Method of Procedure

RadioFrame System

RFN 3.1

May 2003

998-3213-00 Rev B

Notices

These installation standards have been prepared to provide RadioFrame Networks' customers with general standards necessary to ensure that installed RadioFrame Networks equipment operates in accordance with the design parameters in the owned or leased buildings of RFN's customers, and its customers, and to make certain equipment is installed safely and efficiently.

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NOTE: RadioFrame Networks has fully tested up to 6 iDEN RadioBlades per RFU in a full-capacity system (8 ACUs and 64 RFUs).

Revision History

Software Release	Date	Sections Updated
iDEN 1.3	May 2002	Phase 0
iDEN 1.4/802.11b 1.3	July 2002	Phase 1
RFN 2.0	December 2002	5.3, 7.1, 7.5
RFN 2.1	December 2002	5.3, 7.1
RFN 3.1	May 2003	

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Throughout this publication, the terms RadioFrame Networks, RadioFrame and RFN signify RadioFrame Networks, Inc.

Method of Procedure/RadioFrame System

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1 Introduction

1.1 Scope of the Manual

This manual describes standards for installing, modifying and maintaining RadioFrame Networks' equipment at RadioFrame customer sites. All specifications and requirements pertain to the RadioFrame Networks equipment required in RFN customer iDEN (integrated Digital Enhanced Network) and 802.11b installations. RadioFrame Networks recommends reading the entire manual before attempting to install or operate RadioFrame Networks equipment.

1.1.1 Prerequisites and Responsibilities

All installers are required to be trained and certified to install RadioFrame Networks equipment as follows:

- Installers shall be trained for specific equipment or the warranty on that equipment may be invalidated.
- All installers shall be able to use required tools and test equipment properly.
- Installers shall clean up and properly store tools at the end of each day's work.

The installation Project Manager shall be responsible for, but not limited to:

- Ensuring that all detailed engineering specifications, job drawings, technical information, and documentation required to successfully complete an installation are on site.
- Making an inventory and conducting a visual inspection of all equipment shipped to the job site prior to the installation.
- Identifying any physical damage, defects, or problems that may prevent the proper installation, maintenance, or operation of equipment and reporting this information to the proper parties involved.
- Ensuring that all installation job activities are completed in a safe and professional manner whether or not the specific activity is mentioned in this manual.
- Ensuring that all locations where painted surfaces have been marred are touched up. The touch-up paint shall be the same quality and shade as the paint used on the item being touched up.
- Using this *Method of Procedure/RadioFrame System* manual to ensure that each specific job has been performed.
- Ensuring that the site is cleaned up after installation.

Preparation of a site and installation of equipment requires close coordination between RFN, RFN's customer and its customers, and designated third-party RFN Certified Integration Partner(s). Domains of responsibilities are shown in the following table.

Task	Responsible Party
Prepares system design and quotes	RFN Customer
Provides Project Management, including site survey	RFN Customer
Constructs site, including racks, ironwork (ceiling support, ladder racks, etc.), AC power, DC power, and battery backup systems.	RFN Customer/Customer
Lays conduit and cable, installs new fiber raceways, and fire stopping after cables have been laid.	RFN Certified Integration Partner
Installs, tests, and commissions RadioFrame Networks equipment, including site acceptance.	RFN Certified Integration Partner
Maintains RadioFrame Networks equipment, including logbook.	RFN Customer/Customer

1.1.2 Site Documentation

The following documents are required for installing, commissioning, testing, and maintaining RadioFrame Networks equipment. Some or all of this documentation will be left on site. In addition, a logbook will be stored on site that will be used for tracking all changes, updates, and maintenance work done on RadioFrame System equipment.

Document
Site Survey
Pre-Installation Checklist
Equipment Inventory
Site Acceptance Test
Equipment Functionality Acceptance Test
Site As-built
Site As-built Acceptance Test
Equipment As-built
Equipment As-built Acceptance Test
Alarms
Alarm Procedures

1.1.3 Reference Documents

The following documents are intended to supplement the information contained in this manual.

- *RF Planning Guidelines for iDEN Installations*, RadioFrame Networks, 990-1001-00
- *Customer Release Notes RFN_3.1*, RadioFrame Networks, P/N 991-1000-31
- *Gen 3 Site Controller System Manual*, Motorola, 68P80801E30-O
- *PECO II Rectifier System Manual*: 127NHL-IBWS
- *PECO II System Manual* 40-719010-1005
- Battery Manufacturer's Installation and Maintenance Documentation
- *Quality Standards—Fixed Network Equipment (FNE) Installation Manual (R56)*, Motorola, R56 current edition
- *National Electrical Code (NEC)*, current edition

1.2 Quality Standards

The installation section of this manual requires the Motorola *Quality Standards-Fixed Network Equipment (FNE) Installation Manual (R56)* as a reference. The R56 contains onsite installation, integration, optimization, and maintenance information for trunked radio equipment. Technicians and installation personnel must be familiar with procedures and guidelines presented within the R56 manual.

1.3 Static Sensitive Precautions

Electrostatic discharge (ESD) can damage equipment and impair electrical circuitry. It occurs when electronic printed circuit cards are improperly handled and can result in complete or intermittent failures.

Extreme care must be taken while handling, shipping, and servicing boards and RadioBlades. To avoid static damage, observe the following precautions:

- Prior to handling, shipping, and servicing equipment, always put on a conductive wrist strap connected to a grounding device. This discharges any accumulated static charges. All RFN RadioBlades and Field Replaceable Units (FRUs), including NPCs and APCs, are shipped with a disposable anti-static wrist strap (RFN P/N 110-0610-00).


Warning!

Use extreme caution when wearing a conductive wrist strap near sources of high voltage. The low impedance provided by the wrist strap also increases the danger of lethal shock should accidental contact with high voltage sources occur.

- Handle boards by the edges and avoid touching any conductive parts of the board with your hands.
- Never remove a board with power applied to the unit (hot-pull) unless you have verified it is safe to do so. Make sure the unit will not be damaged by removing the board.
- Avoid carpeted areas, dry environments, and certain types of clothing (silk, nylon, etc.) during service or repair due to the possibility of static buildup.
- Apply power to the circuit under test before connecting low impedance test equipment (such as pulse generators, etc.). When testing is complete, disconnect the test equipment before power is removed from the circuit under test.
- Be sure to ground all electrically powered test equipment. Connect a ground lead (-) from the test equipment to the board or module before connecting the test probe (+). When testing is complete, remove the test probe first, and then remove the ground lead.
- Place all boards and RadioBlades on a conductive surface (such as a sheet of aluminum foil) when removed from the system. The conductive surface must be connected to ground through 100kΩ.
- Never use non-conductive material for packaging boards or RadioBlades for shipment or storage. All units should be wrapped with anti-static (conductive) material. Replacement units shipped from the factory are packaged in a conductive material.
- If possible, retain all original packing material for future use.

1.4 Safety Precautions

Read all the notices in this section prior to installing or using the RadioFrame System or any of its components.

1.4.1 Safety Warnings

 Warning!	Only trained and qualified personnel should be allowed to install, replace, or service this equipment.
 Warning!	This product relies on the building's installation for short-circuit (over current) protection. Ensure that a fuse or circuit breaker no larger than 120VAC, 15A U.S. (240VAC, 10A international) is used on the phase conductors (all current-carrying conductors).

 Warning!	To comply with FCC RF exposure requirements, iDEN antennas must be installed to provide at least 8 inches (20 cm) separation from all persons, with antenna gain not exceeding zero (0) dBi.
 Warning!	Never defeat the ground conductor or operate the equipment in the absence of a suitably installed ground conductor. Contact the appropriate electrical inspection authority or an electrician if you are uncertain that suitable grounding is available.
 Warning!	The plug-socket combination must be accessible at all times because it serves as the main disconnecting device.
 Warning!	The RadioFrame Unit (RFU) is intended to be mounted on a wall. The RFU can also be installed on or above a ceiling. Please read the RFU mounting instructions carefully before beginning the installation. Failure to use the correct hardware or to follow the correct procedures could result in a hazardous situation to people and damage to the system.
 Warning!	Ultimate disposal of this product should be handled according to all national laws and regulations.

1.4.2 Safety with Electricity

 Warning!	To avoid electric shock, do not connect safety extra-low voltage (SELV) circuits to telephone-network voltage (TNV) circuits. LAN ports contain SELV circuits, and WAN ports contain TNV circuits. Some LAN and WAN ports both use RJ45 connectors; incorrect interconnection can cause equipment damage. Use caution when connecting cables.
 Warning!	Before working on equipment that is connected to power lines, remove jewelry (including rings, necklaces, and watches). Metal objects will heat up when connected to power and ground and can cause serious burns or weld the metal object to the terminals.
 Warning!	Hazardous network voltages are present in WAN ports regardless of whether power to the attached equipment is OFF or ON. To avoid electric shock, use caution when working near WAN ports. When detaching cables, detach the end away from the router first.
 Warning!	Do not touch the power supply when the power cord is connected. For systems with a power switch, line voltages are present within the power supply even when the power switch is off and the power cord is connected. For systems without a power switch, line voltages are present within the power supply when the power cord is connected.

1.4.3 Recommendations

1.4.3.1 Safety Recommendations

- Keep tools away from walk areas where you and others could fall over them.
- Wear safety glasses if you are working under any conditions that might be hazardous to your eyes.
- Do not perform any action that creates a potential hazard to people or makes the equipment unsafe.

1.4.3.2 Guidelines for Working on Equipment Powered by Electricity

- Locate the emergency power off switch for the room in which you are working. Then, if an electrical accident occurs, you can act quickly to turn off the power.
- Before installing, removing, or repairing an NCU, ACU or URU, unplug the power cord.
- Disconnect all power before working near power supplies.
- Do not work alone if potentially hazardous conditions exist.
- Never assume that power is disconnected from a circuit. Always check.
- Look carefully for possible hazards in your work area, such as moist floors, ungrounded extension cables, frayed power cords, and missing safety grounds.

1.4.3.3 In the Event of an Electrical Accident

- Use caution; do not become a victim yourself.
- Turn off power to the system.
- If possible, send another person to get medical aid. Otherwise, assess the condition of the victim and then call for help.
- Determine if the victim needs rescue breathing or external cardiac compressions, then take appropriate action.

2 System Description

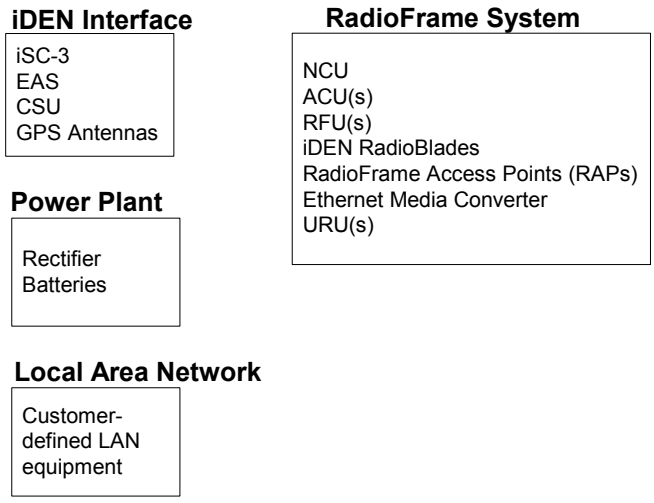
The RadioFrame Networks iDEN/802.11b solution generates RF within the building using low-power transceivers that are placed as needed to meet coverage and capacity requirements. The low-power nature of the transceivers minimizes interference with the surrounding macrocell system so that the macrocell system views the RFN iDEN/802.11b solution as a peer. The RFN iDEN/802.11b solution is remotely monitored down to the component level, including alarms and system performance, using a web-based interface.

The RadioFrame Networks iDEN/802.11 solution consists of the following four systems:

- iDEN Interface
- RadioFrame System
- Power Plant
- Local Area Network

2.1 Functional Relationships

The following diagram depicts the components of each system in the



RadioFrame Networks iDEN/802.11 solution.

Figure 1 The RadioFrame Networks iDEN/802.11b solution consists of the iDEN Interface, the RadioFrame System, a Power Plant, and the customer's Local Area Network.

2.1.1 The iDEN Interface

The iDEN (integrated Digital Enhanced Network) interface supplies T1 and GPS antenna connections, via the iSC-3, for the RadioFrame System. The iDEN interface also provides an Environmental Alarm System (EAS) and a Channel Service Unit (CSU) for the T1 input to the iSC-3.

2.1.1.1 integrated Site Controller (iSC-3)

The integrated Site Controller, or iSC-3, consists of a site controller and an Environmental Alarm System (EAS). Most systems are configured with two iSC-3s (an active and a standby) and one EAS. For more information about the iSC-3, refer to the Motorola document *Gen 3 Site Controller System Manual, 68P80801E30-O*.

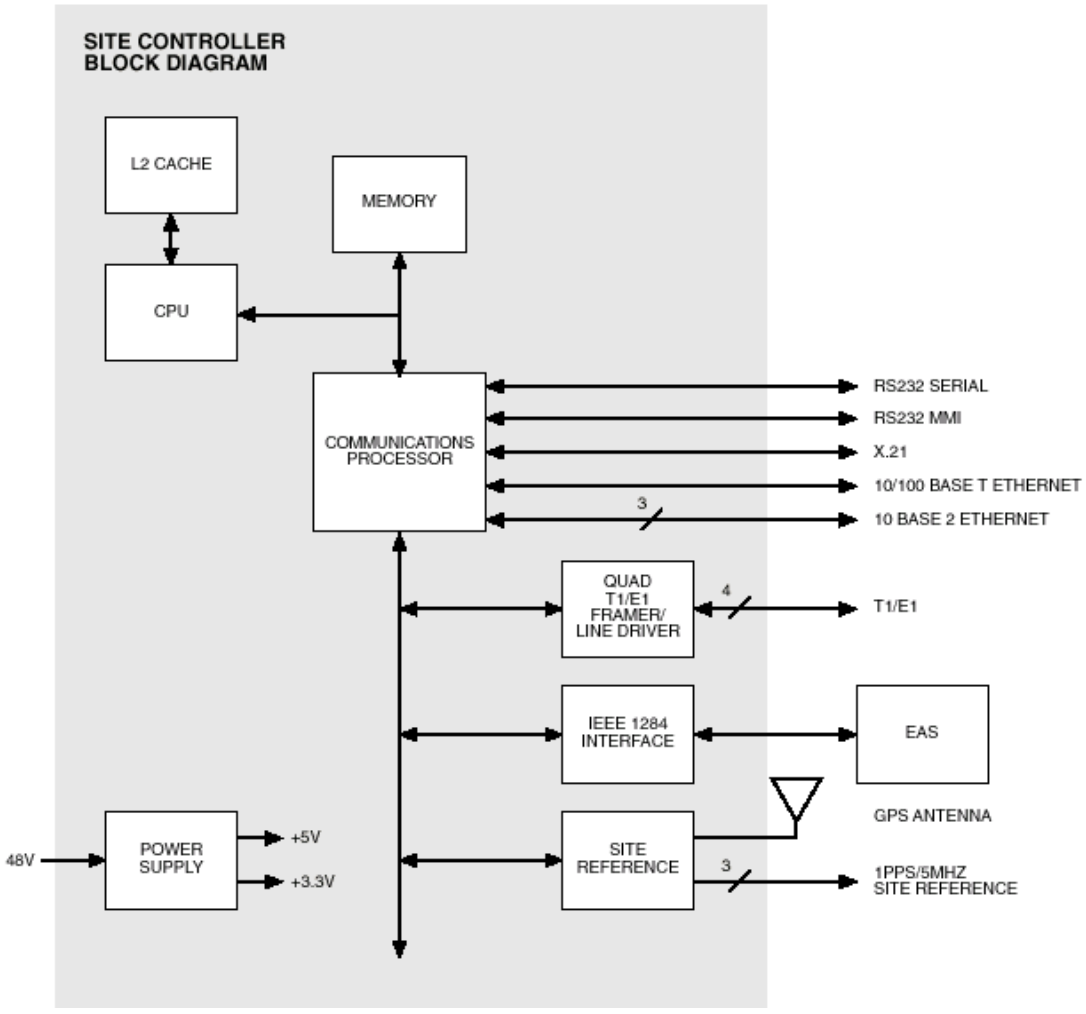


Figure 2 The iSC-3 functional diagram.

Site Controller CPU Board

The following is a list of CPU Board main features:

- PPC750 host processor with 1MByte L2 cache
- MPC8260 communications processor for all serial I/O
- 32 MBytes of FLASH on the PPC bus
- 64 MBytes of SDRAM on the PPC bus
- 16 MBytes SDRAM on the MPC8260 local bus
- 32 KBytes battery backed SRAM with real time clock on the MPC8260 local bus
- Four E1/T1 span lines supported by a single quad E1/T1 framer/line driver IC
- One 10/100BaseT Ethernet port
- Three 10Base2 Ethernet ports
- One X.21 port
- One IEEE 1284 parallel port
- Two RS232 serial ports
- Internal or remote GPS Receiver
- Three time/frequency reference outputs

Environmental Alarm System (EAS)

The EAS provides a central location for site alarm signal processing. The EAS monitors site environmental conditions, including AC power, smoke alarms, intrusion alarms, antenna tower lights, etc.

The Site Controller and EAS interact in a master/slave relationship. The Site Controller sends commands to the EAS to determine the status of alarm inputs or set the state of control outputs. The EAS, in turn, sends alarm status responses to the Site Controller.

The EAS continuously scans the status of the alarm inputs, ensuring that all alarms are consistently monitored.

Alarm wiring routes directly from the RadioFrame Networks site equipment and power supply equipment to the EAS. The EAS sends alarm status to the site controller via the IEEE 1284 parallel connection.

The EAS can monitor up to 48 inputs, each of which must be a contact closure between the alarm input and its return. Alarm inputs are optically isolated. The EAS also provides eight relay outputs. Four RJ45 connectors replicate the physical interfaces to the three RF cabinets and one control cabinet. The remaining alarm inputs and relay outputs are accessible via two 50-pin DSUB

connectors. These connectors are cabled to punch blocks to allow simple installation of the remaining site alarm and control I/O.

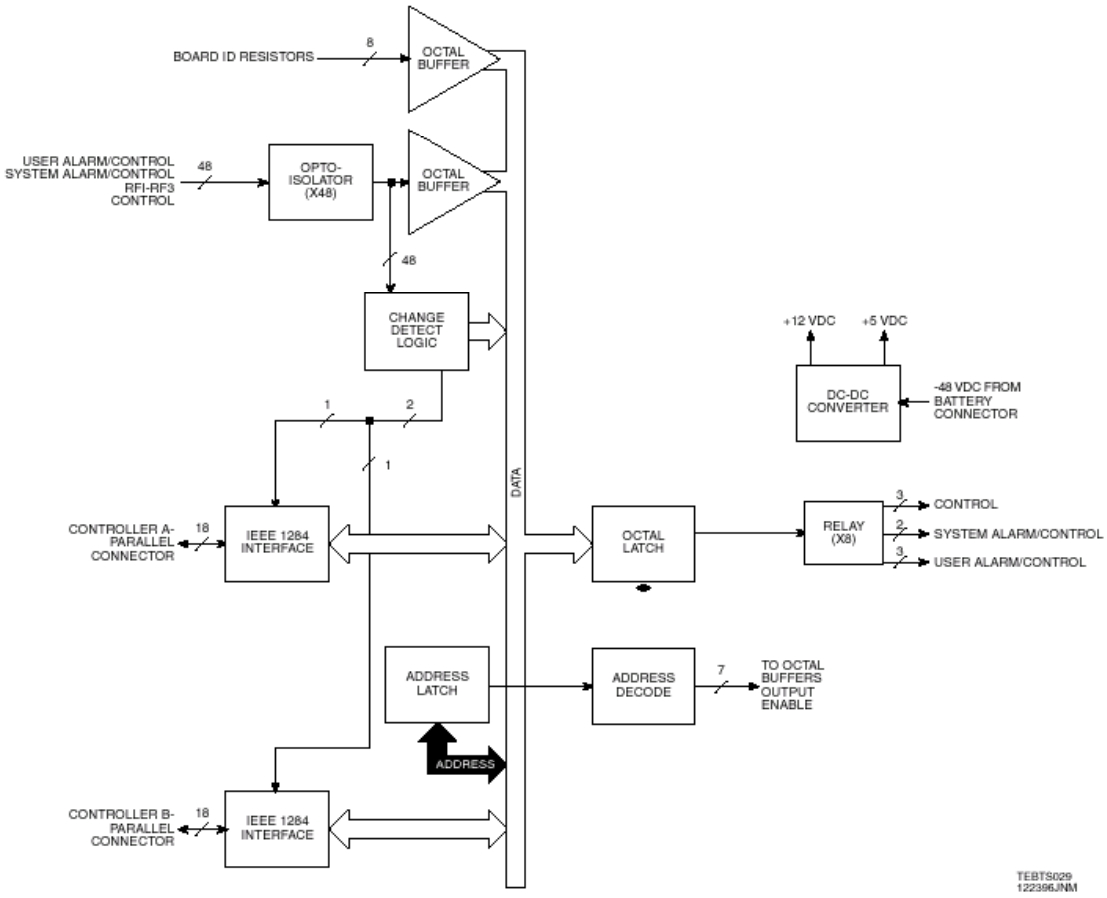


Figure 3 Environmental Alarm System functional diagram.

2.1.1.2 GPS Antennas

The Global Positioning System (GPS) antenna provides the timing reference to the iSC-3. One GPS antenna with a dedicated 50ohm coax is required for each iSC-3.

Generally, the GPS antennas are to be mounted on a stable platform with a clear view of the southern horizon and secured access. Horizontal separation of the antennas is not required for proper operation; however, it is generally required to increase survivability of the antenna from falling objects.

GPS satellite acquisition and lock can be verified with a handheld GPS receiver prior to installation. Four satellites should be available.

Coax size, 1/2" or 7/8", is determined by the overall length of the coax run (the distance in feet from the GPS antenna to the top of the equipment rack containing the iSC-3). The maximum run length for using 50ohm 1/2" coax is 166'. The maximum run length for using 50ohm 7/8" coax is 290'.

2.1.1.3 Channel Service Unit (CSU)

The Channel Service Unit (CSU) provides the T1 connection between the iSC-3 and the telephone company that provides the T1 line. The CSU provides surge protection to the T1 line and loop-back testing for the telephone company.

2.1.2 RadioFrame System (RFS)

The RadioFrame System is comprised of several components, which are connected in a ‘tree’-style architecture (see the following illustration):

- The Network Chassis Unit (NCU) acts as the sole connection point (i.e. the ‘root’) to all ACUs (and RFUs) which ‘branch’ off this ‘root’ chassis. The NCU also connects to the iSC and the customer LAN.
- Up to eight Airlink Chassis Units (ACUs) connect from the NCU and send traffic, power and timing to the RFUs over standard CAT 5 wiring.
- Up to 64 RadioFrame Units (RFUs), that house the RadioBlades, provide access points mounted on walls and ceilings.
- Up to seven iDEN RadioBlades (RBs) can be installed per RFU, and up to three 802.11b RadioFrame Access Points (RAPs) per RFU; the combined total is seven RBs/RAPs per RFU. Each iDEN RB and RAP provides a single RF transceiver that supports iDEN or 802.11b (WLAN).
- Up to two Universal Repeater Units (URUs) can be installed to extend the distance between components from 328’ (100 meters) to 984’ (300 meters).
- An Ethernet Media Converter is provided to connect the NCU and the iSC-3.

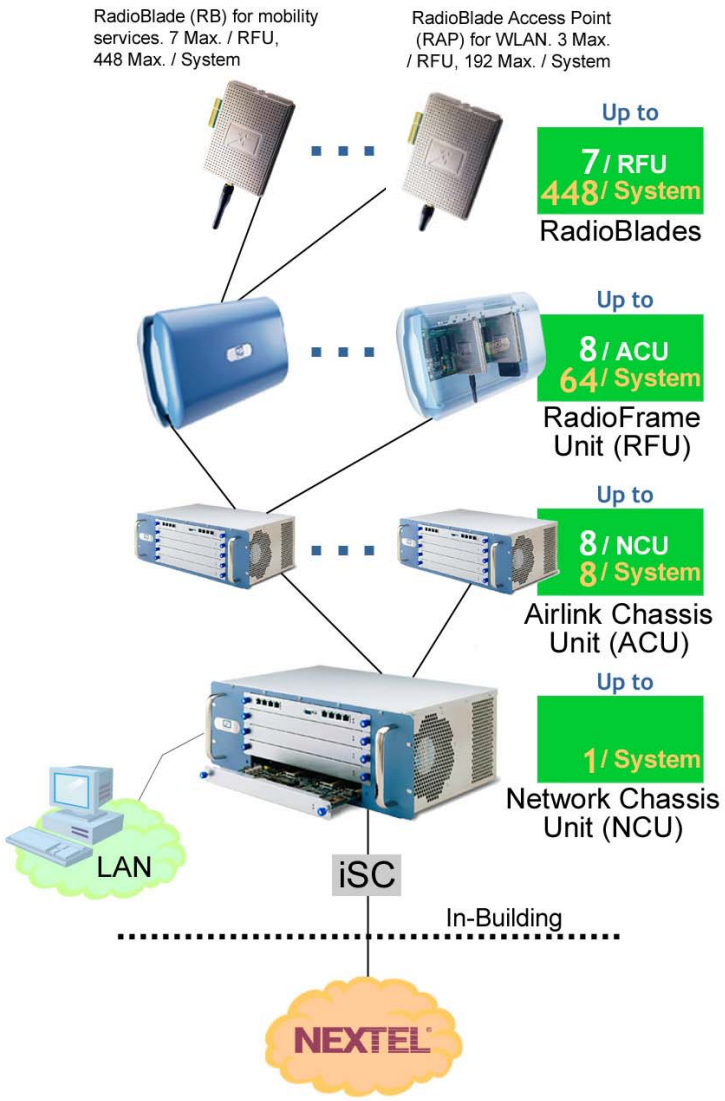


Figure 4 The RadioFrame System uses a ‘tree’-style architecture to connect components.

2.1.2.1 Network Chassis Unit (NCU)

The Network Chassis Unit is the main controller of the RFS, providing external network interfaces and the baseband network processing for the ACUs and RFUs. The NCU also is the interface between the RFS and the telecommunications switching entities.

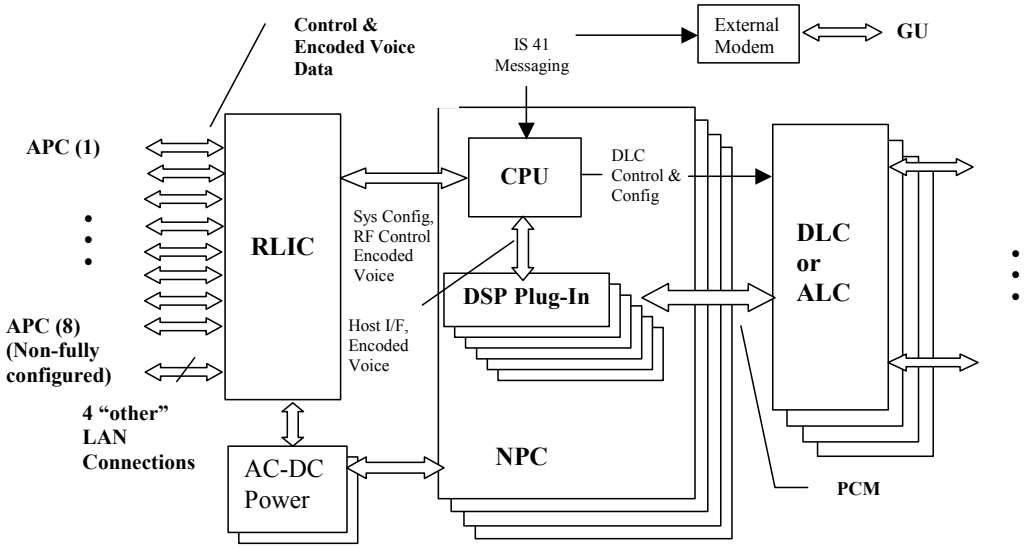


Figure 5 NCU functional diagram.

2.1.2.2 Airlink Chassis Unit (ACU)

The Airlink Chassis Unit provides the baseband airlink processing for up to 8 RadioFrame Units, providing a coverage area up to 250,000 square feet. The ACU is the interface between the RFUs and the Network Chassis Unit, and provides power, signals, and timing to the RFUs.

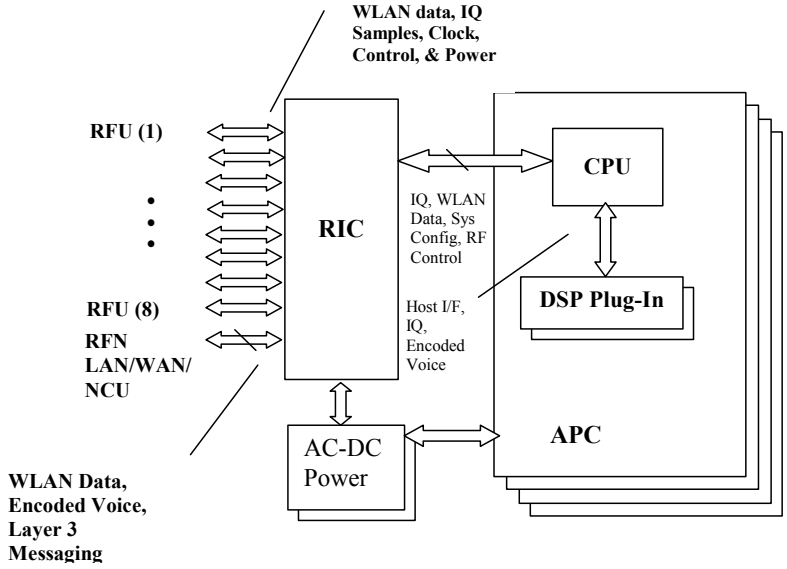


Figure 6 ACU functional diagram.

2.1.2.3 RadioFrame Unit (RFU)

The RadioFrame Unit serves as the access interface between signals received from mobile terminals and the airlink processing performed in the ACU. The RFU connects to the ACU via a single CAT 5 connection, and receives its power, signals, and timing from the ACU. Each RFU holds up to 7 RadioBlades in combination of: a maximum of 6 iDEN RadioBlades, a maximum of 3 RAPs.

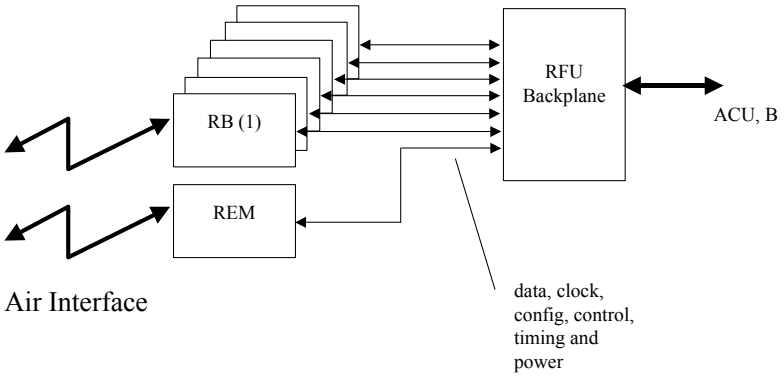


Figure 7 RFU functional diagram.

2.1.2.4 iDEN RadioBlade (RadioBlade or RB)

Each iDEN RadioBlade provides a single RF channel transceiver supporting the iDEN voice standard. Each RadioBlade contains an onboard omnidirectional antenna and provides a coverage area of approximately 32,000 square feet (nominal 100’ radius cell). Each RadioBlade inserts into a slot in the RFU.

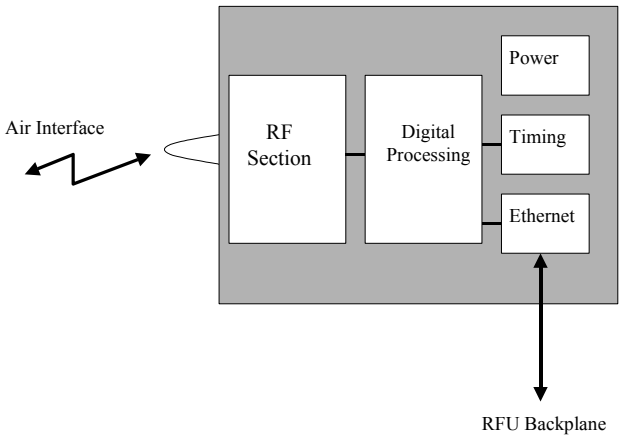


Figure 8 iDEN RadioBlade functional diagram.

2.1.2.5 802.11b RadioFrame Access Point (RAP)

The 802.11b RadioFrame Access Point (RAP) provides a single RF channel transceiver supporting the 802.11b (WLAN) standard for wireless data. Each RAP contains an onboard omnidirectional antenna and provides a coverage area of approximately 32,000 square feet (nominal 100' radius cell). Each RAP inserts into a slot in the RFU.

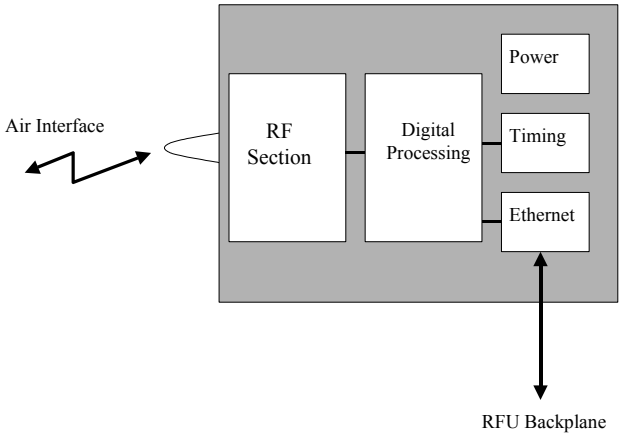


Figure 9 RadioFrame Access Point (RAP) functional diagram.

2.1.2.6 Universal Repeater Unit (URU)

The Universal Repeater Unit (URU) extends the distance between RFS components, including the NCU and the iSC, from 328' (100 meters) to 656' (200 meters). Up to two URUs can extend the distance to 984' (300 meters). The unit repeats the Ethernet signal and timing, and can also supply power to an RFU.

2.1.2.7 Ethernet Media Converter

The Ethernet Media Converter (Allied Telesyn model number AT-MC15) is installed between the NCU and iSC-3. The MC15 converts signals from twisted pair cable to thinnet cable, and vice versa, providing seamless connection between two different media with a 10Base-2 BNC connector. An external 12 Vdc power adapter supplies power to the media converter.

2.1.3 Power Plant

The Power Plant consists of two components: a rectifier and battery plant.

2.1.3.1 Rectifier

The DC power supply is a PECO II 127NHL Low Profile -48 VDC, 20 to 60 Amp power system, which converts 85 to 265 VAC to -48 VDC using one or two 30 Amp Modular Rectifiers (20 Amp output with a 115 VAC @ 15 Amp input circuit). The rectifiers can be paralleled for increased power and redundancy and are capable of "Hot Insertion".

The Low Profile plant is self-contained and includes DC Distribution plus a system Simple Controller. Each rectifier module contains a micro-controller, which monitors internal temperatures, voltages and currents, and makes adjustments to reliably deliver maximum output power.

Rectifier modules digitally exchange status data with the Simple Controller via a data bus. The system Simple Controller evaluates all data, displays rectifier and system parameters, compensates the battery voltage for temperature, extends alarms and provides access to changing setpoints and system status. Monitors for battery string temperature and midpoint are optional. Connections have been connectorized to facilitate installation.

