Reference Manual

- *RC19-1X10 Network Repeater*
- *RC19-1X15 Network Repeater*
- *RC19-2X10 Network Repeater*
- *RC19-2X15 Network Repeater*

REPEATER
3G COVERAGE SOLUTIONS

550-1300-01
Revision C
April 2002

This manual assumes that the installation will be performed by a qualified engineer.

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Unpacking and Inventory 1

1.0 Receiving and Inspecting the Repeater

When you receive a repeater from Repeater Technologies, Inc. (RTI), immediately do the following:

1. Unpack the repeater.
2. Inventory the contents against the packing list and note any missing items.
3. Inspect for shipping damage, especially for damage that might have been hidden by the packaging. Pay particular attention to the following:
   - Bent or dented sheet metal
   - Loose or broken components
   - Damaged or bent connectors
   - Damaged or broken wiring or coaxial cables
   - Missing or damaged contents of the accessory kit
   - Missing or damaged optional equipment ordered with the repeater unit.

If any items are missing or damaged, perform all of the following steps:

1. Report any missing or damaged items by writing them on the shipping waybill.
2. Ask the delivery agent to sign the waybill for verification of the loss or damage.
3. Notify the transfer (shipping) company as soon as possible.
4. Submit a damage report to the shipping carrier.
5. Inform customer service at 1-800-938-1901.

NOTE: Save the original shipping carton and packing materials to reuse for any future transport of the repeater unit. For example, a repeater might be moved to a new location in a PCS network, or a damaged repeater might need to be returned to RTI. Repeater must be transported with backplate. Packaging must be original or warranty may be affected.

1.1 Equipment Required for Installation

Table 1-1 lists required installation equipment RTI does not provide with a repeater. These standard tools should be readily available from local suppliers of telephone, electronic, and/or computer equipment.

NOTE: Installing an RTI repeater requires a site plan. These documents define the intended parameters of the cellular/PCS network project, including the repeater's coverage area, gain settings, and antenna location. If necessary, consult a network administrator for more information.

Table 1-1 Required Installation Equipment

Equipment	Function
Site Plan/Network Engineering documentation	Correctly configure the repeater to operate in the PCS/Cellular network.
1/8 inch Small Flat Blade Screwdriver	Use for AC input power and external alarm plugs.
Voltmeter, Fluke 75 or equivalent VOM	Test voltage and power polarity.
Spectrum Analyzer and/or power meter	Test RF power output.
RF Signal Generator ($\geq$ 2 GHz)	Test antenna isolation.
Pilot scanner (optional)	Measure donor base station receive power.
Type N (m) 50-ohm Termination, 20 W (3 ea.)	Terminate antenna ports during off-air testing.
Mounting Hardware	Mount repeater, antennas and coax cables.
Electrical Wiring Equipment (as needed)	Connect external power to Repeaters.
Laptop Computer (Win95, 98, ME, NT, 2000)	Configure, control and monitor the repeater through the RepeaterNet Craft port.
Pole Mounting Tightening/Crimping Tool (for pole mounting only)	Mount the repeater to a pole and secure pole mounting straps.
Coax Jumper Cables	Type N (male to male) calibration cables for Test Equipment (length depends upon application).
Frequency Domain Reflectometer (Feed Line Sweep Tester) Anritsu Site Master™ or equivalent	Test Coax/Feed Line and Connector VSWR.
Directional coupler (2 each) –30 dB coupled port	Test repeater power output.

Table 1-2 Accessory Kit Inventory P/N 091-1300-01

Part Number	Description	Quantity
129-0008-01	Hex Bit, Pin-In Socket, 7/32”	1
519-1200-03	Craft Software	1
187-0713-02	Cable Assembly, Comp (2M) 2X D-Sub 9-Pin, Male/Female - straight through	1
023-1262-01	Shipping Container Label	1
550-1300-01	Repeater Reference Manual, Printed	1

Mounting the Repeater 2

2.0 Installation Overview

RTI repeaters are designed for indoor or outdoor installation, and can be mounted on either a wall or a pole. The unit's compact cabinet simplifies installation, and its aesthetically-acceptable design means that it conforms to zoning standards in many locations.

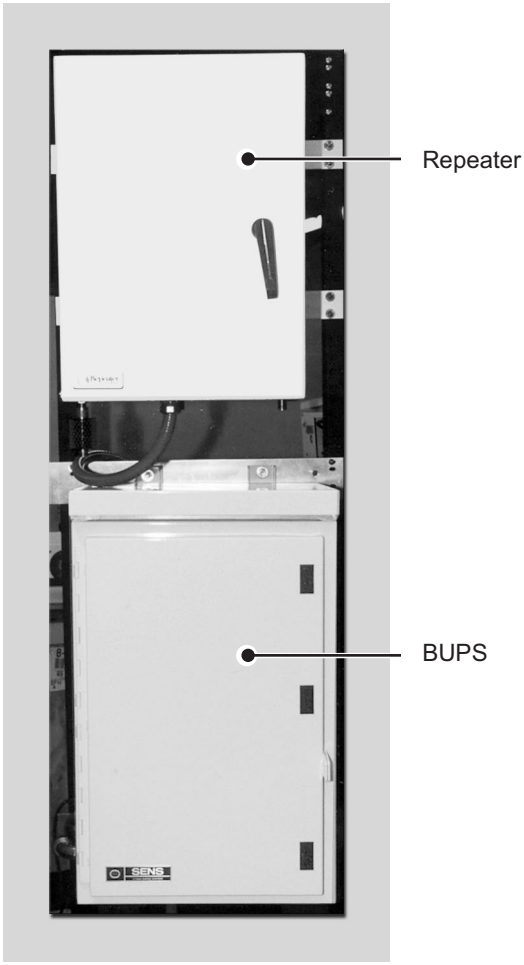
NOTE: Two people are recommended for mounting the repeater.

NOTE: Only qualified service or technical personnel should install the repeater.

Figure 2-1 shows a typical repeater installation with a Back-Up Power System (BUPS).

NOTE: RTI Repeaters are not intended for mobile operation and should be placed in a fixed location.

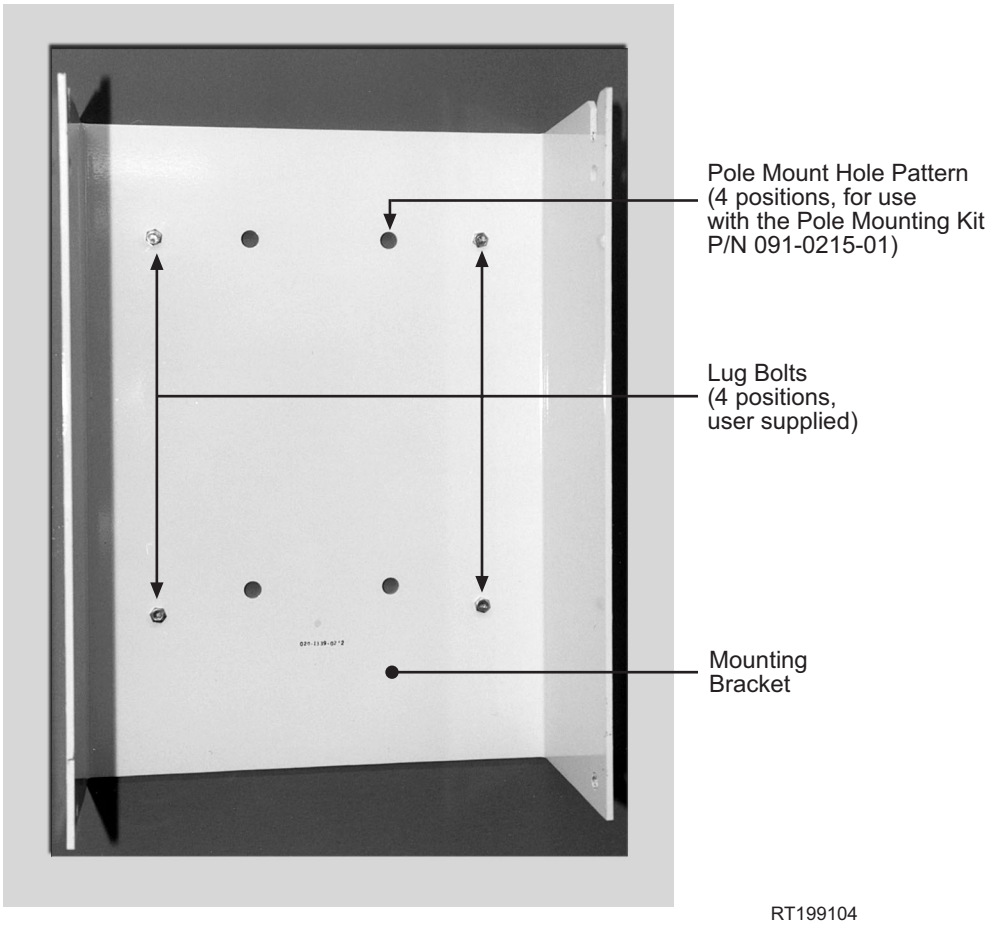
Figure 2-1 Typical Repeater Installation



2.1 Mounting the Repeater

Figure 2-2 illustrates the bracket for mounting the repeater. In both the wall-mounting and pole-mounting installation instructions that follow, this bracket is detached from the repeater and attached to the wall or pole. The repeater is then inserted into the bracket.

Figure 2-2 Rear Mounting Bracket



Mount any antennas, antenna cabling, and BUPS equipment (if used) before mounting and wiring the repeater.

