA, CDMA, AMPS) and distance from the nearest base station.

The mobile unit receives signals through the same antenna it uses for transmission, with antenna gain from unity (1) to 5 dB gain. Typical mobile antennas are 3 dB gain and hand-held units are unity gain.

Assuming a reciprocal path attenuation of L dB, the calculation for RSL is:

RSL (dBm) = ERP (dBm) - path attenuation (dB) + antenna gain (dB)

The cell site input RSL is:

(+36 - L + 10) dBm.

The mobile input RSL is:

(+50 - L +3) dBm

Therefore, the cell site RSLis 7 dB below the Mobile RSL. Typically, using a diversity receive antenna at the cell site balances out this 7 dB difference.

To examine the general case in which a repeater serves a Mobile, assume the following variables—all expressed in dB:

Ld	Reciprocal cell site to reepater path attenuation	Lr	Reciprocal repeater-to-Mobile path attenuation
Gd	Gain of repeater donor antenna	Gr	Gain of repeater re-radiation antenna
Af	Active repeater gain Forward	Ar	Active repeater gain Reverse

The RSL of a donor site receiver is:

(+36 - Lr + Gr + Ar + Gd - Ld + 10) dBm

The RSL of the Mobile receiver is:

(+50 - Ld + Gd + Af + Gr - Lr + 3) dBm

The 7 dB advantage to the Forward direction found in direct coverage can be retained by making the active Repeater gains in Forward (Af) and Reverse (Ar) directions equal. However, due to the loss of the Reverse diversity receive advantage, and to control hand-off from one cell site to another, it may be desirable to adjust the gains to unequal amounts. Actual gains may require field optimization.

Path Loss Equations

Line-of-sight path loss values define the estimated service area of an Cell Site or a repeater. These values should be calculated prior to system installation, and are provided with the site plan or network engineering documentation. Service personnel are not expected to recalculate path loss during installation. If necessary, contact a network administrator for this information.

The following formulas to calculate line-of-sight path loss are provided for reference. The first equation calculates loss between dipoles or antennas that have their gain referenced to a dipole (dBd). The second calculates loss between isotropic radiators or antennas that have their gain referenced to an isotropic radiator (dBi). Note that dBi = dBd + 2.15.

Path Loss, in dBd: L(dBd) = 28.2 + 20log(F x D)
Path Loss, in dBi: L(dBi) = 32.5 + 20log(F x D)

Where:

L = Free Space Path Loss, dB
F = Frequency, MHz
D = Distance, Km

Example:

F = 900 MHz
D = 3.5 Km
L(dBd) = 28.2 + 20log(900 × 3.5)

= 28.2 + 70.0
= 98.2 dBd
L(dBi) = 32.5 + 20log(900 × 3.5)
= 32.5 + 70.0
= 102.5 dBi

With distance measured in miles, the corresponding path loss equations are as follows:

Path Loss, in dBd: L(dBd) = 32.3 + 20log(F x D)
Path Loss, in dBi: L(dBi) = 36.6 + 20log(F x D)

Where:

L = Free Space Path Loss, dB
F = Frequency, MHz
D = Distance, miles

Example:

F = 900 MHz
D = 4 miles

L(dBd) = 32.3 + 20log(900 × 4)
= 32.3 + 71.1
= 103.4 dBd
L(dBi) = 36.6 + 20log(900 × 4)
= 36.6 + 71.1
= 107.7 dBi

Calculate Net Path Loss with the following formula:

NPL = L - (G1 + G2)

Where:

NPL = Net Path Loss, dB
L = Free Space Path Loss, dB
G1 = Gain of first antenna, dB
G2 = Gain of second antenna, dB

Example:

L = 98.2 dBd, G1 = 10 dB, G2 = 3 dB
NPL = 98.2 - (10 + 3)
= 85.2 dBd

Example:

L = 102.5 dBi, G1 = 12.15 dB, G2 = 5.15 dB
NPL = 102.5 - (12.15 + 5.15)
= 85.2 dBi

Configuring for Alarm Reporting and System Operation

After service has been established and confirmed, configure the PES800 NR with RepeaterNet for alarm reporting and system operation. See *RepeaterNet Craft for the PES800 NR* for detailed instructions about using RepeaterNet.