Basic Design

Basic features of all 127NHL plant include Distribution, a Distribution Monitor and a Simple Controller. The Distribution Monitor provides fuse alarm inputs, plant voltage and current monitoring, low voltage disconnect control, and battery monitoring. With the optional Battery Temperature Compensation kits, the 127NHL plant can monitor up to two strings of batteries and adjust rectifier output voltage to compensate for battery temperature, reducing the potential for VLRA battery thermal runaway and potentially extend battery life.

The plant Simple Controller is the user interface and collects and reports monitored signals and alarms. A local display provides a visual indication of plant status, alarm conditions and plant settings as well as status of each individual rectifier. The user interface supports the adjustment of setpoints and changing plant status (i.e. Enter Equalize mode).The controller provides two Form C contacts for PMN (Plant Minor)and PMJ (Plant Major) alarms plus a Maintenance Port for a PC interface. PC Interface software and cabling kit is an available option.

For more information, refer to the product specification information provided by Peco II, Inc., the rectifier manufacturer: *PEC 127NHL.*

2.1.3.2 Battery Plant

The main equipment cabinet relies on an 8-hour backup system. The equipment cabinet requires the following components that will define the Battery Plant.

- 2 Strings of -48 Volts 105 Amp Capacity Battery, such as Deka or Power Batteries (or other approved vendors)

- 2 Standard Battery Shelves (19”)
- 2 Battery Manual Disconnects

2.1.4 Local Area Network (LAN)

The RadioFrame System plugs into the customer’s local area network (LAN) using a standard Ethernet connection over CAT 5 wiring. The customer’s LAN may include a variety of equipment, including switches, routers, and gateways. The RFS connects to the LAN via Port 2 on the front of the NCU. The RAPs installed in the RFUs support the LAN.

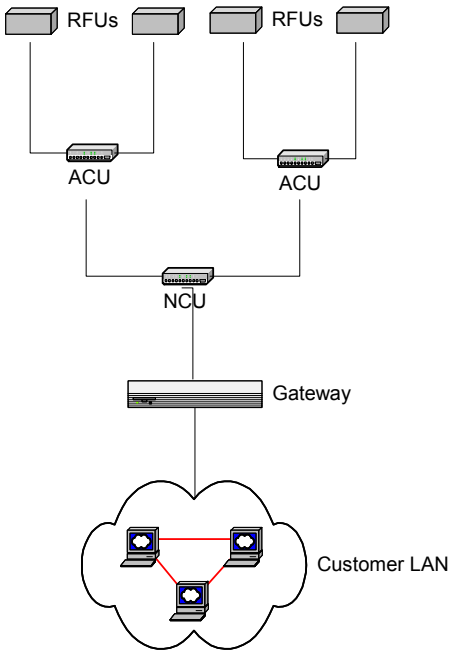


Figure 10 RFS and customer LAN functional diagram.

In the above diagram, an optional “gateway” device is shown between the customer LAN and the RFS to provide a point of control, thus isolating the RFS from the customer’s LAN. The gateway may be used to perform inter-network routing and access control, permitting only authorized users access to the customer LAN via the RFS. It may also perform service accounting and user mobility functions.

NOTE: Though not required, the use of a gateway device is strongly recommended, particularly for use as an access control mechanism to prevent

unauthorized access to the customer LAN. In addition, while a router between the RFS and the customer LAN is not required, it is highly recommended that a combination router and security gateway be used.

The RFN implementation of 802.11b provides a transparent MAC layer bridging function between the RFS and the customer's LAN. No layer 3 (IP) protocol routing is required for operation.

The NCU contains a card that is assigned a fixed address during installation. Once the NCU has been configured, the NCU will automatically assign IP addresses to each network element in the RFS.

2.2 Physical Relationships

The RadioFrame System is laid out as follows:

- Main rack: Located in a Telco closet, the main rack houses the entire iDEN Interface and Power Plant, along with the NCU and one ACU of the RadioFrame System.
- Remote ACUs: Up to seven additional ACUs can be connected to the NCU. The remote ACUs are installed in closets or Telco rooms throughout the building to support additional RFUs.
- RFUs: Up to 8 RFUs per ACU are installed on walls or on or above ceilings throughout the building to provide coverage for the iDEN/802.11b RFS; RFUs house the iDEN RadioBlades RAPs.
- LAN: Customer equipment located in a customer-defined area.

The following illustration depicts a typical RadioFrame Networks iDEN/802.11 solution. The main rack is located on Floor 4 housing the iDEN Interface, Power Plant, and the NCU and one ACU of the RFS. The Customer LAN equipment is also located on Floor 4.

Remote ACUs are located on Floors 1 and 2, with each ACU supporting up to eight RFUs. The ACU located on Floor 1 also supports RFUs in the parking level.

RFUs on each floor of the building, 1, 2, 3, 4 and the parking level, support one of three sectors. RFUs on Floors 1 and 4 support sector 1. RFUs in the parking level and on floor 3 support sector 2. RFUs on Floor 2 support sector 3.

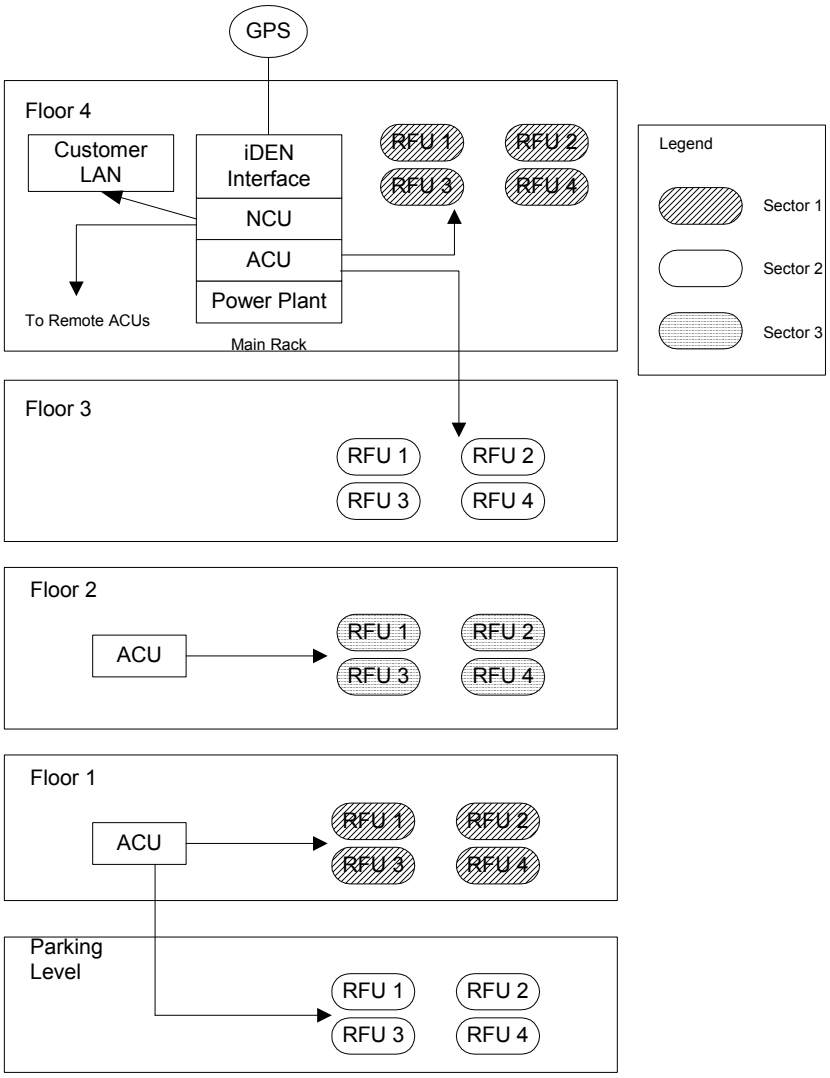


Figure 11 A typical RadioFrame System iDEN/802.11b installation.

2.2.1 Main Rack

The following illustration shows a typical 19” EIA standard rack diagram for a RadioFrame System installation. This main rack includes:

- the entire iDEN interface: two iSC-3s, an EAS, GPS Antennas and a CSU
- the NCU and one ACU of the RadioFrame System
- the entire Power Plant: 2 rectifiers and 8 battery backup units

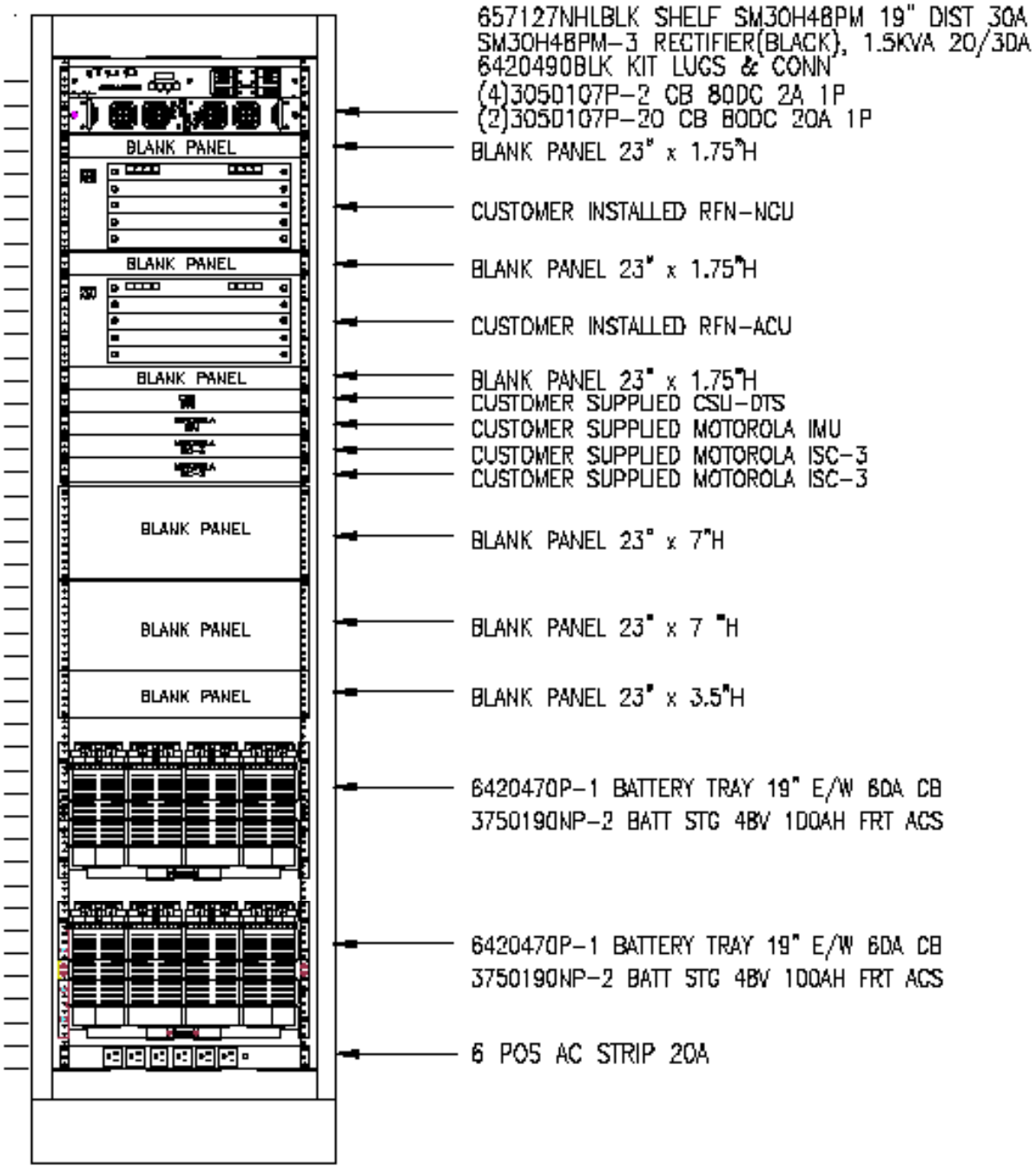


Figure 12 The main rack houses the iDEN interface, the NCU and one ACU of the RadioFrame System, and the Power Plant.

2.2.2 Remote ACUs

Remote ACUs are located in Telco rooms or other closets throughout the building mounted in 19” EIA-standard compliant racks or equivalent. The racks for remote ACUs may be either floor or wall-mounted racks. Any other method used to mount the remote ACU is not approved, and could void the warranty on the product and other components in the RFS.

2.2.3 RFUs

RFUs are located throughout the building to provide coverage for specific areas. RFUs are typically mounted on or above the ceiling, or on a wall. The following illustration depicts typical RFU locations using a simple floor plan. Three RFUs, denoted by triangles, are located along the central hallway providing coverage to each portion of the floor. Antenna coverage for each RFU is a 100-foot radius (30.3 meters) or approximately 32,000 square feet (2,920 square meters).

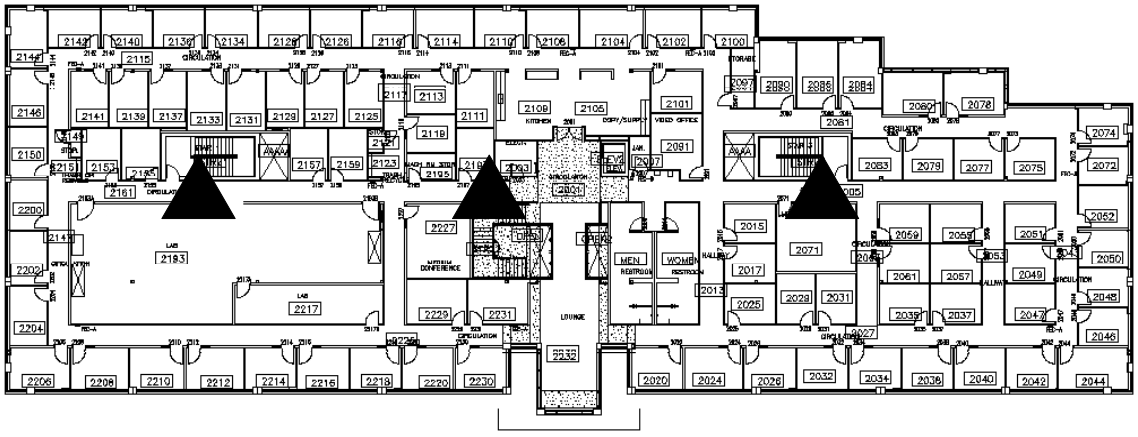
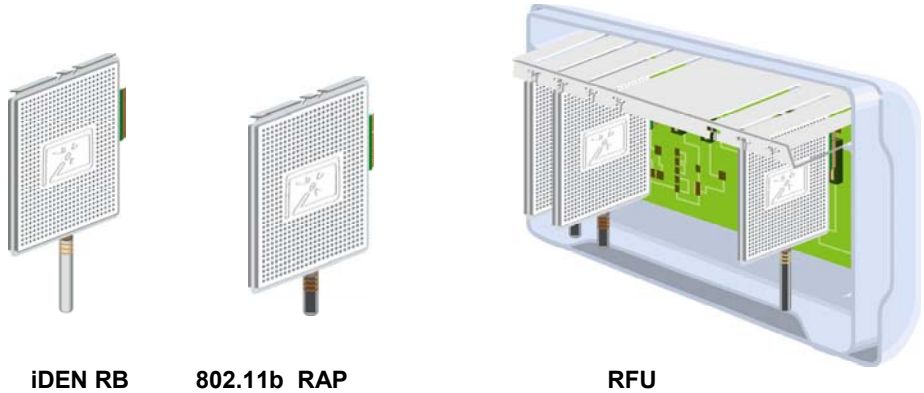


Figure 13 RFUs are located throughout the building to provide coverage.

2.2.3.1 RadioBlades and RAPS

The number and combination of RadioBlades and RAPs to be installed in each RFU is driven by the coverage and capacity requirements of that particular portion of the building. A maximum of six iDEN RadioBlades can be installed in each RFU. A maximum of three RAPs can be installed in each RFU. The combined total of iDEN RBs and RAPs is seven per RFU. Each RadioBlade is supplied with an antenna that must be installed vertically and pointed down towards the ground.



iDEN RB **802.11b RAP** **RFU**

Figure 14 RadioBlade and RAP antennas must point straight down to the ground.

2.2.4 LAN

The customer LAN equipment can be located anywhere within the building. An Ethernet cable connection must available from the LAN to the main rack for connection to the NCU.

3 Pre-Installation

This section provides pre-installation information for a RadioFrame System at a RFN customer site. A pre-installation site review and evaluation helps prevent potential equipment installation problems. Consider every subject discussed in this section before installing the iDEN/802.11b RFS.

3.1 Receipt of Equipment

The main rack is provided pre-installed with the following equipment:

- Rectifier, PECO II
- NCU (Network Chassis Unit), RadioFrame Networks
- ACU (Airlink Chassis Unit), RadioFrame Networks
- CSU (Channel Service Unit), DTS
- EAS (Environmental Alarm System), Motorola
- two iSC-3s (integrated Site Controllers), Motorola
- two battery trays, 2 x 100 amp batteries

All other equipment is RadioFrame Networks equipment and is shipped as follows: each RFU, remote ACU, and URU is shipped in its own box. The iDEN RadioBlades and RAPs are shipped several to a box and individually wrapped in antistatic packaging. Unpack each unit only at the time of installation—leave items in their shipping containers until ready for use. Unpacking instructions are contained inside each shipping container.

3.1.1 Equipment Inspection

Inspect the RadioFrame Networks iDEN solution equipment immediately upon receipt. If obvious damage has occurred to shipping containers before unpacking, contact the shipping agent. Ask that a representative of the shipping company be present while the equipment is unpacked. Observe guidelines for safe handling of electrostatic sensitive devices or equipment to prevent damage due to electrostatic discharge. A conductive wrist strap is provided with each RFU and should always be worn when handling any electrical component, including iDEN RadioBlades.

Check for the following:

- loose or damaged equipment in the pre-installed main rack
- dents, scratches, or other damage on all sides of each component
- physical damage to iDEN RadioBlade or RAP antennas or connectors

If any equipment is damaged, contact the shipping company immediately, then your RFN customer representative.

3.1.2 Equipment Inventory

Check all the RadioFrame System equipment against the itemized packing list to ensure receipt of all equipment. If available, check the sales order with the packing list to account for all equipment ordered. Contact your RFN customer representative to report missing items and for additional information.

3.1.3 RadioFrame Networks Documents Shipped with the RFS

The following RadioFrame Networks documents are shipped with the RadioFrame System.

Document Title	RFN Part Number
RFS Installation Guide	981-6200-00
RFS Operators Guide	981-6300-00
Unpack the Box: NCU	981-5000-00
Unpack the Box: ACU	981-5100-00
Unpack the Box: RFU	981-5200-00
Unpack the Box: URU	981-5300-00
Unpack the Box: Ethernet Media Converter	981-5020-00
RFU Mounting Template: Ceiling	981-1010-00
RFU Mounting Template: Wall	981-1020-00
Universal Repeater Unit Mounting Template	981-0641-00
Product Specification: Chassis Unit	981-0500-00
Product Specification: RFU	981-1000-00
Product Specification: URU	981-0640-00
Product Specification: Ethernet Media Converter	981-0660-00
Product Specification: iDEN RadioBlade	981-0620-00
Product Specification: 802.11b RadioFrame Access Point	981-0531-00

3.2 Site Planning

Licensing and the availability of space help to determine a site selection. On a RFN customer owned or controlled site, field engineering and program management will plan the system and site layouts. Planning helps prevent potential on-site and off-site interference from other RF systems. Site layouts should always be planned to minimize inter-cabling lengths between RF equipment.

3.2.1 Site Considerations

3.2.1.1 Main Rack

The site for the main rack should not contain windows and must be able to resist extreme weather conditions. It should be designed to meet the requirements of the American National Standards, *Building Code Requirements for Minimum Design Loads in Buildings and Other Structure*s. RFN recommends the following considerations when selecting a site:

- A minimum floor space of at least 42 square feet is recommended to allow enough space for front and rear access to the main rack.
- The minimum ceiling height of at least 8’6” above a finished floor is required to allow enough space for the height of the main rack and cable access at the top of the cabinet.
- The ceiling structure should be able to support a cable tray assembly for routing the inter-cabinet cabling and other site cabling. The cable tray assembly is mounted to the site ceiling and walls per site plan and should be at least 7’6” from the site floor to allow for the height of the main rack.
- The minimum door dimensions should be at least 3’ wide and 6’8” high.
- All exterior doors should have tamper proof locks installed for security purposes.
- The interior site environment should be maintained at a constant 78° F (25.6° C). The site should be capable of maintaining this temperature in an outside ambient temperature range of -10 to +105° F (-23.4 to +40.6° C). RadioFrame Networks iDEN solution equipment is not approved or recommended for outdoor use.
- Proper surge protection is required for all antennas and power inputs to prevent potential damage to site equipment.
- The site floor should be level to within 1/8” and able to support the weight of site equipment.

3.2.1.2 Remote ACUs

Remote ACUs are located in Telco rooms or other closets throughout the building. Any such location must be free of dust, wind, salt and liquids. All other operating environment specifications that apply to an ACU in the main rack also apply to a remote ACU.

Remote ACUs must be mounted in a 19” EIA-standard compliant rack or equivalent. The racks for remote ACUs must be either floor or wall mounted. Any other mounting method is not approved, and could void the warranty on the product and other components in the RFS.

The number and location of remote ACUs is determined by the number of RFUs required to provide coverage for the iDEN/802.11b RFS.

3.2.1.3 RFUs

The RadioFrame System is designed to simplify site planning. The RFS intentionally limits antenna coverage to a 100-foot radius (30.3 meters) or approximately 32,000 square feet (2,920 square meters). To determine the number of RFUs required to provide coverage, divide the desired area’s square footage by the RFS minimum coverage area (32,000). This determines the minimum number of RFUs.

The capacity requirements of the site determine the number of iDEN RadioBlades and 802.11b RAPs that will be required. RFUs are mounted so that the antennas of the installed iDEN RadioBlades and 802.11b RAPs point to the ground. This orientation of the antennas must not be changed.

The number and exact location of RFUs is determined by capacity and coverage requirements, as well as site considerations, such as mounting considerations, interior structures, and interference from macro systems. For more information on site planning considerations, refer to the RFN document, *RF Planning Guide for RadioFrame iDEN Systems (P/N 990-1001-00)*.

3.2.1.4 LAN

Connecting the RFS to the customer LAN requires only a single Ethernet cable from the NCU in the main rack to the customer’s LAN equipment (gateway, switch, router etc.). No other site considerations are required.

3.3 Main Rack and Supporting Hardware

Most communications equipment is mounted into standard 19” EIA racks or enclosed cabinets. Follow the rack and/or equipment manufacturer's instructions when installing equipment into racks or cabinets.

For example:

- All supplied bracing hardware shall be properly utilized.

- Proper hardware shall be used to secure equipment.
- Convected heat transfer from one piece of equipment rack to another shall be considered. Heat baffles may be required.

3.3.1 Mounting

The front panels of the NCU, ACU, iSC-3s, CSU, PDU and EAS are 19” wide to allow for installation into 19” wide cabinets. All of this equipment is typically installed into a 19” wide cabinet prior to shipment to the site. For rack installation instructions for the NCU and ACU, see Appendix C NCU and ACU Main Rack Installation.

3.3.1.1 Plumb and Squareness

Equipment shall be level and plumb. Equipment level shall be tested on a known flat surface in at least two directions to verify accuracy.

Equipment shall be parallel or perpendicular to the surrounding walls and adjacent installed equipment.

3.3.1.2 Anchoring

Anchoring is the mechanical fastening of the communications equipment to suitable locations using hardware acceptable for the application.

Although every installation is unique, certain methods for anchoring shall be adhered to for all installations. Typically, at least four anchor points shall be used on each item of equipment mounted to the floor. The only exception is when the equipment manufacturer supplies other than four mounting points.

3.3.1.3 Mounting on Concrete Floors

Equipment racks or cabinets should be positioned and anchored to the floor using preferred mounting methods. In general, observe the following:

- An anchor specifically designed for concrete shall be used. The preferred method for anchoring racks, or other ancillary equipment to concrete floors is to use flush-mount expansion anchors properly sized for the application. Flush mount expansion anchors do not extend above the surface of the floor and provide an easy bolt down. They also provide the required pullout and shear strength. If at a later time equipment needs to be moved, flush mount expansion anchors do not get in the way.

  NOTE: Unless an isolating mounting scheme is used (refer to section 3.3.1.4 Isolated Mounting, next in this section), ensure that no anchors come in contact with reinforcing rods or wire mesh buried in the concrete; the rack shall be electrically isolated from any other equipment or materials at the site.

- In applications where flush-mount expansion anchors are not preferred or acceptable, then wedge-type stud anchors may be used.
- All concrete anchors shall be zinc-plated carbon steel for standard applications, galvanized steel for mildly humid or corrosive environments, and yellow zinc or stainless steel for humid, highly corrosive, or acidic environments. Minimum bolt diameter shall be 10 mm (0.375 in.) with 12 mm (0.5 in.) preferred. Anchor embedment depth should be at least 76 mm (3 in.) to provide good tensile and shear strength. Follow manufacturer's instructions for depth reduction when rebar is encountered. A heavy-duty washer should be part of the anchor assembly to ensure the equipment is secure.

3.3.1.4 Isolated Mounting

Isolated mounting is recommended to prevent a second electrical path to ground through the concrete floor, and is required for the installation of certain equipment. In these cases expansion anchors are inserted into the concrete floor. However, isolation of the equipment rack is ensured using an insulating plate and hardware. If the installation is in an earthquake zone, additional anchors are used.

NOTE: Motorola equipment frames are always required to use, and are shipped with, isolating washer and bolt assemblies, and have separate insulating mounting plates. Refer to the Motorola document 68P09226A18 *Frame Mounting Guide* for more information.

3.3.1.5 Mounting on Wood or Fiberglass Floors

Appropriately sized lag bolts shall be used for mounting on wood or fiberglass floors. If the underside is accessible and the floor stability is questionable, then thru-bolting may be desirable.

RFN recommends mounting non-racked ancillary equipment on a "C-channel" type of mounting track where possible. This provides for easy cleaning and some isolation in the case of standing water. Another benefit of installing non-rack mounted equipment off the floor is that the weight is distributed across the floor. In these cases, C-channel type mounting provides multiple floor anchor points where the equipment provides only four to six anchor points.

When mounting racks to raised computer floors, 0.5 in. (13 mm) minimum diameter allthread rod and flush-mount expansion anchors shall be used to anchor to the concrete subfloor. When mounting consoles to a raised floor, 0.375 in. (10 mm) minimum allthread rod and hardware shall be used for anchoring. Mounting arrangement shall be in accordance with mounting kit manufacturer's instructions.

3.3.1.6 Anchoring Equipment to Raised Floors

The anchoring of overhead and wall-mounted devices present a number of considerations. Placement is very important; if equipment is bolted to a wall that is on an aisle, the aisle may be unacceptably narrowed with the danger of injury to personnel. Also, the serviceability of the equipment being mounted to adjacent equipment may be inhibited.

Overhead applications generally include coax cabling, cable runways, and mounts for earthquake bracing. All overhead applications should keep in mind loading of overhead surfaces. Care must be exercised when deciding how much can be held by the ceiling without some sort of building foundation support. In the case of earthquake bracing equipment, cable runways can be secured overhead then affixed to the equipment racks providing acceptable foundation support.

When anchoring cable runways to ceilings or walls, the manufacturer-supplied support hardware shall be used.

Anchors used in overhead applications vary depending on the ceiling structure as follows:

- For concrete and wood ceilings, the same principles discussed in floor anchoring apply.
- For an exposed steel I-Beam ceiling, many cable runway manufacturers make beam clamps for C-channel or threaded drop rods.
- For corrugated steel ceilings, C-channel tracks can be affixed to the ceiling using properly sized lag bolts. The C-channel will span the corrugated steel and provide multiple anchor points.

For drywall or plasterboard ceilings, special considerations are required:

- If the drywall is on steel or wooden roof joists, locate and tap into the roof joist with lag bolts.
- C-channel mounting can be used.
- An alternative to C-channel mounting is using large toggle or molly wings with hex head tap bolts.

  NOTE: Make certain joists are properly located before drilling into drywall.

3.3.1.7 Seismic Anchoring

Seismic anchors are designed, tested, and specified for seismic zones 3 and 4. Seismic anchors enhance the stability of equipment due to the special characteristics specifically suited to the dynamic and cyclic loading effects experienced during earthquake events. As such, anchors shall be used that are manufactured to particular specifications that make them the most resistant to the effects of dynamic and cyclic loading effects.

Selected anchors shall meet standards set forth in NESS (Network Equipment Building Systems) TR-64 and ASTM (American Society For Testing and Materials) 488-90 for earthquake compliance. This testing evaluates anchors for bolt failure from shearing and from pullout or slippage. Compliance with these standards requires that the anchor not allow a standard top heavy 7 ft. (2.2 m) rack to have a deflection greater than 3 in. (7.6 cm) at the top of the frame. This compliance will also adhere to Bellcore Technical Specifications AU-434 for earthquake concrete expansion anchors.

Anchor selection criteria shall comply with all general requirements for standard concrete anchors plus meet the above seismic requirements. All seismic anchoring shall be enhanced with top cabinet or rack bracing.

Seismic Considerations

All RadioFrame Networks equipment is seismically rated to withstand vibrations of a Level 3 earthquake. The property owner is responsible for any damage to RFN equipment due to building or rack structures that are not rated to withstand vibrations of a Level 3 earthquake, or not secured to withstand vibrations of a Zone 4 earthquake.

Site protection from earthquakes may be required in certain areas. Typically, this would be an area having historical data indicating a Moment Magnitude rating of 3 or 4. Note that areas other than historically prone areas may need consideration. Obviously, addressing such concerns results in increased costs of equipment installation.

A certified architect specializing in earthquake-resistant installation shall be consulted for seismic designs and recommendations in areas where the potential loss of the site may outweigh associated costs of earthquake-resistant design. In the United States, it is recommended to consult the US Geological Survey for more information regarding earthquake probability and historical data for various areas. In other areas, similar consultation should be done.

- The US Geological Survey information can be accessed at: http://geohazards.cr.usgs.gov
- Seismic maps are available at: http: //www.neic.cr.usgs.gov

Earthquake-resistant design should be contracted to a firm specializing in such work. However, the following general considerations need to be observed and factored into a seismic design program:

- Equipment shall not be secured to both the shelter walls and floors, since dissimilar movement between these surfaces is likely in an earthquake.
- Mounting should provide for some "sway" in the overall equipment mounting, thereby absorbing the energy of an earthquake. This is typically accomplished by rigid mounting of racked equipment or cabinets at the base, while semi-rigidly attaching the rack top using 1/8 in (3.2 cm) diameter steel

braided wire rope. Wire rope anchors are then secured to ceilings joists. The benefit of this type of installation is that racks are allowed to sway within limits but can't fall over.

- Cabinet designs with wide footprints can be used to help prevent cabinets from tipping over.
- Columns of cabinets stacked and bolted back-to-back present a very stable and wide footprint. The bottom cabinets shall still, however, be bolted to the floor for complete security.
- Some cabinets can be outfitted with outrigger-type support legs to prevent tip-over. These outriggers alone do not provide adequate earthquake protection, but are typically adequate if the cabinet is bolted to the floor.

  NOTE: If a rack is seismic rated, any add-on aftermarket equipment or equipment that is not seismic rated will render the overall package as not being seismic tested and certified as a unit. Therefore, the unit would no longer be considered as seismic rated.
- When bolting down to computer floor, be sure to anchor all the way to the subfloor.
- Columns of cabinets must be supported, though not rigidly. Rigid mounting will result in extreme vibration and resultant mechanical failure during an earthquake. Semi-rigid mounting is preferred. Semi-rigid bracing is defined as bracing which allows a measurable amount of movement.
- Some computer floors lose mechanical integrity if several panels are simultaneously removed. This could lead to equipment floor collapse during at earthquake. The flooring manufacturer shall be consulted for floor removal procedures.
- Equipment shall be stabilized by a top support. This is critical in preventing a column of equipment from toppling, causing injury to personnel. The footings cabinet columns and racks shall be bolted to the floor as appropriate, using concrete anchors. Sometimes the cabinet columns are placed on C-channel tract or wooden pedestals.
- Cables and transmission lines should not be installed rigidly, and without strain relief. Make broad service loops.
- Lighting fixtures should be prevented from swaying by the addition of one or more guy wires. A fluorescent lighting fixture in particular, can be very dangerous if allowed to swing against a wall or equipment racks, shattering and spraying broken glass below. Fluorescent lighting fixtures shall have protective lenses or protective plastic sleeves that cover the fluorescent tube, preventing broken glass from falling on occupants.
- Storage cabinets shall be secured to the wall to prevent upset. Storage cabinets shall also have closable, secured doors to prevent contents from spilling during an earthquake.

- Ladders and other large objects shall be secured to a wall or removed from the equipment room when not in use. These items have been known to fall into “live” equipment during earthquakes.

3.3.2 Clearances

Proper spacing of equipment is essential for efficient use of the room area, ease of maintenance, and safety of personnel. The following specifications have been established to meet the National Fire Protection Associations (NFPA) Code, and the American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) standards. Any local regulations, as applicable, shall also be adhered to.

- To provide adequate working space, a 576 sq. in. (0.37 m^2) footprint (as measured from facing equipment surfaces) shall be used for combining equipment.

  NOTE: Local codes may require additional clearance. In such cases, the local code shall prevail.

- 36 in. (91 cm) front and side aisles shall be maintained around electrical panel boards (NPPA 70, Article 110-26).
- 36 to 48 in. (91 to 123 cm) front, side, and (where applicable) rear aisles are required for servicing equipment.
- 36 in. (91 cm) aisle shall be maintained in front of all equipment.
- 36 in. (91 cm) aisle shall be maintained between at least one end of an equipment row and building wall or other obstruction; longer aisles may require additional access breaks. Larger aisles and additional access breaks in a row may be require as the row becomes longer, such that a fire in the aisle does not prevent egress. Comply with any codes regarding fire egress specifications.
- Ingress and egress to equipment rooms shall conform to NFPA 70, Article 111 and local building and fire codes.
- In US installations where a facility is to be normally occupied, American with Disabilities Act (ADA) shall be complied with. Some general requirements of ADA are 91.5 cm (36 in.) wide doors, ramps and safety rails, 36 in. (91.5 cm) can turn around clearance for wheelchairs, and specific placement of telephones, fire extinguishers, light switches, etc.

  NOTE: ADA compliance in architectural plans may be required in obtaining a construction permit in some localities.