2.1.1 Wall Mounting

Customer supplied hardware for wall-mounting a repeater includes the following:

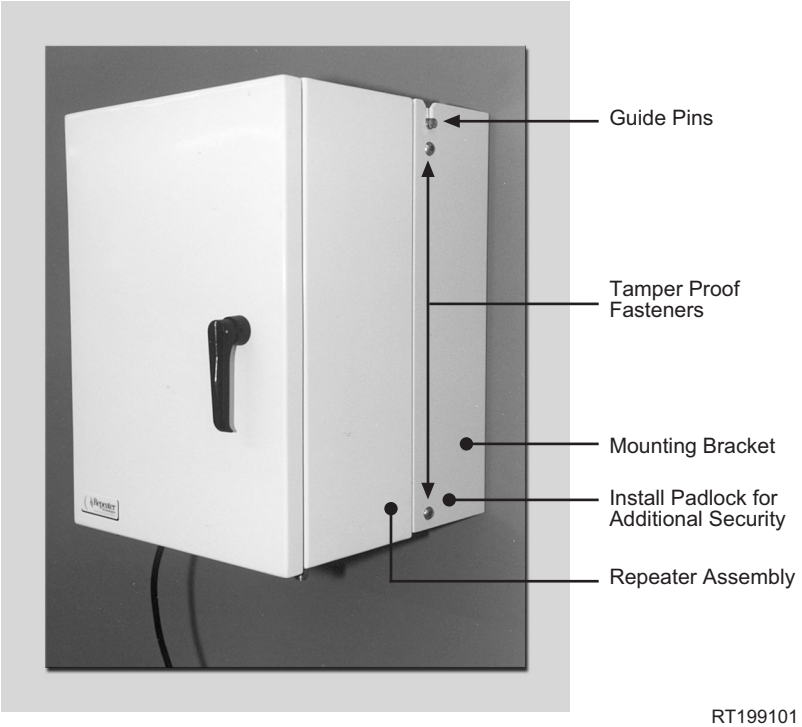
- Four(4) lag (hexagonal-head) bolts
- Four(4) flat washers
- Four(4) split-lock washers

To mount the repeater on a wall:

1. Separate the rear mounting bracket from the repeater by removing the security bolts and washers.

   To do this, use either a ratchet or a 1/4" hex driver, and the 7/32" pin-in-socket driver that is provided in the accessory kit.
2. Using the mounting hardware (hex-head lag bolts, split-lock washers, and flat washers), secure the bracket to a wall.
3. To set the repeater into the bracket, align the top of the repeater cabinet just above the top of the mounting bracket so that the mounting bracket will fit inside the left and right walls of the repeater cabinet.
4. Slide the repeater cabinet downward so that the guide bolt (on the repeater cabinet) slips into the guide slot (on the mounting bracket), as shown in Figure 2-3.
5. Replace the security bolts and washers that were removed in Step 1.

Figure 2-3 Guide Bolt and Slot



2.1.2 Pole Mounting

NOTE: Two people are recommended for pole-mounting the repeater.

RTI offers optional pole-mounting equipment that you can order with the repeater.

Pole installation requires the following materials:

- Pole mounting kit (available from RTI). See Table 2-1.
- Banding kit (purchased separately; available from McMaster-Carr) for mounting the repeater on a concrete or metal pole. See Table 2-1.
- Class A - Pole Line Hardware for bolting the Pole Mounting Bracket to a wood pole.
- Class A - Pole Line Hardware is a telephone term. It specifies bolts and screws that have a heavy electro-galvanized plating so they do not rust. This type of rugged hardware typically is available from telephone equipment distributors such as Graybar Electric, ALLTEL Supply, Spring-North Supply, PowerTel Supply, and so on. The same type of hardware is also available from antenna suppliers and from tower erector companies.

The Pole Mounting Channel is designed so that the repeater is squarely mounted on the pole and does not wobble.

When mounting the repeater onto a concrete or metal pole, use the Banding Kit. You ordinarily would not drill a mounting hole through the center of a concrete pole. Similarly, because metal poles might have cables running up the center, drilling is not recommended. In both cases, banding is preferred over drilling.

However, wood telephone-type poles are easier to drill, so you **can** use lag screws or through-pole bolts to fasten the pole-mounting channel.

Table 2-1 describes the Pole Mounting and Banding Kits. Because the Banding Kits includes 100 feet of band, you do not need to purchase a separate kit with every repeater.

The banding kit is available from McMaster Carr Supply Co, Los Angeles, CA USA, telephone# (562)692-5911.

Table 2-1 Pole Mounting Kit (P/N 091-0215-01)

Quantity	Item
1	Pole Mounting Channel
4	Bolts
4	Split-Lock Washers
4	Flat Washers
4	Tapered Plug, .312D Hole

Table 2-2 Banding Kit (P/N 5653K12)

Quantity	Item
1	Tightening-Crimping Tool
100 ft.	3/4-inch, Type 201 Stainless Steel Band
100	Stainless Steel Buckles
25	Stainless Steel Scru-Locket Buckles
1	Carrying Case

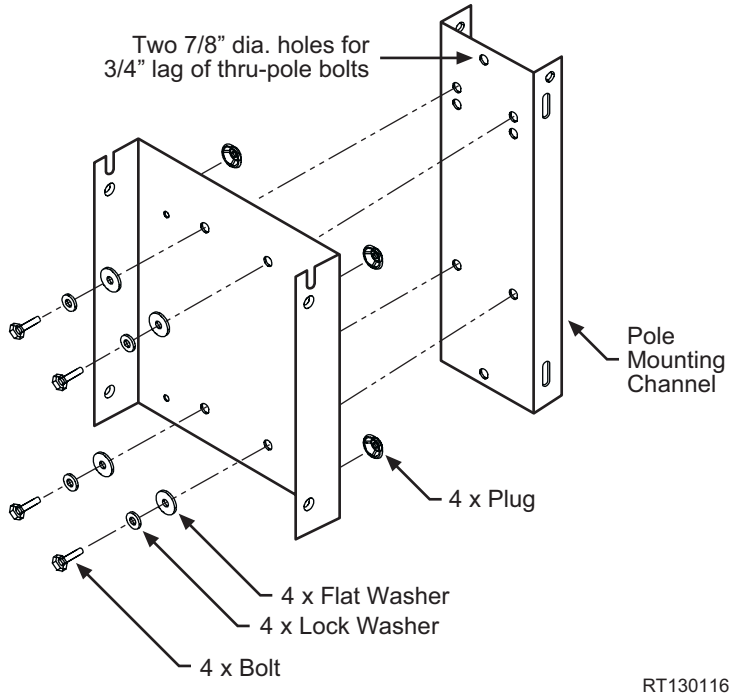
To mount the repeater to a pole:

1. Separate the rear mounting bracket from the repeater by removing the security bolts and washers.

   Use either a ratchet or a 1/4" hex driver, and the 7/32" pin-in-socket driver that is provided in the accessory kit.
2. Using the hardware provided with the accessory kit, secure the rear mounting bracket to the two(2) pole brackets - see Figure 2-4 and Figure 2-5.
3. Insert the four plugs provided, into the four outer holes in the rear mounting bracket.
4. Position the rear mounting bracket (the bracket that has an attached pole channel) against the pole and hold it in place.
5. While one person holds the rear mounting bracket in place, the second person installs the steel bands that hold the bracket against the pole.

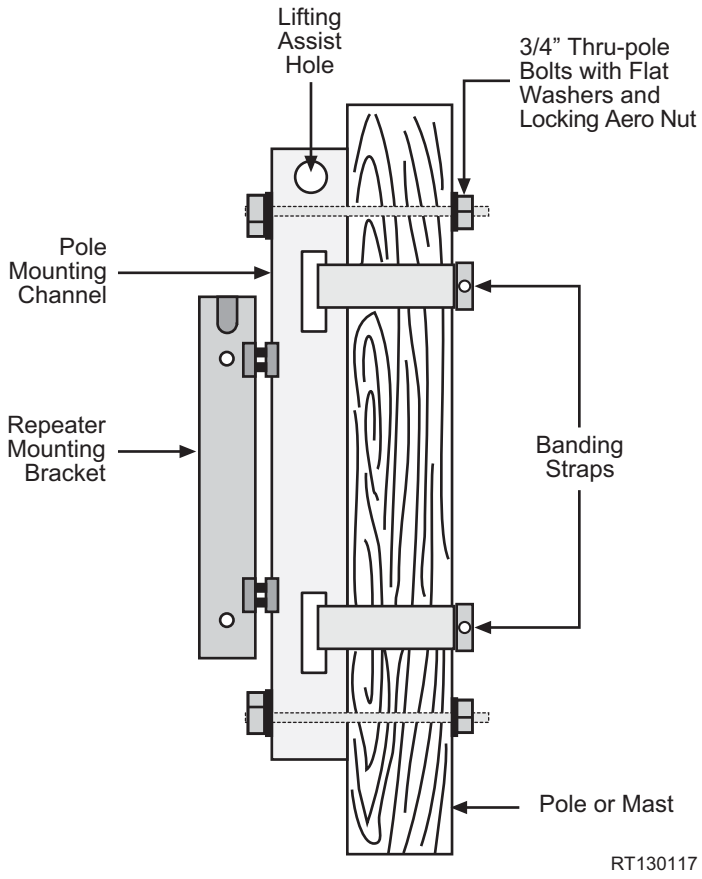
   Consult the manufacturer's instructions (included with the Banding Kit) for this procedure.

Figure 2-4 Pole Mounting Hardware



6. To set the repeater into the bracket, align the top of the repeater cabinet just above the top of the mounting bracket so that the mounting bracket will fit inside the left and right walls of the repeater cabinet.
7. Slide the repeater cabinet downward so that the guide bolt (on the repeater cabinet) slips into the guide slot (on the mounting bracket), as shown in Figure 2-3.
8. Replace the security bolts and washers that were removed in Step 1.

Figure 2-5 Pole Mount - Side View



Connecting Primary Power to the Repeater 3

3.0 Introduction

Primary power connects to the repeater through the bottom of the cabinet.

Table 3-1 shows the specifications for the input power.

Table 3-1 Input Power Specifications

Type	Power Specification
Alternating Current	115/230 Volt AC Auto-ranging, 47 to 63 Hz (Operating Range: 100 to 240 Volt AC)
	RC-1X10 260 Watts, typical RC-1X15 330 Watts, typical RC-2X10 400 Watts, typical RC-2X15 470 Watts, typical
Direct Current	24 Volt DC, -3/+6 Volts
	RC-1X10 9.0 Amps, typical RC-1X15 11.0 Amps, typical RC-2X10 13.0 Amps, typical RC-2X15 15.0 Amps, typical

CAUTION: This system requires either AC or DC power to operate. Do not connect both AC and DC at the same time as it will damage the system.

ATTENTION: Ce système requiert une alimontation CA ou CD pour operer. Ne pas brancher le CA et le CD simultanément leci porrait endommager le système.