Use the RepeaterNet Craft for the PES800NR for instructions on the following procedures, which let you finish installing the repeater:

⇒ **Configure system properties**.
Configuring system properties allows easy identification of repeaters within a network and periodic automatic status reporting. See "Configuring Properties" in *RepeaterNet Craft for the PES800 NR*.

⇒ **Configure subsystem properties**
(Modem Settings, ACU subsystem inputs and outputs, DC voltage alarm threshold). See "Configuring Properties" in *RepeaterNet Craft for the PES800 NR*.

⇒ **Define alarm severity settings**.
See "Defining Alarm Severity" in *RepeaterNet Craft for the PES800 NR*.

⇒ **Back up your system configuration**.
See "Download Properties" and "Upload Properties" in *RepeaterNet Craft for the PES800 NR*.

NOTE: *If necessary, turn ON the repeater and open a connection with RepeaterNet.*

Configuring Alarm Severity

Alarm severity determines the actions taken by the PES800 NR when that alarm is triggered. The five levels of alarm severity trigger different actions by RepeaterNet are shown in the following table.

Table 30. Alarm Severity Settings

Severity	Action
Critical	Repeater dials out to report alarm. Alarm recorded in Alarm and Event Log. Alarm displayed on Main control screen and subsystem Status screen.
Major	Repeater dials out to report alarm. Alarm recorded in Alarm and Event Log. Alarm displayed on Main Control screen and subsystem Status screen.
Minor	Repeater dials out to report alarm. Alarm recorded in Alarm and Event Log. Alarm displayed on Main Control screen and subsystem Status screen.
Event	Alarm recorded in Alarm and Event Log. Alarm displayed on subsystem Status screen.
Disabled	No Action.

Although the PES800 NR comes factory-configured with predefined alarm severity settings, it is necessary to customize alarm severity settings during installation. See "Defining Alarm Severity" in *RepeaterNet Craft for the PES800 NR*.

See the following table for a listing of alarms and their factory-configured settings.

Table 31. Factory Default Alarm Severity Settings

Subsystem	*Alarm*	*Default Severity*	*Subsystem Problem*	*Effect on Service*
Filters: Channel 1 and Channel 2	Forward Filter	Critical	Loss of phase lock.*	Interrupted
	Reverse Filter	Critical	Loss of phase lock.*	Interrupted
PAs: Forward and Reverse	Power Amplifier	Critical	PA power supply current out of range	Interrupted (turn OFF PA)
	Thermal Shutdown	Critical	PA temperature too high.*	Interrupted (turn OFF PA)
	External Shutdown	Critical	Local Wireless Technician has manually shut-down Power Amplifiers.	Interrupted (turn OFF PA)
	RFE (Reverse Front End) Attenuation Active	Major	Fast acting/fast release Hot-Tone front-end protection activated. Protects RFE from mobile parking under subscriber antenna.	Degraded service. Repeater coverage area reduced until offending signal goes away.
ACU	External Input	Disabled†		n/a
	External Input	Disabled†		n/a
	Fan	Major	Fan stopped working.*	None, but eventual thermal shutdown probable.
	Temperature (system temp.)	Minor	Repeater heatsink temperature too high.*	None, but eventual thermal shutdown possible.
	Tamper Alarm (door open)	Major	Someone has opened the repeater cabinet door.	None, but possible security breech.
	DC Voltage	Disabled†		n/a
Modem	Modem	Minor	Modem not working.*	None, but reporting disabled and remote connection impossible
Cellular Phone	Cellular Phone	Minor	Cellular phone not working.*	None, but reporting disabled and remote connection impossible
Power Supply	Input Power	Critical	Loss of AC or DC input power to repeater..*	Interrupted
	Battery	Minor	External battery voltage is too high or too low.*	None, but repeater cannot call out in event of system power loss.
	Power System (internal)	Major	Loss of one or more internal power supply voltages.*	Interrupted

† If external inputs or equipment are used, set alarm severity as appropriate.
** May require maintenance visit to the repeater.*

Testing Inputs and Outputs

After configuring the PES800 NR for normal operation, test the operation of all external equipment connected to the inputs and outputs of the repeater. If any of the inputs and outputs do not function as expected, confirm that equipment is connected to the correct terminal positions on the QCCB, check for loose wiring connections, and examine the external equipment. External equipment can vary from site to site.