Main Rack Clearances	
BACK	36”
FRONT	36”
SIDES	36”
ABOVE	36”

System	Unit	Equipment Dimensions		
		Width	Depth	Height
RadioFrame System	NCU	19”	13”	7”
	ACU	19”	13”	7”
iDEN Interface	iSC-3 (1)	17”	9”	1.75”
	iSC-3 (2)	17”	9”	1.75”
	EAS	17”	15”	1.75”
	CSU	19”	12.5”	1.75”
Power Plant	Rectifier	19”	12.5”	5.25”
	Battery	19”	20”	14”

3.3.2.1 Back

System	Unit	Back Clearance
RadioFrame System	NCU	7”
	ACU	7”
iDEN Interface	iSC-3 (1)	7”
	iSC-3 (2)	7”
	EAS	7”
	CSU	7”
Power Plant	Rectifier	7”
	Battery	7”

3.3.2.2 Front

System	Unit	Front Clearance
RadioFrame System	NCU	12”
	ACU	12”
iDEN Interface	iSC-3 (1)	12”

System	Unit	Front Clearance
	iSC-3 (2)	12”
	EAS	12”
	CSU	12”
Power Plant	Rectifier	12”
	Battery	12”

3.3.2.3 Sides

System	Unit	Side Clearance
RadioFrame System	NCU	right side facing 2”; left side 0”
	ACU	right side facing 2”; left side 0”
iDEN Interface	iSC-3 (1)	right side facing 2” / left side 2”
	iSC-3 (2)	right side facing 2” / left side 2”
	EAS	right side facing 2” / left side 2”
	CSU	right side facing 2” / left side 2”
Power Plant	Rectifier	right side facing 2” / left side 2”
	Battery	right side facing 2” / left side 2”

3.3.2.4 Above

System	Unit	Above Clearance
RadioFrame System	NCU	0”
	ACU	0”
iDEN Interface	iSC-3 (1)	0”
	iSC-3 (2)	0”
	EAS	0”
	CSU	0”
Power Plant	Rectifier	0”
	Battery	0”

3.3.3 Weight

System	Unit	Weight
RadioFrame System	NCU	27 lbs
	ACU	27 lbs
iDEN Interface	iSC-3 (1)	

System	Unit	Weight
	iSC-3 (2)	
	EAS	
	CSU	
Power Plant	Rectifier	72 lbs (Power Plant 58 lbs) + (two Rectifiers at 7 lbs ea.)
	Battery	600 lbs (eight batteries at 75 lbs each)

3.3.4 Power

System	Unit	Power	
RadioFrame System	NCU	▪ 100-240 Volts AC, 47-63 Hz, 8-3.5A, or ▪ Negative 52.5 ±.5 Volts DC, 11A	
	ACU	▪ 100-240 Volts AC, 47-63 Hz, 8-3.5A, or ▪ Negative 52.5 ±.5 Volts DC, 11A	
iDEN Interface	iSC-3 (1)	▪ Negative 40-60 Volts DC; 1.5 A	
	iSC-3 (2)	▪ Negative 40-60 Volts DC; 1.5 A	
	EAS	▪ Negative 40-60 Volts DC	
	CSU	▪ Negative 40 Volts DC	
Power Plant	Rectifier	**Input**	
		Voltage	▪ 85 to 265 VAC (continuous) ▪ 45 to 70 Hz
		Current	▪ 12 Amp maximum The rectifier's micro-controller adjusts the output current to limit the input current to allow each rectifier to be plugged into a standard 115/230 VAC @ 15 Amp IEC outlet.
		Power Factor	>90% for 20% to 100% loads
		Output	
		Voltage	▪ 50.00 to 60.00 VDC ▪ 52.5 VDC Factory Set (default)
		Regulation	▪ ± 1.0% (includes output o-ring diode)
		Overvoltage	▪ 50.00 to 60.00 VDC ▪ 57.00 VDC Factory Set (default) ▪ RED [FAIL] LED indication and shuts down rectifier providing output current.
		Noise	▪ <32 dBmC (voice frequency) ▪ <100 millivolts-RMS (wide band) ▪ <250 millivolts peak-to-peak

System	Unit	Power	
		Output	
Power Plant	Rectifier	Current	▪ 20 Amperes/Rectifier for 100/120 VAC ▪ 30 Amperes/Rectifier for 200/240 VAC
		Output Paralleling & Hot Insertion	Each rectifier has an output o-ring diode in the –48 VDC lead for the purpose of paralleling and hot insertion in a working system.
	Battery	105ah; VRLA	

3.3.5 Grounding

System	Unit	Grounding
Main Rack		▪ #2 AWG green-insulated copper wire between the main rack and the master ground bar ▪ do not daisy-chain multiple equipment cabinet grounds using a single ground wire
RadioFrame System	NCU	▪ internal grounding (UL and CE safety certified) ▪ bonding point provided for protective earth grounding; #8 screw with internal sems washer
	ACU	▪ internal grounding (UL and CE safety certified) ▪ bonding point provided for protective earth grounding; #8 screw with internal sems washer
iDEN Interface	iSC-3 (1)	#6 AWG ground wires are attached from the ground studs on the rear of the iSC-3 to the cabinet ground bus bar
	iSC-3 (2)	#6 AWG ground wires are attached from the ground studs on the rear of the iSC-3 to the cabinet ground bus bar
	EAS	#6 AWG ground wires are attached from the ground studs on the rear of the EAS to the cabinet ground bus bar
	CSU	#6 AWG ground wires are attached from the ground studs on the rear of the CSU to the cabinet ground bus bar
Power Plant	Rectifier	#6 AWG ground wires are attached from the ground studs on the rear of the Rectifier to the cabinet ground bus bar

3.3.6 Environment

System	Unit	Storage Temp	Operating Ambient Temperature	
			MIN	MAX
RadioFrame System	NCU*	-40ºF to +158ºF (-40ºC to +70ºC)	+32ºF (0ºC)	+104ºF (+40ºC)
	ACU*	-40ºF to +158ºF (-40ºC to +70ºC)	+32ºF (0ºC)	+104ºF (+40ºC)

			Operating Ambient Temperature	
iDEN Interface	iSC-3	-40ºF to +185ºF (-40ºC to +85ºC)	-22ºF (-30ºC)	+140ºF (+60ºC)
	EAS	-40ºF to +185ºF (-40ºC to +85ºC)	+32ºF (0ºC)	+122ºF (+50ºC)
	CSU	-40ºF to +185ºF (-40ºC to +85ºC)	+32ºF (0ºC)	+122ºF (+50ºC)
Power Plant	Rectifier	-40ºF to +185ºF (-40ºC to +85ºC)	+32ºF (0ºC)	▪ Sea level to 4800': 122ºF (50ºC) ▪ 4800-7000': 113ºF (45ºC) ▪ 7000-10,000' +104ºF (+40ºC)
	Battery	77ºF (+25ºC)	-40ºF (-40ºC)	+122ºF (+50ºC)

* Altitude: -200 to +8,000 feet above mean sea level; above 8000' reduce maximum operating ambient temperature by 2ºC per 1000' to a maximum of 13,000'.

System	Unit	Relative Humidity
RadioFrame System	NCU	10-90% non condensing
	ACU	10-90% non condensing
iDEN Interface	iSC-3	5-90% non condensing
	EAS	5-90% non condensing, non-operating 0-90% non-condensing, operating
	CSU	5-90% non condensing
Power Plant	Rectifier	5-90% non condensing
	Battery	N/A

3.3.7 Heat Load

System	Unit	BTUs per Hour
RadioFrame System	NCU	700
	ACU	700
iDEN Interface	iSC-3 (1)	140
	iSC-3 (2)	140
	EAS	170
	CSU	17
Power Plant	Rectifier	13.5 KBTUs (max)
	Battery	683

3.3.8 GPS Antennas

The following apply to the GPS antenna array:

- For cable runs up to 166 feet, use ½" diameter LDF.
- For cable runs from 167-290 feet, use 7/8" diameter LDF.
- For cable runs longer than 290 feet consult with the RFN customer's RF Engineering.
- For interior cable runs from Polyphaser to site control cabinet use ½" diameter FSJ.
- Terminate all LDF within 6" of antenna.

3.3.9 Surge Arrestors

The local telephone company installs the T1/E1 line, which terminates in an 8-pin modular plug. This demarcation (demarc) point connects to the T1/E1 through a surge arrestor. The following illustration shows the T1/E1 interface with the iDEN/802.11b RFS.

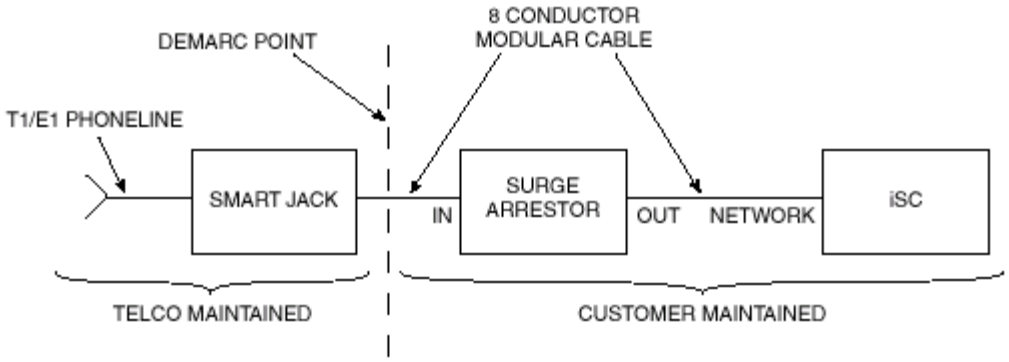


Figure 15 Telco (T1/E1) interface with the iDEN/802.11b RFS.

The surge arrestor must be adequately grounded as outlined in the *Quality Standards Fixed Network Equipment - Installation Manual (R56*). The surge arrestor usually mounts near the demarcation (demarc) point. The cable connecting the surge arrestor to the Telco SmartJack should be locally procured, or should be provided with the surge arrestor. The cable connecting the iSC-3 to the surge arrestor is locally procured. The following table lists RFN-approved surge suppression equipment.

AC Data Part #	Application	Clamp Voltage
TJ1010B	T1/E1 Surge Suppression, SAD + Gas Tube Hardwire and/or RJ connection	10 V
TJ3010B	T1/E1 Surge Suppression, SAD + Gas Tube Hardwire	7 V

3.3.10 Cable Support

This section describes requirements for cabling within equipment cabinets and racks. Cabling within racks and cabinets shall conform to the requirements of NFPA 70, Article 300, Article 800, Article 810, and Article 820. (Refer to ANSI/TIA/EIA-568(a) and 569(a) for additional information.)

All cables shall be installed and routed so that personal safety and equipment functionality is not compromised and that all equipment is accessible for servicing. The following requirements apply to cabling installed in racks or cabinets.

3.3.10.1 Securing cabling within racks or cabinets

To help prevent damage or accidental disconnection, cables and conductors shall be secured at intervals of no more than 3 ft (91 cm). Attachment shall be accomplished in a manner that does not restrict access to the equipment in the rack or cabinet.

Insulated standoffs are recommended for use in racks or cabinets. The standoffs should be of sufficient length to maintain the proper cable separation.

Nonmetallic cable ties shall be used to secure cables and conductors. Attachment shall be tight enough to secure cables without crushing them.

Cables that span a gap greater than 2 ft (61 cm) shall be supported.

3.3.10.2 Routing cables within racks and cabinets

Grounding conductors within racks or cabinets shall be routed toward the RGB, MGB, SSGB, or ground bus conductor. Connections to the RGB or ground bus conductor shall always be made with the equipment grounding or tap conductors being routed toward the MGB, SSGB, or RGB.

At points where grounding conductors must pass through a hole in a metallic surface and the hole is slightly larger than the conductor, the conductor shall be bonded to the metallic surface through which it passes. If the hole or opening is much larger than the conductor, and it is intended to accommodate several conductors, the conductor is not required to be bonded.

Cables in racks or cabinets shall be sized to length, and shall be installed and routed neatly and in a professional manner.

Excess cable shall not be coiled on top of cabinets or racks.

AC power cords longer than necessary may be looped down and back up a rack or cabinet. Excess lengths of AC power cord shall not be coiled on top of racks or cabinets.

3.3.10.3 Protecting cables within racks and cabinets

Grounding conductor tap joints shall be installed in order to prevent the conductor or connection device from coming in contact with metallic surfaces.

Where cables or conductors are routed through holes in metallic surfaces or near sharp edges, the sharp surfaces shall be suitably protected with a grommet or similar material to help protect the cable or conductor from damage caused by sharp edges.

3.3.10.4 Cable bending radius within racks and cabinets

Grounding conductors of all sizes shall maintain a minimum bending radius of 8 in. (20 cm). The angle of any bend shall be not less than 90°.

The bending radius of CAT 5 cables shall be not less than 10 times the outside diameter of the cable. Follow the cable manufacturer's recommendation and refer to ANSI/TIA/EIA-568 and CSA-T529 for additional information.

All other cables shall not have sharp bends that will damage or degrade the performance of the cable. The cable manufacturer's specifications shall be followed.

3.3.10.5 Cable separation and grouping within racks or cabinets

Cabling in racks or cabinets shall be grouped according to function.

Cable groups within racks and cabinets shall be separated by a minimum of 2 in. (5.1 cm) from other cable groups. Refer to ANSI/TIA/EIA-568a and -569; and NFPA 70, Articles 800-52, 810-18, and 820-52 for more information.

3.3.11 Alarm Blocks

All alarm wires shall be tagged and labeled with the appropriate alarm item. All contacts will be normally closed, dry, and isolated from ground. Alarm wire will be neatly run and secured using nylon cable ties/clamps every three feet to walls and existing cable tray. All alarm wiring shall be two-wire, 22 AWG.

3.4 Remote ACUs

Up to seven remote ACUs may be installed for a total of 8 ACUs per NCU.

3.4.1 Mounting

Remote ACUs are located in telco rooms or other closets throughout the building, mounted in 19” EIA-standard compliant racks or equivalent. Any other method used to mount the remote ACU is not approved, and could void the warranty on the product and other components in the RFS.

NOTE: The ACU may be placed on a flat surface only if the front and back of the unit are accessible and if the side vents are not blocked. In this case, the ACU is not secured and, therefore, is not rated to withstand any level of earthquake, and the warranty may be voided.

Currently, the remote ACU does not include a Universal Power Supply (future enhancement). Grounding of the remote ACU is not required by RadioFrame Networks and is the responsibility of the RFN customer or its customer. A bonding ground point for protective earth grounding is provided; #6 screw with internal sems washer.

3.4.2 Clearances

- Dimensions: 19" wide x 7" high x 13" deep (approx.)

3.4.2.1 Back

- 7”

3.4.2.2 Front

- 12”

3.4.2.3 Sides

- Left side (facing unit): 0”; right side: 2”

3.4.2.4 Above

- Above: 0”

3.4.3 Weight

- 27 lbs (fully loaded)

3.4.4 Power

- 100-240 Volts AC, 47-63 Hz, 8-3.5A , or
- Negative 48-56 Volts DC, 11A

3.4.5 Grounding

The ACU is internally grounded by connecting the appliance inlet earthing ground to the power supply ground terminal.

The chassis unit is also internally bonded by connecting the appliance inlet earthing ground directly to the chassis (#6 AWG screw with internal sems washer).

3.4.6 Environment

- Operating Ambient Temperature: 0°C to +40°C (+32°F to +104°F)
- Altitude: -200 to +8000 feet above mean sea level; above 8000', reduce maximum operating ambient temperature by 2°C per 1000' to a maximum of 13000'
- Storage Temperature: -40°C to +70°C (-40°F to +158°F)
- Relative Humidity: 10-90% non condensing
- Shock: 40 g's
- Vibration: Level 3 earthquake
- Keep product free from dust, wind, salt, liquids

3.4.7 Heat Load

- 700 BTUs

3.4.8 Cable Support

- Power cord
- CAT 5 wiring to NCU
- CAT 5 wiring to as many as 8 RFUs

3.5 RFUs

3.5.1 Location

RFU placement is determined by first choosing an approximate location for each RFU using basic coverage requirements, then identifying the mounting configuration for each RFU (ceiling or wall). The number of RFUs is determined by dividing an area's square footage by the minimum RFU coverage area, (32,000'). Typically, a floor plan of each story in the building is used as an aid to identify RFU placement.

In addition, RFU placement requires taking into consideration such factors as interior structures, multiple-floor installations, elevators and stairwells, and neighboring macro cell systems. For more information, refer to the RFN document, *RF Planning Guide for RadioFrame Systems (990-1001-00).*

3.5.2 Mounting

Once the approximate RFU locations have been identified, determine the mounting configuration required for each RFU—on or above the ceiling, or on a wall. Wall mounts are ideal, provided the wall is of low density. Mounting the RFU to a structural brick or concrete wall can alter the unit's omni directional pattern. Also, each RadioBlade installed in an RFU is supplied with an antenna designed to be installed vertically and pointed down. Do not change this orientation.

Suspended ceilings are very common in commercial buildings and mounting the RFU above the ceiling can work well, provided lower half of the RFU is kept clear of metal objects such as water pipes, wire bundles and light fixtures. The added benefit of an above-ceiling installation is that the RFU is hidden yet still easily accessed. Generally, suspended ceiling panels are of low-density lightweight materials that do not attenuate RF. The metal grid supports typically are spaced at greater than 2-foot intervals and will not dramatically affect the RFUs' performance if they are kept at least 1-foot away from the antennas.

3.5.3 Clearances

- Dimensions: 13.5" wide x 8" high x 5" deep (approx.)

3.5.3.1 Back

- 0”

3.5.3.2 Front

- 0”

3.5.3.3 Sides

- 0”

3.5.3.4 Above

- Leave at least 1.25” between the top of the RFU and the ceiling or any overhead structure.
- Leave at least 3” below the RFU.

3.5.4 Weight

- 12 lbs (fully loaded with 7 RadioBlades/RAPs)

3.5.5 Power

- Negative 36-56 Volts DC, 0.8A

3.5.6 Grounding

- No additional grounding required

3.5.7 Environment

- Operating Ambient Temperature: 0^{o}C to +40^{o}C (+32^{o}F to +104^{o}F)
- Altitude: -200 to +8000 feet above mean sea level; above 8000', reduce maximum operating ambient temperature by 2^{o}C per 1000' to a maximum of 13000'
- Storage Temperature: -40^{o}C to +70^{o}C (-40^{o}F to +158^{o}F)
- Relative Humidity: 10-90% non condensing
- Shock: 40 g’s
- Vibration: Level 3 earthquake
- Keep product free from dust, wind, salt, liquids

3.5.8 Heat Load

- 85 BTUs

3.5.9 RF Exposure

To comply with FCC RF exposure requirements, iDEN antennas must be installed to provide at least 9 inches (20 cm) separation from all persons, with antenna gain not exceeding zero (0) dBi.

3.5.10 Cable Support

- CAT 5 wiring to ACU

3.6 RadioBlades

3.6.1 Mounting

- The iDEN RadioBlades are inserted into the RFU.
- RFUs must be mounted in such a way that the iDEN RadioBlade antenna points downward to the ground.
- To prevent RF attenuation within the RFU, a ground strap is placed between the iDEN RadioBlades and the RadioBlade antennas.

3.6.2 Clearances

- Dimensions: 3” wide x 4” high (plus antenna) x 0.5” thick (approx.)
- The iDEN RadioBlade is housed in the RFU. If the RadioBlade is properly inserted into the RFU, no additional clearances are required.

3.6.2.1 Back

- 0”

3.6.2.2 Front

- 0”

3.6.2.3 Sides

- 0”

3.6.2.4 Above

- 0”

3.6.3 Weight

- 0.5 lb (approx.)

3.6.4 Power

- 3.3 VDC, 720mA max
- 2.5 VDC, 50mA max

3.6.5 Grounding

- No additional grounding is required

3.6.6 Environment

- Operating Ambient Temperature: 0°C to +40°C (+32°F to +104°F)
- Altitude: -200 to +8000 feet above mean sea level; above 8000', reduce maximum operating ambient temperature by 2°C per 1000' to a maximum of 13000'
- Storage Temperature: -40°C to +70°C (-40°F to +158°F)
- Relative Humidity: 10-90% non condensing
- Shock: 40 g's
- Vibration: Level 3 earthquake
- Keep product free from dust, wind, salt, liquids

3.6.7 Heat Load

- Not applicable

3.7 RAPs

3.7.1 Mounting

- The 802.11b RadioFrame Access Points (RAPs) are inserted into the RFU.
- RFUs must be mounted in such a way that the RAP antenna points downward to the ground.

3.7.2 Clearances

- Dimensions: 3" wide x 4" high (plus antenna) x 0.5" thick (approx.)
- The RAP is housed in the RFU. If the RAP is properly inserted into the RFU, no additional clearances are required.

3.7.2.1 Back

- 0"

3.7.2.2 Front

- 0”

3.7.2.3 Sides

- 0”

3.7.2.4 Above

- 0”

3.7.3 Weight

- 1 lb (approx.)

3.7.4 Power

- 3.3 VDC, 1.5A
- 2.5 VDC, 1.5A

3.7.5 Grounding

- No additional grounding is required

3.7.6 Environment

- Operating Ambient Temperature: 0^{o}C to +40^{o}C (+32^{o}F to +104^{o}F)
- Altitude: -200 to +8000 feet above mean sea level; above 8000', reduce maximum operating ambient temperature by 2^{o}C per 1000' to a maximum of 13000'
- Storage Temperature: -40^{o}C to +70^{o}C (-40^{o}F to +158^{o}F)
- Relative Humidity: 10-90% non condensing
- Shock: 40 g’s
- Vibration: Level 3 earthquake
- Keep product free from dust, wind, salt, liquids

3.7.7 Heat Load

- Not applicable

3.8 URU

3.8.1 Mounting

The URU can be placed on any flat surface or mounted using the provided mounting screws. The URU must be located within 12 feet of an approved power source.

3.8.2 Clearances

- Dimensions: 5.5" wide x 1.25" high x 5.5" deep (approx.)

3.8.2.1 Back

- 2”

3.8.2.2 Front

- 3”

3.8.2.3 Sides

- 1”

3.8.2.4 Above

- Above: 0”
- Below: 0.125”

3.8.3 Weight

- 1.5 lbs

3.8.4 Power

- 100-240 Volts AC converts to negative 48VDC (power cord provided)*
  * The URU uses –48 VDC. The input voltage connector on the URU requires –48 VDC. The provided power cord includes an external isolated power supply that converts 100-240 VAC to –48 VDC. The input supply requires 48 volts DC, 2A.

3.8.5 Grounding

- No additional grounding is required
- A ground point for chassis ground is provided: #4 screw with internal sems washer

3.8.6 Environment

- Operating Ambient Temperature: 0°C to +40°C (+32°F to +104°F)
- Altitude: -200 to +8000 feet above mean sea level; above 8000', reduce maximum operating ambient temperature by 2°C per 1000' to a maximum of 13000'
- Storage Temperature: -40°C to +70°C (-40°F to +158°F)
- Relative Humidity: 10-90% non condensing
- Shock: 40 g's
- Vibration: Level 3 earthquake
- Keep product free from dust, wind, salt, liquids

3.8.7 Heat Load

- Not applicable

3.9 Interconnecting Cabling

Site planning requires true single point grounding. The Telco entrance and Telco termination board should be located as close to the transmission line entry and AC service entrance as possible. This enables the individual ground leads to bond to a single point, with the least amount of distance between the ground leads.

3.9.1 T1

T1 lines are used to connect the RadioFrame System with the Mobile Switching Center (MSC). Each RFN customer iDEN/802.11b RFS site is typically fed with a single T1 line, and subsequently protected with a surge suppressor. The suppressor is located between the "smart jack" (maintained by the local telephone company) and the Channel Service Unit (CSU). The suppressor should be grounded downward directly to the master ground bus (MGB) using a #6 AWG green wire.

The Telco board and the MGB should be mounted adjacent to each other on the same wall (the coax ground and power ground should also be at this same

location to achieve single point grounding). The Smart Jack and T1 suppressor are located on the Telco board near the T1 line entrance to the site. The CSU is located in main rack. The CSU is grounded to the main rack and subsequently to the master ground bar approximately 15 wire-feet away.

3.9.2 Power Cabling

All electrical wiring for the site must meet the requirements of NEC and all applicable local codes.

3.9.2.1 AC Power Cabling

This section describes only the AC power. All grounding shall limit the exterior connections to a single point. The transmission wire entrance for the GPS and the telco service and board must be installed on a common wall to have true single point grounding.

Caution

Facility AC wiring within junction boxes, receptacles, and switches shall be performed by a licensed and bonded electrical contractor. Personnel safety and liability hazards can result from AC wiring performed by installation personnel other than an electrical contractor.

When an open equipment rack is used, hardwiring of power is not always possible. Mounting a dedicated simplex receptacle or receptacle assembly on the rack may be the most convenient method of supplying power, especially if multiple pieces of equipment are mounted on the rack. This is also a convenient way to install personal protection type 3 SPD devices (such as Motorola PN RLN4924A) to the equipment.

These receptacle assemblies can be pre-manufactured and mounted to the top face of an equipment rack. Mounting can also use a fabricated power pole mounted between racks.

Equipment that contains its own AC power supply is typically fitted with a standard grounded line cord. Where this equipment is used, the rack shall be equipped with a dedicated simplex receptacle or receptacle assembly.

Use only the power cables provided by RadioFrame Networks. Use of any other cable is strictly prohibited and may void the warranty and/or cause electrical fire and damage.

Caution

Under no circumstances shall consumer-grade power outlet strips be used In any Installation. Extension cords of any type shall not be use for connecting line power to communications equipment.

AC input power

Main Rack: The AC input power for the RFN iDEN/802.11b RFS solution shall be of 208/240 single phase and shall be coming off one designated 30 amp breaker. AC input power will be supplied to the Peco II rectifier panel.

Remote ACUs: for 120VAC power, use the power cord provided (use of a different cord may void the warranty and/or cause electrical fire and damage).

URUs: for 120VAC power, use the power cord provided (use of a different cord may void the warranty and/or cause electrical fire and damage).

Circuit breakers

Square D QO Plug-On type (30 Amp breaker)

Rectifier frame feeds (for Peco II Rectifiers)

Refer to the *PEC 127NHL* document for more information.

3.9.2.2 DC Power Cabling

Use of UL approved cable is required; the suggested standard is UL1007.

For RFN equipment, follow the cabling instructions described below for proper cable gauge, length, and color.

Caution

The power supply cord is used as the main disconnect device; ensure that the socket-outlet is located/installed near the equipment and is easily accessible.

For -48VDC power, use only an AMP connector Part Number 350766-1 or equivalent using the following pinout:

Pin Number	Wire Connection
1	-48 Volts DC Return (black)
2	-48 Volts DC (red)
3	No connect

Wire shall be sized to carry a minimum of 11 Amps per these recommendations:

Length of Run	Minimum recommended wire gauge
Up to 6’	16 AWG
6’ - 10’	14 AWG
10’ - 15’	12 AWG
15’ - 24’	10 AWG

3.9.3 Category 5 Cabling

All components of the RFS are connected using standard CAT 5 cabling installed in existing raceways or conduits when available. Use only RJ45 (T568B) connectors for system components. The same is true for connecting the RFS to the iDEN Interface and the Customer LAN.

If using a patch panel between RFS components, ensure the following:

- Use only a CAT 5e- or CAT 6-rated patch panel.
- Follow all TIA 568B standards.
- Total impedance, end to end, *cannot* exceed 8 ohms.
- Use only CAT 5e or CAT 6 wiring.

Maximum length between RFS components shall not exceed 328’ (100 meters).

A Universal Repeater Unit (URU) can be installed to extend the distance between any two RFS components to 656’ (200 meters).

Up to 2 URUs can be used between any two RFS components to extend the distance to 984’ (300 meters).

The maximum DC resistance allowed cannot exceed 26.2 Ohms per 1000 feet.

Use plenum rated cable if the cable traverses through a plenum (open air) space.

The proper installation of computer network cabling is critical to the safe and reliable operation of the computer network. It is recommended that standards developed by the Telecommunications Industry Association/Electronic Industries Association (TIA/EIA) and the Canadian equivalent (or equivalent standards in other countries) be followed. Applicable NFPA codes, local electrical codes, local building codes and other standards in this manual shall also be conformed to when installing computer network cabling.

NOTE: It is recommended that a specialist in the installation of computer networks perform computer network cable installations. The specialist should have the expertise, knowledge of applicable local codes, and the test equipment required for a quality installation.

NOTE: This section cites standards from the American National Standards Institute (ANSI), the Electronic Industry Association (EIA), the Telecommunications Industry Association/Electronic Industries Association (TIA/EIA), and the Canadian Standards Association (CSA). Even in non-domestic installations, these standards should be adhered to.

3.9.3.1 Case Type

CAT 5 Unshielded Twisted Pair (UTP), 100-ohm cable is the recommended cable type for computer network cabling, and will be the assumed cable type throughout this section. CAT 5 cable is preferred over CAT 3 and CAT 4 cables because of its ability to support 100Mbps (Megabits per second) systems and because of its better immunity to Electromagnetic Interference (EMT) and Radio Frequency Interference (RFI). Refer to ANSI/TIA/EIA-568-A, and CSA-T529 for more information.

3.9.3.2 Connecting Hardware

UTP cables shall be terminated with connecting hardware of the same category rating or higher. This includes all connectors, punch blocks, cross-connect jumpers and patch cords. It is recommended that hardware used to terminate cables be of the insulation displacement (IDC) type. Modular connectors shall also be of the proper typed for the cable used; solid conductor cable uses a different connector than stranded cable. Refer to ANSI/TIA/EIA-568-A, and CSA-T529 for more information.

3.9.3.3 Cable and Connector Wiring

Appropriate color-coding and jack pair assignments should be followed when wiring modular jacks, connectors, and cables. The same wiring standard shall be used throughout the cabling system. ANSI/TIA/EIA T568B is the recommended standard. The following illustration shows end views of an 8-pin Modular female jack for T568B with the pairs and colors identified. Refer to ANSI/TIA/EIA-568-A, and CSA-T529 for more information.


Warning!

Crimp all connector wiring *completely*. Ensure that all crimps have fully penetrated the protective coating on the wiring. Ensure that enough of the protective coating is left in place to fit inside the connector. Failure to follow these instructions may cause system failures to occur.

Pin#	Color Code (wires)
1	white/orange
2	orange/white
3	white/green
4	blue/white
5	white/blue
6	green/white
7	white/brown
8	brown/white

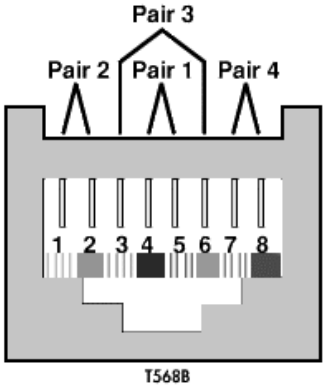


Figure 16 T568B standard.

3.9.4 Installation

Avoid any unnecessary junction points and cross-connects. Every added junction point and cross-connect can decrease the performance of the network.

Multiple appearances of the same cable at different locations, referred to as bridge taps shall be avoided. Each cable segment shall have only one source and one destination.

Never untwist the twisted pairs of a CAT 5 cable beyond 1.3 cm (0.5 in.) from the point of termination. Untwisting the wires can decrease the cable's category performance rating and degrade system performance. Refer to ANSI/TIA/EIA-568-A and CSA-T529 for more information.

Do not make sharp bends in CAT 5 cable. The bend radius for CAT 5 cable shall not be less than ten times the outside diameter of the cable. Bending the cable with a shorter bend radius can affect the electrical characteristics of the cable and degrade system performance. Refer to ANSI/TIA/EIA-568-A and CSA-T529 for more information.

Do not pull a CAT 5 cable with excessive force. CAT 5 cable should not be pulled with a force greater than 110 Newtons (25 lbs force), or as suggested by the cable manufacturer. Pulling a cable with too much force can change the cable's electric characteristics and degrade its performance. Refer to ANSI/TIA/EIA-568-A and CSA-T529 for more information.

Do not over tighten CAT 5 cable with cable ties or other supports. Over tightening cable ties or other supports can change the electrical characteristics of the cable and degrade the system performance. Refer to ANSI/TIA/EIA-568-A and CSA-T529 for more information.

CAT 5 segment lengths shall not exceed 100 m (328 ft.). This includes 90 m (295 ft.) of building cabling and up to 10 m (32.8 ft.) of equipment cords, cross-

connects and patch cords. Of the 10 m (32.8 ft.) allowed for equipment cords, cross-connects and patch cords, a maximum of 3 m (9.8 ft.) should be used from the computer workstation to the information outlet. Refer to ANSI/TIA/EIA-568-A and CSA-T529 for more information.

For simplifying installation and reducing cable runs, a single CAT 5 cable may be run from the equipment room hub to an additional hub in the computer workstation area for distribution to the individual computers. This can reduce the number of cables required between the equipment room and the individual computers. Refer to ANSI/TIA/EIA-569-A for more information.

If cable segments need to be extended beyond 100 m (328 ft.), an additional hub may be installed. Each individual segment between hubs shall not exceed 100 m (328 ft.). Note that no more than the one intermediate hub shall be used. If the required distance is greater than, a specific cabling system shall be engineered. Refer to ANSI/TIA/EIA-569-A for more information.

3.9.4.1 NEC Compliance

All RadioFrame Networks products and equipment are NEC compliant.

3.9.4.2 Local Jurisdictions

Local jurisdiction codes shall apply and override any other requirements specified in this document.

3.9.4.3 Routes

Consideration should be given to using some method of cable management and containment for runs of CAT 5 cable. Such methods can be dedicated cable runs, lay-in wireways, cable runways and conduits. Refer to ANSI/TIA/EIA-569-A and CSA-T530 for more information.

CAT 5 cable shall not be installed in the same conduit, cable runway, outlet box, or similar device with AC power cables, unless separated by a barrier as allowed in NFPA 70, Article 800-52. Doing so can be unsafe and is likely to cause EMI onto the CAT 5 cable, causing network errors. Refer to NFPA 70, Article 800-52, ANSI/TIA/EIA-568-A, and CSA-T529 for more information.

Precautions should be taken to avoid routing CAT 5 cable near sources of EM/RFI. Such noise sources may be electrical power wiring, dimmer switches, radio frequency transmitters, motors, generators, and fluorescent lights. Precautions may include, increasing the physical distance between the CAT 5 cable and the source of the EMI/RFI, installing the CAT 5 cable inside of a grounded metallic conduit, or use of a CAT 5100-ohm screened twisted pair cable as permitted by ANSI/TIA/EIA-568-A. Routing cables near sources of EMI/RFI can cause data errors and degraded system performance. Refer to ANSI/TIA/EIA-568-A and CSA-T529 T530 for more information.

Cables shall be separated by at least 5.1 cm (2 in.) from AC power conductors. Refer to NFPA 70, Article 800-52 for more information.

CAT 5 cables installed in ducts, plenums, and other air-handling spaces shall be installed in accordance with other sections of this document and NFPA 70, Article 300-22. Also refer to NFPA 70, Article 645.

CAT 5 cables installed in hazardous areas as defined in NFPA 70, Article 500 shall be installed in accordance with NFPA 70, Article 500 and any other applicable electrical and building codes.

CAT 5 cable shall not be attached by any means to the exterior of a conduit or other raceway as a means of support. Refer to NFPA 70, Article 725-54 and NFPA 70, Article 800-52 for more information.

Suspended ceiling support rods and wires may be used as a means of support for computer network cabling if used in conjunction with appropriate cable fasteners. Refer to ANSI/TIA/EIA-569-A and CSA-T530 for more information.

CAT 5 cables shall not be laid directly on the tiles of a false ceiling. Refer to ANSI/TIA/EIA-569-A and CSA-T530 for more information.

CAT 5 cables shall not be run from one building to another building. If the computer network needs to be extended to another building, a specific cabling system shall be engineered. Options for extending from one building to another may include the use of fiber optic cable or a T1. Computer network cabling entering and/or leaving a building shall be properly grounded and protected from surges as required elsewhere in this document.

3.9.4.4 Testing

Every effort should be made to ensure a quality installation of the computer network cabling system. Even the best installation effort cannot guarantee a properly working system. It is therefore required that a computer network cabling system be tested for proper performance.

The procedures and specifications in the TIA/EIA Telecommunications System Bulletin (TSB) 67 shall be used for this testing. TSB 67 has four primary parameters to test. Below is an overview of the four test parameters needed to assure a properly working system.