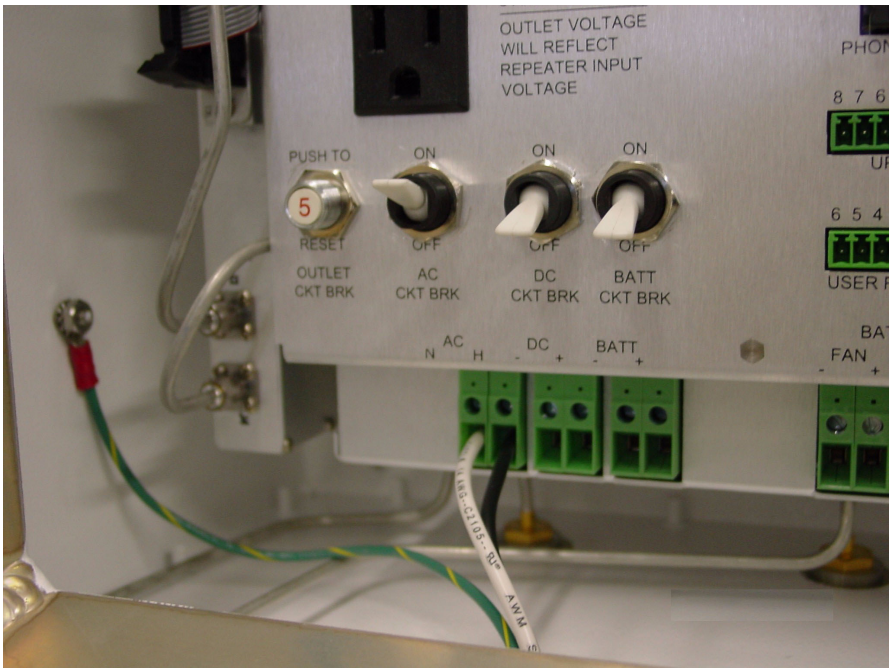
NOTE: RTI recommends using a 15 Amp circuit for AC powered systems and a 25 Amp circuit for DC powered systems.

3.1 AC Power Wiring

The following steps describe how to connect AC power to the repeater:

NOTE: Before wiring the repeater, verify that all input power is OFF and all circuit breakers in the repeater are in the OFF position.

Figure 3-1 Line Entry Module - AC Wiring



1. Route AC power to the repeater using 1/2" liquid tight flexible conduit, and the appropriate liquid tight conduit fittings. Access holes are located at the bottom of the repeater for convenience. For indoor installations, normal 1/2" metal conduit may be used. See Figure 3-1.
2. Wire the repeater using #14 AWG or larger stranded PVC wire. Connect the neutral and hot leads to the Line Entry Module and the ground lead to the interior ground lug located on the inside of the cabinet. Connect the repeater to an AC power source using a dedicated 15 Amp fuse or circuit breaker.

NOTE: Number 14 gauge wire complies with most local and national electrical codes because the Repeater Power Switch is also a magnetic circuit breaker which limits current to a maximum of 15 Amps. Consult your local or national electrical safety codes for the appropriate wire sizes.

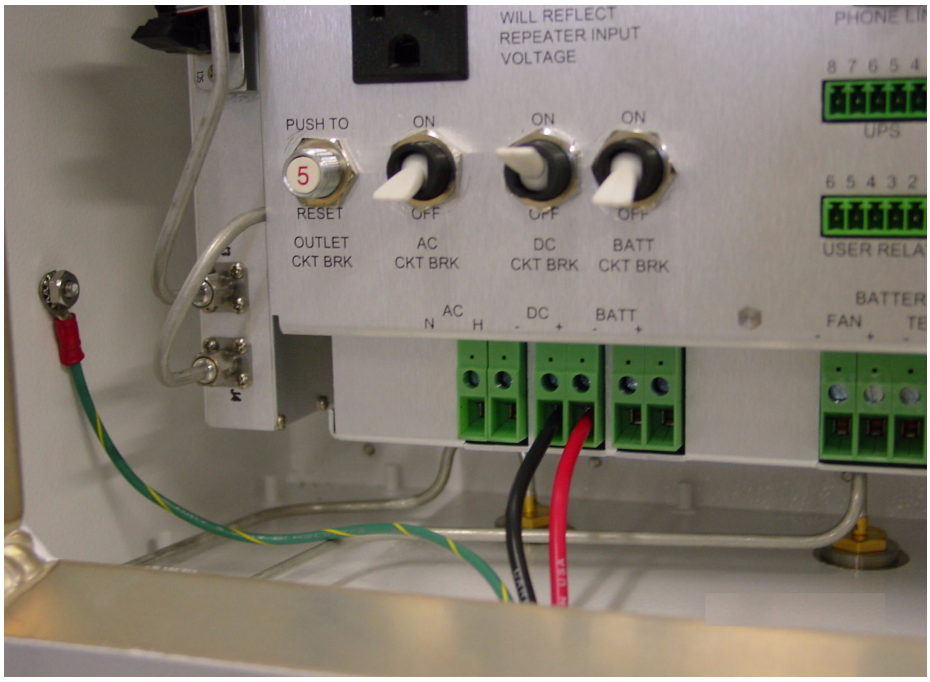
3. Close the AC circuit breaker to turn the repeater on.

3.2 DC Power Wiring

The following steps describe how to connect DC power the repeater:

NOTE: Before wiring the repeater, verify that all input power is OFF and all circuit breakers in the repeater are in the OFF position.

Figure 3-2 Line Entry Module - DC Wiring



1. Route DC power to the repeater using 1/2" liquid tight flexible conduit, and the appropriate liquid tight conduit fittings. Access holes are located at the bottom of the repeater for convenience. For indoor installations, normal 1/2" metal conduit may be used.
2. Wire the repeater using up to #10 AWG stranded PVC wire. Connect the positive and negative leads to the Line Entry Module and an earth ground lead to the interior ground lug located on the inside of the cabinet. Connect the repeater to a DC power source using a dedicated 25 Amp fuse or circuit breaker. See Figure 3-2.

NOTE: Consult your local or national electrical safety codes for the appropriate wire sizing.

3. Close the DC circuit breaker to turn the unit on.

3.3 Wiring an External Back-up Power Supply

A typical Back-up Power Supply (BUPS) consists of a charger/rectifier, and has 24-Volt batteries floated across the charger/rectifier output.

Figure 3-3 shows the block diagram of a BUPS available from RTI.

- The RTI BUPS-25/80 rectifier supplies up to 25 Amperes of continuous current at 24 Volts DC.
- Two internal batteries are sized to provide 80 Amp-Hours of service without AC power.
- The backup times for the different models are listed below:

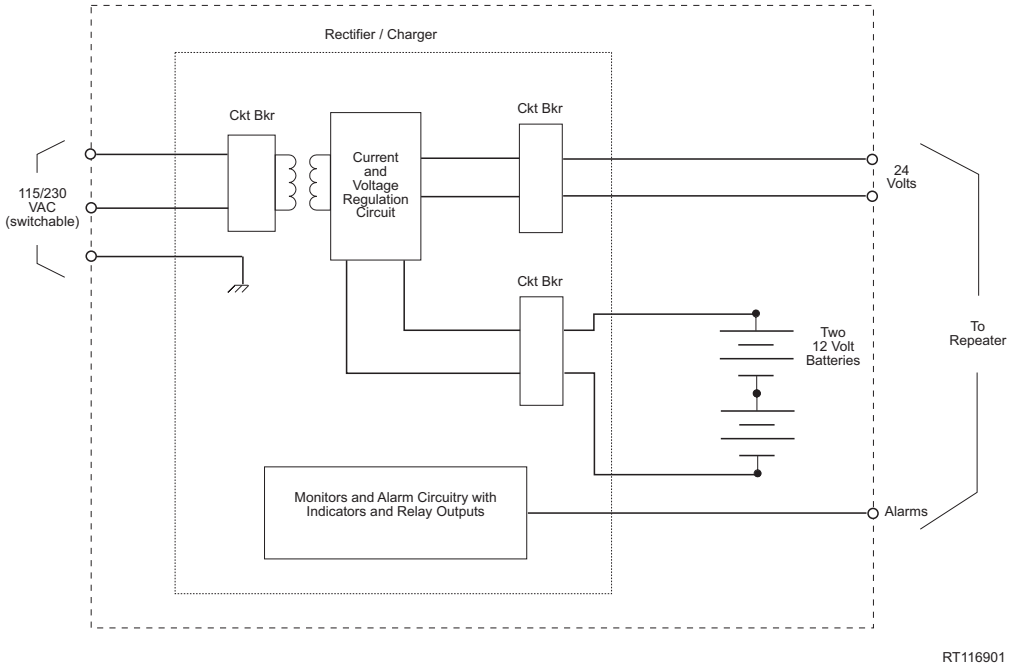
RC19-1X10	9 Hours
RC19-1X15	7 Hours
RC19-2X10	6 Hours
RC19-2X15	5 Hours

CAUTION: Risk of explosion if battery is replaced by incorrect type.

ATTENTION: Risque d'explosion si le modèle de pile n'est pas utiliser recommandé.

For more details about the RTI BUPS, see the RTI BUPS-25/80 Operation Manual, Document Number 550-1011-01.

Figure 3-3 Simplified BUPS-25/80 Block Diagram, RTI P/N 250-1011-07



The following steps describe how to power a BUPS and connect it to a repeater:

NOTE: Before wiring the repeater, verify that all input power is OFF and all circuit breakers in the repeater and BUPS are in the OFF position.

1. Route AC power to the BUPS using 1/2" liquid tight flexible conduit, and the appropriate liquid tight conduit fittings. Access holes are located at the bottom of the repeater for convenience. For indoor installations, normal 1/2" metal conduit may be used.
2. Wire the BUPS using #10 AWG or larger stranded PVC wire. Connect the neutral, hot and ground leads to the rectifier front panel. Figure 3-4 shows the front panel of the BUPS Charger-Rectifier. Connect the BUPS to an AC power source using a dedicated 15 Amp fuse or circuit breaker. Typical BUPS-25/80 input voltage and current specifications are:

   115 Volts AC @ 10 Amps

   230 Volts AC @ 5 Amps

3. Install the two 12-volt Gel Cell batteries.
4. Use the wires provided with the BUPS to connect the batteries to the rectifier.
5. Verify the battery voltage at the BUPS Rectifier terminal block, using a multi-meter. The multi-meter should read approximately 25 to 27 Volts.
6. Wire the BUPS to the repeater as shown Figure 3-5. The RTI BUPS-25/80 includes the 1/2" Liquidtight flexible steel conduit, the power and alarm wiring, and the necessary Liquidtight conduit fittings to connect the BUPS to the repeater.
7. Close the BUPS AC Input circuit breaker.
8. Close the BUPS Charger circuit breaker.
9. Close the Battery circuit breaker.
10. Verify the voltage using the BUPS Test Terminals. The multi-meter should read approximately 27 Volts.
11. Close the repeater DC circuit breaker.
12. Observe the Repeater load in Amps using the BUPS Load Test Terminals. Under normal conditions, the load should be approximately 9 - 15 Amps depending on the repeater model. Reference Table 3-1