To test inputs and outputs:

1. Activate all connected digital and relay control outputs. Confirm proper operation.
2. Simulate alarm conditions for all equipment connected to digital inputs and monitor the results with RepeaterNet.
3. If applicable, use a DVM to check the voltage level of the external DC power source. Compare the measurement to the value displayed by RepeaterNet.
4. Check the modem connection (land line or cellular) by having someone else call into the repeater and initiate a modem session. Have them adjust settings to confirm their link and then log off. Be sure to return settings to their proper values.
5. If the repeater is configured for automatic reporting, test its automatic reporting by completing the following steps:

   ⇒ Set the **Tamper Alarm** to critical or major severity if necessary.

   ⇒ End your session with the repeater, exit RepeaterNet, and turn off the computer.

   ⇒ Trigger the Tamper Alarm by opening the repeater door.

   If it is properly configured, the repeater calls out to report the alarm.

   Note that to report an alarm, the repeater must call to a computer that is ON with a copy of RepeaterNet active.

   ⇒ Confirm that the repeater called out and reported the alarm. Note that to confirm the report, someone must be present at the computer, which the PES800 NR is calling.

   ⇒ Reconnect to the repeater and login with RepeaterNet.

   ⇒ Return the Tamper Alarm severity to its original setting, if necessary.

6. When finished, do not end the active session or exit RepeaterNet. Proceed with installation.

Backing-Up Repeater Configuration

The final step in installation is to make a back-up of the repeater's configuration. Although configuration information is preserved in the event of a power outage, backing up is strongly advised whenever adjustments are made.

To back up system settings:

1. Upload system properties to your computer.
2. Copy the resulting Repeater Configuration file (.rcf) to a floppy disk or memory device.
3. Label the floppy disk with the name of the repeater site and the date.
4. Store the floppy disk or memory device in a safe place.
5. Exit the active session.
6. Exit RepeaterNet and turn off the computer.
7. Disconnect the direct connect cable and store it in a safe place.

Creating a Standard Software Configuration

To simplify the installation of multiple repeaters, you can create a standard software configuration.

To create a standard configuration:

1. Login to a session with a correctly configured repeater.
2. Upload a backup copy of the repeater's system settings to a Repeater Configuration (.rcf) file.
3. Configure the repeater exactly as required for the standard configuration. Include general settings, such as alarm severity settings. Exclude site-specific settings from the configuration; for example, the site name and telephone number.
4. Upload the system settings to a configuration file on a floppy disk or memory device with an appropriate file name—for example, *stdconfig.rcf*.
5. Download the backup copy of the Repeater Configuration file (created in step 2) to the repeater.
6. Make a copy of the standard configuration file and store it in a safe place.
7. Download the standard Repeater Configuration to other repeaters during subsequent installations.

Chapter 7. Maintenance and Troubleshooting

The PES800 NR is a field-replaceable unit, and therefore requires no component-level repair, while the use of highly reliable components virtually eliminates the need for maintenance. However, routine checks of the PES800 NR and its supporting equipment ensure reliable operation and early detection of problems.

Routine Maintenance

Peninsula Engineering Solutions recommends a semiannual maintenance schedule for the repeater. The following is a procedure for routine maintenance:

1. Observe the general condition of the installation site and correct any problems.
2. Verify that the PES800 NR and all associated hardware, including antennas, is securely mounted and properly in place.
3. Check input electrical wiring and BUPS for damage and ensure that connections are tight.
4. Check any battery terminals for corrosion; clean terminals, if necessary.
5. Clean solar panels and remove obstructions, if applicable.

CAUTION: *Follow manufacturer's instructions when cleaning solar panels. Abrasive or acetone-based solutions can cause damage.*

6. Check antennas and coaxial cabling for damage and ensure that connections are tight.

Fan Replacement

If one of the fans of the PES800 NR fails, the entire blower assembly (part number 090-1121-01) must be replaced. A fan failure is reported by a fan alarm in the ACU Status screen.

To replace the blower assembly:

1. Turn OFF the repeater.
2. Loosen the two captive screws that hold the blower assembly to the bottom of the cabinet—see the following figure.