Wire map

The wire map test is used to verify wire pair to pin termination at each end of the cable and to check for installation connectivity errors. It is recommended that 100% of cables be tested using a testing tool such as Microtest® Microscanner™ Pro. (Be sure the tester can check for a “split pair” configuration).

Each of the 8 conductors in the cable are tested for:

- Conductor continuity to the remote end of the cable

- Shorts between any two or more conductors in the cable
- Crossed pairs in the cable
- Reversed pairs in the cable
- Split pairs in the cable
- Any other wiring errors in the cable

Length

The length test is used to determine the maximum physical length of the cable segments. The Microscanner™ Pro and many other models can be used to check cable, which are accurate within a few feet. The RFN guideline for cable length is 100 meters (approximately 328' for less).

Attenuation

Attenuation is the measure of signal loss in the cable segment.

Near-End Crosstalk (NEXT) loss

NEXT loss is a measure of signal coupling from one wire pair to another within a single UTP cable segment.

3.9.4.5 Labeling

Cabling shall be identified with a standardized, double-ended system to facilitate cable and equipment connection identification. (Refer to ANSI/TIA/EIA-606 for more information.) The label should show the following:

- Equipment identification for each end of cable.
- Connector reference designator for each end of cable.
- Direction along the cable where terminating equipment is located.
- Floor and room of the equipment.

In general, the following considerations need to be observed in implementing a labeling system:

- Labeling shall indicate the destination ends of the cable, in terms of equipment name and connector reference designator or name. This applies to connectorized, lugged, or punched-down cable terminations, regardless of the application (RF, audio, or control).
- Labeling shall be imprinted on white opaque material (preferably plastic or plasticized paper) using indelible black ink.

- Labeling should wrap entirely around the cable. It should be secure enough to assure label retention if the cable is to be pulled through conduit.
- Label placement shall be between 10 and 16 cm (4 and 6 in.) from each end of the cable (or the most logical point that would allow the label to be easily read).
- Information printed on each label should be brief but clearly understandable. Because of limited space, abbreviations and acronyms should be used. If abbreviations are used, they should be industry standard.
- All cables shall be properly labeled by the manufacturer as to the type, capacity, and approval ratings of the cable.

3.10 Main Rack Configuration

The following illustration shows a typical main rack installation for a RadioFrame System. The main rack contains the iDEN Interface, the NCU and one ACU of the RadioFrame System, and the Power Plant. The rack must be an EIA-standard compliant rack, or equivalent.

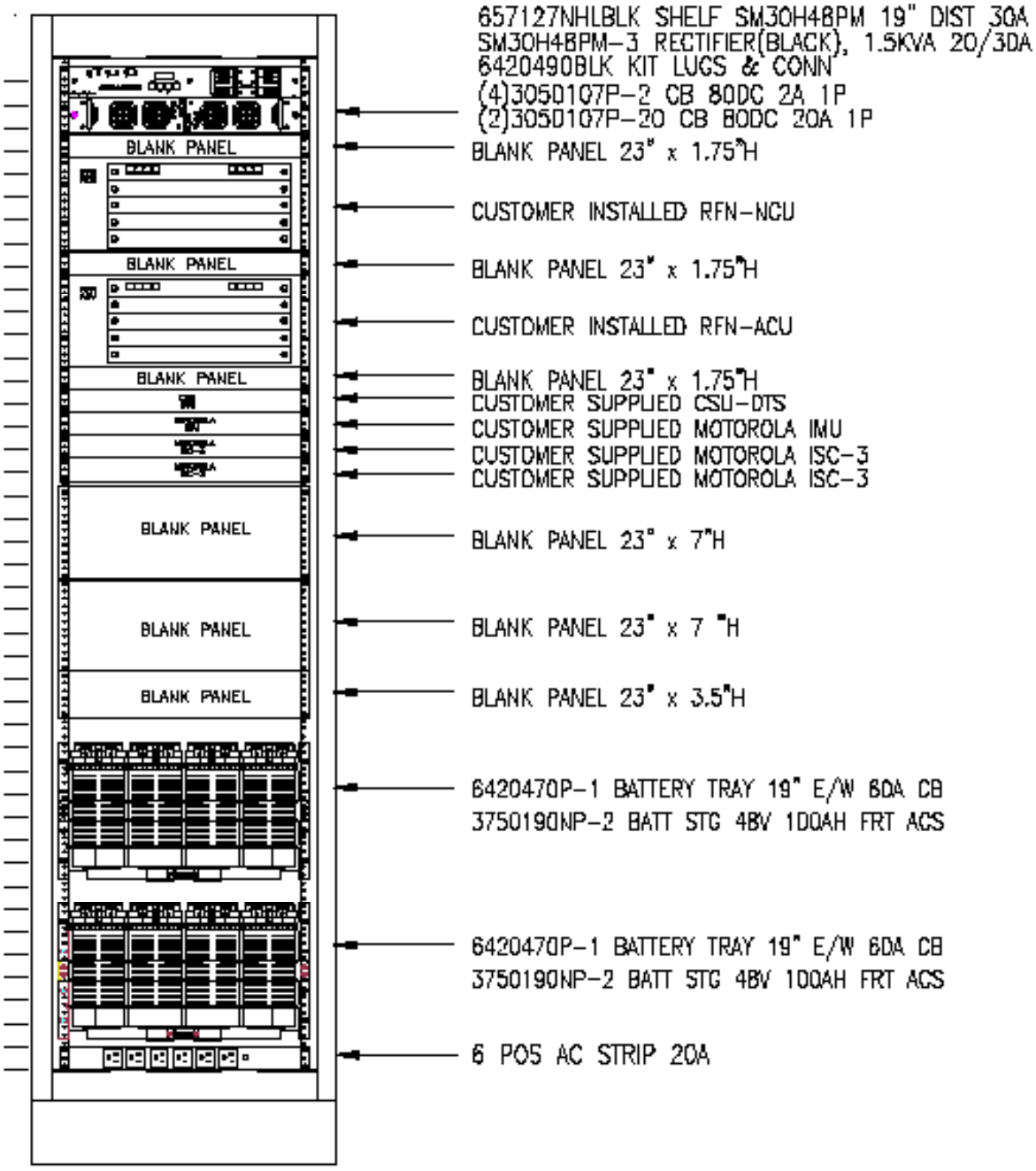


Figure 17 Standard 19" 7' rack configuration and power requirements for the RadioFrame System.

3.11 RF Planning

RF planning places a minimum number of RadioFrame Units in locations that will provide optimal coverage and voice quality. RF planning for the RadioFrame System takes into consideration anything that might affect RF propagation, including:

- RFU locations, including coverage and mounting requirements, multi-story installations, and elevator shafts and stairwells
- Simulcasting, including single-sector and multi-sector systems
- Interference, including out-of-building emissions and in-building interference from macro systems
- RFN recommends using three channels of separation

For more information about site planning, refer to the RFN document, *RF Planning Guide for RadioFrame iDEN Systems (990-1001-00)*.

3.12 Site Survey

An informal site survey can be conducted to determine RFS equipment locations. Based upon the RFS square footage model, preliminary site designs are relatively easy to calculate prior to a formal site survey (refer to Appendix B “Site Survey” for an example of site survey questions and information).

3.13 Alarm Configuration

Various alarms or sensors are installed within the RFN customer RFS site building. All alarm wiring terminates at the Environmental Alarm System (EAS) location within the main rack. The electrical contacts for the alarms must be dry contacts and normally remain closed (open on alarm).

3.14 Tools Required

The RadioFrame System comes with all the parts necessary to mount each component of the system. This section describes all of the equipment necessary to install the RadioFrame System.

3.14.1 Hand Tools

- #2 Phillips screw driver.
- Optional: For RFU ceiling mounts, a drill with a 3/16” bit for use with provided wood screws, or a 9/32” bit and four ¼” bolts (not provided).

3.14.2 Laptop Computer

A laptop computer is required to bring up the RFS. The laptop must be loaded with the following fully functional equipment (or equivalent):

- Serial cable
- Adapter for APC/NPC cards
- Ethernet cables to connect to the RLIC:
  - crossover EIA/TIA 658A
  - straight through EIA/TIA 568B
- EtherPeek
- CD-ROM capability
- FTP server (WFTPD)
- Telnet and serial communications software (TeraTerm)
- Administration rights to change settings on laptop

3.14.3 System Manager Software

- Loaded on RLIC, which is used for the download
- Up-to-date version loaded on the laptop (backup)
- Loaded on a CD ROM (backup)
- New versions can also be downloaded from RFN web site (backup)

3.14.4 IP Addresses for all cards in the RFS

- RadioFrame LAN Interface Cards (RLIC)
- Network Processing Cards (NPC)
- RadioFrame Interface Cards (RIC)
- Airlink Processing Cards (APC)

3.14.5 iSC-3 Configuration

- Data fill of iSC (refer to *RFN Recommended Data Fill*, P/N 998-0100-00)
- Method by which regional office identifies sector/cabinet positions

3.14.6 Test Equipment

- Ethernet cable tester

3.14.7 Additional Materials

- Wire ties
- Straight blade screwdriver
- Spare RJ45 connectors
- Wire cutters
- RJ45 connector crimper

4 Installation

Following all construction work, both exterior and interior, the site and facility shall be in a suitable condition for the installation of communications equipment. In general, the following considerations need to be observed:

- Interior of facility shall be free of excessive dust.
- All refuse related to the installation tasks shall be removed.

Consideration should be exercised when laying out a site to allow primarily for all code requirements for spacing, and then the most efficient use of space. Special attention shall be given to future expansion with regard to cable runway heights, electrical outlet placement, and equipment placement.

The procedures described in this chapter assume the field technician or installer has knowledge of the installation techniques contained in the *Quality Standards Fixed Network Equipment - Installation Manual (R56*).

Prior to performing the installation procedures, prepare the site with all associated antennas, phone lines, and other related site equipment. This information is covered in the Pre-Installation chapter. The main rack may already be installed, depending on the site configuration.

4.1 Main Rack and Supporting Hardware

This section provides installation instructions for a cabinet already containing the iDEN Interface, RadioFrame Networks NCU and ACU, and the Power Plant. The procedure listed here is for permanently mounting the equipment cabinet within a site.

The following procedures describe how to mount non-wheeled cabinets in a system site building. Be sure to read all of the procedures carefully to ensure a quality installation.

4.1.1 Main Rack

The main rack must be secured to the floor for optimum stability. Since the main rack is very heavy, this procedure is written so that the rack is moved only once.


Warning!

Always use two or more persons whenever moving a cabinet. A fully configured equipment cabinet weighs approximately 800 lbs (360 kg).

Perform the following steps to properly install the main rack within the site building:

1. Measure the mounting location for the main rack within the row.
2. Carefully mark the mounting holes with a pencil, as indicated on the appropriate main rack footprint.
3. Drill the marked mounting holes to the appropriate depth of the mounting hardware with a hammer drill and bit.
4. Insert an anchor into the drilled hole.

   If necessary, tap the anchor into place using a hammer.
5. Remove the four screws securing the bottom kick panel to the front and back of the main rack.

   Remove the kick panel and set aside during installation.
6. Carefully move the main rack into the position indicated by the holes in the floor.

   Adjust and level the main rack as necessary to align the rack mounting holes with the pre-drilled holes in the floor.
7. Secure the main rack to the site floor with the locally procured mounting hardware.
8. If required, connect adjacent cabinets to each other using ganging hardware.

4.1.2 Auxiliary Equipment

Auxiliary equipment for the main rack includes:

- GPS antenna
- Environmental alarm block
- Mandatory alarms
- Optional alarms
- Surge arrestors
- Grounding
- Cable supports

4.1.2.1 GPS Antennas

When locating the GPS antennas, install vertical mast (or antenna mount) at a location that provides a line of sight to as much of the horizon as possible. Solid buildings and overhanging trees will block the 1.575 GHz signal and cut down on the amount of sky visible and therefore the number of satellites the antenna can see. Satisfactory performance can be achieved with as much as 25 percent of

the sky being obscured. Reflecting objects such as air conditioners, walls, and metal surfaces may cause multi-path interference with the GPS signal and should be kept below 10 degrees above the horizon.

- Minimum separation between GPS antennas is 4 feet.
- GPS antennas should be installed at a height that allows for regional snow depth.

The antennas may be installed on building tops utilizing mounting hardware designed to allow physical positioning aiming the antennas to the designated coverage area sectors. Downtilt brackets should be installed during initial installation of antenna at all sites other than omni configurations.

Antenna installation shall be per the manufacturer's instructions. All antennas shall be placed according to RF engineering information supplied by the RFN customer. The installation hardware supplied with the antennas by the manufacturer shall be used unless the RFN customer is supplying special brackets for unusual mounting.

In order for sites to hand off correctly, each site's GPS antenna must receive pulse signals from a minimum of one satellite. From that pulse the sites will set their "internal clocks" so that all sites will be synchronized.

4.1.2.2 Environmental Alarm Block

Alarm wiring fitted with modular (8-pin Telco) connectors terminate at the EAS. All other connections are designed to terminate at a punch block.

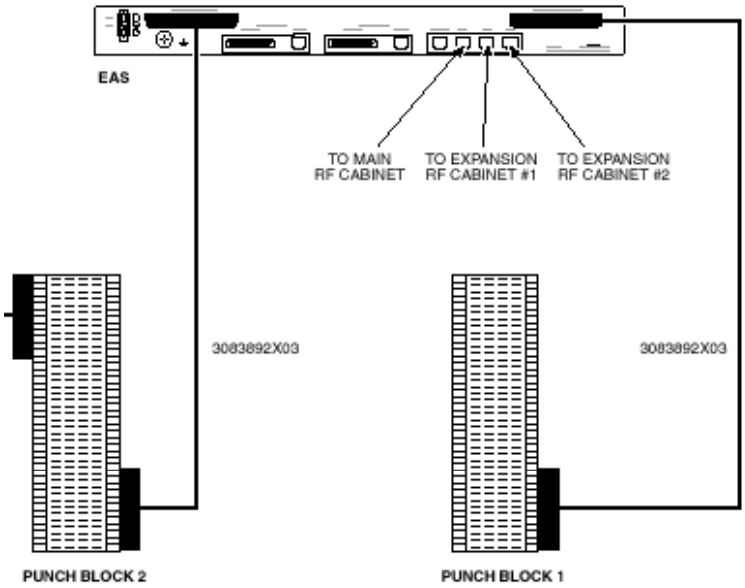


Figure 18 Environmental Alarm Block

Each of the site alarm contacts are normally closed and connected to the EAS through a 50-pin Champ cable that connects to a punch block. All alarm contact pairs must be dry (isolated from ground). Most alarm connections are inputs. Outputs provide a dry relay closure rated at 0.5 Amps, 30 Vrms or 60 Vdc, 10VA max.

Alarm wiring for the main rack terminates directly to the EAS rear panel. Connect the alarm cable as shown in the previous illustration.

Four outputs on the User Alarm/Control and System Alarm/Control connectors are available for customer-defined applications. Diode suppression of inductive surges is required if anything but a resistive load is connected to this output.

Eighteen customer-defined alarm inputs are available on the User Alarm/Control connector. The alarms are reported to the Operations and Maintenance Center (OMC) by the respective alarm code. The OMC must be programmed with the proper alarm name corresponding to each code. All connections on User Alarm/Control and System Alarm/Control connectors must be defined and provided to the OMC to insure the effectiveness of monitoring those alarms.

Backboard

A wall mounted AC grade fire-rated plywood backboard (1/2” x 4’ x 4’) must be provided within the site. Reserve a two square foot area on the Telco backboard for dedicated system use.

A 117 VAC dual receptacle outlet (3 prong) should be installed on or adjacent to the Telco backboard. This outlet can be used for accessories, such as modems and other AC powered devices. It may also be used as a general service outlet.

4.1.2.3 Mandatory Alarms

RFN recommends site installation of the following alarms:

Alarm Code	Alarm Type	EAS standard alarm connection
219	Intrusion alarm	predefined input, site entry
220	High temperature	predefined input, site high ambient temperature
221	Low temperature	predefined input, site low ambient temperature
222	Smoke detector (120 VAC)	predefined input, site smoke detector
242	Power Plant alarms:	AC power failure
243		low DC voltage
244		high DC voltage
245		breaker alarm failure

Alarm Code	Alarm Type	EAS standard alarm connection
246		minor rectifier failure
247		major rectifier failure

4.1.2.4 Surge Arrestors

T1

The T1 surge arrestor must be adequately grounded as outlined in the *Quality Standards Fixed Network Equipment - Installation Manual (R56*). The surge arrestor usually mounts near the demarcation (demarc) point. The cable connecting the surge arrestor to the Telco SmartJack should be locally procured, or should be provided with the surge arrestor. The cable connecting the iSC-3 to the surge arrestor is locally procured.

GPS antennas

All antenna feed lines should terminate with a suitable surge arrestor within 12” inside of the entry window. Each arrestor must connect to the master ground bar located below the entry plate. It is recommended that the arrestors be mounted to a mounting bracket to simplify grounding and cable installation.

AC power (optional)

An RFN customer-approved surge arrestor must be installed adjacent to the AC power panel. Very short wire lengths between the arrestor and the power panel are required for proper operation of equipment.

4.1.2.5 Grounding

Within the site, ground the main rack with a single dedicated connection between the main rack and the master ground bar. The connecting wire must be a #2 AWG green-insulated copper wire.

Use appropriate lugs (and split ring lock washers when possible) with an anti-oxidant grease applied for interior grounding connections and exterior secondary grounding connections. If lock washers are used, they should be placed between the nut and the lug to ensure the mechanical integrity of the connection. The washer must not be secured between the lug and the surface to which it is connected. Painted connections must be scraped clean before applying the anti-oxidant grease and lug.

The main rack (ground bus) must be connected to the site ground using a single dedicated ground wire.


Warning!

Never use a bare or damaged wire for the connection of chassis ground or for the electrical wiring to prevent damage to equipment or potential injury to personnel.

4.1.2.6 Cable Supports

All installations requiring cable trays shall be the responsibility of the RFN customer or its customer. Cable tray requirements vary from site to site and are not specific to the RadioFrame System. All cable tray installations shall receive permits from and be inspected by the local municipality governing tenant improvements, including mechanical and electrical inspections. Site plans, procurement, installation, grounding/bonding, and inspecting of the cable tray shall be the responsibility of the RFN customer or its customer.

4.2 Remote ACUs

To install a remote ACU, first mount the unit then connect the ACU to the NCU and each associated RFU. Repeat the following two procedures for each remote ACU.

4.2.1 Mount the remote ACUs

Mount each remote Airlink Chassis Unit (ACU) as follows:

1 Find these items in the ACU shipping container: one ACU, four mounting screws, and one 120VAC power cord.

2 Mount the ACU only in an EIA-standard compliant (19”) rack using all 4 screws provided. Refer to the site documentation for the exact location of the ACU. For safe operation, follow these guidelines:

- Do not mount the ACU in any orientation other than that specified in the following illustration.
- Mount the ACU so that both the front and the back are accessible.
- If the mounting holes do not line up, adjust the ACU up or down until the mounting holes line up.


Caution

Do not block the air vents on the sides or rear of the ACU.

3 Plug the ACU into an approved power source with the provided power cord.

Caution The power supply cord is used as the main disconnect device; ensure that the socket-outlet is located/installed near the equipment and is easily accessible.

4 Verify that the ACU is receiving power and that all cards installed in the ACU, front and back, are operational.

Each card installed in the front and back of the ACU has two LEDs: Power and Status. All LEDs should light green.

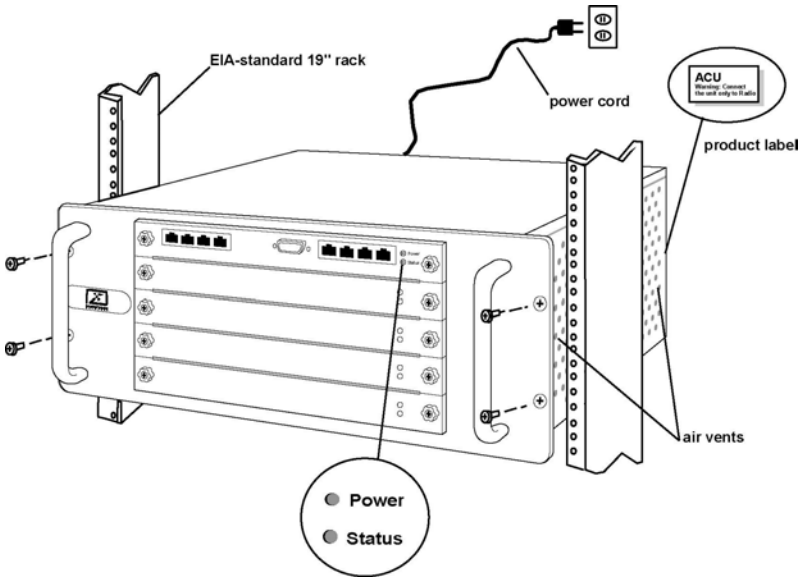


Figure 19 Mount the ACU only in an EIA-standard compliant 19” rack.

4.2.2 Connect the ACUs to the NCU and the RFUs

1 Connect Port 1 on the front of the ACU to the specified port (1-8) on the back of the NCU using an RJ45-to-RJ45 CAT 5 cable (see the following illustration).

2 Verify that the ACU is connected to the NCU.

The Link and Activity LEDs on Port 1 should both light green, and the Activity LED should blink rapidly indicating that the connection to the NCU is operating.

3 Connect the RJ45-to-RJ45 CAT 5 cable for each RFU to the specified port (1-8) on the back of the ACU.

The Link and Activity LEDs on the ports will remain unlit until each RFU has been installed.

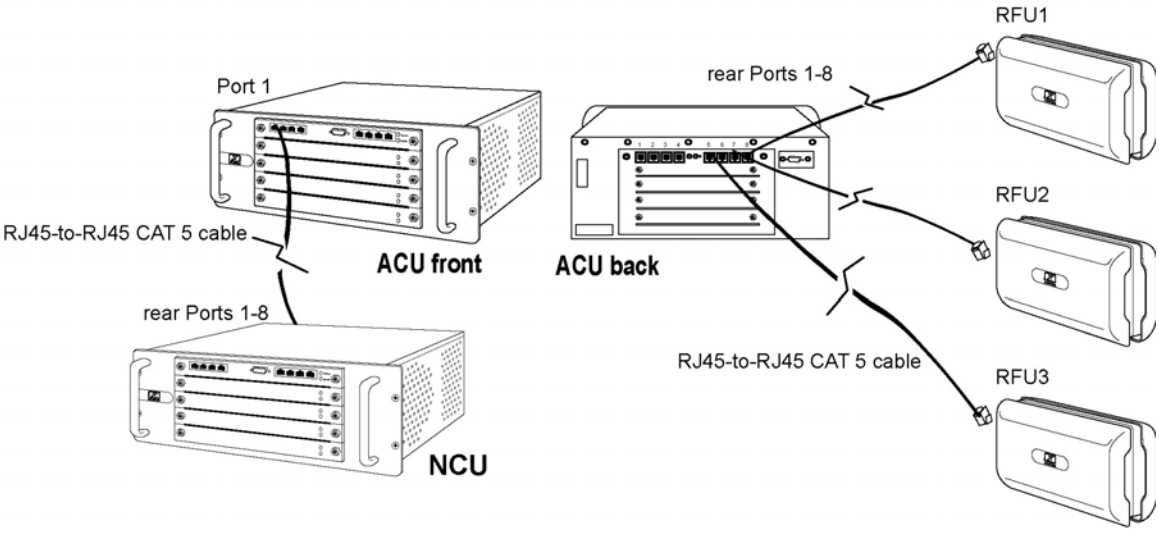


Figure 20 Connect Port 1 on the front of the ACU to the specified port (1-8) on the back of the NCU. Connect RFUs to Ports 1-8 on the back of the ACU.

4.3 URU

The maximum length of CAT 5 wire between RadioFrame System components is 100 meters (approximately 328'). The distance between any two components can be extended by installing additional CAT 5 cabling and up to two URUs.

# of URUs	Maximum CAT 5 Cable Length between RFS components
no URU	100 meters (approximately 328')
1 URU	200 meters (approximately 656')
2 URUs	300 meters (approximately 984')

4.3.1 Installing a URU

Install Universal Repeater Units while wiring the RadioFrame System.

1 Find these items in each Universal Repeater Unit (URU) shipping container: one URU, mounting screws, and one power cord with a 120VAC-to-negative 48VDC converter.

2 Place or mount the URU on any flat surface (see the following illustration).

The URU can be placed or mounted on any flat surface using the provided mounting screws. The URU must be located within 12 feet of an approved power source. Refer to the site documentation for the exact location of each URU.

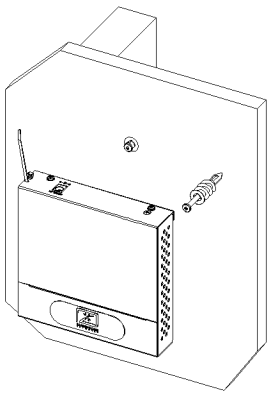


Figure 21 The URU can be placed or mounted on any flat surface.

3 Plug the URU into an approved power source, then, using the tie wrap attached to the URU, secure the power cord to the unit.

4 Verify that the URU is receiving power.

The Power and Status LEDs should both light as green.

4.3.2 Changing the URU Mode of Operation

On the bottom of the URU is a dip switch that is in the “Auto Sense” configuration by default (see the following illustration). If the URU receives 48 Volts DC on either “IN” connector, it will output 48 Volts DC on its respective “OUT” connector. If any other mode of operation is required, set the dip switches as follows:

DIP Switch Number	Desired Mode of Operation		
	Auto Sense Power In/Out	48VDC Output On	48VDC Output Off
1	OFF	ON	OFF
2	OFF	ON	OFF
3	ON	OFF	OFF
4	ON	OFF	OFF

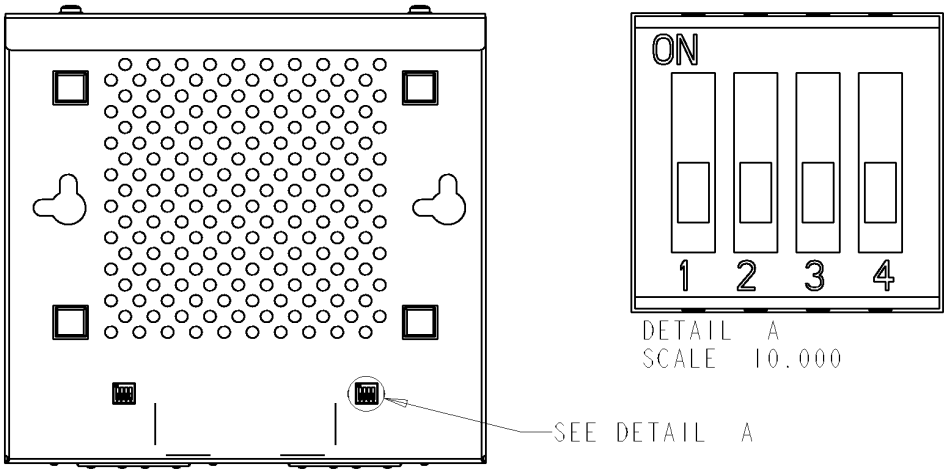


Figure 22 The URU dip switch is located on the bottom of the unit and is used to configure the input and output power for the unit.

4.4 RFU

This section describes the methods used to mount an RFU, including both wall and ceiling mounts. The RFU is shipped with mounting screws and anchors, two mounting templates (wall and ceiling), one ceiling bracket (optional), and two ground straps (one 3-hole and one 4-hole) for the iDEN RadioBlades.

First, mount an RFU, then connect it to the ACU and verify that the RFU is receiving power from the ACU. Next, insert the RadioBlades into the RFU in the configuration specified in the site documentation, and replace the front cover on the RFU.

4.4.1 Mounting and Anchoring

The RFU is to be installed on a wall or on or above the ceiling. The RFU is to be fix-mounted on indoor permanent structures providing a separation distance of at least 8 inches (20 cm) from all persons during normal operation and 10 feet (3 meters) from other RFU mounted assemblies.

The RadioFrame Unit (RFU) is not intended for mounting to drop ceilings. Mounting this unit to a drop ceiling voids any warranty, expressed, implied, or otherwise. Mounting this unit to a drop ceiling voids any regulatory agency approvals, including, but not limited to, Underwriters Laboratories (UL), Canadian Standards Association (CSA), and the European Community (CE).

NOTE: Mounting the RFU directly to a drop ceiling is expressly forbidden by the National Electric Code (NEC), National Fire Protection Association (NFPA), and the Uniform Building Code (UBC). RadioFrame Networks is not liable for any direct, indirect, special, incidental, or consequential damages arising out of

mounting this unit in any fashion not recommended and approved by RadioFrame Networks. This includes, but is not limited to, damage to, or loss of, equipment, loss of data, or loss of profit, even if RadioFrame Networks was advised of the possibility of such damages

4.4.1.1 Wall Mount

1 Place the 11” x 17” drawing template (P/N 981-1020-00) on the wall where the RadioFrame Unit is to be mounted.

2 Mark the two locations indicated on the template.

3 Screw the two supplied anchors into the locations as shown in the following diagram.

4 Screw the two supplied screws into the anchors, leaving approximately 1/4” of each screw exposed.

5 Hang the RFU on the anchors and fully tighten both screws.

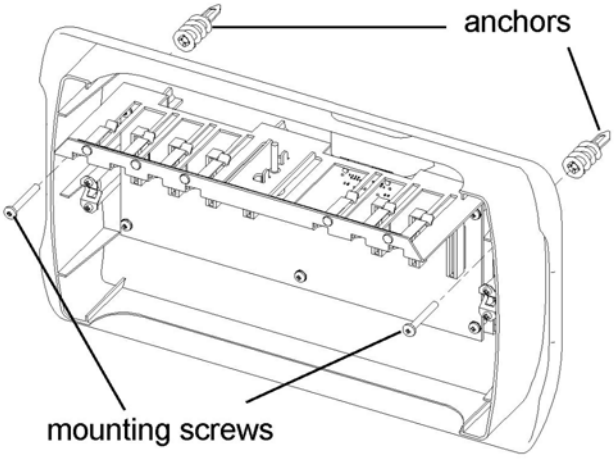


Figure 23 A wall mount requires two screws to anchor the RFU.

4.4.1.2 Ceiling Mount

1 Place the 8.5” x 11” drawing template (P/N 981-1010-00) on the ceiling where the RFU is to be mounted.

2 Mark the four locations indicated on the template.

3 Drill four holes with the appropriately sized bit: 3/16” for the provided wood screws, or 9/32” for 1/4” bolts (bolts not provided).

If using the provided wood screws, ensure that all four screws penetrate wood. Otherwise, use alternative mounting screws or bolts to secure the ceiling bracket.

4 Using four screws or bolts, attach the ceiling bracket to the ceiling as shown in the following diagram.

5 Attach the RFU to the ceiling mount bracket and fully tighten the thumbscrew.

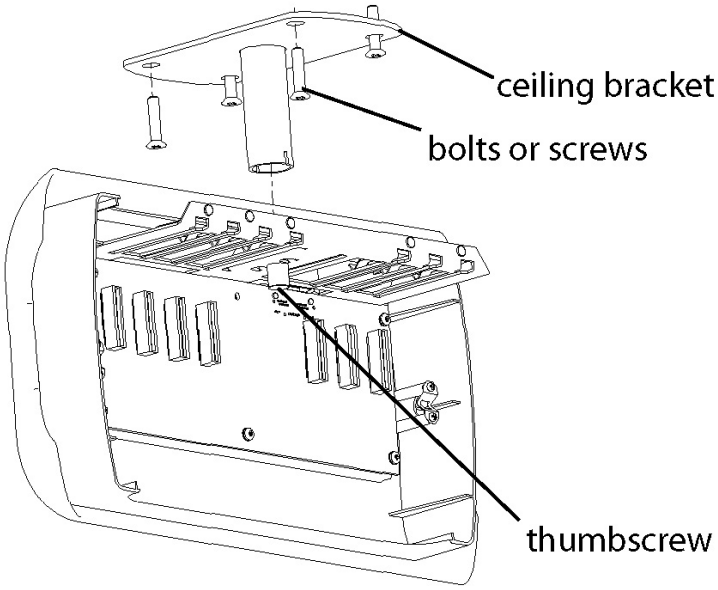


Figure 24 Use the provided bracket when mounting an RFU on the ceiling, ensuring that all bolts or screws penetrate wood.

4.4.2 Connect the RFUs to the ACUs

1 Connect the RJ45 port labeled MAIN on the top of the RFU to the ACU using an RJ45-to-RJ45 CAT 5 cable (see the following illustration).


Caution

Do not remove the protective cover from or use the RFU port labeled AUX. Damage may occur to the RFU, ACU, or both.

2 Verify that the RFU is receiving power and connectivity from the ACU.

The Link and Activity LEDs on the MAIN port should light as green, and the Activity LED should blink rapidly indicating connectivity. If the LEDs do not light, verify that the ACU is powered on, and if a URU is installed between the ACU and RFU, that the URU is receiving power.

3 Complete the next procedure “Insert the RadioBlades” before placing the front cover on the RFU.

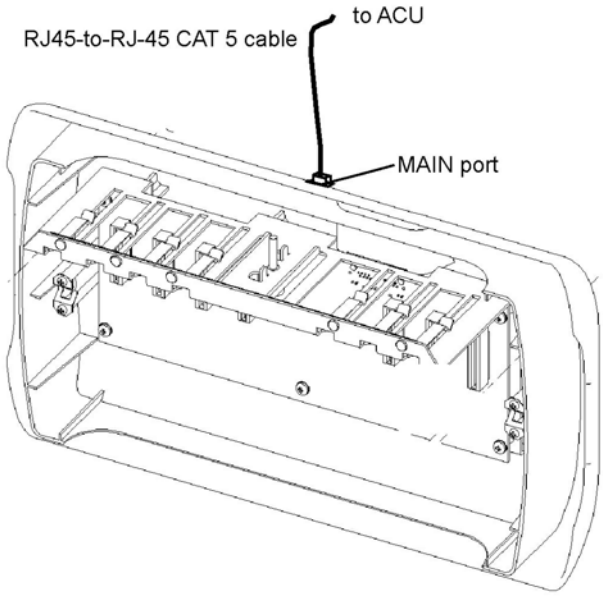


Figure 25 Connect the RFU to the ACU, then ensure that the RFU is receiving power and connectivity from the ACU.

4.4.3 Insert the RadioBlades and RAPs into the RFU

The iDEN RadioBlades and 802.11 RAPs are shipped several to a box in individually wrapped antistatic packaging. Each box of RadioBlades/RAPs includes a disposable antistatic wrist strap to be used when inserting the RadioBlades/RAPs into the RFU. Refer to the site documentation for the exact slot location of each RadioBlade/RAP within the RFU.

1 Unwrap 30 cm (12”) of the disposable wrist strap and wrap the adhesive side around your wrist.

2 Unroll the rest of the band and remove the liner from the copper tape.

3 Attach the copper tape to the metal card cage inside the RFU.

4 Un-package the iDEN RadioBlades to be inserted in the RFU.

5 Insert the iDEN RadioBlades, one at a time, into the specified slots (1 through 7) in the RFU until the connector on each RadioBlade seats firmly into the back of the RFU (see the following illustration).

6 Unscrew the antenna from each iDEN RadioBlade, one at a time, and place the antennas on an antistatic surface (see the second following illustration).