Figure 3-4 Front Panel of the BUPS-25/80 Charger-Rectifier

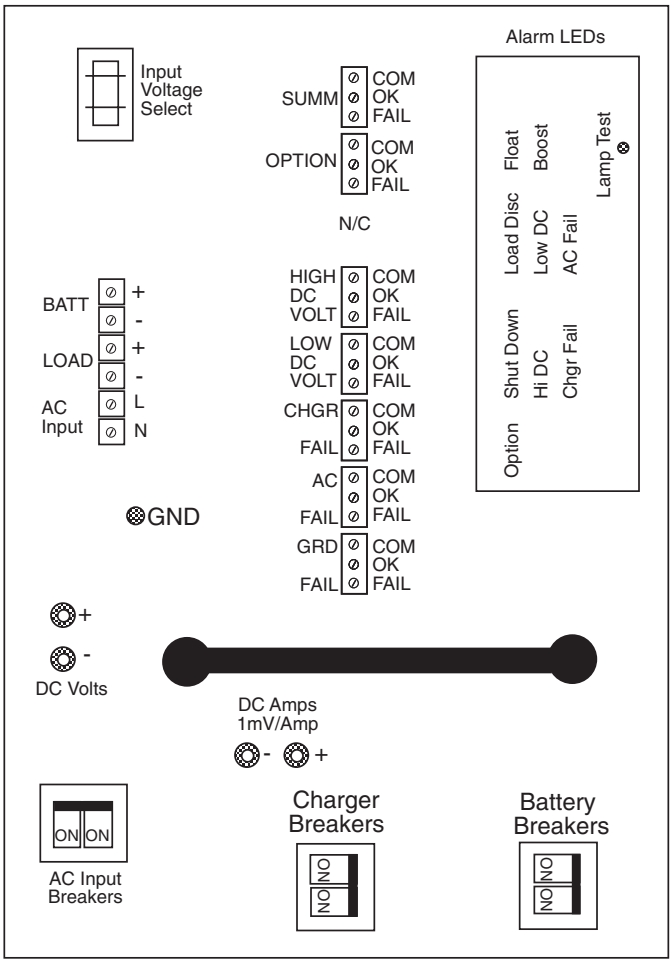


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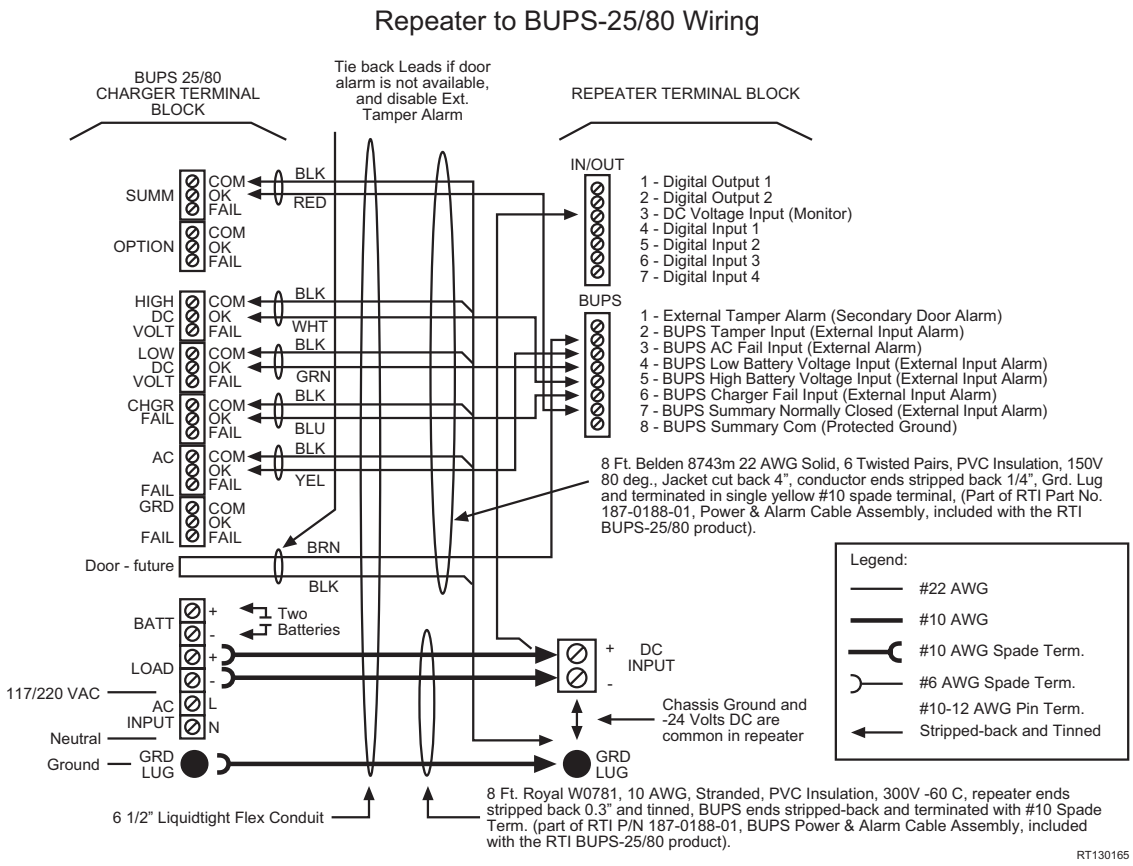
Figure 3-5 Wiring Connections from the Repeater to a BUPS-25/80



3.4 Grounding

Connecting input power to the repeater includes installing the standard electrical service grounds. However, you must also make sure that the repeater and any associated equipment is properly grounded to a water pipe or earth ground. For more information about grounding repeaters, consult the RTI Application Note titled Installation Standards for Ground Requirements, Document Number 650-0002-01, Rev. 2.

The repeater cabinet includes one external ground lug as shown in Figure 3-6.

1. Connect number 6 AWG minimum solid copper wire to the repeater ground lug.
2. Carefully dress the wire along cabinet, and the mounting surface, to the Repeater Grounding System or the Ground Rod.

NOTE: When dressing the ground wire, and forming it around corners, avoid making sharp bends in the wire. Use a generous radius for each wire bend.

3. Connect the ground wire to a suitable earth ground - for example, to a copper ground rod, copper pipe, grounded steel building frame, or similar ground point. - see Figure 3-7
4. Ground all other cabinets, enclosures, antennas, and coaxial cables used for installation, to reduce any damage from a lightning strike or power surge.

Figure 3-6 Location of External Ground Lug

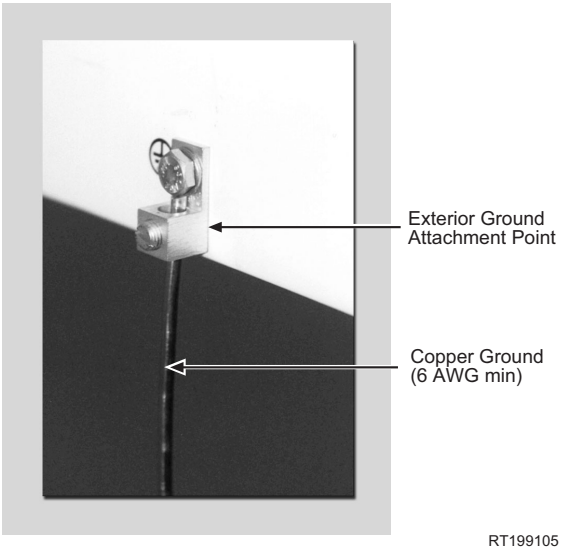
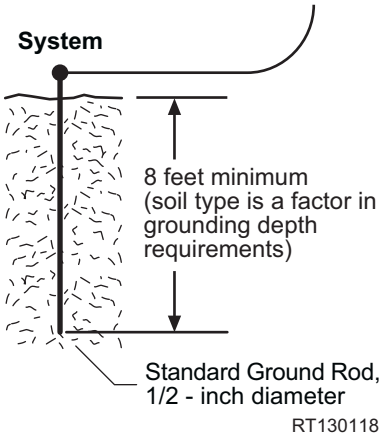


Figure 3-7 Typical System Ground



Installing Antennas 4

4.0 Moisture Protection for Antenna Connections

NOTE: This should be done after the repeater has been fully configured, functionally set-up and further work is not required.

The bottom of the repeater cabinet has N-type (7/16" DIN is optional) connections for donor and subscriber antennas, as shown in Figure 4-1. RTI recommends that before installing the repeater and connecting it to the antennas, you apply a tar-like Vapor Wrap, to seal these antenna connections against rain or other water sources (See Figure 4-2).

1. Wrap the threads of the N-type antenna connectors, with electrical tape. This protects the connector threads from the sticky Vapor Wrap substance.
2. Thoroughly coat the outside of the electrical tape with the Vapor Wrap putty.
3. Wrap another layer of electrical tape over the Vapor Wrap to seal the Vapor Wrap into place.

After you complete this procedure for all N-type antenna connectors, moisture should not adversely affect the connections between the repeater cabinet, and the donor and subscriber antennas.

Figure 4-1 N-Type Antenna Connectors, Looking Up From the Bottom of the Repeater Cabinet

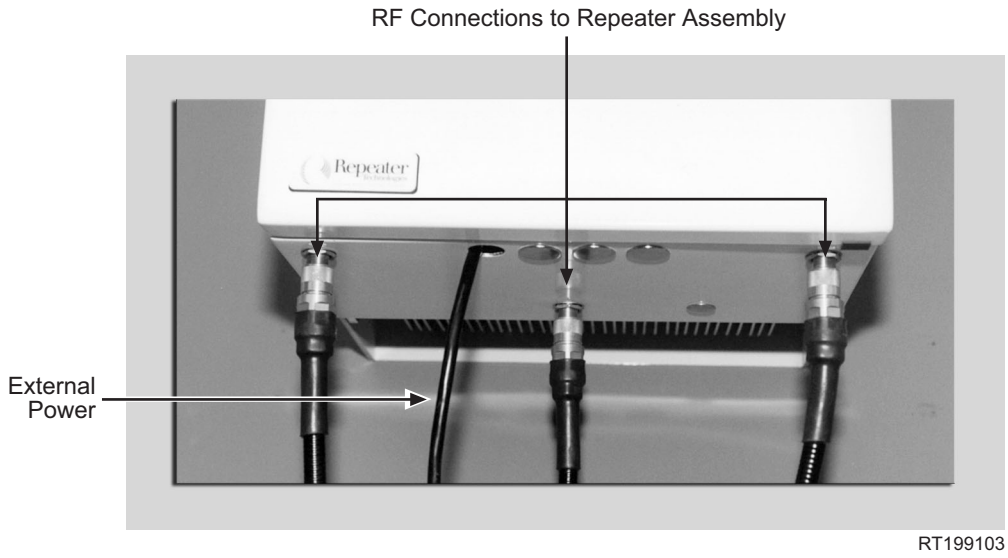
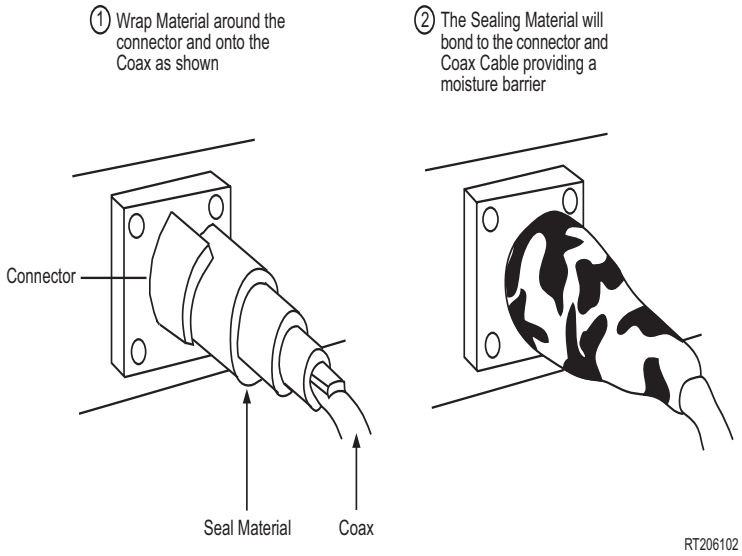