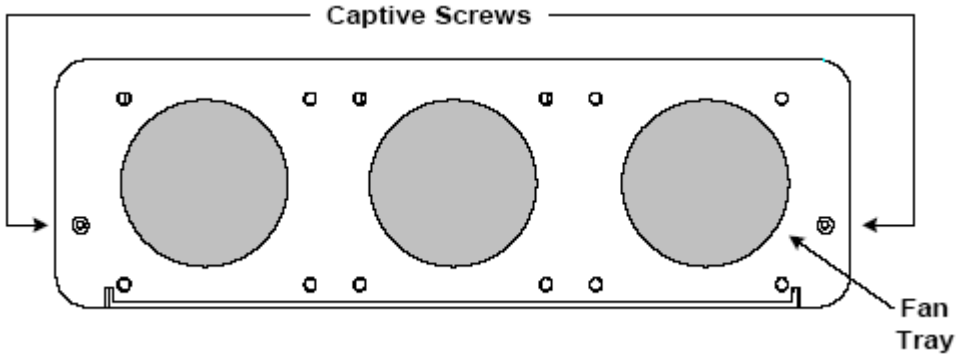

Figure 27. Blower Assembly

3. Carefully remove the blower, twist the inside connector counter-clockwise, and unplug the power cord harness from the heatsink.
4. Plug the power cord harness for the replacement assembly into the socket on the heatsink.
5. Insert the replacement blower, keeping the power cord harness clear of the fans.

6. Tighten the blower captive screws into their guide holes on the repeater cabinet.
7. Turn ON the repeater
8. Verify that there is no FAN alarm.

LEDs

Two status LEDs are located on the bottom of the PES800 NR cabinet—see ***Figure 14***, page 21. The green LED is the system power ON light. The red LED lights only when a repeater subsystem triggers a critical alarm.

Troubleshooting

Perform all troubleshooting of the PES800 NR with RepeaterNet. See ***Table 32*** for a listing of common problems and possible solutions.

NOTE: *Contact the Customer Service Department of Peninsula Engineering Solutions whenever problems with the unit cannot be resolved—see Section 0.*

Table 32. System Troubleshooting

Problem	***Cause***	***Solution***
Unable to Start RepeaterNet	Corrupted Program Data⇒	Run the Scan Disk and Defrag utilities included with Windows.
	Improper Installation of RepeaterNet⇒	Reinstall RepeaterNet.
	Damaged Hard Drive⇒	Repair or replace hard drive.
No Connection	Improper COM Settings⇒	• Check telephone number, COM port, stop bits, parity settings, and baud rate. Correct settings, if necessary. • Check advanced settings from the COM Properties screen. Reduce buffer sizes or disable buffer and retry connection.
	Serial Cable Failure⇒	• Check the cable for a tight connection. • Check the cable and connection ports for damage. Replace cable, if necessary. Contact Peninsula Engineering Solutions if the connection port is damaged.
	Modem Failure⇒	• Check telephone line connections at the computer and the repeater. Re-connect, if loose. • Check telephone line for damage. Replace, if necessary. • Log in to a direct session with the repeater and check the modem and cell phone alarms. If either alarm is active and does not clear, contact Peninsula Engineering Solutions. • Check the computer's modem. Replace or repair computer modem, if necessary.
Overheating *(Temperature or Fan Alarm)*	Inefficient Cooling⇒	• Check the heatsink and fans. Clear any airflow obstructions. • Shade the unit if it is in an extremely hot environment.
	Fan Failure⇒	Replace blower assembly—***see*** *Fan Replacement.*