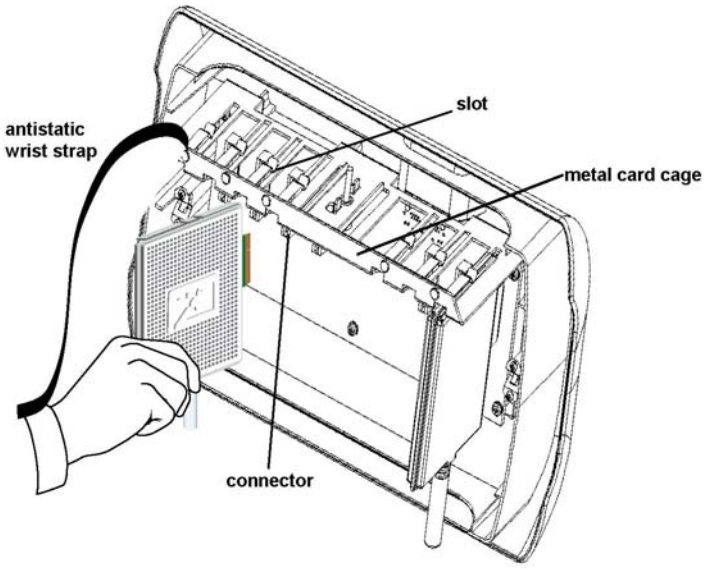


Figure 26 Slide each iDEN RadioBlade into the specified slot in the RFU.

7 Place the provided ground strap over the SMA connectors using either the 3-hole ground strap (P/N 510-0931-99) or the 4-hole ground strap (P/N 510-0933-99) depending on the number and configuration of iDEN RadioBlades in the RFU (see the following illustration).

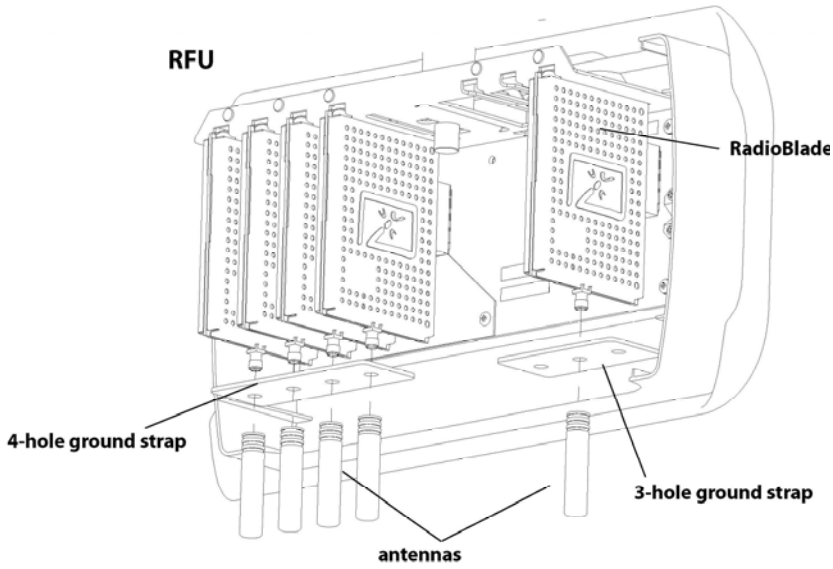


Figure 27 Place the ground strap(s) between the iDEN RadioBlades and their antennas.

8 Holding the ground strap in place, replace each iDEN RadioBlade antenna one at a time.

9 Insert the 802.11b RAPs, one at a time, into the specified slots in the RFU until the connector on each RAP seats firmly into the back of the RFU (see the following illustration).

10 Remove the antistatic wrist strap and place the front cover on the RFU.

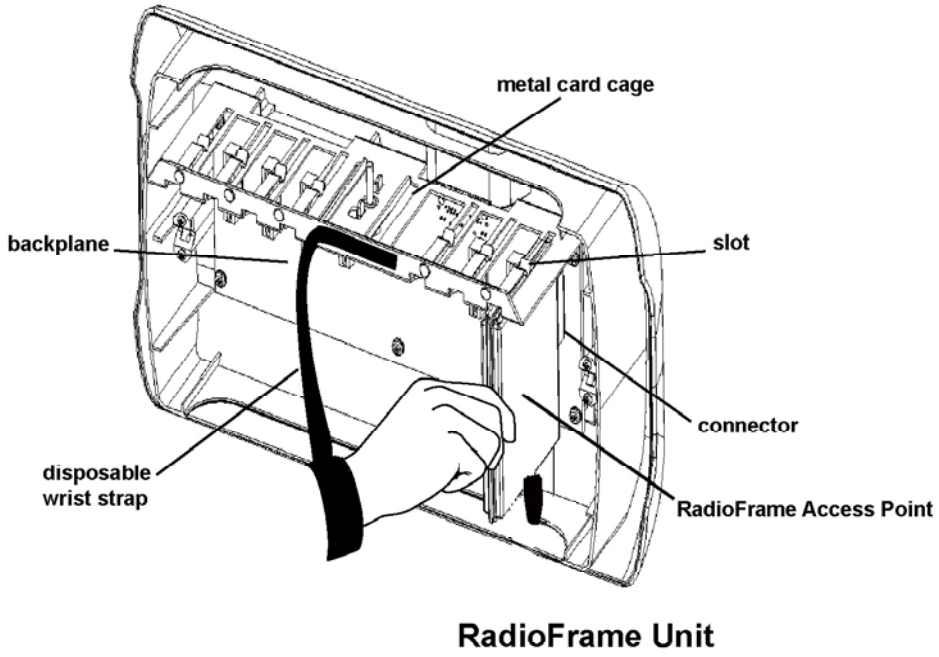


Figure 28 Insert the 802.11b RAPs into the specified slots of the RFU.

4.5 Interconnecting Cabling

4.5.1 T1

The Telco interface should have been installed according to the Pre-installation chapter.

NOTE: The equipment can be installed and tested without the Telco T1/E1 present. The T1/E1 must be connected for proper operation of the site.

NOTE: Some modular cables have a ridge along one side of the cable for purposes of alignment with the connector.

NOTE: The SmartJack is capable of passing -48V Telco power through to the site controller. For operation, iDEN does not require this power. If -48V is present

on the network connection to the site controller, the SmartJack is incorrectly configured. Contact the service provider immediately to correct this situation. The SmartJack switch should be set so that -48V power does not pass through to the site controller.

If this cable is locally manufactured, crimp the 8-pin connectors as shown in the following illustration. The wires should be routed straight through. Make sure that the conductor color is the same at both ends for each conductor of the cable.

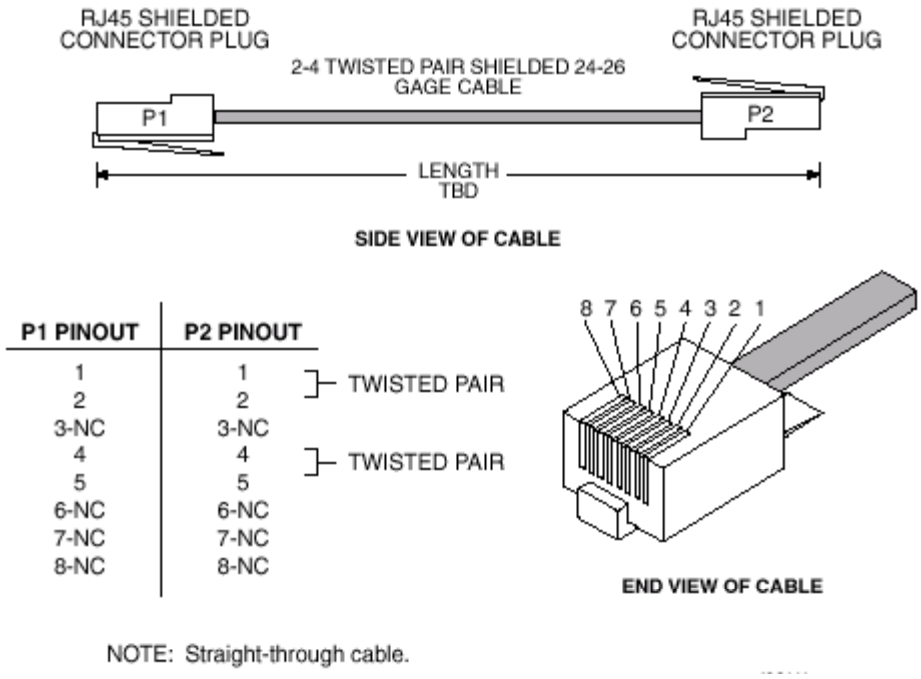


Figure 29 T1 interface cable configuration

4.5.2 RFS to iDEN Interface

To connect the RFS to the iDEN Interface, connect the NCU to the iSC-3 using an Ethernet Media Converter. The Ethernet Media Converter is shipped with other RadioFrame System equipment in its own container with all the cables necessary to install it.

Connecting the NCU to the iSC-3

1 Find these items in the shipping box: one MC15 Ethernet Media Converter, Allied Telesyn User Guide (contains all product specifications), four rubber feet, one AC-DC power adapter, one 10BaseT Ethernet cable (straight-through RJ45-to-RJ45 CAT 5 cable), and one 10Base2 cable (50 ohm coaxial

cable with two male BNC connectors; one connector is a tee adapter terminated on end of the tee—this end is connected to the iSC-3).

2 Lay the Ethernet Media Converter on any flat surface following these guidelines:

- Do not block the air vents on the sides of the Ethernet Media Converter.
- Mount the Ethernet Media Converter so that both the front and back are accessible.

3 Plug the Ethernet Media Converter into an approved power source using the provided power adapter (use of a different cord may void the warranty and/or cause electrical fire and damage).

4 Set the Terminator switch on the front of the Ethernet Media Converter to “On”, and set the MDI switch to “MDI-X” (see the following illustration).

5 Connect Port 1 on the front of the NCU to the 10BaseT port (RJ45) on the Ethernet Media Converter using the provided straight-through CAT 5 cable.

6 Connect one of the three 10Base2 ports on the back of the iSC-3 (port to be specified by the RFN customer) to the 10Base2 port on the Ethernet Media Converter.

Use only the provided 10Base2 cable: 50 ohm coaxial cable with two male BNC connectors; the terminated tee adapter connector connects to the iSC-3 *only*.

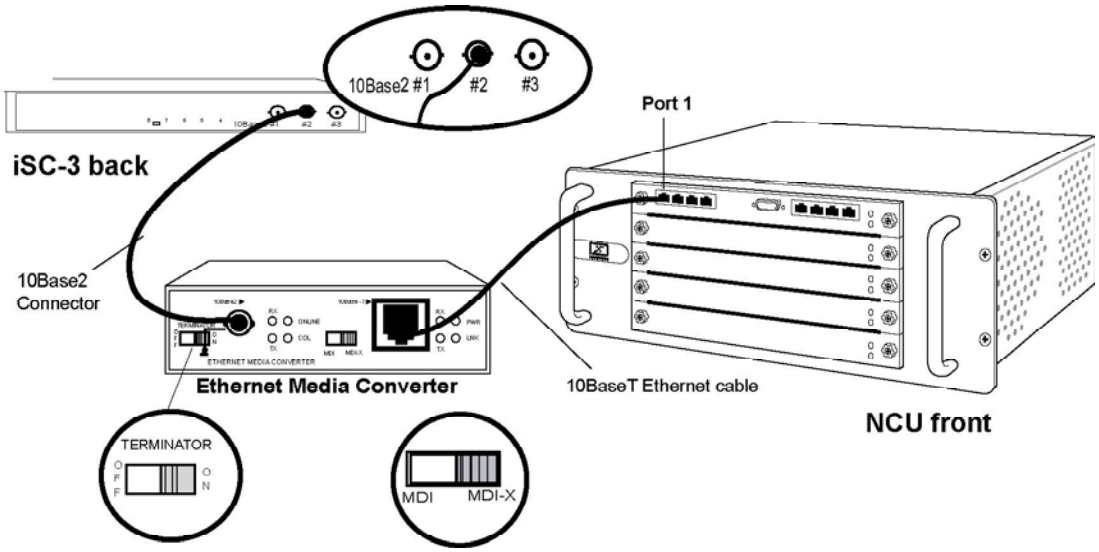


Figure 30 Connecting the RFS to an iSC-3 requires using an Ethernet Media Converter.

4.5.3 RFS to Customer LAN

The RFS is connected to the customer LAN only after all other connections have been made and all other system functionality has been tested and is performing accurately. The RFS is connected to the Customer LAN using an RJ45-to-RJ45 CAT 5 cable. For more information, refer to Chapter 6 “Connecting the RFS to the Customer LAN”.

4.5.4 Punch Block to EAS

Each alarm is connected to a pair of terminals on the punch block, the upper terminal of the pair represents the return and the lower terminal represents the hot side (see the following illustration). For example, on the first numbered pair of the punch block 26 represents return and 1 represents the hot side. The punch block wiring as it appears here is the recommended wiring.

The EAS connector and pin label information refers to the connectors on the EAS itself. Only the alarm code number is passed to the OMC. The following table shows those alarms that connect from the System/Alarm/Control connector on the back of the EAS to punch block 1.

Alarm Code	Punch block 1 pairs	EAS standard alarm connection
219	7, 32	predefined input, site entry
220	8, 33	predefined input, site high ambient temperature
221	9, 34	predefined input, site low ambient temperature
222	10, 35	predefined input, site smoke detector
242	12, 37	AC power failure
243	13, 38	low DC voltage
244	14, 39	high DC voltage
245	15, 40	breaker alarm failure
246	16, 41	minor rectifier failure
247	17, 42	major rectifier failure

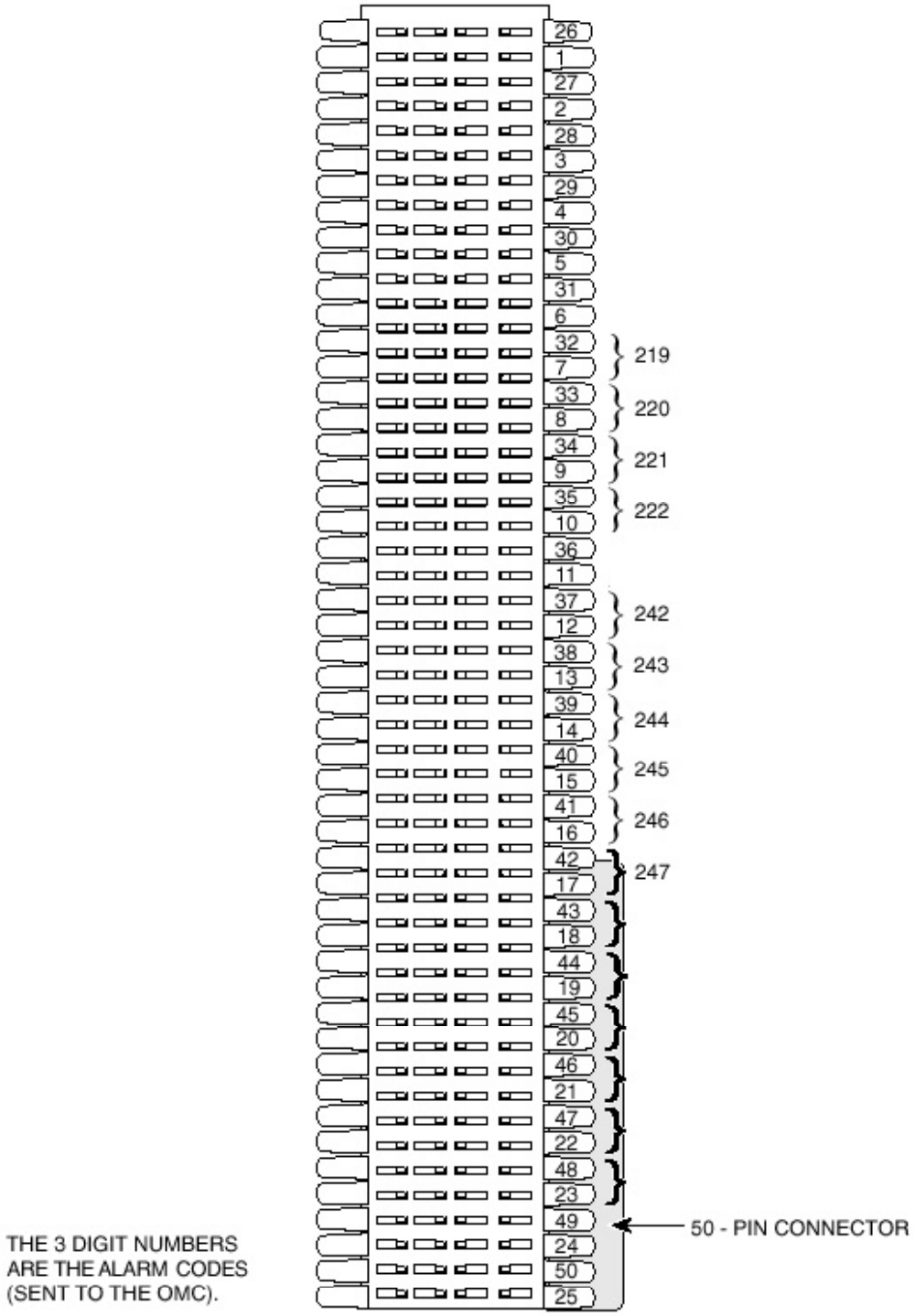


Figure 31 Punch Block 1: EAS pinout

5 Equipment Commissioning

The procedures in this chapter describe how to conduct final checkout and system test procedures for each portion of the iDEN/802.11 RadioFrame System, including the iDEN Interface, the Power Plant, and the RFS. Following the successful completion of procedures described in this chapter, the RFS can be connected to the customer LAN as described in Chapter 6 “Connecting the RFS to the Customer LAN”.

The procedures in this chapter are to be used in conjunction with troubleshooting and repair information provided in Chapter 7 Operations and Maintenance and the RFN document, *Field Guide to the RadioFrame System*. Together, these troubleshooting solutions and commissioning procedures provide the necessary information to isolate failures to a Field Replaceable Unit (FRU). This minimizes system downtime by quickly returning the site to normal operation.

This chapter’s procedures check system functions and help isolate failures down to the FRU level. If a failure cannot be isolated after performing these tests, refer to Chapter 7 “Operations and Maintenance” for technical assistance information.

5.1 iDEN Interface

Perform the following procedures described in the *Gen 3 Site Controller System Manual*, Motorola, 68P80801E30-O:

Chapter	Procedure Title
5 Final Checkout	Final Checkout Setup
	Powering the Site Controller Rack
	Circuit Breakers
6 System Testing	Site Controller Startup Sequence
	T1 Connection Test
	EAS Alarm Checkout
	GPS Status

5.2 Power Plant

Perform the following procedures described in the *PEC 127NHL Manual*, PECO II, 438127NHL-IBWS-PD:

Chapter	Procedure Title
4 Initial Turn On and Acceptance Test Procedures	Complete Operational Checkout
	Alarm Tests
	BTC Probe Compensation Test

Chapter	Procedure Title
	Test Completion
	GPS Status

5.3 RadioFrame System

After installation of all RadioFrame Networks equipment, including verification that each unit is receiving power, start the System Manager to complete the installation of the RadioFrame System.

The System Manager automatically downloads information about each component in the RFS, including assigned IP addresses, sector information, port connections, and component status, as well as specifying default information that can be changed, or 'configured'.

To configure each system component, you will specify a device name, adding building/site location information for each component. Anytime an RFU port connection is moved or changed, or when an NPC or APC is moved to another slot within the same chassis unit (NCU and ACU, respectively), you must restart the System Manger to download the new information. For other RFS component changes, restarting is not required, however, RFN recommends validating that the port change is reflected in System Manager. When new releases of System Manager are provided, download the new release as described in section 7.1 Upgrading System Software.

NOTE: During configuration, verify that the following information displayed in System Manager matches the Equipment Inventory. If any changes are made in System Manager, those changes must also be shown on the Equipment Inventory or site as-built documentation.

- Physical location
- IP addresses
- Port connections
- Sector locations

5.3.1 Start System Manager

1 Using a 9-pin serial cable, connect a laptop computer to the RS232 port on the front of the NCU.

2 Start the browser on the laptop, and enter the provided URL to start System Manager.

The System Manager Home page appears (see the following illustration). System Manager contains five tabs you select from to set up and monitor the RadioFrame System:

- *Home*—displays a welcome banner and a link for setting up users and changing the RFS password.
- *System Configuration*—displays the configuration of each RFS component, and depicts the location and status of each component, including the NCU, ACUs, and RFUs.
- *Alarms*—displays alarm information for each component of the RFS.
- *Performance Monitoring*—displays real-time performance information about the RFS.
- *Support*—displays support information, including online help.

3 To log in, select any tab except the Home tab.

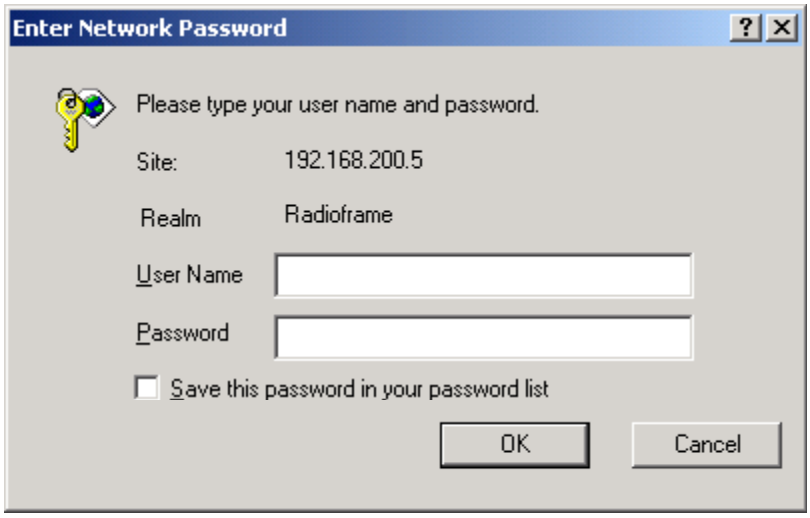
The login page appears (see the following illustration).

4 For **User Name**, type your RFS user name.

5 For **Password**, type your RFS password.

6 To save the password so you don't have to retype it the next time you log in, check '**Save this password in your password list**' checkbox.

7 Select **OK**.



5.3.2 Navigating the System Configuration

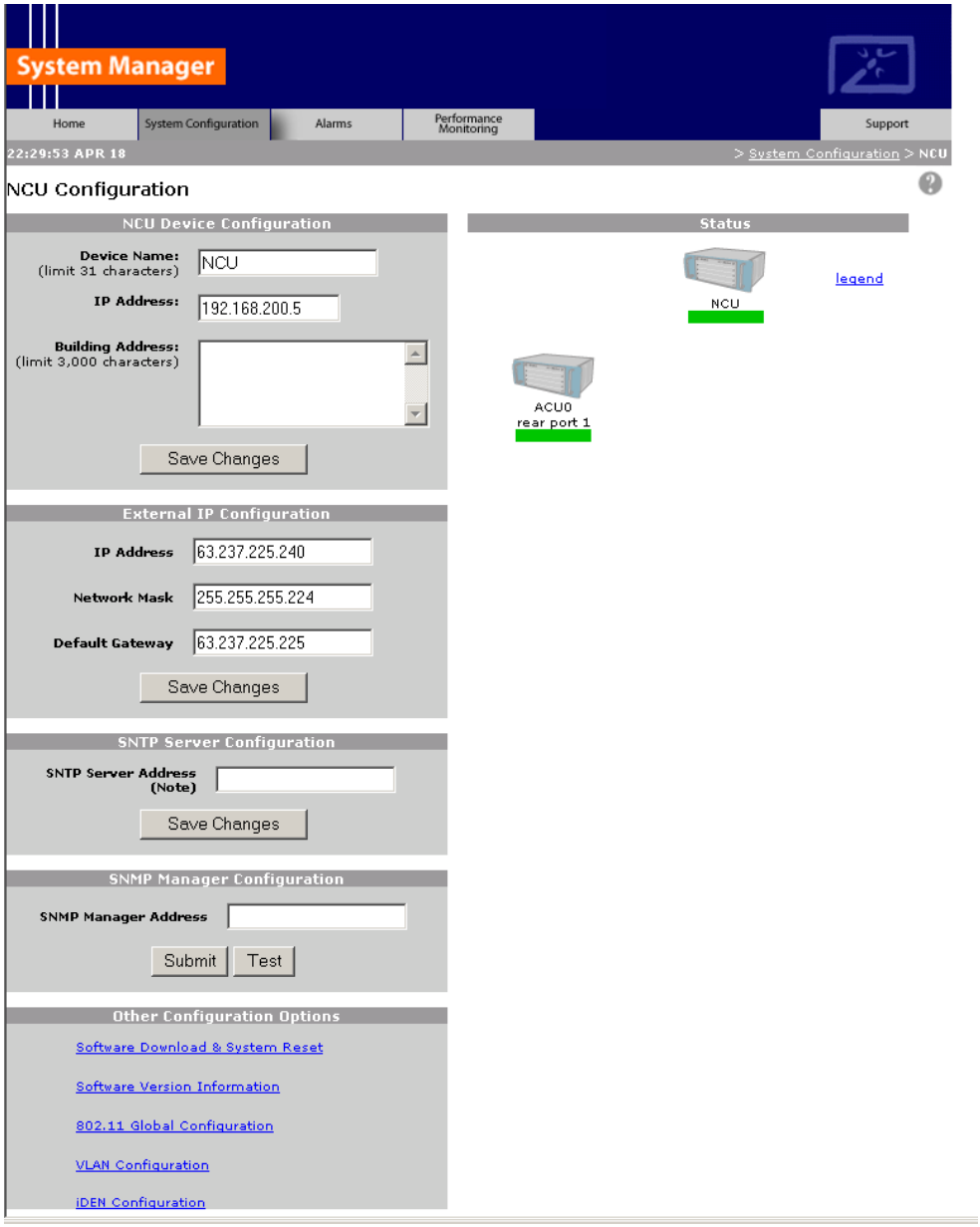
The System Configuration displays icons representing each component included in the RFS starting with the NCU (see the following illustration). In the following example, one ACU is connected to the NCU: ACU0 is connected to the NCU via rear port 1. Generally, ACU0 is the ACU located in the main rack, while ACU1 through ACU7 are remote ACUs. Configuration information for the NCU is displayed on the left side of the page, including the device name and IP address.

1 To view configuration information for an ACU, select its icon.

A page similar to the NCU page appears displaying configuration information for the selected ACU and icons for each RFU connected to the ACU. In the same way you can view the status of each iDEN RadioBlade installed in every RFU in the RFS by selecting an RFU icon.

2 To return to a previous page, select the component pathname shown at the top of the tab (System Configuration>NCU>ACU…).

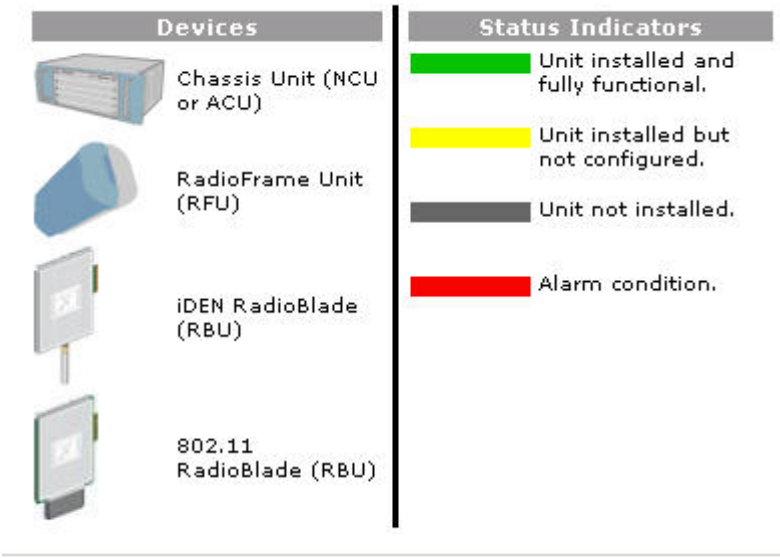
3 To return to the NCU, select the System Configuration tab at any time.



5.3.3 Checking the Status of RFS Components

The colored bar beneath each component icon shows the status of that component. Select legend on any System Configuration page to display the legend of available status conditions (see the following illustration). The legend displays the icon representations of each component of the RFS as well as each available status condition.

Status Indicator	Description	Action
Green	Unit Installed and fully functional	The component has been installed, configured, and is operating as it should.
Yellow	Unit installed but not configured	Component has been installed and the System Manager software is still configuring the component. When System Manager has finished startup (10 to 20 minutes), the status will turn to green, unless there's a problem with the unit.
Gray	Unit not installed	Component has not yet been installed.
Red	Alarm condition	The component has returned an alarm condition. Refer to Section 7 "Operations and Maintenance" for specific alarm conditions pertaining to the component.



5.3.4 Configuring the NCU

The NCU System Configuration page displays the **NCU Device Configuration**, including the Device Name, IP Address, and Building Address for the NCU—you can change this information at any time. This page also displays the **External IP Configuration**, the information that systems outside the RFS use to recognize the RFS, the **SNTP Server Configuration**, and **Other Configuration Options**.

1 For **Device Name**, enter up to 31 alphanumeric characters to uniquely identify the NCU.

2 The **IP Address** is assigned during the installation of the RFS. You don't need to change the value of this internal address.

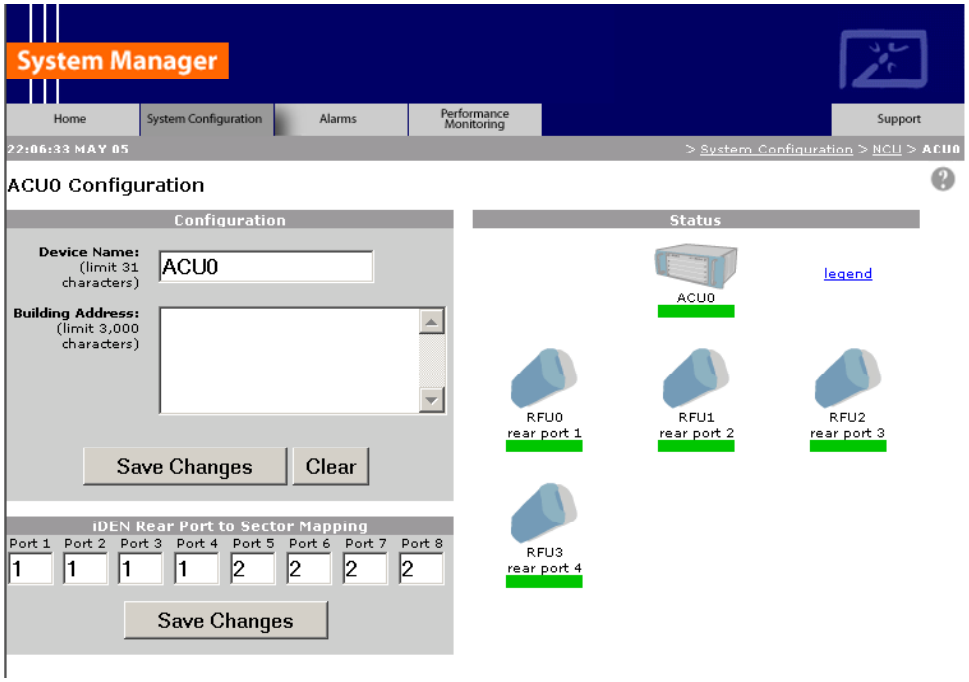
3 For **Building Address**, enter up to 3,000 alphanumeric characters specifying the location of the NCU.
You can describe the street address, mailing address, building, and other site information, as well as the building floor, telco closet, and rack to indicate the location of the unit.

4 Select **Save Changes**.

5.3.5 Configuring the ACUs

Configure each ACU as you would the NCU, by entering a device name and site address information (see the following illustration). For each ACU, the System Configuration page shows the RFUs connected to the ACU (by port) and which ACU ports are dedicated to which sectors in the iDEN installation. Sector information is provided to the RFS via the iSC-3 data fill.

1 Navigate to the page of the ACU you want to configure.



2 For **Device Name**, enter up to 60 alphanumeric characters to uniquely identify the ACU.

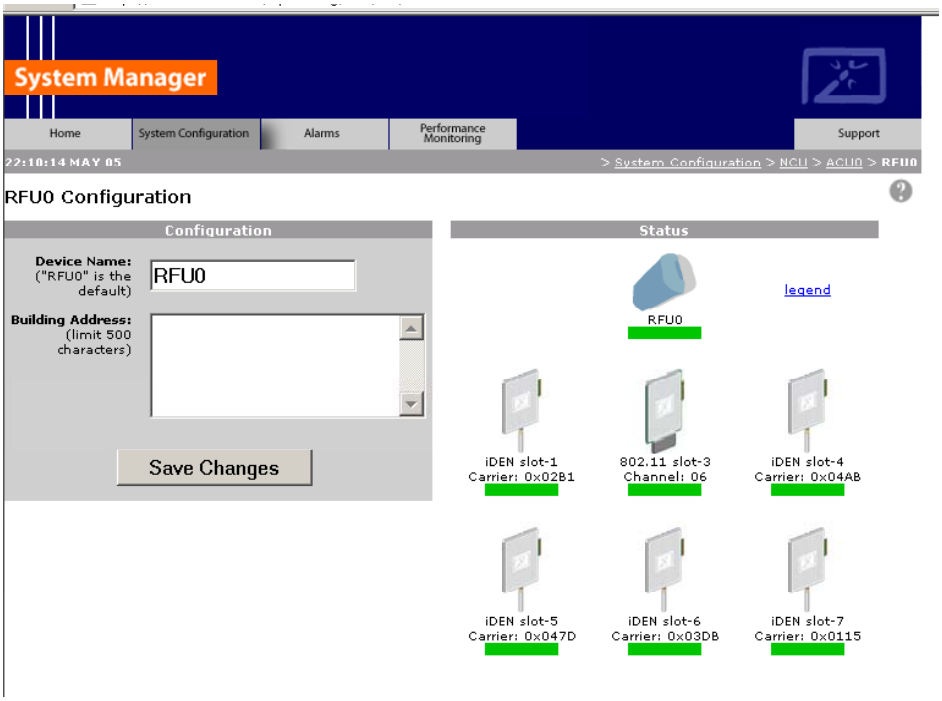
3 For **Building Address**, enter up to 3,000 alphanumeric characters specifying the location of the ACU.
You can describe the street address, mailing address, building, and other site information, as well as the building floor, telco closet, and rack to indicate the location of the ACU.

4 Select **Save Changes** or **Clear** to start over.

5.3.6 Configuring the RFUs

Configure an RFU as you would the NCU or ACU, by entering a device name and site address information. For each RFU, the configuration page shows the iDEN RadioBlades and RAPs inserted into the RFU by slot.

1 Select the icon of the RFU you want to configure.



2 For **Device Name**, enter up to 60 alphanumeric characters to uniquely identify the RFU.
Use names that are meaningful to the installation.

3 For **Building Address**, enter up to 3,000 alphanumeric characters specifying the location of the NCU.
You can describe the street address, mailing address, building, and other site information, as well as the building floor to indicate the location of the unit.