Figure 4-2 RF Connector Cable with Vapor Wrap



4.1 Antenna Configurations

RTI repeaters can use any one of following antenna configurations:

- Donor antenna, and one dual polarized subscriber antenna (see Figure 4-3)
- Donor antenna, and two vertically polarized subscriber antennas (see Figure 4-4)
- Donor antenna, and two dual polarized subscriber antennas-back beam configuration (see Figure 4-5)
- Donor antenna, and one vertically polarized subscriber antenna (see Figure 4-6)
- Donor antenna, and two dual polarized subscriber antennas-dual direction configuration (see figure Figure 4-7)

NOTE: When included in a CDMA network, an RTI repeater can use a back-beam antenna, to transmit energy from the repeater, back towards the donor base station. A back-beam antenna increases the allowable distance between the donor BTS and the repeater site.

Figure 4-3 Dual Polarized Subscriber Antenna Configuration

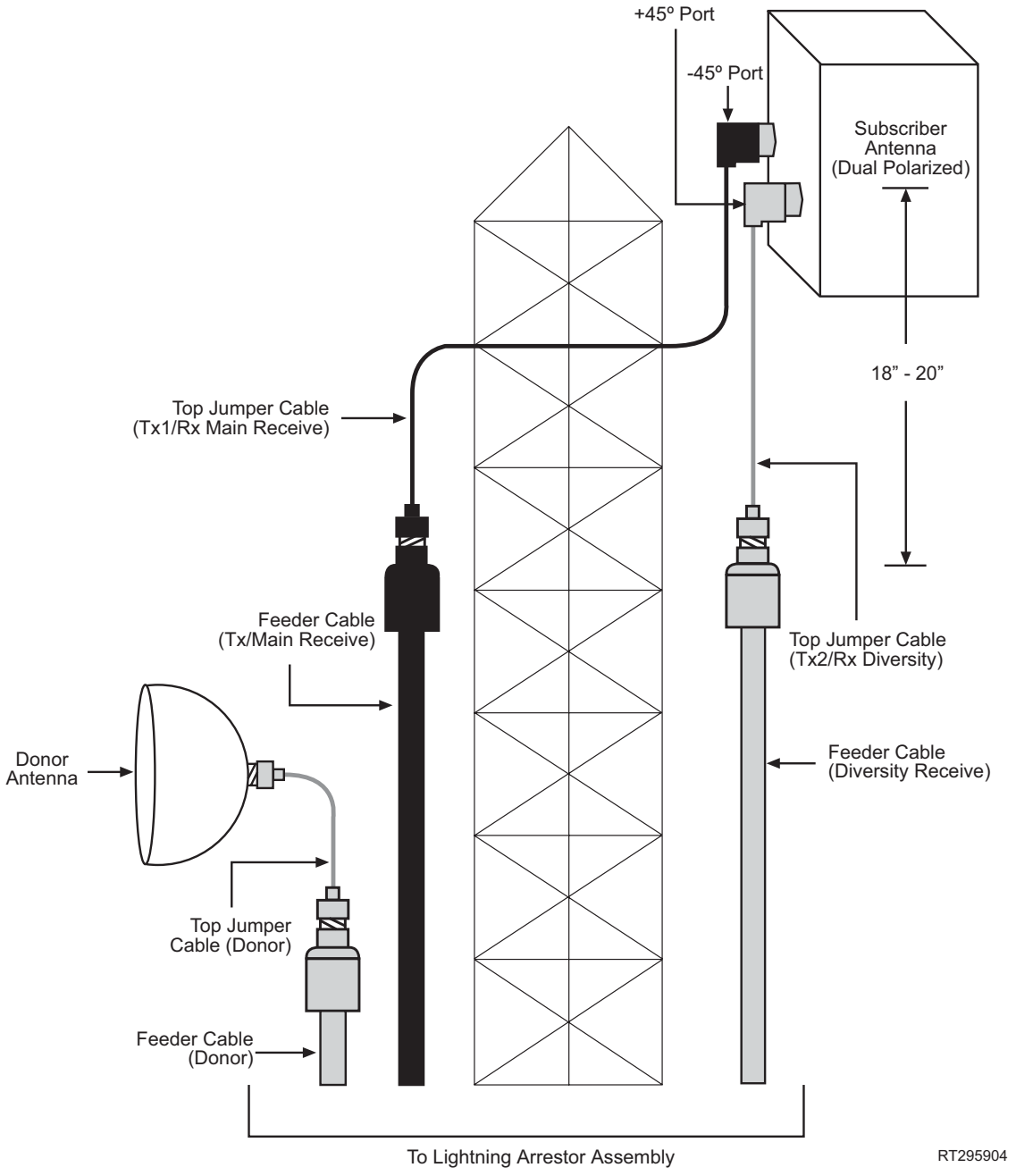


Figure 4-4 Two Vertically Polarized Subscriber Antennas

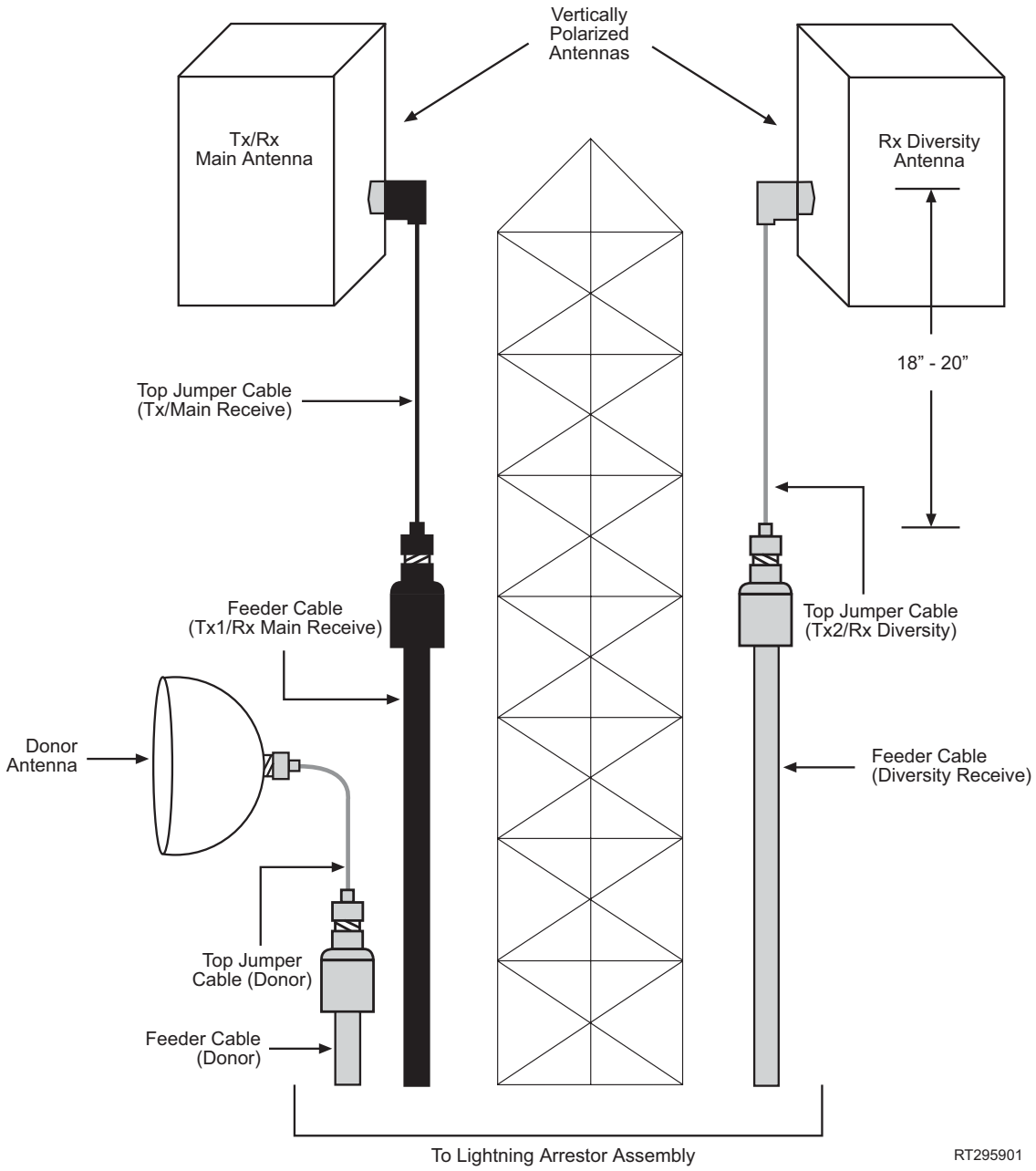


Figure 4-5 Back Beam Antenna Configuration

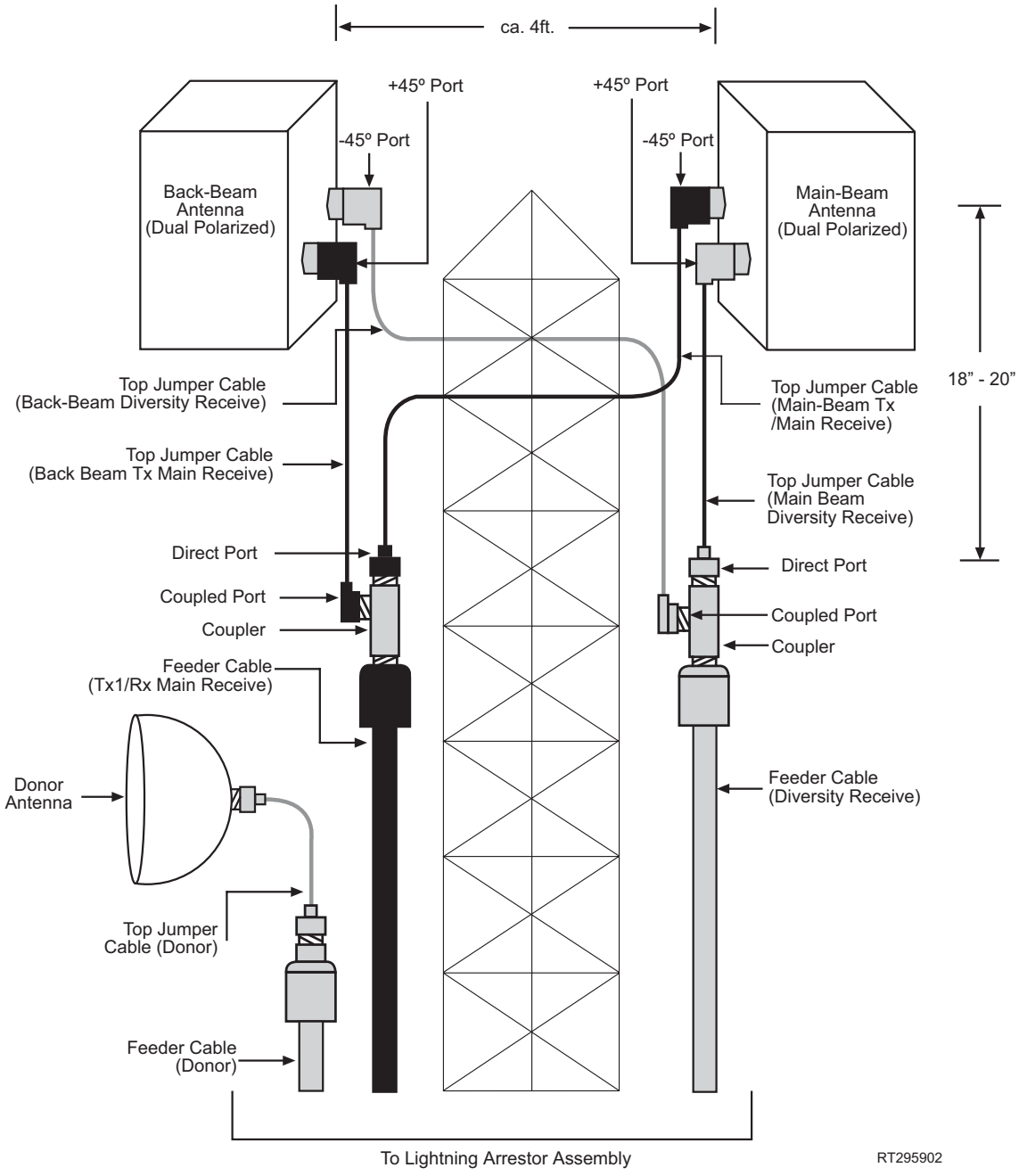


Figure 4-6 Non-Diversity Antenna Configuration

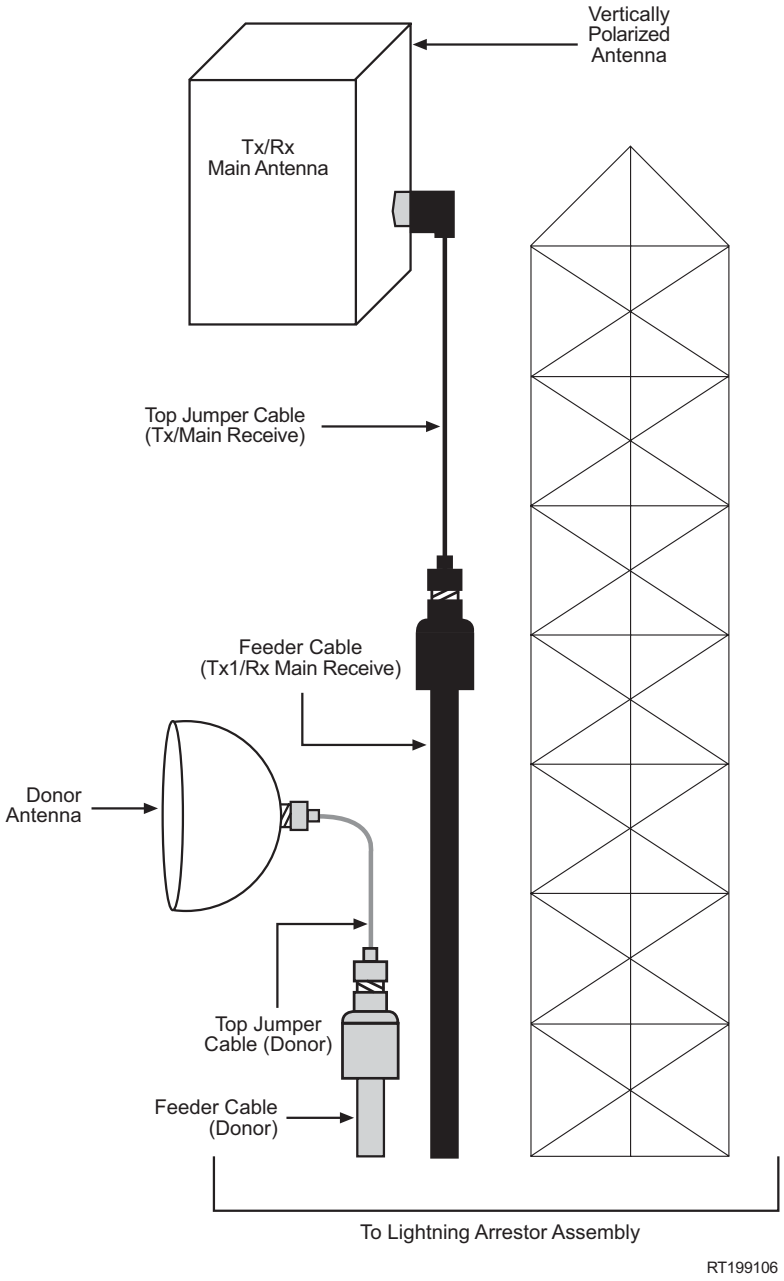
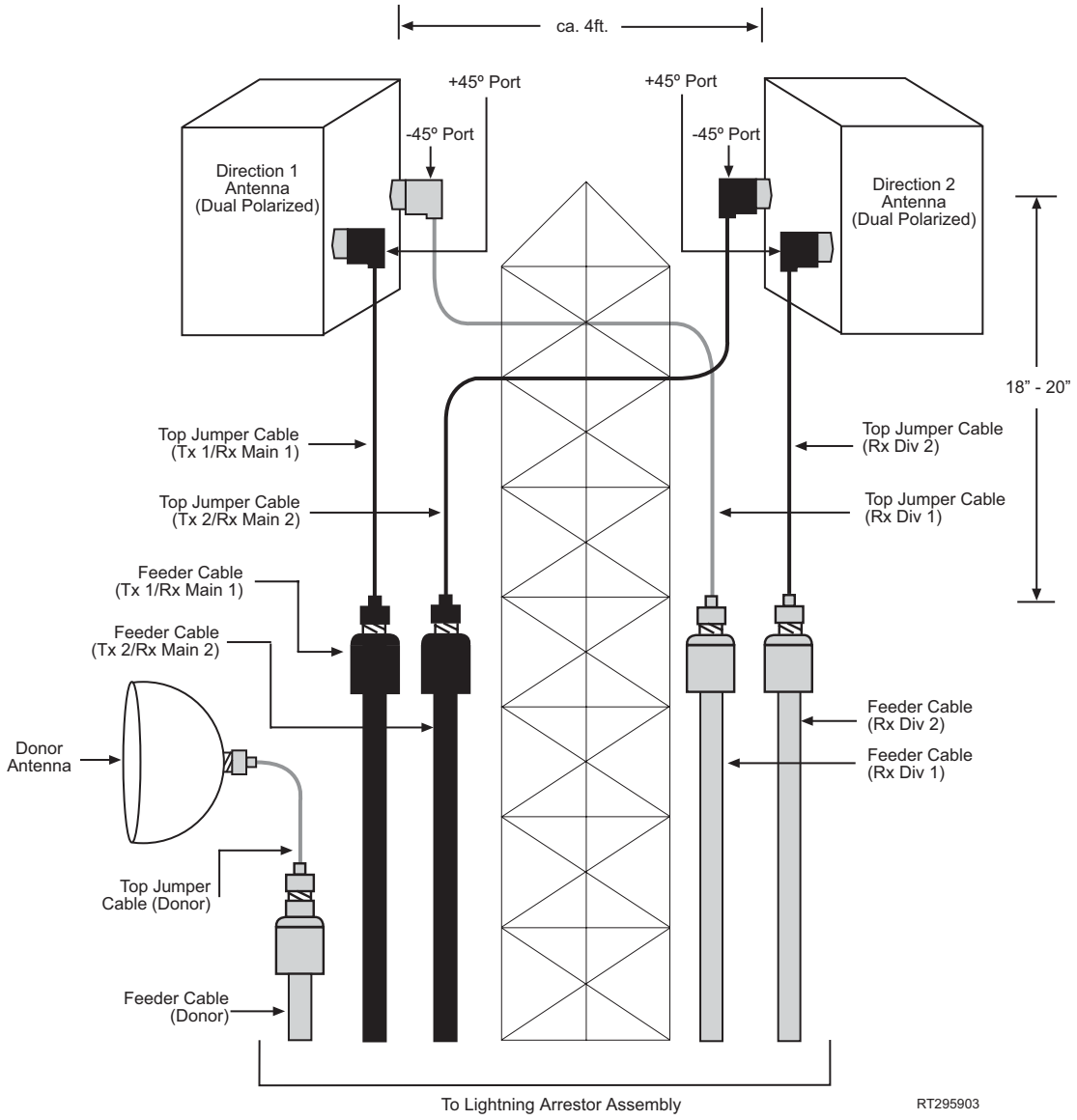


Figure 4-7 Dual Direction Antenna Configuration



4.2 Antenna Cables

A repeater uses the same type of RF cabling as a base station does. Usually, the top and bottom jumper cables are made from flexible, 1/2" air dielectric coaxial cable, and the feeder lines are made from 7/8" to 1-5/8" foam dielectric coaxial cable.