Problem	*Cause*	*Solution*
Low Voltage or No Voltage *(Input Power Alarm)*	Improper Solar Charging⇒	Clean solar panels or remove obstructions. Do *not* use an acetone-based solution for cleaning.
	Power Supply Failure⇒	• Check the condition of the power source. • Check all wiring and power leads to the power source. • Check any fuses or circuit breakers in power supply equipment. • Check AC power service for outages or other service problems.
	Internal Power Converter Failure⇒	Contact Peninsula Engineering Solutions to replace unit.
Internal Battery Malfunction *(Internal Battery Alarm)*	Bad Connection to Battery⇒	Check leads to internal battery backup and re-connect.
	Internal Battery Backup Overdraw⇒	Call Peninsula Engineering Solutions for replacement of internal battery backup.
Low RF Output or No RF Output	Controls Not Turned ON⇒	• Check to ensure Repeater power is ON. • Check ensure PAs are both turned ON.
	Mobile or Base Antennas Oriented Incorrectly⇒	Check antenna orientation and re-align, if necessary.
	Alarm Conditions⇒	Check for alarm conditions and resolve, if necessary.
	Strong, Out-of-Band Inputs⇒	Check antenna orientation.
	Improper gain setting⇒	Check gain and re-set, if necessary.
Oscillation	Active Alarm⇒	Resolve alarm.
	Foreground reflections⇒	• Remove object causing reflection. • Adjust antenna orientation. • Move antenna mounting.
	Improper Antenna Isolation⇒	• Clear area around antennas of excessive plant growth.
	Improper Gain Settings⇒	Adjust gain.

Backing Up the Internal Battery

The PES800 NR includes an internal battery backup to provide limited back-up power for the ACU, and, if applicable, the cell phone and internal modem. In the event of a loss of system power, the internal battery provides power for the repeater to call out and report the failure, and to save the Alarm and Event Log. The length of time the internal battery provides power depends upon repeater configuration and environmental conditions (such as temperature)—see the following table.

Table 33. Internal Battery Backup Operation Estimates

Configuration	*Operating Time**
Repeater with no internal modem	5.5 hours
Repeater with internal modem and no cell phone	2.5 hours
Repeater with internal modem and cell phone, with modem and phone continuously transmitting.	45 minutes
**Values are estimates only: actual battery life may vary. Estimates assume a fully charged battery, adverse environmental conditions, and a 600 mW AMPS cell phone.*	

System power charges the internal battery during normal operation. Note that the internal battery has a low-voltage cut-off to allow for a full recharge when power is restored.

If a power outage lasts longer than the operational limit of the internal battery, the modem cannot send or receive calls, and Alarm and Event Log data is lost. Save the Alarm and Event Log when the repeater calls out to report a system power failure. However, repeater configuration information—gain, frequency, alarm severity, and other settings—is preserved beyond the life of the internal battery.

NOTES:

- *The internal battery does not provide power for RF transmission during a power outage. Service is interrupted during a loss of system power.*
- *The internal battery has a useful life of approximately 2 to 3 years, depending upon the temperature range experienced and the number of charge and discharge cycles. For preventative maintenance, Peninsula Engineering Solutions suggests that the battery be replaced every 3 years. See Spares list for replacement part numbers.*

Keeping Spares

Because repeaters are often used to provide critical coverage, customers are advised to follow a sparing policy. While most telecommunications carriers or system operators have internal policies relative to equipment sparing, in the event that one does not exist, Peninsula Engineering Solutions recommends maintaining a minimum of one (1) spare unit for every increment of 10 units or fraction thereof. This assumes that all spares are immediately available to the technician in need for installation. Each organization should develop a company-specific, equipment-specific policy that meets their needs, taking into account geographic considerations and the quantity of repeaters used in the network.

Returning the PES800 NR for Repair

If a repair or return of the PES800 NR is necessary, contact the Peninsula Engineering Solutions Customer Service Department for instructions. When calling, include the following information:

⇒ Nature of the problem
⇒ Model name
⇒ Unit serial number

For equipment returns, a representative issues an RMA (Return Material Authorization) and shipping and packaging instructions. When returning the PES800 NR to Peninsula Engineering Solutions, always use the original shipping carton and packaging materials. If the original shipping materials are unavailable, Peninsula Engineering Solutions can send replacement materials at your cost.

CAUTION: *If equipment is not returned to Peninsula Engineering Solutions in the original packaging materials, possible damage could result. Peninsula Engineering Solutions is not liable for any damage resulting from improper shipment.*

The telephone number for the Customer Service Department follows:

⇒ +1 925 901-0103

Product Warranty

A one-year, limited warranty is provided with the PES800 NR. A copy of the product warranty is included with the Standard Terms and Conditions. For more information, contact the Peninsula Engineering Solutions Customer Service Department.