4 Select **Save Changes**.

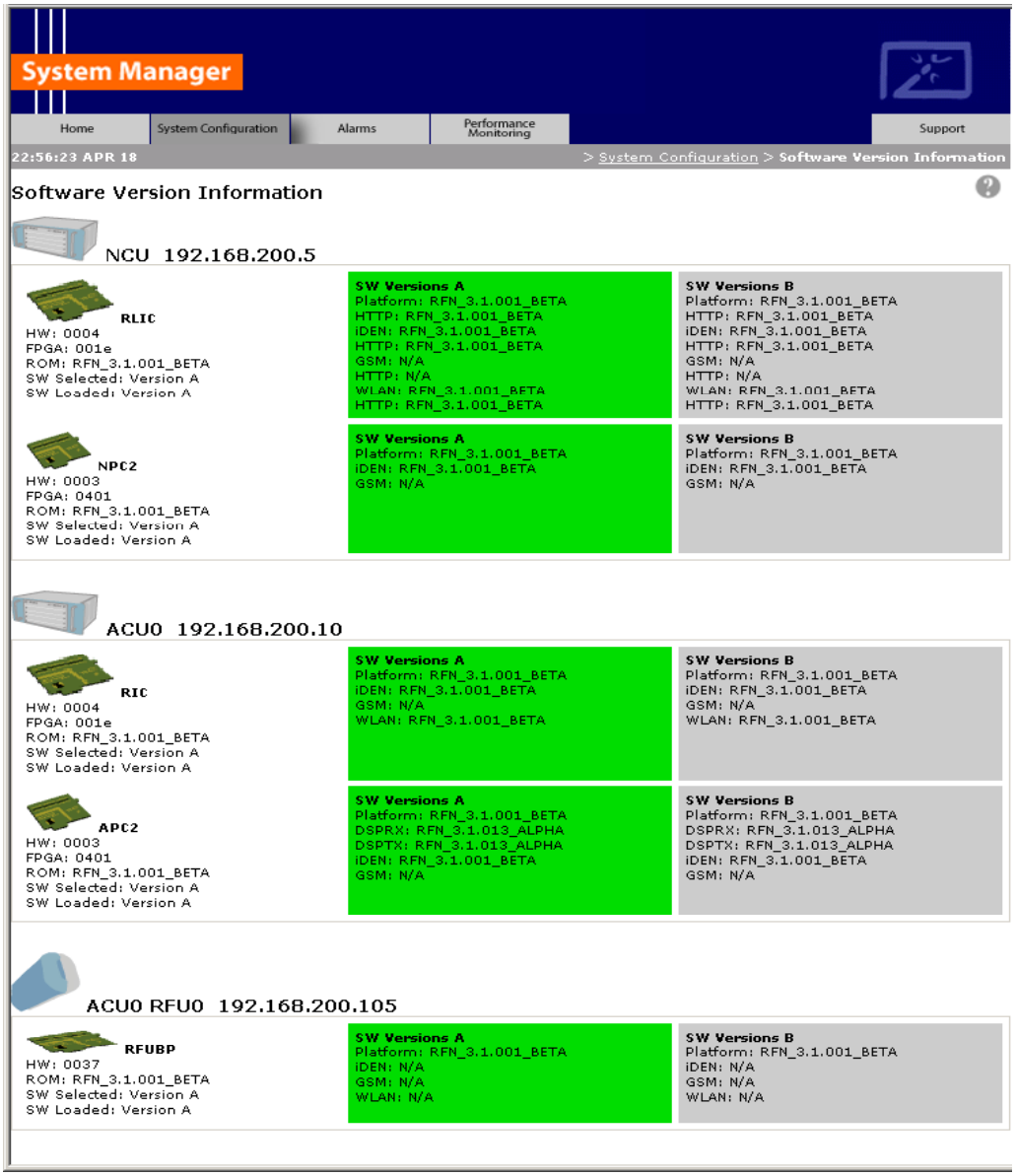
5.3.7 Viewing Hardware and Software Versions

1 On the System Configuration (the 'NCU Configuration') page, select the link Software Version Information in the **Other Configuration Options** section.

The Software Version Information page depicts component in the RFS, and each board installed in that component (see the following illustration). For each board, the page lists:

- HW—hardware version of the component

- FPGA—Field Programmable Gate Array version (manufacturer defined)
- ROM—software loaded onto board at time of shipment
- SW Selected—currently selected software version, A or B
- SW Loaded—currently loaded software version, A or B
- SW Versions A—Software version
- SW Versions B—Software version



5.3.8 Changing the Default iDEN BR Cabinet Position

The RadioFrame System operates as a series of base radios. Each iDEN RadioBlade in the RFS is assigned a BR ID and sector (1, 2, or 3). Each BR in the RFS is assigned a default cabinet position in the iSC data fill.

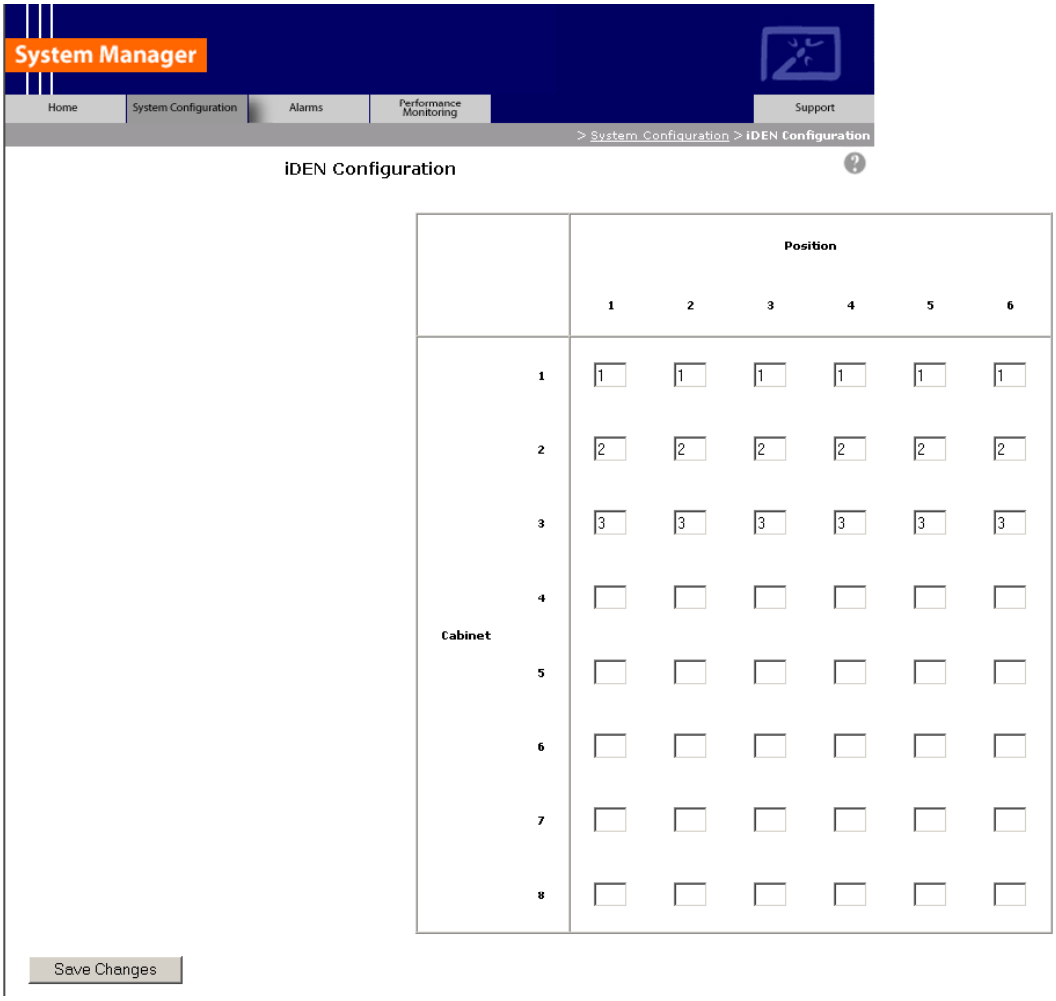
To change the default Cabinet Position:

1 Select the iDEN Configuration link at the bottom of the System Configuration tab.

The iDEN Configuration page appears (see the following illustration).

2 Enter the new cabinet position for the specified RFS BR(s).

3 Select the Save Changes button to save your changes.



5.4 Coverage Validation

Once the components of the RadioFrame System have been configured, use iFTA-software, a laptop and an iDEN handset to check for regions of low signal strength. If increasing the transmit power from one or more local RFUs does not resolve the problem, adding another RFU is the surest remedy.

5.4.1 Detailed Building Plans—RF Modeling

Testing by RFN has shown that simple Linear Attenuation Models (LAM) as discussed in COST 231, Chapter 4 section 4.7 “Indoor Propagation Models” work well provided they are used on a floor-by-floor basis. An attenuation coefficient of 0.62dB/m is recommended for dense, single-floor propagation, but this can double if concrete walls are present.

5.4.2 Measurement-based Estimate

A battery-powered test transmitter can be moved between each RFU location and a handheld signal strength meter used to monitor RSSI. This method can be useful when RF penetration is desired through suspect walls or where wall construction data is lacking. Generally, this method provides good agreement when it is used to identify regions of poor coverage rather than to establish sufficient coverage zones. This is because it is usually inconvenient to duplicate an RFUs’ position during initial coverage surveys.

5.4.3 Floor Plan Estimate

Oftentimes, only simple floor plans are available for the building in which the RFUs are to be installed. Without specifics about the building construction, such as interior wall, floor and ceiling construction, propagation models are of limited value. A measurement-based approach (discussed earlier) works well, but for simple buildings, installing RFUs at the candidate locations and then testing the results will likely be adequate. If regions of poor coverage are found, transmit power can be increased or if necessary, additional RFUs added.

5.5 Site Acceptance Guidelines

5.5.1 Site As-Built Documentation

As-built documentation consists of the original site development documentation with post-installation information. On the job, installers use site development documentation for reference, to make notes, and to document completion of each step of the installation.

Conduct an onsite walk through to verify that the following Site Development Punch List items have been properly installed. This inspection ensures that the site installation meets quality standards.

- Grounding
  - buss bar OK (optional)
  - NCU/ACU rack(s)
  - rectifier rack
  - battery shelf (GNB)
- Peco II Rectifier Voltages (measured voltages)
  - float voltage
  - equalize voltage
  - high voltage
  - low voltage
  - low voltage pickup
  - low voltage drop out
- Battery Information (for batteries 1 through 8)
  - Plant voltage
  - Measured voltage
  - connections corroded
  - terminals greased
  - signs of leakage
- Main Rack
  - EAS revision complete
  - CSU grounded
  - 5 MHz ‘A’ split with ‘T’
  - 5 MHz ‘B’ split with ‘T’
- T1 Information, Primary and Secondary
  - T1 circuit ID#
  - T1 surge arrestor installed/grounded
  - T1 repeater shelf / cfl cabinet location
  - T1 level at extended demarc (RJ48 x jack)
- Summary
  - log book at site with recent entry
  - outstanding issues/punch list items for site
  - defective equipment found/replaced

5.5.2 Site As-Built Acceptance Test Procedures

Complete the test procedures described in this section to record the site as built.

5.5.2.1 Grounding

Record the following grounding information. For any unacceptable item, take corrective action and record what occurred, or record the item for the next site visit.

	Yes	No
Buss Bar O.K. (optional)		
NCU/ACU rack(s)		
Rectifier rack		
Battery shelf (GNB)		

5.5.2.2 Power Plant

Measure and record the following voltages for the Peco II rectifier. (For further information, refer to the product specification information provided by Peco II, Inc., the rectifier manufacturer: *Small DC Power Systems*, Spec. No. 127NHL.)

		GNB	Dynasty		
Float voltage	Suggested	-54.0 vdc	-54.8 vdc	**Measured at**	
Equalize voltage	Suggested	-56.4 vdc	-58.4 vdc	**Measured at**	
High voltage	Suggested	-56.0 vdc	-58.0 vdc	**Measured at**	
Low voltage	Suggested	-43.0 vdc	-43.0 vdc	**Measured at**	
Low voltage Pick-up	Suggested	-46.0 vdc	-46.0 vdc	**Measured at**	
Low voltage drop-out	Suggested	-42.0 vdc	-42.0 vdc	**Measured at**	

5.5.2.3 Battery

Record the following information for each of the eight batteries.

	Plant Voltage	Measured At	Connections Corroded (Y/N)	Terminals Greased (Y/N)	Signs of Leakage (Y/N)
Battery 1					
Battery 2					
Battery 3					
Battery 4					
Battery 5					
Battery 6					
Battery 7					
Battery 8					

5.5.2.4 Main Rack

Record the following information for the main rack.

	Yes	No
CSU grounded		
5 Mhz “A” split w/ “T”		
5 Mhz “B” split w/ “T”		

5.5.2.5 T1 Line

Record the following information for the T1 line.

T1 circuit ID #	Primary		Secondary	
T1 surge arrestor installed/grounded	**Yes**		**No**	
T1 repeater shelf/cfl cabinet location	**Inside**		**Outside**	
T1 level at extended demarc (RJ48x jack)	**+/- dbsx**		**Voltage**	

5.5.3 RadioFrame System As-Built Documentation

As-built documentation for the RadioFrame Networks equipment includes the following:

- Equipment inventory
- Cabling pathways
- Floor Plan with site configuration and component locations

5.5.3.1 Equipment Inventory

The final Equipment Inventory should show the following information for the RFS components installed:

- Part number
- Serial number
- Rack position (NCUs and ACUs only)
- Card position (APCs and NPCs only)
- RFU location (including floor and sector)
- iDEN RadioBlade and RAP positions in RFU
- Universal Repeater Unit (URU) location
- MAC Address
- IP Address

- Channel (RAPs only)
- Port connections between RFS components

5.5.3.2 Cabling Pathways

A schematic showing the route of each cable run at the site. For each cable run, list the following:

- Cable length
- Cable type
- Connector types (both ends)
- Cable labeling completed per specs
- Port Connections
- Continuity test results
- Distance test results

5.5.3.3 Floor Plan/Site Drawing

Use a floor plan or site drawing to denote the location of the following on each floor of the building:

- Main rack
- Remote ACUs, including power source
- RFUs
- URUs, including power source

5.5.4 RadioFrame System Acceptance Test

During installation, each component of the RFS is verified for power and connectivity. Assuming that each system component—NCU, ACU, RFU, and URU—has been properly installed and is receiving power, double check that all Power, Status, Link and Activity LEDs throughout the system are lit and are green. For any other condition on any system component or connection, refer to section 7.3 Corrective Maintenance, subsection 7.3.3 RadioFrame System for troubleshooting procedures.

5.6 RadioFrame System Functionality Test

This section describes the procedures that are used to test and verify the RadioFrame Networks equipment. This certification process ensures proper operational performance and verifies the integrity of the following services:

- RFS iDEN functionality test:
  - iDEN 3:1 Interconnect Voice
  - iDEN 6:1 Private and Group Dispatch
  - iDEN Packet Data
  - iDEN Short Message Service
- Rectifier & AC power alarms
- iSC-3 functionality test

Once the RFS System Functionality Testing is successfully completed, the RFS can be connected to the Customer LAN, and system testing for the WLAN may be completed.

5.6.1 RadioFrame System iDEN Functionality Test

Test and verification of the RadioFrame System will specifically validate the following aspects of the above services:

- Voice quality for 3:1 Interconnect Voice
- Voice quality for 6:1 Private Group Dispatch Voice
- Call setup reliability for 3:1 Interconnect Voice
- Call setup reliability for 6:1 Private and Group Dispatch Voice
- Call stability for all of the above voice services
- Voice capacity
- Connection quality, stability, delay and perceived throughput for the Packet Data service
- Connection setup reliability for Packet Data
- Idle SQE quality and variation
- Call up SQE quality and variation
- Short Message Service
- Handover and cell reselection
- Overall system stability (includes recovery from T1, iSC-3 and GPS outages)
- Performance will also be validated by collecting at least one week of performance statistical data

5.6.1.1 Interconnect & Dispatch Setup & Voice Quality

Interconnect and Dispatch voice quality will be assessed by evaluating voice links as described in Tables 1, 2, and 3. RSSI and SQE measurements will be

made via the handset. These tests are to be performed on a selected sample set of links.

Table 1 Interconnect Call Quality, Setup and Stability

Test #	MOP/PSTN	Carrier #	RSSI (dbm)	SQE (dbm)	Quality (1-5)	Distance (ft)	Sector	Duration (Min)
1						50		2
2						50		2
3						50		2
4						50		2
5						50		2
	PSTN/MT							
1						50		2
2						50		2
3						50		2
4						50		2
5						50		2
	MO/MT							
1						50		2
2						50		2
3						50		2
4						50		2
5						50		2

Table 2 Group Dispatch Call Quality, Setup, and Stability

Test #	MO/MT	Carrier #	RSSI (dbm)	SQE (dbm)	Quality (1-5)	Distance (ft)	Sector	Duration (Min)
1						50		2
2						50		2
3						50		2
4						50		2
5						50		2
6						50		2
7						50		2
8						50		2
9						50		2
10						50		2

Table 3 Private Dispatch Call Quality, Setup, and Stability

Test #	MO/MT	Carrier #	RSSI (dbm)	SQE (dbm)	Quality (1-5)	Distance (ft)	Sector	Duration (Min)
1						50		2:30
2						50		2:30
3						50		2:30
4						50		2:30
5						50		2:30
6						50		2:30
7						50		2:30
8						50		2:30
9						50		2:30
10						50		2:30

5.6.1.2 Packet Data Service Connection and Latency

The Packet Data service will be tested and verified on the RadioFrame System. Motorola's Packet Data Applet will be used to connect to the RFN customer's Packet Data network over the RadioFrame System, using a tethered connection with a Motorola handset.

Several samples of PING requests will be sent to a Router in the RFN customer's Packet Data network and average round trip times will be recorded to measure latency. The table below presents the data to be collected for each ping using the RFS. These tests shall be performed using Windows 2000 OS and the timeout for each ping reply shall be set to 2000 milliseconds.

Table 4 Packet Data Latency over the RFS (Ping –n 100 –w 2000 xx.xxx.xxx.x)

Test #	Handset	Carrier #	RSSI (dbm)	SQE (dbm)	Ping (No. of Echos)	Router (IP Address)	Average Round Trip Time (msec)	Packet Loss (%)
1					100	xxx.xxx.xxx.x		
2					100	xxx.xxx.xxx.x		
3					100	xxx.xxx.xxx.x		
4					100	xxx.xxx.xxx.x		
5					100	xxx.xxx.xxx.x		

The following table presents (baseline) data collected for each ping using a Motorola Macrocell in order to average Round Trip time over the RFS versus over Motorola standard Base Station equipment.

Table 5 Packet Data Latency over Motorola EBTS

est #	Handset	arrier #	RSSI (dbm)	SQE (dbm)	Ping (No. of Echos)	Router (IP Address)	Average Round rip Time (msec)	Packet Loss (%)
1					100	xxx.xxx.xxx.x		0
2					100	xxx.xxx.xxx.x		0
3					100	xxx.xxx.xxx.x		0
4					100	xxx.xxx.xxx.x		0
5					100	xxx.xxx.xxx.x		0

5.6.1.3 Short Message Service

The Short Message Service (SMS) will be tested and verified by initiating the delivery of a voice mail notification to the handset via one of the iDEN RadioBlade links. Complete the following only if such testing is available via the RFN customer's web site.

1 Navigate on a network connection to the Internet.

2 Navigate to the RFN customer's web site in the web browser.

3 On the RFN customer's web site, enter the 10-digit phone number of the test phone in the messaging field, which will display the mobile messaging page.

4 Enter a short text message into the field for message, and also enter a subject in the subject line.

5 Press the Send button.

The message should appear on the test phone within a few minutes.

5.6.1.4 Handover and Cell Reselection

Handover and Cell Reselection shall be tested and verified that mobiles on the RFS successfully handoff to the macro-cellular network during an interconnect call. These tests shall also verify that mobiles on the RFS perform successful cell reselection when in an idle state. The following table presents the data to be collected for the handover and reselection tests.

Table 6 Handover & Idle Mode Reselection

Test #	Handover (Mobile #)	Carrier # from (HEX)	Carrier # to (HEX)
1			
2			
3			

	Cell Reselection (Mobile #)		
1			
2			
3			

5.6.1.5 Interconnect Connection Stability and SQE Performance

A single link for 3:1 Interconnect will be maintained for 30 minutes each. The following table presents the data to be collected for each selected link. The iDEN Field Test Application (IFTA) shall be used in “Single Cell” mode to observe the SQE performance and plotted over time.

Table 7 Interconnect Connection Stability

Interconnect #1	Carrier #	RSSI (dBm)	SQE (dB)	Sector	Duration (min)
					30
Interconnect #2					
					30
Interconnect #3					

5.6.1.6 Dispatch Connection Stability

To verify Dispatch connection stability, a Dispatch (private or group) call will be maintained for several minutes. The following table presents the data to be collected for each dispatch call.

Table 8 Dispatch Connection Stability

Dispatch #1	Carrier #	RSSI (dB)	SQE (dB)	Sector	Quality (1-5)	Duration (min)
						3
Dispatch #2						
						4
Dispatch #3						
						5

5.6.1.7 Idle SQE Testing and Validation

To validate SQE performance, the following test shall be conducted:

1 Control Channel SQE:

The iFTA tool shall be used in “Single Cell” mode and idle RSSI and SQE values shall be recorded for control channel for at least one hour per sector, while the mobile remains fixed.

A second test per sector shall be performed in “Single Cell” mode while walking the facility for approximately 15 minutes.

2 SQE and RSSI Variation Test for all 4 iDEN Channels

In this test, the iFTA shall be placed in “Monitor Many” mode and idle RSSI and SQE values shall be recorded for all iDEN channels for at least one hour per sector while the mobile remains fixed.

These tests shall be conducted over a period of 3 days and minimally 3 times in a 24-hour period.

5.6.1.8 System Self-Recovery Test

The following test is to determine the RFS’ ability to recover from various iSC-3 conditions.

1 Loss of T1

While the RFS is operating, the T1 connection to the iSC-3 will be disconnected for one minute and then reconnected. System recovery will be monitored and validated by placing a successful call on each sector.

2 iSC-3 Power Loss

While the RFS is operating, the iSC-3 shall be power cycled and system recovery will be monitored and validated by placing a successful call on each sector.

3 Loss of GPS

While the RFS is operating, the GPS connection to the iSC-3 will be disconnected until all Satellites are lost and then reconnected. System recovery will be monitored and validated by placing a successful call on each sector.

4 New data-fill download

System recovery will be verified by pushing a new data-fill download to the iSC-3.

5.6.1.9 Packet Data Stability and Throughput

The Packet Data stability and throughput to the Internet will be verified. A tethered Packet Data connection will be set up on a laptop and speed tested by using the www.bandwidthplace.com website. This continuous download of data stream will validate system stability and help to quantify user experience of Packet Data over the RadioFrame System.

5.6.1.10 Validation of 'Unable to Key BR' Alarm

While the RFS is operating, any system component, from the NCU to the RFU, will be disconnected, and the OMC will be monitored to validate the generation of the "Unable to Key BR" alarm by the RFS.

The RFS provides fault alarming and isolation within System Manager for individual components, which consists of detecting catastrophic faults that prevent an RFS component from responding to a periodic "ping". All fault alarms generated by the RFS are received at the OMC via the iSC. The "Unable to Key BR" alarm will appear at the OMC as minor, major, or critical as follows (for more information about alarms, refer to section 7.5 Alarm Resolution Procedures):

Unable to Key BR' alarm severity	Indication
minor	An iDEN RadioBlade or 802.11b RAP has failed.
major	An RFU has failed.
critical	A card in a chassis unit has failed (except for the RLIC, which is responsible for returning the alarm information.)

5.6.2 Rectifier & AC Power Alarms

For information on conducting an Rectifier functionality test, refer to the Peco II document: *Peco II 127HNL.*

5.6.3 iSC-3 Functionality Test

For information on conducting an iSC-3 functionality test, refer to the Motorola document: *Gen 3 Site Controller System Manaual*, 68P80801E30-O.

6 Connecting the RFS to the Customer LAN

Once the RadioFrame System has been installed, commissioned, and all iDEN Acceptance Test and System Functionality procedures have been successfully completed, the RFS can be connected to the Customer LAN. Once the LAN has been physically connected, the RFS must be globally configured to support the LAN. Individual RAPs can also be configured, overriding certain global configuration options.

6.1 Connect the NCU to the Customer LAN

In an 802.11b installation, RAPs are installed in each RFU supporting the WLAN. Once the RFS has been physically connected to the LAN, use the System Manager to configure the RFS to support the WLAN.

1 Connect Port 2 on the front of the NCU to the customer's local area network using an RJ45-to-RJ45 CAT 5 cable (see the following illustration).

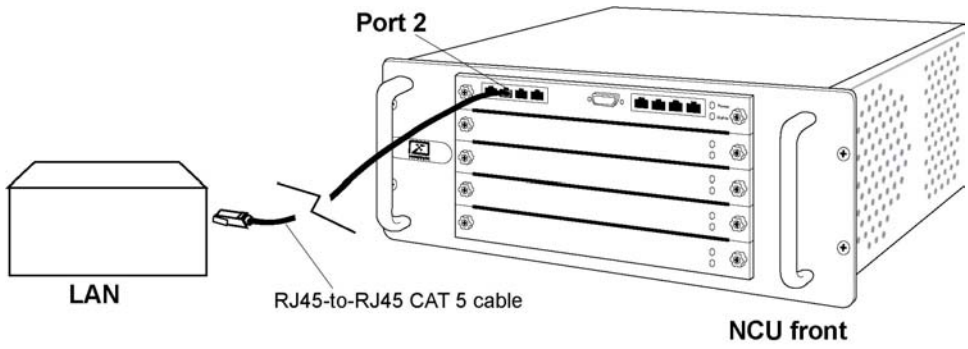


Figure 32 Connect Port 2 on the front of the NCU to the customer's LAN.

6.2 Configure the RFS Global 802.11 Services

This section describes how to configure the RFS global, or system-wide, 802.11 configuration settings. First, start the System Manager, then configure the following five items:

- Service Set Identity (mandatory)
- WEP Encryption (optional)
- Enhanced Security (optional)
- User Access Control (optional)
- Add/Remove MAC Addresses (optional)

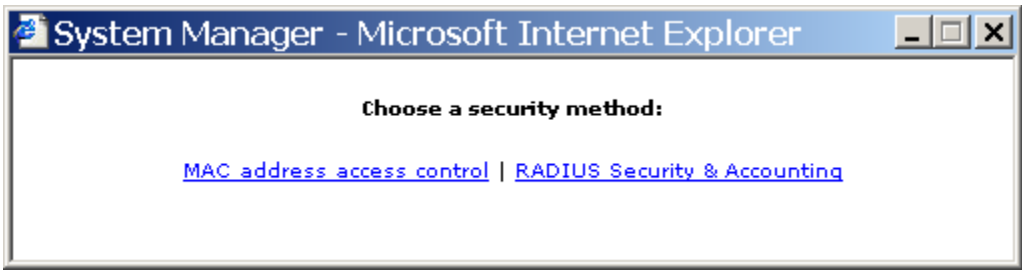
1 Start System Manager and log in to the RFS.

Start your browser, and enter the provided RFS URL to start System Manager. Enter your User Name and Password to log in to the RFS.

2 Select the System Configuration tab.

3 Select the 802.11 Global Configuration link under **Other Configure Options**.

The following screen appears. You must choose a security method for the RFS, or the RFS will not work.



4 Select “MAC address access control”.

The 802.11 Global Configuration page appears (see the following illustration). The 802.11 settings are divided into five groups:

- SSID
- WEP Encryption
- Enhanced Security
- User Access Control
- Add/Remove MAC Addresses.

When you make changes to any of these five settings, you must save the changes for that section using the **Save Changes** button for that setting.

5 For **SSID**, enter up to 32 alphanumeric characters to identify the Service Set Identity for the RFS, and select Save Changes to save your changes.

You must enter an SSID in order for the RFS to have 802.11 capabilities. Typically, the SSID reflects the owner of the RFS. By default, the owner is RFN Customer. For more information, refer to section 6.2.1 Service Set Identity (SSID).

6 For **WEP Encryption**, RFN recommends that you set **Encryption** to “On”. In this case, you must also define the four WEP keys.

To enter a **WEP Key**, first select the radio button next to the text box of the WEP key you want to enter or change. Enter each WEP key in hexadecimal format consisting of five pairs of hex digits. Five pairs of hex digits form a 40-bit binary string, which is the standard length of a WEP key. Only one WEP Key can be selected at a time (the radio button is selected). Then, choose

one of the four keys to be used for RAP identification (select the radio button of the key you want to use).

For **Shared Key Authentication**, RFN recommends that you leave this option disabled, that is, do not select the option. When you have set all the WEP Encryption options you want, select Save Changes.

Refer to section 6.2.2 WEP Encryption for more information on using WEP Encryption settings.

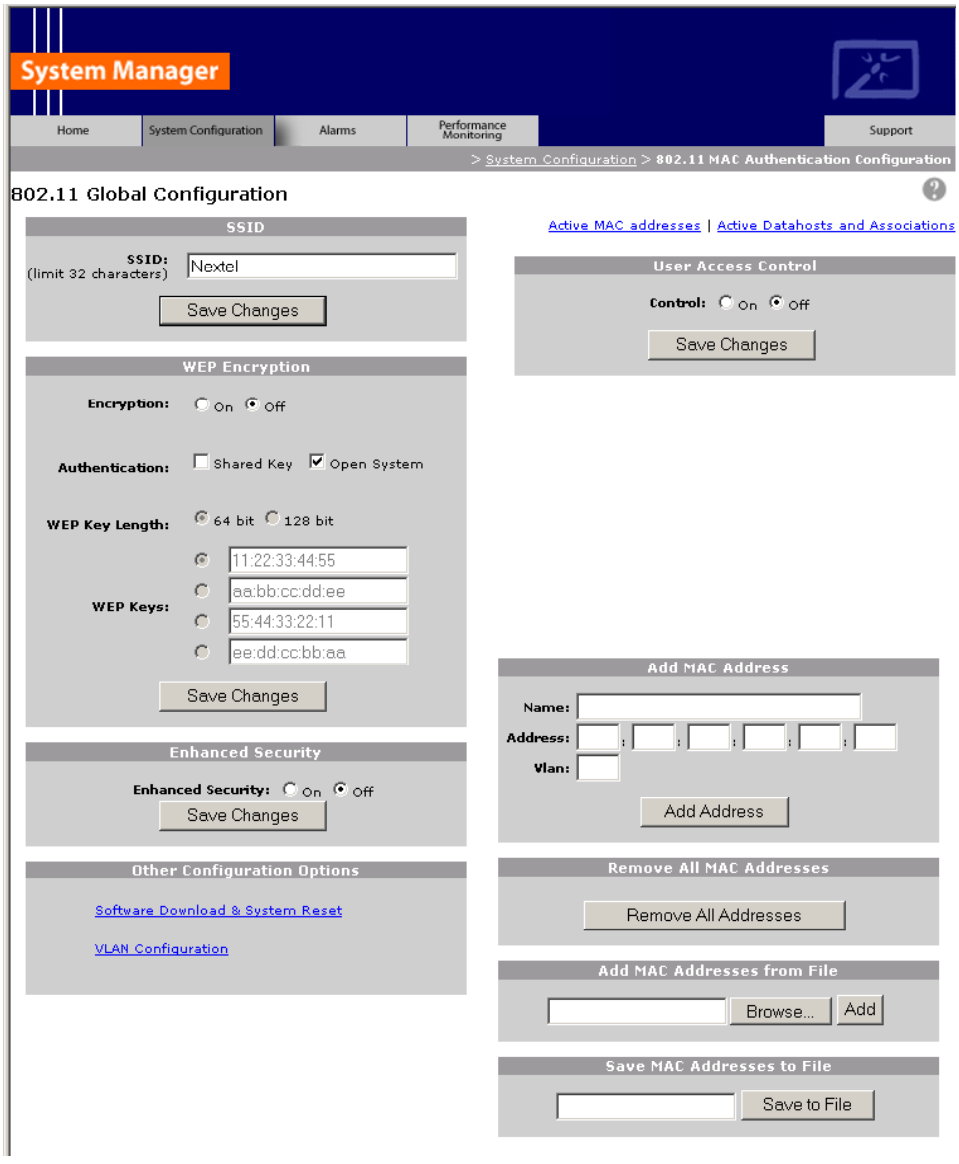


Figure 33 Each global 802.11 configuration setting has a separate “save” button.

7 For **Enhanced Security**, RFN recommends that you select “On” to prevent RAPs from broadcasting their SSIDs. Then select Save Changes.

For more information, refer to section 6.2.3 Enhanced Security for more information on using this setting.

8 For **User Access Control**, RFN recommends that you select “On” to control which devices will have access to the customer LAN via the RFS. Then select Save Changes.

For more information, refer to section 6.2.4 User Access Control for more information on using this setting.

9 For **Add MAC Address**, enter the MAC address of each device that will be authorized to the use the customer LAN. You can enter MAC addresses one at a time, or copy them from a database or other file (**Add MAC Addresses from file**). You can also remove the entire list of MAC addresses (**Remove All MAC Addresses**), or save the list of MAC addresses to a file (**Save MAC Addresses to File**).

For more information, refer to section 6.2.5 Add/Remove MAC Addresses for more information on using these options.

6.2.1 Service Set Identity (SSID)

The only mandatory RFS 802.11b configuration setting is the Service Set Identity (SSID). The SSID must be configured in all installations where 802.11b RadioFrame Access Points are installed. If the SSID is not configured, the 802.11b capability will not be available.

The SSID is necessary because, unlike wired LANs, a device which is part of an 802.11 LAN may be within radio range of multiple “groups” of 802.11 stations. In order to isolate stations in one group from stations in another group, the SSID was created. It is an 802.11-only construct, which does not exist for any other type of LAN. The SSID identifies a collection of 802.11 stations for the purpose of communication as a group.

The SSID is 1 to 32 characters in length. Typically, the SSID reflects the owner of the RFS. By default, the SSID is ‘RFN Customer’. This way, users can distinguish their LAN from any other 802.11 LAN which might physically overlap their area.

For example, the SSID “RFN_Customer_Marketing” could provide the Marketing department at the RFN customer with its own distinct wireless LAN. Other departments within the RFN customer, such as “RFN_Customer_Operations”, might be in close proximity to the Marketing department. The staff in the two departments would both have 802.11 access to the company LAN, but their access would be provided via different RAPs, based on which SSID they use.

6.2.2 WEP Encryption

The Wired Equivalent Privacy (WEP) encryption technology is defined in the IEEE 802.11 standard, and is intended to provide the same quality of privacy and access control for an 802.11 LAN as is provided for a wired LAN. That is, a WEP-protected 802.11 is should be no easier to infiltrate or eavesdrop than would be on a wired LAN.

Any LAN (wired or wireless) can be made more secure and private by applying additional security measures (such as encryption, centralized strong authentication, firewalling, etc.). The difference between a wired LAN and a wireless LAN, however, is that without including encryption of user traffic and encryption-based access control, a wireless LAN is inherently less secure than a wired LAN, all other things being equal.

6.2.2.1 Encryption (On/Off)

WEP encryption is enabled or disabled by selecting “On” or “Off,” respectively. When “Off” is selected, all other items related to WEP encryption are disabled (WEP Keys and Shared Key Authentication), and need not be configured. When “On” is selected, then the WEP keys must be entered.

6.2.2.2 Shared Key Authentication

When Shared Key Authentication is enabled, or “checked,” the RAPs will require client devices (such as laptop computers) to prove their authenticity by answering a challenge from the RAP. This challenge (authentication protocol) can be answered correctly only if the client device “knows” the WEP keys configured into this RFS.