Diversity repeater configurations (see Figure 4-3, Figure 4-4, and Figure 4-5) require three(3) RF lines:

- One for the donor antenna
- One for the main subscriber antenna
- One for the diversity subscriber antenna

4.3 Lightning Protection

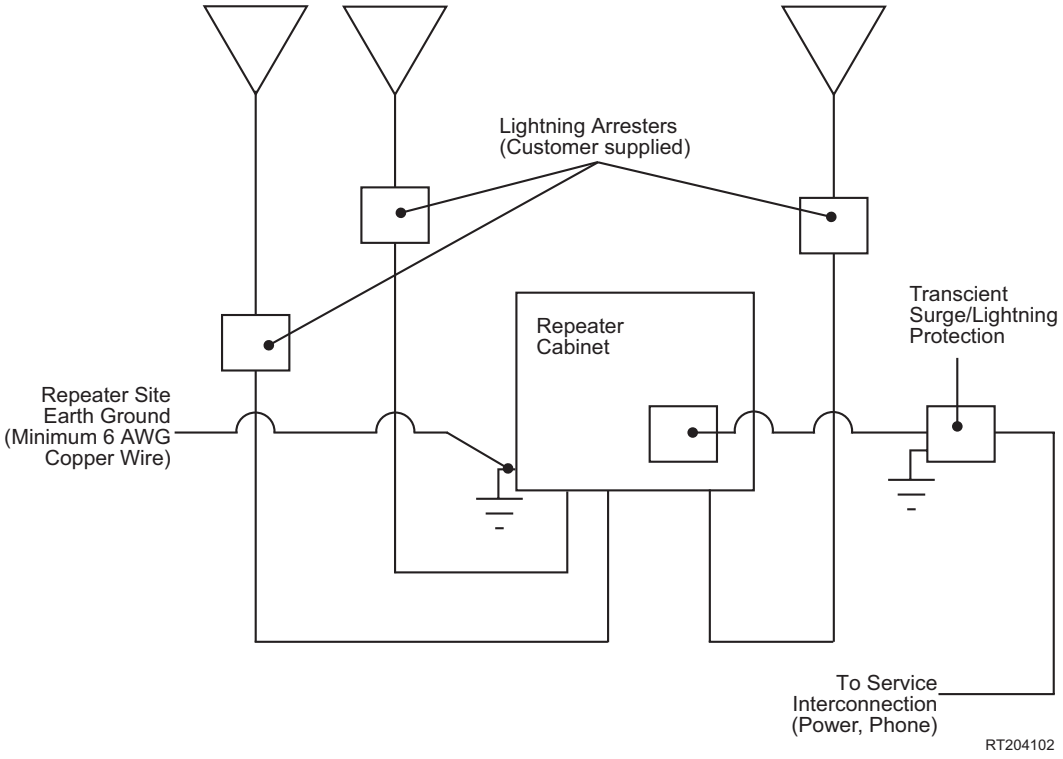
RTI strongly recommends installing lightning arrestors on all feeder cables to the repeater. **A direct lightning strike can damage any electronic equipment. Damage resulting from a lightning strike is not covered under the RTI manufacturer's warranty, whether or not you use lightning arrestors.** However, using lightning arrestors can minimize the risk of damaging a repeater, and of losing cellular phone coverage, during lightning storms.

Use lightning arrestors that attach directly to the large-diameter feeder cables, and not to the repeater itself. Do not use screw-on lightning arrestors, because they attach to the repeater's antenna terminals. Shunt the lightning to the ground, as far away from the repeater as possible.

For additional lightning protection of the power and telecommunication lines, please contact RTI.

Figure 4-8 shows a typical repeater installation, using coaxial lightning arrestors on the feeder lines. For safety and operational dependability, RTI also recommends attaching all antennas to the repeater site's single point ground.

Figure 4-8 Lightning Arrestor, Grounding, and Repeater RF Cabling



4.4 Back-Beam Antennas and Directional Couplers

A back-beam antenna transmits a portion of the repeater's power back toward the donor base station (BTS). This technique is helpful on long rural routes, where two repeaters are cascaded. In suburban or rural areas, this type of antenna can provide additional signal capability, in the area between the donor BTS and the repeater site.

As shown in Figure 4-5, power from the repeater is applied to a directional coupler (or power divider), which divides the power proportionately to both the main-beam and back-beam antennas. These couplers are available in several power division ratios:

- 50/50
- 60/40
- 75/25
- 80/20
- 90/10

These ratios represent the percentage of total power that the repeater channels either to the direct port (the higher number) or the coupled port (the lower number). For example, if the repeater uses a 75/25 coupler, the repeater sends 75% of its power to the main-beam subscriber antenna, and the remaining 25% to the back-beam antenna.

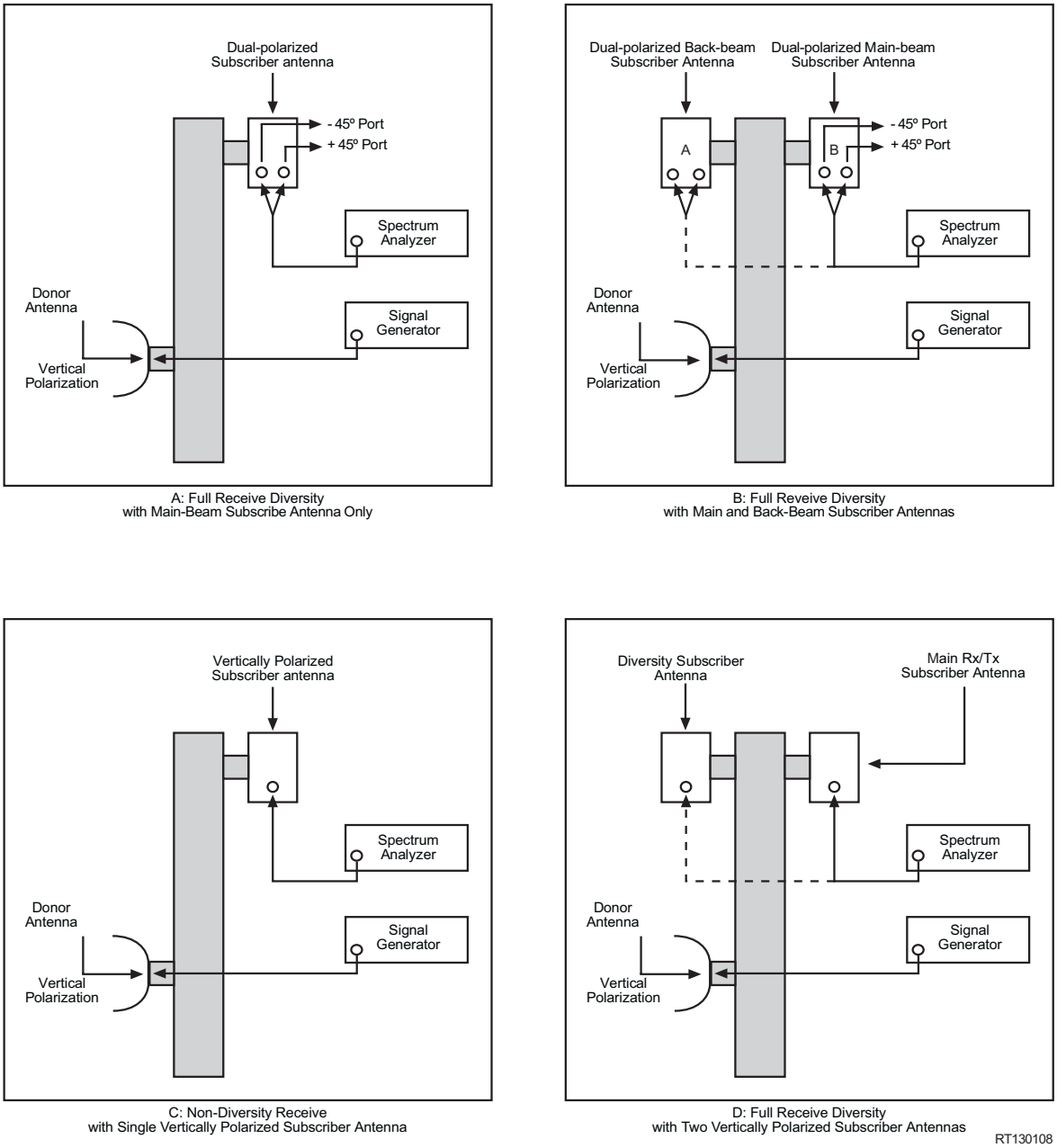
4.5 Measuring Antenna Isolation

Measure the actual isolation between the antennas, to ensure that the donor (base station) antenna is sufficiently isolated from the subscriber (mobile) antenna. See Figure 4-9 and Figure 4-10.

WARNING: This is a crucial step in **all** repeater installations.

If the isolation is not sufficient, the repeater might oscillate, or it might operate with less gain (signal amplification). In the first case, the repeater can introduce spurious emissions into the network. The second case, reduces the range of the repeater's coverage area.

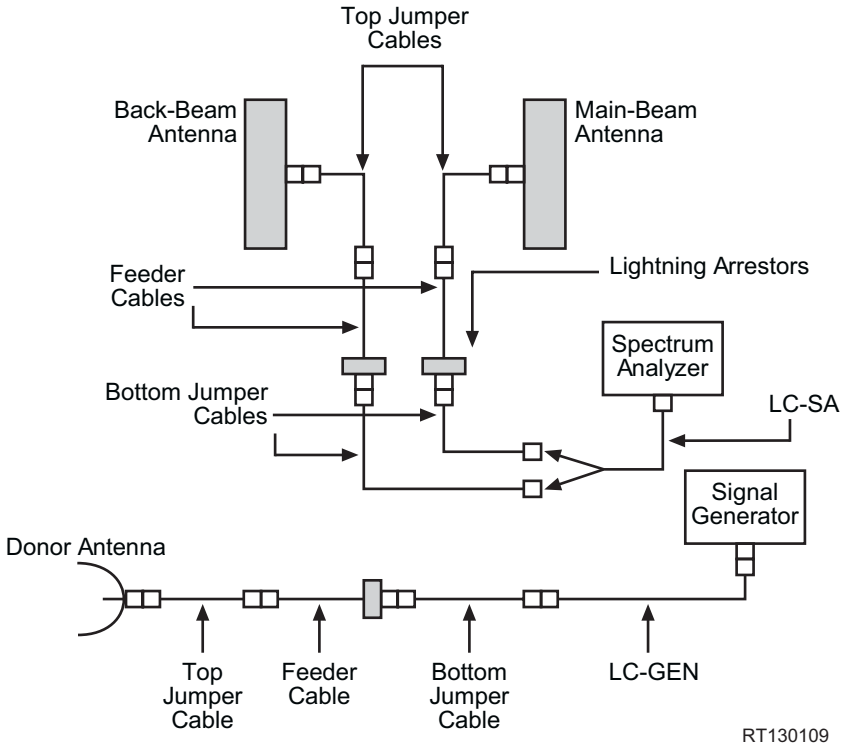
Figure 4-9 Equipment Setup for Measuring Antenna Isolation



Measuring antenna isolation requires a signal generator and a spectrum analyzer. The generator transmits a signal from the donor antenna, and the spectrum analyzer measures the same signal as the subscriber antenna receives it. Figure 4-9 shows the equipment set-up for each antenna configuration.