NOTE: RFN does not recommend the use of Shared key authentication, because the messages used to accomplish this authentication may provide information to eavesdroppers as an aid in cracking the WEP encryption on future messages. The ability to enable or disable Shared Key Authentication is provided mainly for compatibility purposes. Some client adapters may require Shared Key Authentication whenever WEP encryption is enabled. If this is not the case with the client adapters used in your location, then it is best to leave this setting disabled. This does not compromise security, however, because with WEP encryption enabled, the RAP will not accept traffic from 802.11 client devices unless the traffic is encrypted.

6.2.2.3 WEP Keys

When WEP Encryption is enabled, you must enter values for the four WEP keys in order for the RFS 802.11 implementation to function. WEP Keys are used to encrypt 802.11 traffic that is transmitted by a RAP.

Each WEP Key has a radio button. When you select the radio button, you can enter, change, or delete information for that key only. Each WEP key consists of

five pairs of hex digits forming a 40-bit binary string, which is the standard length of a WEP key.

Only one WEP Key can be selected at a time. The selected key is used to encrypt 802.11 traffic that is transmitted by a RAP. However, any of the four keys may be used by client devices for their transmissions. The determination of which key is used by a client device is performed at the client device, usually in a manner similar to the way the RAP is configured.

6.2.3 Enhanced Security

Enhanced Security provides another layer of protection for the RFS 802.11 implementation. When enabled, or “On”, this setting prevents RAPs from broadcasting their SSID information. This helps to prevent unwanted users from accessing the customer’s WLAN. When disabled, or “Off”, any system can ‘see’ the SSID of RAPs in the customer WLAN.

6.2.4 User Access Control

The RFS provides the ability to restrict access to the customer LAN to certain pre-authorized devices. RFN recommends setting the User Access Control option to “On” to provide a means to identify those devices that are authorized to communicate over the customer’s LAN via the RFS. When this option is disabled, set to “Off”, any client device may associate with the RFS.

Devices are identified by a number that is programmed into the 802.11b network interface installed in the device. For instance, laptop PCs typically use a PCMCIA card plugged into the laptop’s PCMCIA bay to access an 802.11 network. Every 802.11b PCMCIA card comes from the manufacturer with a unique serial number programmed into it. No two 802.11b devices are ever manufactured with the same serial number.

In IEEE 802 networking terminology, this serial number is called the MAC address (Media Access Control address), an addressing mechanism that is present in all types of IEEE 802 LANs. The MAC address is typically represented as six sets of hexadecimal (base 16) numbers, with two hexadecimal digits in each set. The following is an example of how a MAC address may be written:

00:04:16:A3:29:B7

Authorized MAC addresses/devices are listed below the User Control option. To learn how to add and remove MAC addresses, read the following section 6.2.5 Add/Remove MAC Addresses. When you are done adding and removing MAC addresses, you’ll select the Save Changes button under User Access Control.

6.2.5 Add/Remove MAC Addresses

Start by collecting a list of MAC addresses for all user devices that will be authorized to access the customer’s LAN via the RFS 802.11. It is best to keep a

permanent list (on paper, in a spreadsheet, or other computer storage) that includes each MAC address and a description of the device, including the name of the person who owns the device, etc. Also refer to section 6.4 Viewing WLAN User/RAP Associations, later in this chapter.

6.2.5.1 Adding MAC Addresses

MAC addresses are added to the list of authorized client devices in one of two ways: one, you can enter the addresses one at a time, or two, you can enter the MAC addresses into a text file and "upload" this list into the MAC address database.

To add an individual MAC address, enter it in the box labeled **Address**. Enter each MAC address in the format described above, that is, six pairs of hexadecimal digits (for example 00:04:16:A3:29:B7). The alphabetic values of hexadecimal digits—A,B,C,D,E,F—may be in either upper case or lower case. For **Name**, enter a meaningful device name or identifier, or the name of the person who owns the device, then select **Add Address.**

To add MAC addresses from a file, either enter the file name under **Add MAC Addresses from File** (including drive letter and full pathname), or select the **Browse…** button to locate the file. Then, select **Add**. This appends the MAC addresses from the file to any other MAC addresses already entered into System Manager.

TIP Add one or two individual MAC addresses, then save those MAC addresses to a file (see "Saving MAC Addresses" later in this section). Then open the text file and copy the saved address(es) to a new line in the file, and edit each line to specify a different client device and MAC address. This way, you can create your list of authorized devices, save the file as a backup, and upload the file into the System Manager knowing that the format of the text file will be acceptable to the System Manager.

6.2.5.2 Removing MAC Addresses

To remove a MAC address, select the delete option listed next to the MAC address you wish to remove.

To remove all MAC addresses, select the **Remove All Addresses** button under **Remove All MAC Addresses**.

6.2.5.3 Saving MAC Addresses

When all additions or removals have been completed, select the **Save Changes** button at the bottom of the **User Access Control** section. This will record the MAC addresses and the User Access Control setting and activate them.

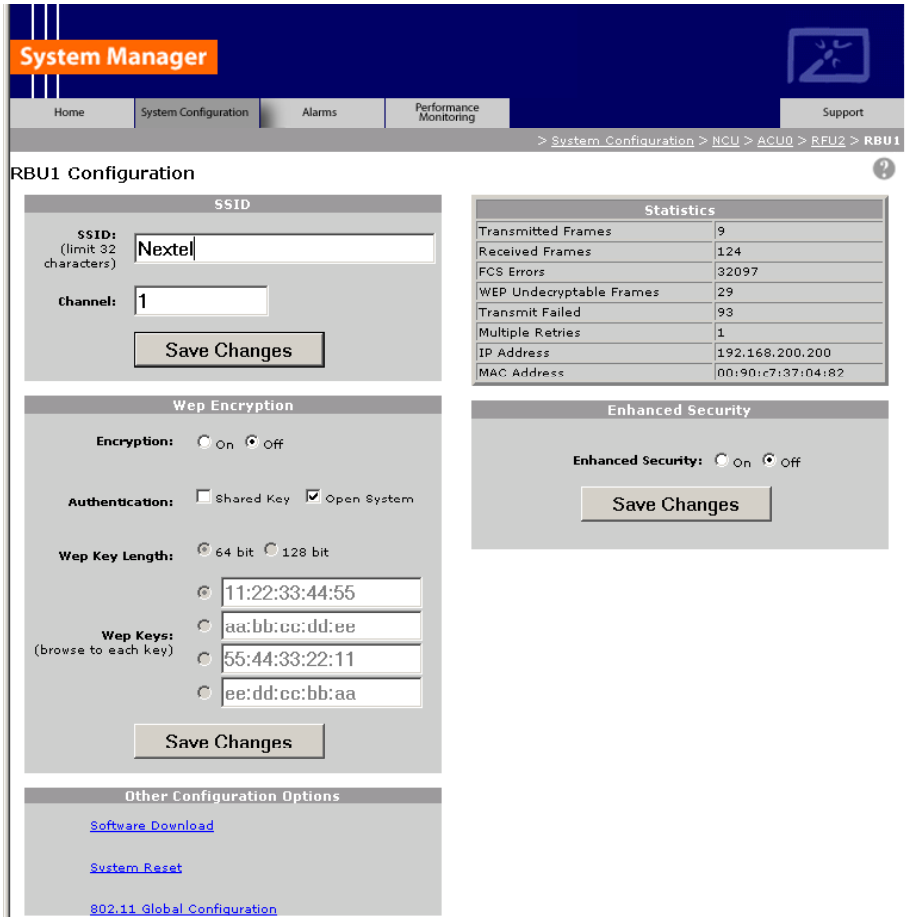
To save the entire list of MAC addresses to a file, enter a file name in the text box under **Save MAC Addresses to File**, then select the **Save to File button**.

6.3 Configuring an Individual RAP

RadioFrame Access Points (RAPs) provide the 802.11b wireless interface between the RFS and the corporate local area network (LAN). Typically, all RAPs in the RFS are configured at one time using the 802.11 Global Configuration options. These global settings can be overridden by changing configuration information for individual RAPs. Individual RAPs can also be isolated from further global changes as well.

NOTE: WEP Encryption and Enhanced Security settings override global 802.11 settings. Typically, changing these settings is done to isolate the RAP for testing.

1 Using the System Configuration tab, drill down to the RFU that contains the RAP(s) you want to configure, and then select the RAP icon to display its configuration page.



2 For **SSID**, either leave the globally configured SSID name as it is, or enter up to 31 alphanumeric characters to change it.

The SSID you enter must be a valid SSID that is recognized by System Manager.

3 For **Channel**, type 1, 6, or 11 to specify the channel to be used by the RAP.

At the time of shipment, all RAPs are set to Channel 6 by default. Channel numbers can only be changed at the RAP level—channels cannot be changed using global settings. If a 3-channel frequency plan is implemented, RFN recommends using channels 1, 6, and 11 (in countries where these channels are permitted).

4 Select 'Save Changes' to save the SSID and Channel settings.

5 When **WEP Encryption** is disabled or "Off", all other items related to WEP encryption are disabled (WEP Keys and Shared Key Authentication). When "On", a **WEP Key** other than the globally configured WEP key can be selected. Also, **Shared Key Authentication** can be enabled or disabled, "checked" or "unchecked" respectively. For more information about Shared Key Authentication, refer to section 6.2.2.2 Shared Key Authentication.

RFN recommends that RAP WEP Encryption settings be set globally rather than individually.

RAP WEP Encryption changes remain until changes are made to the global 802.11 settings.

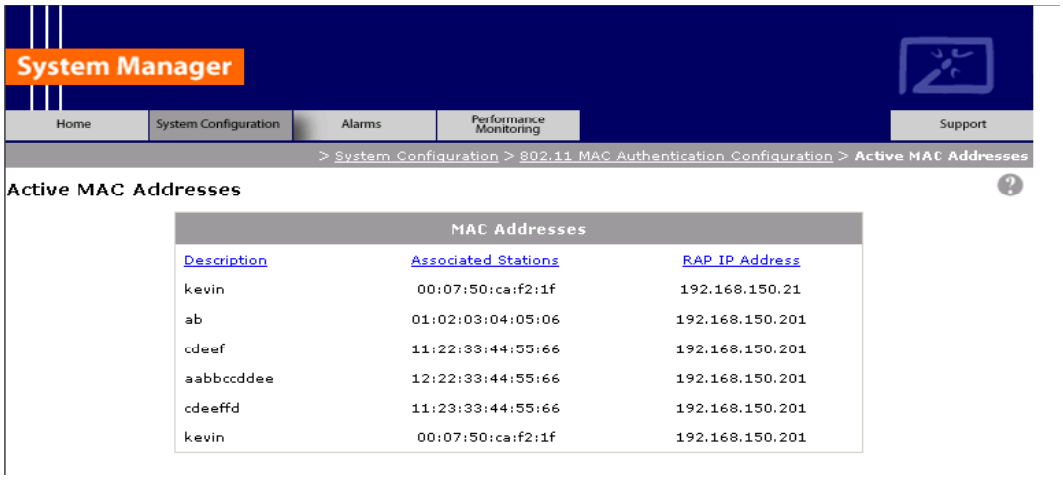
6 **Statistics** lists information about the functioning of the RAP, including:

Statistic	Description
Transmitted Frames	Number of frames transmitted by the RAP
Received Frames	Number of frames received by the RAP
FCS Errors	Number of FCS errors
WEP Undecryptable Frames	Number of frames that could not be unencrypted
Transmit Failed	Number of failed transmissions
Multiple Retries	Number of retries attempted
IP Address	IP address of the RAP
MAC Address	MAC address of the RAP

7 For **Enhanced Security**, select either "On" or "Off", and then select Save Changes.

6.4 Viewing WLAN User/RAP Associations

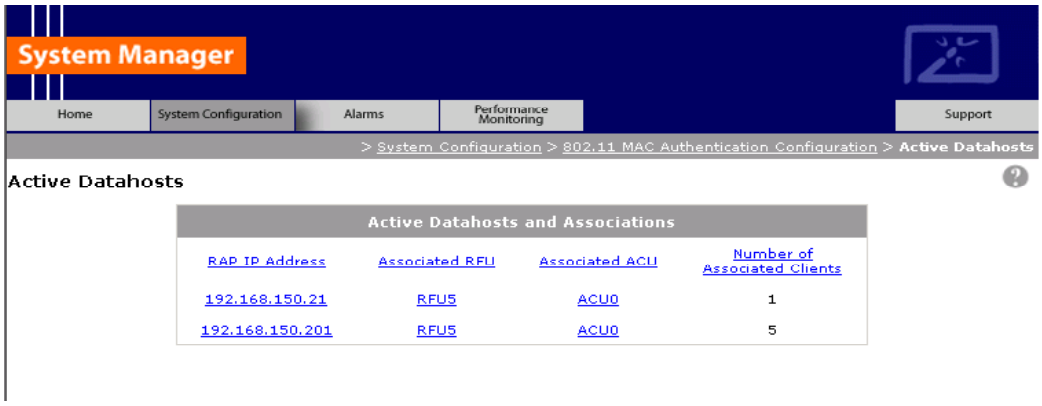
To view clients and their associated RAP(s), select the Active MAC addresses link on the 802.11 Global Configuration page. For each RAP, the Active MAC Addresses page lists each user associated with the RAP, including the user name (Description) and the IP address of the workstation or piece of equipment. Information is sorted by the RAP IP address.



MAC Addresses

Description	Associated Stations	RAP IP Address
kevin	00:07:50:ca:f2:1f	192.168.150.21
ab	01:02:03:04:05:06	192.168.150.201
cdeef	11:22:33:44:55:66	192.168.150.201
aabbccddee	12:22:33:44:55:66	192.168.150.201
cdeeffd	11:23:33:44:55:66	192.168.150.201
kevin	00:07:50:ca:f2:1f	192.168.150.201

To view the number of users supported by each RAP, select the Active DataHosts and Associations link at the top of the 802.11 Global Configuration page. The Active DataHosts page identifies the location of each RAP by RFU and ACU, and displays the number of users associated to the RAP. You can view the configuration for each RAP, RFU or ACU by selecting the link for that component. This information can be used to analyze the load distribution in the WLAN RadioFrame system.



Active Datahosts and Associations

RAP IP Address	Associated RFU	Associated ACU	Number of Associated Clients
192.168.150.21	RFU5	ACU0	1
192.168.150.201	RFU5	ACU0	5

6.5 Verifying the Wireless LAN (802.11b) Installation

Verifying the LAN installation requires a laptop that has 802.11b internally or a client card that plugs into the PCMCIA port.

1. Associate with a RAP in the RFS by matching the SSID on the client (laptop) and the SSID that is configured in the System Manager.
2. Setup a static address on the client to communicate with the RFS (refer to the appendixes for a list of default IP addresses for the RFS).
3. Once associated, open a command window and ping the RLIC IP addresses to confirm that the client is properly associated with the RAP (this also confirms connectivity up to the RLIC).
4. Once associated, navigate to a few Internet addresses. This requires that the Administrator correctly configure their network for this navigation.

7 Operations and Maintenance

A report of the RFS iDEN/802.11 site should be maintained and left on site. The report should include iDEN Interface, Power Plant, and RFS. This report will provide metrics for possible concerns with individual components and /or the entire system.

It is important that the technician performing the checks understand the equipment theory and operation. Review the documentation (references) prior to verification and performing service.

This chapter contains procedures for the following:

- Upgrading System Software
- Preventive maintenance
- Corrective maintenance
- Field replaceable units (FRUs)
- Alarm resolution procedures,
- Repair and technical support

7.1 Upgrading System Software

The RadioFrame System is shipped with the latest software and hardware installed. With each new software release, RFN provides its customers with the new software (this software can also be downloaded from the RFN FTP site) and upgrade instructions for that release in the *Customer Release Notes RFN_X.X* (P/N 991-xxxx-00). The instructions describe how to upgrade to the latest software from any prior version.

To upgrade hardware, refer to section 7.4 Field Replaceable Units—RadioFrame System.

7.2 Preventive Maintenance

7.2.1 iSC-3

Refer to the *Gen 3 Site Controller System Manual*, Motorola, 68P80801E30-O for preventive maintenance information.

7.2.2 Power Plant

A report of the Total Plant Condition should be maintained and left on site. The report should include rectifier, controller operation and condition of batteries. This

report will provide metrics for possible concerns with individual cells and /or the entire battery string. This service is available from PECO II. Call 1-(419)-768-7700 for more details.

It is important that the technician performing the checks understand the equipment theory and operation. Review the documentation (references) prior to verification and performing service.

- PECO II Rectifier System Manual: 127NHL-IBWS
- PECO II System Manual 40-719010-1005
- Battery Manufacturers Installation and Maintenance Documentation

The 127NHL-IBWS plant should have the following semi-annual and annual maintenance procedures performed. Also verify all plant settings after adding or replacing rectifiers and/or batteries.

NOTE: A software kit with interface cable is available from PECO II to aid in troubleshooting and maintenance, via interface port to laptop. Contact PECO II for ordering information.

7.2.2.1 Semi-Annual Maintenance

Visually inspect Rectifiers for loose or foreign items and for heat spots.

Verify proper Plant Voltages at Rectifiers, Batteries and Plant Controller.

7.2.2.2 Annual Maintenance

General

Visually inspect Rectifiers for loose or foreign items and for heat spots.

Verify proper Plant Voltages at Rectifiers, Batteries and Plant Controller.

Power Plant

Verify Alarms settings as follows:

- Fuse Alarms (FA)
- Battery Disconnect set point
- Rectifier Fail Alarm (RFA)
- Power Minor Alarm (PMN)
- Power Major Alarm (PMJ)

Check all set points and adjust if necessary. The factory settings are as follows:

- Float Voltage: 54.45 VDC
- Equalize Voltage: 55.0 VDC
- Low Voltage Alarm: 51.0 VDC ± .5VDC
- High Voltage Alarm: 56.0 VDC ± .5VDC
- Low Low Voltage Alarm: 46.0 VDC ± .5VDC
- Low Voltage Disconnect for A & B Loads: 42.0 VDC ± .5VDC
- Low Voltage Reconnect for A & B Loads: 52.0 VDC ± .5VDC (not adjustable)

If deviations from the factory settings are desired, refer to Section 1.18 “Navigating the Simple Controller” in the PECO II Rectifier System Manual: 127NHL-IBWS manual.

To verify system connections, refer to Chapters 2 & 3 for mechanical and electrical installation information in the PECO II Rectifier System Manual: 127NHL-IBWS manual.

Verify alarms if extended to an Alarm Termination Panel.

Check operation and calibration of Plant Volt and Amp Meter.

It is important that the rectifier fans be inspected regularly to make sure they aren't damaged or filled with dust. Be sure the plant is getting adequate ventilation by ensuring there are no restrictions in the surrounding area such as boxes leaning against any of the plant components, or within 18 inches of them.

Inspect all cable connections, and tighten if necessary. System connections for AC input, battery, and distribution are plug-in, and should be checked to ensure they are properly seated.

Ground studs/bolts should have the following torque:

Bolt Size (inches)	Bolt Steel (Grade 5) FT LBS / IN LBS
¼	7.6 / 91.2
5/16	15.3 / 183.6
3/8	27.0 / 324.0
7/16	43.0 / 516.0
½	64.0 / 768.0

Rectifiers

Verify Rectifier voltage and amperage setting: High Voltage (HV), Current Limit, Low Current, Float as applicable.

Verify Alarms are extended to Plant Controller.

Thermography (optional)

A thermal scan should be done on all AC components associated with the DC power system.

Perform thermal scans on all battery and DC power connections, DC buss-work, and circuit breakers.

7.2.3 Batteries

Conduct the following **annual maintenance**:

- Inspect Batteries: All cable connections and inter-cell connections. Check for oxidation at terminal posts and clean as required.
- Check for leaks or seepage at terminal posts and battery jar seals.
- Replace the battery jar if any leak or seepage.
- Torque battery terminal and strap connections nuts and bolts to manufacturer's specifications. Power Battery CSL-12100 Specification is 115 in/lbs.
- Verify battery voltage and mid-point voltage.
- Perform Midtronics battery analysis using digital battery analyzer (optional).

7.2.4 RadioFrame System

Conduct the following **semi-annual maintenance**:

- Visually inspect all RFS components for loose or foreign items and for visible damage.
- Confirm that each component is receiving power (refer to the troubleshooting tables listed in 7.3 Corrective Maintenance, next in this chapter).
- Verify that all RFS components are operational (refer to section 5.3.1.2 Checking the Status of RFS Components).
- Verify coverage validation by conducting spot tests described in section 5.4 Coverage Validation.
- Verify iDEN functionality by conducting spot tests using the procedures described in section 5.6 RFS Functionality Test.

7.3 Corrective Maintenance

The fault indications identified in this section provide a guide for isolating failures to a Field Replaceable Unit (FRU). The service technician should perform troubleshooting whenever a failure occurs during normal operation that cannot be resolved by the Operations and Maintenance Center (OMC).

Some indications list several possible failures along with corresponding corrective actions. If a failure is isolated to the FRU level, the suspected component should be replaced with a new one. This restores the system to normal operation as quickly as possible. For more information, refer to section 7.6 Repair and Technical Support.

7.3.1 iSC-3

This section lists troubleshooting procedures for both the iSC-3 (site controller) and the Environmental Alarm System (EAS). For further information, refer to the *Gen 3 Site Controller System Manual*, Motorola, 68P80801E30-O.

Site Controller Troubleshooting

Indication	Possible failure	Corrective action
status gps MMI command response: Satellite tracking mode on all channels is less than 8	Antenna, cables, surge arrestors, RFI	▪ Check antenna, cables, and surge arrestors before placing the site controller. ▪ If antenna installation is OK, suspect intermodulation desensitizing.
status gps MMI command response: S/N numbers of mode 8 satellites are less than 25	Antenna, cables, surge arrestors, RFI	▪ Check antenna, cables, and surge arrestors before placing the site controller. ▪ If antenna installation is OK, suspect intermodulation desensitizing.
ping gps MMI command indicates no satellites tracked.	Open or damaged GPS and surge satellites tracked.	▪ Verify GPS antenna, lead-in, and surge arrestor.
Slow handovers.	Open or damaged GPS and surge satellites tracked.	▪ Verify GPS antenna, lead-in, and surge arrestor. ▪ Check for open 5 MHz cable and missing termination of 5 MHz cable.
Power LED is not lit	No power to site controller	▪ Check power source
	Cabling	▪ Check power cabling to site controller. If necessary, replace cabling.
	Site controller failure	▪ Replace the site controller.
Site controller can't communicate over Ethernet	Ethernet cabling or terminations	▪ Check cabling. Verify that each end of the cable has a 50-ohm termination.
	Site controller failure	▪ Replace the site controller.
LOS/OOF LED is lit (Loss of Signal/Loss of Frame)	T1/E1 cabling	▪ Check cabling to site controller. If necessary, replace the cabling.
	Site controller failure	▪ Replace the site controller.
Yellow Alarm LED is lit	Site controller is receiving an alarm from the far end.	▪ Check for proper operation of external site equipment.

Indication	Possible failure	Corrective action
	alarm from the far end.	▪ Notify far end.
AIS LED is lit (Alarm Indication Signal)	Far end equipment failure	▪ NOTE: The AIS LED is lit when the All Ones Keep Alive signal is received. ▪ Check for proper operation of external site equipment. ▪ Notify far end.
FE/CRC LED is lit (Framing Error/CRC Error)	T1 is no configured for ESF	▪ Configure T1 correctly.
	Bit errors	▪ Check T1/E1 cabling. ▪ Check T1/E1 levels. ▪ Check for T1/E1 noise or crosstalk.
	Site controller failure	▪ Replace Site controller.
BPV/PD LED is lit	T1 is not configured for B8Zs	▪ Configure T1 correctly
	Bit errors	▪ Check T1/E1 cabling. ▪ Check T1/E1 levels. ▪ Check for T1/E1 noise or crosstalk.
	Site controller failure	▪ Replace iSC-3.
Net LED is lit (Network Loopback)	The Site controller has received an in-band or out-of-band loopback code, and is in loopback mode.	▪ Notify far end.
Local LED is lit (Local Loopback)	Front panel switch has put the iSC-3 into loopback mode.	▪ Push and hold the Sel/Loop switch for 2 seconds. This action takes the unit out of loopback mode.

EAS Troubleshooting

Indication	Possible failure	Corrective action
EAS breaker on Cabinet breaker is on, but POWER LED (green) on EAS is not lit.	No power connected to EAS.	▪ Check power source.
	Cabling	▪ Check power cabling to EAS; replace cable if necessary.
Wrong EAS response.	Miswired modular cable	▪ Check EAS modular cabling.
AC fail alarm	AC input, or an open or disconnected alarm lead.	▪ Verify AC in put, check for open and disconnected alarm leads.
High temperature alarm	AC input to air conditioner	▪ Verify AC input.
	Site air conditioner	▪ Call for service on air conditioner.

Indication	Possible failure	Corrective action
	Alarm sensor improperly set or wires shorted.	▪ Check and adjust alarm sensor.
	Alarm sensor located in a hot spot.	▪ Check and adjust alarm sensor.
Low temperature alarm	Air conditioner does not shut off.	▪ Repair HVAC.
	Thermostat is set too low.	▪ Set thermostat to 78ºF
	Cold air blowing on alarm sensor.	▪ Shield or relocate sensor.

7.3.2 Power Plant

If for any reason assistance is needed on any Power equipment, Field Service technicians are available through Gallon, OH to assist you. Call (419)-468-7700 or (419)-468-7600 and ask for Field Service.

Troubleshooting

Indication	Corrective Action
Rectifier Fail Alarm	▪ Review alarm status on controller. ▪ Review all alarms to ensure only an RFA and a PMN condition exists. ▪ Confirm error condition.
	▪ Is there an AC fail alarm? ▪ If an AC fail condition exists, troubleshoot AC source.
	▪ If no other error conditions are present that would cause the RFA alarm, remove and reseat the rectifier. ▪ Does the alarm condition continue to be present?
	▪ If alarm condition is present, remove rectifier and replace with a known good rectifier. ▪ Error condition should clear. ▪ If condition clears, send the faulty rectifier to PECO II following the instructions given on page 6 of the 127NHL manual.
	▪ If the error condition did not clear, check the pins on the backplane and the rectifier jack. ▪ Do all appear to be okay? ▪ If okay, contact PECO II service following the instructions on page 6 of 127NHL manual.
Fuse Alarm	▪ Determine if FA originates from the six breakers on the shelf or from an external FA that is being detected by the system. (During installation, an external FA can be connected to the rear of the plant to monitor for an FA condition).

Indication	Corrective Action
	▪ Reset the breaker and measure the load through the breaker using a current measuring device. ▪ Does the current exceed 80% of the rating of the breaker? ▪ If yes, remove and replace the breaker with a breaker that meets the 80% rule. ▪ Note: Maximum rating of the shelf is 30 amps and per CB position is 30 amps. ▪ Do not exceed the CB/plant ratings.
	▪ If current does not exceed 80% rating and breaker does not trip, troubleshooting is complete.

7.3.3 RadioFrame System

RadioFrame Networks equipment and components are not field repairable. Do not attempt to repair RFN equipment and components in the field. RFN components are individually tested prior to shipment. Should a failure occur replacement boards must be inserted and the RFS re-booted.

This section describes troubleshooting information for each component of the RadioFrame System: NCU, ACU, RFU, and URU. If the provided solutions do not resolve the problem, refer to the *Field Guide to the RadioFrame System* for further troubleshooting information. If none of the provided solutions resolve the problem, contact the Customer Assistance Center (TAC) at (425) 424-7620.

7.3.3.1 Network Chassis Unit

NCU front ports	Description
Port 1 (RJ45)	iSC—iDEN installations only
Port 2 (RJ45)	Ethernet LAN—network installations only
Ports 3-8 (RJ45)	additional Ethernet LANs
EIA-232 9-pin serial port	for debugging—Customer Service use only
NCU back ports	
Ports 1-8 (RJ45)	ACUs—up to 8 ACUs may be connected to the NCU
5MHz/1PPs IN	BNC connector for timing interface

NCU back ports	
5MHz/1PPs OUT	BNC connector for timing interface
GPS ANT	GPS antenna connection

Each card installed in the front and back of the NCU has two LEDs: Power (top) indicates power, and Status (lower) indicates the status of the card. Each RJ45 port has two LEDs: Link (right) indicates Ethernet connectivity, and Activity (left) blinks to indicate Ethernet activity. All LEDs should light as green. For all other conditions, refer to the following table.

Indication	Possible failure	Corrective action
Power and Status LEDs for cards installed in front or back of NCU are not lit	no power to NCU	▪ Verify that the power cord is installed and properly seated. ▪ Verify that the power source is operational (120VAC or –48VDC). ▪ Contact Customer Support.
Status LED is red—top front card *only*	timing source not available	▪ Connect the timing source. In iDEN installations, this is usually the iSC-3. In some cases, the timing source is the GPS antenna. ▪ Check all connections.
	failed initialization	▪ Reboot the system: unplug the NCU, and plug it in again. Boot up may take several minutes.
	fan is not working	▪ Verify that the fan is operational. ▪ If the fan is not working, unplug the NCU and contact Customer Support.
Status LED is red—any card	card is not operational	▪ Remove and reseat card. ▪ Contact Customer Support.
RJ45 port Link and Activity LEDs are not lit, or the Activity LED is not blinking	connection is not being made between RFS components	▪ For the affected port, verify that all cabling between components is properly connected.

7.3.3.2 Airlink Chassis Unit

ACU front ports	Description
RJ45 Port 1	NCU—connects the ACU to the NCU
RJ45 Ports 2-8	not currently used
EIA-232 9-pin serial port	for debugging—Customer Service use only
ACU back ports	
Ports 1-8 (RJ45)	RFUs—up to 8 RFUs may be connected to the ACU
5MHz/1PPs IN	not currently used
5MHz/1PPs OUT	not currently used
GPS ANT	not currently used

Each card installed in the front and back of the ACU has two LEDs: Power (top) indicates power, and Status (lower) indicates the status of the card. Each RJ45 port has two LEDs: Link (right) indicates Ethernet connectivity, and Activity (left) blinks to indicate Ethernet activity. All LEDs should light as green. For all other conditions, refer to the following table.

Indication	Possible failure	Corrective action
Power or Status LEDs for cards installed in front or back of ACU are not lit	no power to ACU	▪ Verify that the power cord is installed and properly seated. ▪ Verify that the power source is operational (120VAC or –48VDC). ▪ Contact Customer Support.
Status LED is red—any card	card is not operational	▪ Remove and reseat card. ▪ Contact Customer Support.
	failed initialization	▪ Reboot the system: unplug the ACU, and plug it in again. Boot up may take several minutes.
	fan is not working	▪ Verify that the fan is operational.

Indication	Possible failure	Corrective action
		▪ If the fan is not working, unplug the ACU and contact Customer Support.
RJ45 port Link and Activity LEDs are not lit, or the Activity LED is not blinking	connection is not being made between RFS components	▪ For the affected port, verify that all cabling between components is properly connected.

7.3.3.3 RadioFrame Unit

The RadioFrame Unit (RFU) has two RJ45 ports on the top of the back cover of the unit: MAIN and AUX. *Only the MAIN port is used*. The AUX port has a protective cover that must not be removed. During installation, ensure that the RFU is receiving power and connectivity from the ACU before inserting RadioBlades into the RFU or placing the front cover on the RFU.

Warning!

Do not remove the protective cover from or insert a connector into the AUX port. This will cause damage to the RFU, the ACU, or both.

The MAIN port has two LEDs: Link (right) indicates Ethernet connectivity, and Activity (left) blinks to indicate Ethernet activity between the RFU and the ACU. For all other conditions, refer to the following table.

Indication	Possible failure	Corrective action
MAIN Port LEDs do not light	connection is not being made between the RFU and the ACU	▪ Verify that all cabling between the ACU and the RFU is properly connected. ▪ Verify that the ACU is powered on. ▪ Contact Customer Support.

7.3.3.4 Universal Repeater Unit

The Universal Repeater Unit (URU) has two pairs of RJ45 ports on the front of the unit. Each pair (IN/OUT) indicates Ethernet connectivity and activity between

two RFS components. During installation, ensure that the URU is receiving power before installing RFS components.

Each RJ45 port has two LEDs: Link (right) indicates Ethernet connectivity, and Activity (left) blinks to indicate Ethernet activity between RFS components. For all other conditions, refer to the following table.

Indication	Possible failure	Corrective action
LEDs are not lit	connection is not being made between URU and RFS components	▪ Verify that the URU is plugged in to an approved power source. ▪ Verify that each RFS component is powered on. ▪ Verify that all cabling between the RFS components is properly connected.

7.4 Field Replaceable Units

7.4.1 iSC-3

For the iSC-3 and EAS, refer to Chapter 11 “FRU Replacement Procedures” of the *Gen 3 Site Controller System Manual*, Motorola, 68P80801E30-O.

7.4.2 Power Plant

7.4.2.1 Removal and Replacement of Distribution CBs

1 Loosen the three screws that secure the top access cover, and then remove the cover.

2 Grasp the Circuit Breaker to be replaced and pull it out until it is removed from the assembly.

3 Install the new CB, pressing it in until it is firmly seated.

Note: Be very careful when installing the output breakers. The common pin of the alarm circuit on the breaker must engage the jack on the plant. Tolerance is tight; go straight in with the breaker.

4 Ensure there is not a Fuse Alarm condition present. If an FA is present, remove and install the CB until the FA condition clears.

7.4.2.2 Rectifier Removal and Replacement

1 Loosen the retaining screw and gently pull on the rectifier handle until the rectifier is removed from the cage.

2 Install the new rectifier into position, and gently push on the front until it is seated.

3 Secure the rectifier module to the cage with the retaining screw.

7.4.3 RadioFrame System

In the case of chassis units, replacement boards must be inserted and the RFS re-booted.

1 Always use a static grounding wrist strap before handling any board—*do not* attach the wrist strap to any painted surface on the chassis unit.


Note

It is not necessary to unplug the NCU or the ACU prior to removing or inserting a board.

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2 Facing the chassis unit, remove the card that is to be replaced, or the blank faceplate, following these guidelines:

- Loosen the blue knurled knobs on both sides of the board.
- Pull firmly to unseat the board from the connectors inside the chassis unit.
- Gently slide the board straight out and away from the chassis unit so as not to damage any components contained on the board.

3 Remove the new board from its antistatic packaging and insert it into the chassis unit as shown in the following illustration, and follow these guidelines:

- Do not jam the board in any way while inserting it.
- Do not mount the board in any orientation other than that specified in the diagram.
- Insert the board straight into the chassis unit so as not to damage any components contained on the board.
- Press firmly to seat the board into the connectors within the chassis unit.
- Tighten the blue knurled knobs on each end of the board finger tight only—do not use a screwdriver to tighten the screws and do not over tighten.

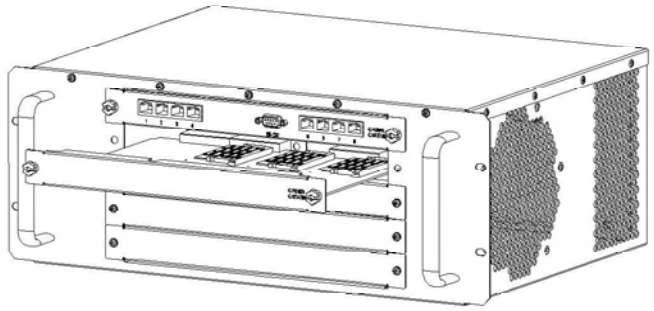
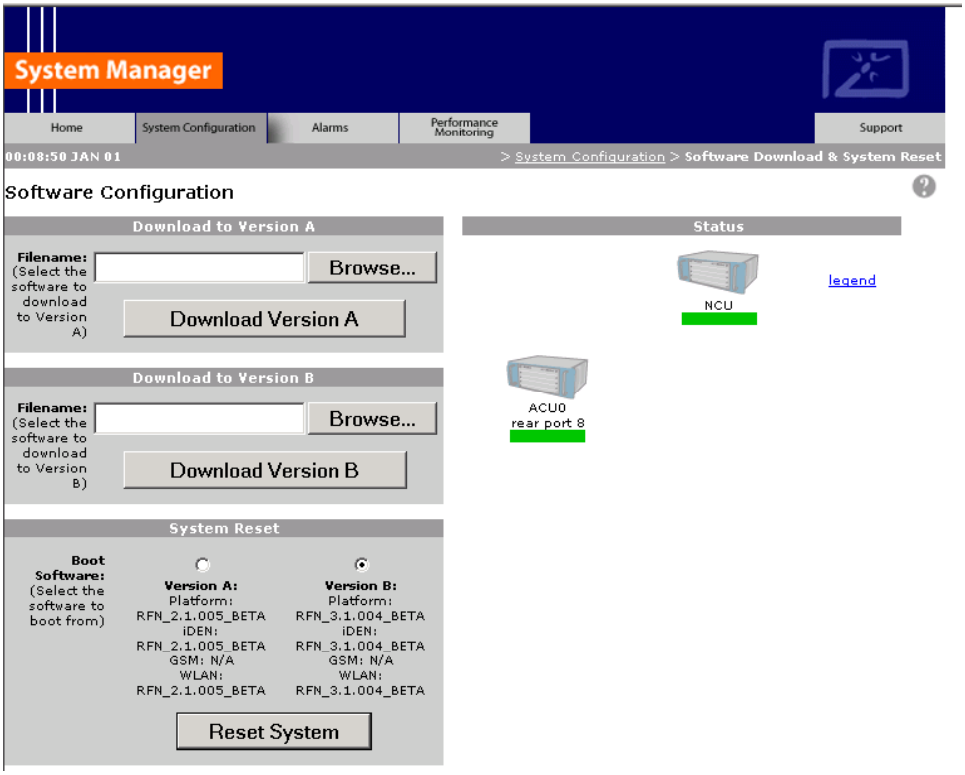


Figure 34 Replacing a board in an NCU or an ACU.

4 Place the old board in the antistatic packaging for shipment.

5 Restart the RadioFrame System.

Select the Software Download & System Reset link located at the bottom of the NCU configuration page, and select the “Reset System” button to cause a system reset. The reboot may take several minutes to complete.



7.5 Alarm Resolution Procedures

The RFS provides fault alarming and isolation within System Manager for individual components, which consists of detecting catastrophic faults that prevent an RFS component from responding to a periodic “ping”. Depending on the severity, alarms are sent to the OMC via the iSC-3. All alarms passed to the OMC use an Alarm Code, such as 39005, which uses the event description “Unable to key BR”.

This section describes:

- How to view alarms in System Manger,
- OMC alarm code and severity levels, and
- System Manager alarms and resolution procedures.

7.5.1 Viewing System Manager Alarms

System Manager displays system-related errors. Only some of these errors are sent to the OMC.

1 To view alarms and other system-related errors in System Manager, select the Alarms tab.

The **Alarms Log** displays RFS alarms, listed by **Time** of occurrence (including the date), in a sequence of 200 alarms at a time—**No.** (see the following illustration). Approximately 25 alarms are visible at any one time. At the bottom of the page, you can see which alarms are currently displayed, in this case, 99 through 118 of 118 alarms.

NOTE: If the Alarms page is empty, System Manager is still loading the page.

2 To display alarms that have scrolled out of view, select **first**, **prev**, **next**, **last** or **all** at the bottom of the alarm page, then enter a value in the **Show** text box and press enter.

For example, to view the first 20 alarms, click first and type 20 in the text box, then press Enter. To return to the bottom of the list of alarms, select last and type a value in the text box.

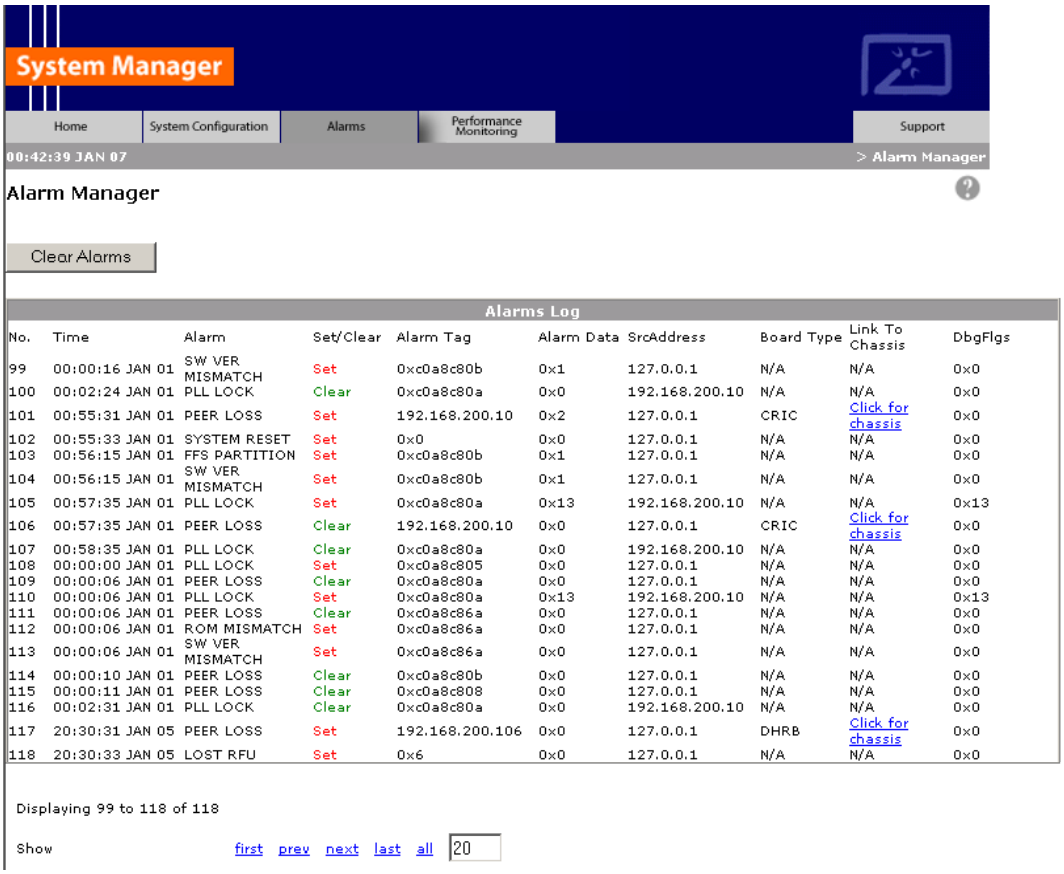


Figure 35 Alarms are listed up to 200 at time and continue to scroll as events occur.

For each **Alarm**, System Manager displays the alarm description and whether the alarm is new (**Set**) or has been cleared (**Clear**). The same alarm will continue to be listed as a set alarm until it has been cleared. If an alarm is not cleared, it will be sent to the OMC (see “System Manager Alarm Descriptions” later in this section). Other alarms might occur before an alarm clears, so the ‘set’ and ‘clear’ for the same alarm do not necessarily appear in sequence.

The **Alarm Tag** uniquely identifies each alarm using either the actual IP address or hex digits to represent the IP address of the affected component. In the latter case, the last four digits of the alarm tag represent the last two sets of digits of the IP address of the component. For example, 0xc0a80679 represents xxx.xxx.06.121. The IP address of the board generating the alarm is shown under **SrcAddress**, or ‘source address’.

Board Type identifies which board within a chassis unit is affected (APC, CRIC, etc.). For these alarms, select **Click for chassis** link to display the page for that component.

NOTE: When troubleshooting alarms that require assistance from RadioFrame Networks, you'll need to provide the data displayed in the **Alarm Data** and **DbgFlgs** fields.

7.5.2 OMC Alarm Code and Severity Levels

All RFS alarms sent to the OMC use an Alarm Code, such as 35009 (see the following table). The Event Description for this alarm is 'Unable to key BR'. The severity level—minor, major or critical—indicates which RFS component has been affected (see the second table below).

Event	Description
Alarm Code	**35009**
Event Type	CntrlBrd
Alarm Type	Equipment Failure
Actionable	Yes
Severity	**Minor, Major or Critical**
Bounce Threshold (x)	3
Bounce Threshold Minutes	30
Duration Threshold	10
Related Alarms	None
R & C	RC
Outage Y/N	S1_El CY
Event Description	**Unable to key BR**
Advisor	Site Service call
Comments	None
Alert Names	BREFCTLBD35009
Last updated	8/3/2001
Revision	
Change Notes	8/3/2001: per new EBTS rules baseline. Changed severity and threshold from GR1 to: ▪ Severity=minor ▪ BounceThreshold=3 ▪ Bounce Threshold Minutes=30 ▪ Duration Threshold=10
Action	▪ Create trouble ticket. ▪ Contact Field Technician. ▪ TS/BR

'Unable to Key BR' alarm severity	Description
minor	An iDEN RadioBlade or 802.11b RAP has failed.
major	An RFU has failed.
critical	A card in a chassis unit has failed (except for the RLIC, which returns alarm information.)

7.5.3 System Manager Alarms

The first table below lists System Manager alarms that are sent to the OMC, the OMC alarm message, and the severity of the alarm. The second table describes all System Manager alarms, and what action is required, if any, to resolve the problem.

OMC Alarm	System Manager Alarm	Severity
BOARD DISABLED	PEER LOSS	MINOR (RAP only)
BOARD DISABLED	PEER LOSS	CRITICAL (any board except RAP)
EXCESS RESETS	EXCESS RESETS	CRITICAL
ENABLE WAIT	BR ENABLE FAIL	MINOR
NO SPAM IN APC	APC NO SPAM	CRITICAL
RADIO BLADE LOST	IDENRB LOSS	MINOR
RFU DISABLED	LOST RFU	MAJOR

Alarm	Description	Action
5MHz CLOCK	RIC or RLIC temporarily lost the 1 PPS reference.	No action required.
ALARMS CLEARED	Alarm Manager was cleared using the Clear Alarms button.	No action required.
APC NO SPAM	There are more BRs than the current SPAM resources can support.	Add more SPAMs as required.
APC SLOT MISS	Slot mismatch detected on APC or NPC. Causes a slot sync procedure three times. If the slot still is not found, generates the alarm APC SYNC FAIL.	
APC SYNC FAIL	APC SLOT MISMATCH is not able to recover after three attempts. Causes a system reset.	
ASSGN FAILURE	More than three consecutive assignment failures occurred on a BR without any successful calls in between. The BR is locked out.	

Alarm	Description	Action
BAD RB SLOT	RB reported a slot number that is out of range (1-8).	Replace either the RFU or the RB.
BAD VGA	1180s received from the RB have a consistently high Gain setting, even in the absence of any signal indicating Rx Calibration issues. RIC will attempt to reset the RB three times, and then generates a Calibration alarm.	
BR ACTIVITY	Not currently used.	No action required.
BR ENABLE FAIL	BR remained disabled for more than 30 minutes. Causes the BR to go into permanent Error mode and will not participate in further fault recovery procedures.	
BR STARTUP FAIL	Not currently used.	No action required.
CHNL SETUP ERR	iSC channel setup (channelSetup) is invalid or inconsistent. Causes the BR to be de-keyed and to return to LEI mode to restart the channel allocations with the iSC.	
COMMANDED RESET	System Reset was initiated via System Manager. Causes a system reset.	
COVERAGE HOLE	One BR in a sector has fewer RBs than other BRs in that sector. The BR that is short of Radio Blades has locked.	
DHRB RESET	A problem in the DHRB has caused it to reset.	No action required.
DHRB TASK EXCEP	Task Exceptions has occurred for some task on the DHRB. DHRB resets.	No action required.
DSP 1180 FLOOD	The RB 1180 DSP address is flooding all ports. Sends a Stop Tx command to the RB and causes a system reset.	
DSP HPI ERROR	Problem in accessing HPI interface for a DSP. If errors go beyond a threshold, SPAM is reset.	
DSP LOAD ERROR	DSP software not found. DSP was not initialized.	Check the ffs files etc.

Alarm	Description	Action
DSP LOST PDU	DSP is not sending any PDUs to the APC. The CPU received fewer than threshold PDUs within a fixed period from the DSP. SPAM is reset.	
DSP TX IQ FAIL	DSP Tx counter is not incrementing as per expectations, implying that DSP has stopped transmitting. SPAM is reset.	
DSP TX NULL PDU	DSP is transmitting too many NULL packets because it didn't receive PDUs from CPU. SPAM is reset.	
EXC DSP RESET	DSP SPAM has been reset more than four times within the last 20 minutes. Causes a system reset.	
EXCESS RESETS	More than four resets have occurred within 30 minutes. BRs permanently lock up and require a system reset.	Reset system.
EXT BR RESET	BR received a reset command from the iSC. Event logged to indicate that BRs went down on iSC request.	
FAN1 ALARM	Chassis FAN1 is malfunctioning.	Check the chassis fans for proper operation.
FAN2 ALARM	Chassis FAN2 is malfunctioning.	Check the chassis fans for proper operation.
FFS PARTITION	Board booted from wrong partition. May indicate problem with the files on boot partition.	Verify software versions for each partition in System Manager.
IDENRB LOSS	Communication with the iDEN Radio Blade has been lost. The corresponding BR is locked and all associated RBs have stopped.	
LAPD LINK FAIL	The LAPD connection between the BR and the iSC has been lost. The BR will try to re-establish the LAPD and sends a state change trap to iSC.	Check the iSC connection.
LOST RB	DSP is not getting 1180 packets from the RB. APC logs the alarm and sends a message to the RIC to reset the RB.	
LOST RFU	All the iDEN RBs and Datahosts in an RFU have been lost.	Check the RFU connections, etc.
MISC EVT/ALM		

Alarm	Description	Action
NET POOL ERROR	The free Mblock cluster has gone below 40 on an NPC or AP, the threshold for APC_NETPOOL_LOWMARK or NPC_NETPOOL_LOWMARK. Causes a system reset.	
OVERTEMP	A chassis has overheated.	Check the chassis for proper operation.
PEER LOSS	Communication with a board has been lost. RIC has detected a PEER LOSS from the RLIC. Causes a system reset, unless the cause is a DHRB, which self resets.	
PLL LOCK	A RIC or RLIC PLL went out of lock. The RLIC locks and de-key all BRs, and then sends a state change trap to the iSC.	
RB ALARMS-CRC	An RB has generated a RIC CRC error within the last 30 minutes.	Monitor the RB/RFU and if it keeps incrementing, replace the RB/RFU.
RB ALARMS-MISC	An RB has generated a RIC error other than the CRC error.	If this alarm occurs frequently while the system is running, monitor the RIC.
RB CALIBRATION	The RB did not reset after three attempts due to a Bad VGA.	Identify the RB and replace it.
RB E2 READ ERR	RBSession EEPROM read attempts have failed beyond threshold. The RB goes into an error state.	Replace something.
RB ERROR STATE	The RB has gone into an error state because there was either an error reading I/Q DAC values, or the values were invalid.	Identify and replace the RB.
RB SLOT MISS	APC has detected an RB in the wrong slot. APC sends a message to the RIC with the RBIndex. Causes slot synchronization for the RB.	
RB SYNC FAIL	Three consecutive attempts to sync up the RB failed.	Reset the SPAM.
RB TX GAIN CAL		
ROM MISMATCH	Board boot version is not the same as the RLIC.	
SPAM FAILED	Lost DSP PDUs have exceeded threshold. SPAM is reset.	
SW VER MISMATCH	Board software version is not the same as the RLIC.	
SYSTEM RESET	Alarms that result in a system reset cause	

Alarm	Description	Action
	this alarm, except for the RLIC. All BRs and boards are locked and reset except the RLIC.	
TASK STARVATION	A task is using all the CPU time and starving other tasks. Prints a list of ready task and causes a system reset (unless it's a DHRB, which resets itself).	
TASK SUSPEND	A task got suspended on a board. Board is reset (unless source is RLIC).	
UNK 1180 FAIL	The message UNK 1180 FLOOD failed to recover after three attempts. Causes a system reset.	
UNK 1180 FLOOD	RB registration caused wrong address for DSP 1180 packets. RB is reset to cause registration. If fails after three attempts, causes alarm UNK 1180 FAIL.	
UNKN ISC MSG	Unknown iSC message has been received.	Let the developers know.

7.6 Repair and Technical Support

RadioFrame Networks provides technical support services to RFN customers for the installation and maintenance of RadioFrame Networks equipment. For iSC-3 or T1 related questions, please contact the RFN customer.

7.6.1 Before calling...

Have the following information available prior to contacting RadioFrame Networks Technical Assistance Center (TAC) to minimize downtime:

- location of the RadioFrame System
- date the RadioFrame System was put into service
- System Manager software version
- symptoms of the problem
- if an alarm was generated, the alarm information including the information from the **Alarm Data** and **DebugFlag** fields on the Alarms page in System Manager
- date the problem was first noticed
- if the problem can be reproduced

- what causes the problem to occur
- any unusual circumstances contributing to the problem (i.e., dropped calls)

7.6.2 Technical Assistance Center

For support of RadioFrame Networks equipment, contact the RadioFrame Networks Technical Assistance Center at:

(US) (800) 762-6322

7.6.3 Repair Procedure

If RFN equipment should require service or repair, note the following information, then contact the RFN Technical Assistance Center at (800) 762-6322:

- Include the warranty and serial numbers of the affected equipment.
- Give a clear return address, including a contact person, phone number and, preferably, an alternate contact person and phone number.
- Always use a static grounding wrist strap before handling any board or RadioBlade.
- Securely package the board in the original shipping carton, if available. Otherwise, package in a static protection bag in a well padded carton.

Appendix A Glossary

Acronym	Term	Description
10Base2		10Base2 is also known as Thin Ethernet. 10Base2 cables support transmission speeds up to 10 Mbits/second. The maximum distance per segment is 185 meters.
10BaseT		10BaseT is the most common form of Ethernet cabling. The cable is thinner and more flexible than the coaxial cable used for the 10Base2 standard. 10BaseT is also known as unshielded twisted-pair (UTP). 10BaseT cables support speeds up to 10 Mbps. The maximum distance per segment is 500 meters.
ACU	Airlink Chassis Unit	The central baseband processing unit for the RFS. Rx/Tx airlink traffic to/from RFUs.
APC	Airlink Processing Card	Interface to the RIC for the control of RFU components and the transfer of voice I/Q samples to/from RFUs.
CSU	Channel Service Unit	The CSU provides the T-1 connection between the iSC-3 and the telephone company that provides the T-1 line.
EIA	Electronic Industries Alliance	The EIA organization establishes electronic interface standards.
EAS	Environmental Alarm System	The EAS provides a central location for site alarm signal processing. The EAS monitors environmental conditions of the site, including power, smoke alarms, and intrusion alarms.
ERTM	Ethernet Rear Transition Module	Located in the NCU, provides clock and data to the ACU.
ESD	Electrostatic Discharge	The dissipation of electricity, commonly known as a shock. ESD can destroy semiconductor products, even when the discharge is too small to be felt.
	ethernet media converter	Hardware box that converts the 10base2 (coaxial television) cable to a 10baseT (RJ45) cable. In the RadioFrame System, this hardware connects the 10base2 cable coming from the iSC-3 to Port 1 of the NCU.
FRU	Field Replaceable Unit	Any unit (module, board, or card) that can be “hot-swapped”, that is, replaced with another unit while the power is connected to the item housing the unit.
GPS	Global Positioning System	A system that uses geostationary satellites to triangulate the position of a GPS receiver located on earth.
	ground strap	A metal strip placed between the antennas of RadioBlade that are installed in an RFU. It prevents RF attenuation within the RFU.
iDEN	integrated Digital Enhanced Network	Motorola’s proprietary digital technology that combines the capabilities of a standard analog dispatch system with that of a cellular interconnect system. iDEN uses an advanced proprietary modulation technology consisting of a speech compression scheme enabling three or six communication paths over a single 25 kHz RF channel.
iSC-3	integrated Site Controller	The controller and communications gateway between the RFS and the RFN customer central network. The iSC-3 is required for all RadioFrame Networks iDEN installations.

Acronym	Term	Description
NCU	Network Chassis Unit	The central network processing unit for the RFS. Also central management entity for managing configuration and User Information.
NPC	Network Processing Cards	Interface to the RLIC for the bi-directional transfer of voice I and Q samples to/from RFUs.
PDU	Power Distribution Unit	The panel used for distributing power to the units within the main rack.
PERTM	Powered Ethernet Rear Transition Module	Located in the ACU, provides power, clock, and data to the RFUs.
RB	RadioBlade	Provides the airlink interface for the iDEN standard.
RFN	RadioFrame Networks	Equipment designer and manufacturer of RFS equipment.
RFS	RadioFrame System	Digital Communication System for indoor wireless device users. The RFS consists of several components: NCU, ACU, RFUs and iDEN RadioBlades.
RFU	RadioFrame Unit	RF front end for each of the implemented air interface to the User equipment and connects to ACU on the other end.
RFU BP	RadioFrame Unit - Back Plane	Facilitates High speed intermodule communication between RFU components and between RFU and ACU.
RIC	RadioFrame Interface Card	Provide the Ethernet switch fabric to route packets to/from ACUs, RFUs and external IP networks. Also will host a micro-P (MPC-8240) as primary controller to APCs.
RLIC	RadioFrame LAN Interface Card	Provide the Ethernet switch fabric to route packets to/from ACUs. Also hosts a micro-P serving as primary controller of NPCs.
RSSI	Received Signal Strength Indication	Strength of the received call signal, in dBm.
SELV	Safety Extra-Low Voltage	A secondary electrical circuit designed so that under normal and signal fault conditions, its voltages do not exceed a safe-value.
SPAM	Signal Processing Array Module	A connectorized card which plugs into an APC or NPC and provides the digital signal processing resources.
SQE	Signal Quality Estimate	An estimate of signal quality, based on the received signal strength and quality.
T1	Digital Transmission Rate 1	A North American leased-line connection capable of carrying 1.544 megabits of data per second (Mbps). T-1 lines are commonly used to connect networks, ISPs and others to the Internet.
T1/E1		An E-1 line is the European equivalent to the North American T-1. However, an E-1 line carries information at the rate of 2.048 Mbps instead of the 1.544 Mbps of a T-1.
T568B		Wiring standard for RadioFrame System CAT-5 cables. Denotes a specific order of the CAT 5 wires leading into the RJ-45 connector.
URU	Universal Repeater Unit	Repeats signal and timing and can also provide power to an RFU. Extends distance between RFS components from 100 meters to 300 meters.

Appendix B Site Survey

Site Survey REV A

Carrier _____ Date__

Customer _____ Project #_____

Site Location _____ RFN Project Engineer

Present for Site Survey		Name	Email	Phone
	Carrier representative			
	Customer representative			
	Building/Site Manager			
	Installation vendor			
	RFN Engineer			
	RFN Project Manager			
	Other			
Customer Expectations				
	Who will provide RF measurements?			
	Who will install the RFS?			
	Who will commission the installation?			
	Will the RFS be shipped directly to the site or staged?			
	Will the RFS be assembled and tested at the customer site?			
	Digital photos permitted during the site survey?			

Customer Expectations (continued)	
	Troubleshooting expectations?
	Other
RF Planning	
	Which and how many channels will be provided for indoor use?
	Coverage requirements (see RF Measurements below)
	Vertical coverage required?
Site WLAN	
	What is the internet connectivity?
	WLAN configuration?
	Mobile IP?
	Static/administration of IP?
	24 X 7 point of contact
RFS Equipment Requirements	
	Cable path from iSC
	Wall mount or ceiling mount of RFUs preferred?
	iSC Equipment
	iSC location
	Power requirements
	Rack size

RFS Equipment Requirements (continued)	
	iSC Equipment (continued)
	T1 connection location
	GPS antenna requirement (cable path to outside antenna location)
	NCU
	NCU location
	Power requirements
	4U 19” rack space available per NCU?
	Cable run distance from iSC
	ACU
	ACU location
	Power requirements
	4U 19” rack space available per ACU?
	Cable run distance from NCU
	RFU
	Wall mount?
	Above ceiling panels available? If so, which floors?
	Power Requirements
	120VAC or –48VDC available?
	UPS required?

Installation Requirements	
	Cable and Path Requirements
	Plenum rated cable required?
	Innerduct required?
	Conduit required?
	Existing vertical access between floors?
	Space available for additional new cable in existing stubs and/or conduit?
	Core drill required?
	Dedicated CAT 5 (or higher) available?
	Ceiling Type
	Open
	Suspended
	Acoustical tile
	Hard plaster
	Metal
	Other
	Ceiling Height
	Standard
	Other

Installation Requirements (continued)	
	Wall Type
	Standard drywall construction
	Cement/brick
	Metal
	Other
	Firewall
	Load bearing
	Other RF Barriers
	Identify RF blocking areas, items and locations
	Local Issues
	Union(s) required (identify)?
	Local code requirements?
	Building management standards?
	Permits required?
	Other
	Access
	When can work be conducted (regular hours, after hours, weekends)?
	Special scheduling requirements
	Point of contact

Installation Requirements (continued)	
	Access (continued)
	Escort required
	Between Buildings Only
	Space available to mount hubs in 19” racks (fiber solution only)?
	New rack space location identified?
	Identify all Telecom closets for remote fiber units
Other Requirements/Comments	

Appendix C NCU and ACU Main Rack Installation

The RadioFrame System NCU and one ACU are mounted in the main rack prior to shipment to the site. Complete the following three procedures to install the NCU and main rack ACU:

- Mount the NCU in the Main Rack
- Mount the ACU in the Main Rack
- Connect the NCU to the ACUs

Mount the NCU in the Main Rack

The NCU is the main controller of the RadioFrame System. The NCU is mounted in the main rack supplied with –48VDC power.

1 Find these items in the NCU shipping container: one NCU, four mounting screws, one coaxial cable with two male BNC connectors for connecting to the iSC, and one set of product documentation.

2 Mount the NCU only in an EIA-standard compliant (19”) rack using all 4 screws provided. Refer to the site documentation for the exact location of the NCU. For safe operation, follow these guidelines:

- Do not mount the NCU in any orientation other than that specified in the following illustration.
- Mount the NCU so that both the front and the back are accessible.
- If the mounting holes do not line up, adjust the NCU up or down until the mounting holes line up.
-


Caution

Do not block the air vents on the sides or rear of the NCU.

3 Plug the NCU into main rack power source (rectifier or PDU).

4 Verify that the NCU is receiving power and that each NCU card is operational.

Each card installed in the front and back of the NCU has two LEDs: Power and Status. All LEDs should light green.


Note

The Status LED on the top card in the front of the NCU will remain red until the NCU is connected to a timing source.

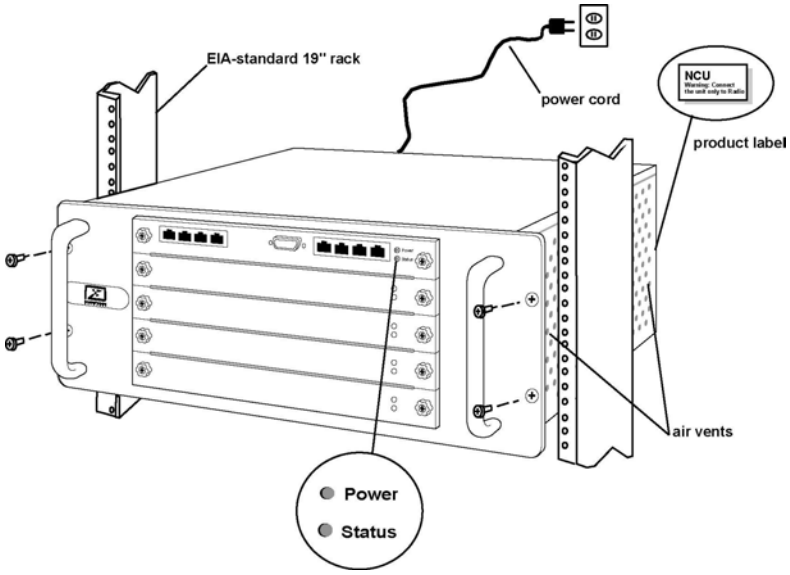


Figure 36 Mount the NCU only in an EIA-standard compliant 19” rack.

Mount the ACU in the Main Rack

The ACU is mounted in the main rack supplied with –48VDC power.

1 Find these items in the ACU shipping container: one ACU and four mounting screws.

2 Mount the ACU only in an EIA-standard compliant (19”) rack using all 4 screws provided. For safe operation, follow these guidelines:

- Do not mount the ACU in any orientation other than that specified in the following illustration.
- Mount the ACU so that both the front and the back are accessible.
- If the mounting holes do not line up, adjust the ACU up or down until the mounting holes line up.


Caution

Do not block the air vents on the sides or rear of the ACU.

3 Plug the ACU into main rack power source (rectifier or PDU).

4 Verify that the ACU is receiving power and that each NCU card is operational.

Each card installed in the front and back of the ACU has two LEDs: Power and Status. All LEDs should light green.

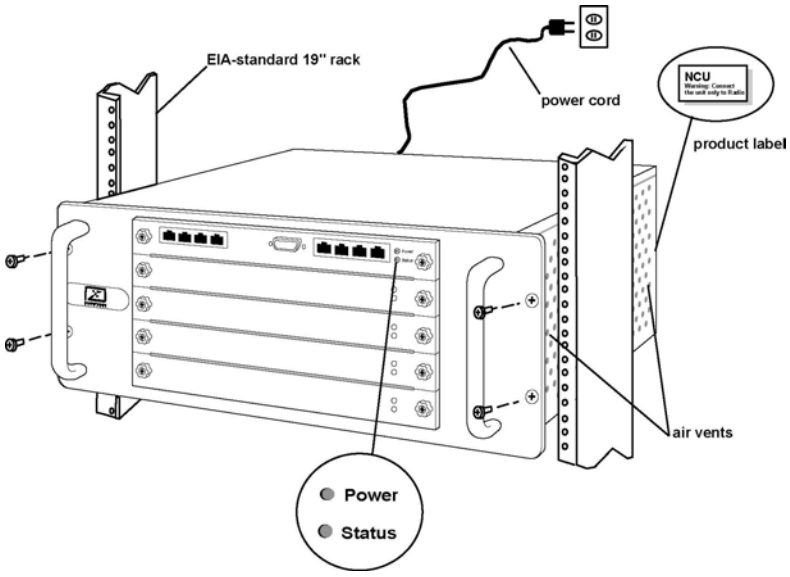


Figure 37 Mount the ACU only in an EIA-standard compliant 19” rack.

Connect the NCU to the ACUs

After the main rack has been installed and all wiring for the RFS has been completed, connect the main rack ACU and all remote ACUs to the NCU.

1 Connect the RJ45-to-RJ45 CAT 5 cable for each ACU to the specified RJ45 port (1-8) on the back of the NCU.

Refer to the site documentation to determine which ACU connects to each port on the NCU. The Activity and Link LEDs above the ports will remain unlit until each ACU has been installed and plugged in.

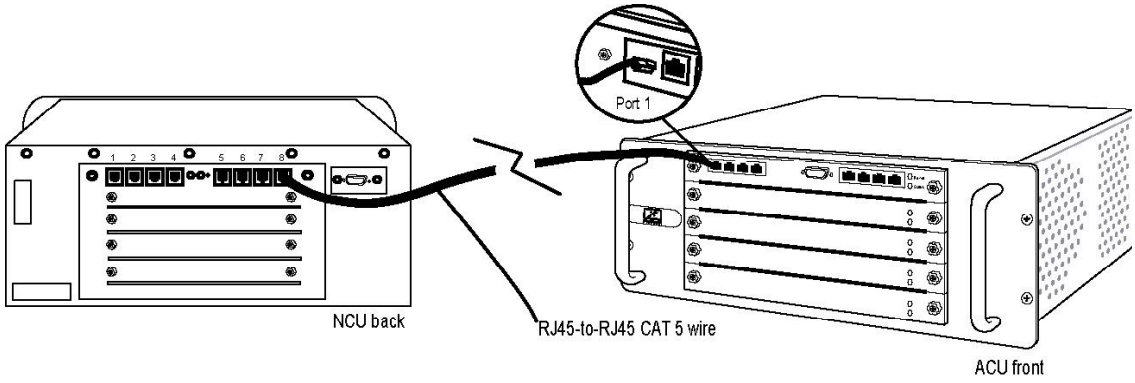


Figure 38 Connect the RJ45-to-RJ45 CAT 5 cable for each ACU to the specified RJ45 port on the back of the NCU.

Appendix D RFS Default IP Addresses

All chassis boards, RFU backplanes, and RAPs are issued a default IP address during initial setup (iDEN RadioBlades do not require IP addresses). The following table lists default IP addresses for all chassis unit boards, as well as the default IP address required for logging in to the RadioFrame System. In addition:

- RFU backplane default IP addresses are 192.168.200.90 through 192.168.200.153
- RAP default IP addresses are 192.168.200.154 through 192.168.200.254

Device	Card Type	Chassis Slot	IP Address	
Laptop	N/A	N/A	192.168.200.	4
NCU	RLIC	Slot 0	192.168.200.	5
	NPC	Slot 1	192.168.200.	6
	NPC	Slot 2	192.168.200.	7
	NPC	Slot 3	192.168.200.	8
ACU-1	RIC	Slot 0	192.168.200.	10
	APC	Slot 1	192.168.200.	11
	APC	Slot 2	192.168.200.	12
	APC	Slot 3	192.168.200.	13
ACU-2	RIC	Slot 0	192.168.200.	20
	APC	Slot 1	192.168.200.	21
	APC	Slot 2	192.168.200.	22
	APC	Slot 3	192.168.200.	23
ACU-3	RIC	Slot 0	192.168.200.	30
	APC	Slot 1	192.168.200.	31
	APC	Slot 2	192.168.200.	32
	APC	Slot 3	192.168.200.	33
ACU-4	RIC	Slot 0	192.168.200.	40
	APC	Slot 1	192.168.200.	41
	APC	Slot 2	192.168.200.	42

Device	Card Type	Chassis Slot	IP Address	
	APC	Slot 3	192.168.200.	43
ACU-5	RIC	Slot 0	192.168.200.	50
	APC	Slot 1	192.168.200.	51
	APC	Slot 2	192.168.200.	52
	APC	Slot 3	192.168.200.	53
ACU-6	RIC	Slot 0	192.168.200.	60
	APC	Slot 1	192.168.200.	61
	APC	Slot 2	192.168.200.	62
	APC	Slot 3	192.168.200.	63
ACU-7	RIC	Slot 0	192.168.200.	70
	APC	Slot 1	192.168.200.	71
	APC	Slot 2	192.168.200.	72
	APC	Slot 3	192.168.200.	73
ACU-8	RIC	Slot 0	192.168.200.	80
	APC	Slot 1	192.168.200.	81
	APC	Slot 2	192.168.200.	82
	APC	Slot 3	192.168.200.	83
RFU-1	Backplane	N/A	192.168.200.	90
RFU-2	Backplane	N/A	192.168.200.	91
RFU-3	Backplane	N/A	192.168.200.	92
				.
				.
				153
RAP-1	N/A	N/A	192.168.200	154
RAP-2	N/A	N/A	192.168.200	155
RAP-3	N/A	N/A	192.168.200	156
				.
				.
				254

Appendix E RF Planning Guide 990-1001-00

Appendix F System Manager Guide 981-6300-00

Appendix G RFN Recommended Data Fill 998-0100-10

Appendix H RFN Field Guide 998-1000-00