Figure 4-9 shows four simplified setups. They show only the overall configuration for measuring antenna isolation. Isolation must take into account all cables that will be attached when the repeater is in operation. You must measure isolation with all jumpers and feeder lines in place. The only other cables present, that are not part of the actual isolation measurement, should be the one from the signal generator, and the one to the spectrum analyzer. Figure 4-10 shows all cables and equipment in place for measuring actual antenna isolation. Isolation should be measured as close as possible to the carrier frequency but not in the carrier itself.

Figure 4-10 Antenna Isolation Measurement - Equipment Configuration



NOTE: If the repeater uses a back-beam antenna, you must measure antenna isolation from both ports of both antennas (four measurements). If the repeater uses only one antenna, only two isolation measurements are needed: one from the left port, and one from the right port, of the subscriber antenna.
In all cases, measure antenna isolation with all cables, connectors, and lightning arrestors in place. Record all measurements for future reference.

The equation for antenna isolation is

$$ISO = P_{GEN} - L_{C\text{-}GEN} + L_{C\text{-}SA} - P_{SA}$$

Where:

ISO	=	Isolation in dB between the antennas
P_{GEN}	=	Output level of the signal generator (dBm)
$L_{C\text{-}GEN}$	=	Loss of the signal generator cable (dB)
$L_{C\text{-}SA}$	=	Loss of the spectrum analyzer cable
P_{SA}	=	Power indicated on the spectrum analyzer (dBm)

This equation holds true for one donor antenna, and for one vertically-polarized subscriber antenna. For a dual-polarized antenna, the equation becomes:

$$ISO = P_{GEN} - L_{C\text{-}GEN} + L_{C\text{-}SA} - MAX(P_{SA}(L), P_{SA}(R))$$

Where:

$P_{SA}(L)$	=	Spectrum analyzer level measured on the left antenna port.
$P_{SA}(R)$	=	Spectrum analyzer level measured on the right antenna port.

The stronger of the two readings represents the actual isolation available. For example:

P_{GEN}	=	0 dBm
$L_{C\text{-}GEN}$	=	1.0 dB
$L_{C\text{-}SA}$	=	1.0 dB
$P_{SA}(L)$	=	-90 dBm
$P_{SA}(R)$	=	-88 dBm
ISO	=	0 - MAX(-90 or -88) = 88 dB

NOTE: A signal level of -88 dBm is stronger than a level of -90 dBm.

In this example, the usable antenna isolation is 88 dB.

4.6 Sweeping Antenna Cables

RTI recommends sweeping all RF cables for the repeater, using a network analyzer or a time-domain reflectometer. This procedure is similar to the sweeping required for a normal base station. At a minimum, record the following data, for each cable or cable assembly:

- Return Loss (dB): the ratio of power transmitted to, versus reflected from, the cable.
- Voltage Standing Wave Ratio (VSWR): a factor in measuring the cable's impedance.
- Insertion Loss (dB): the ratio of power delivered with the cable, versus without the cable.
- Distance (in feet or meters) from one end of the cable, to a detected fault.

CAUTION: If the sweep finds any faults, correct them before placing the repeater into service.

Configuring the Repeater 5

5.0 RepeaterNet Craft Software

The RepeaterNet Craft Software provides configuration management and alarm monitoring capabilities for individual repeaters from RTI. It also dynamically manages repeater maintenance sessions in real time through one of the following connections:

- Direct Connection - A laptop computer with a direct connection to the repeaters - a technician can visit repeater sites and connect to a repeater directly, using the serial port on the laptop.
- Remote Connection (optional) - A laptop or desktop computer with a modem connection to the repeater - a technician can use the modem to connect to a repeater, without visiting the physical repeater site.

The Craft software can operate under either Windows 95, 98, ME, Windows NT[4], or Windows 2000. The Craft user interface varies, depending on the model of repeater that the software is configured for monitoring.

5.1 Minimum System Requirements

Craft system requirements include:

- Pentium 120 MHz, running Windows 95, 98, ME, Windows NT[4], or Windows 2000, with 32 Mb of memory
- If you are using the Craft system with Windows 95, you must use the Microsoft Service Pack 1 Update (Version 4.00.950 A) or later releases.
- If you are using the Craft system with WindowsNT, you must use the Microsoft Service Pack 3 Update or later.
- Approximately 10 Mb of free disk space
- Modem (if a modem connects the laptop to the repeater)

NOTE: RTI repeaters are compatible with Rockwell Chip Set certified for modems operating at 56k or below. **US Robotics modems are not supported.**

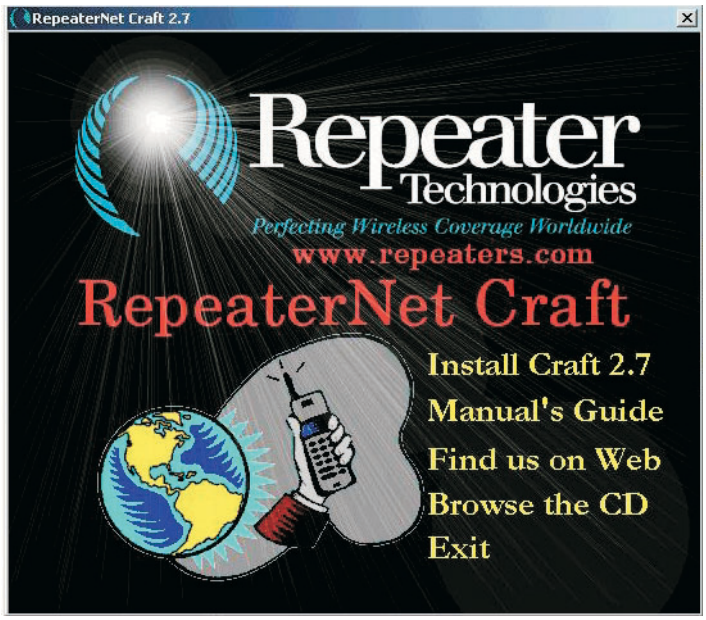
If the PC or laptop uses a fax program, such as Microsoft Fax, make sure that the Auto Answer feature is disabled. See Appendix B, Troubleshooting (Problem 7) for how to disable Auto Answer for Microsoft Fax.

5.2 Installation Procedure

The Craft software is distributed on a CD-rom. To install this software, use the following procedure.

1. Insert CD into the rom drive.
   If auto run is enabled, program will self start.

Figure 5-1 Startup Screen



RT205101

2. Click Install Craft 2.7.
   Accept defaults.

Upon completion, you will have shortcuts to Craft Administrator and Craft Software on the desktop. See Figure 5-2.

5.3 Configuring the Repeater Connection

You must use Craft Admin to configure the connection to the repeater before you can access the Craft software.

Double Click on the RepeaterNet Admin icon from the desktop. See Figure 5-2.

Figure 5-2 Starting the RepeaterNet Administrator

When you invoke the Administrator, RepeaterNet displays the window shown in Figure 5-3.

You can save both Direct and Dial-Out (Modem) configurations, but you must assign a unique COM Port Number to each. Also, you can check Use this connection for only one of the configurations. The Craft software uses the selected connection to connect to the repeater.

You can also access and save the appropriate Craft login password by clicking on the Show Login button. (See Figure 5-4).

Figure 5-3 RepeaterNet Admin

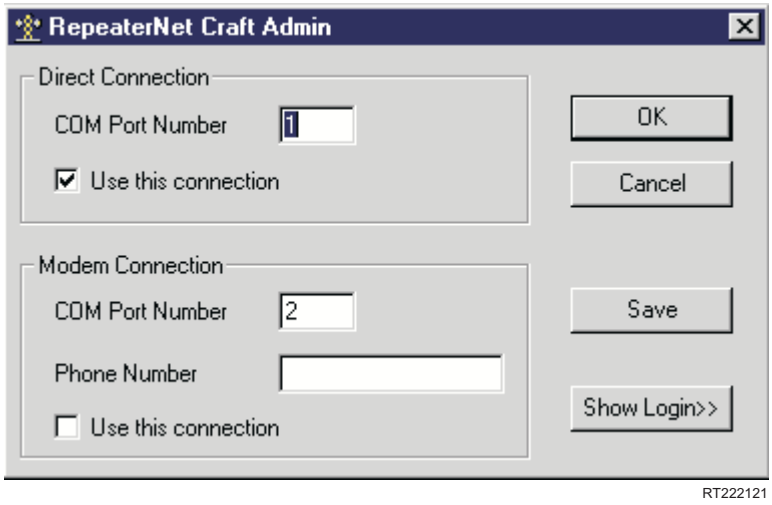
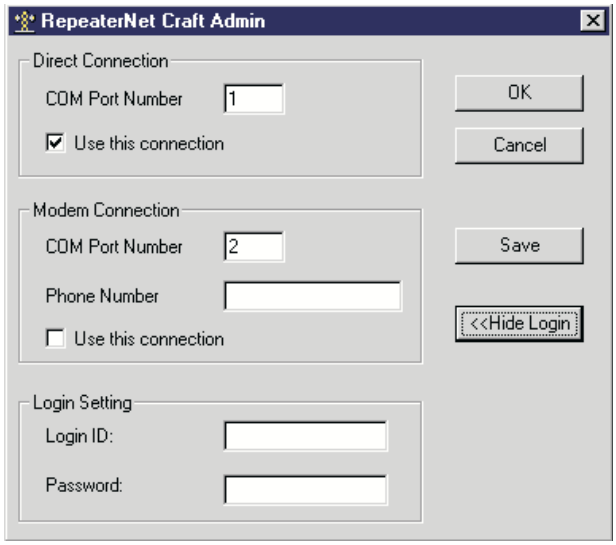


Figure 5-4 RepeaterNet Admin, Login Setting shown



For example, you might do the following:

1. Assign the connection type as Direct through an available port.
2. Check the Use this connection box to make this the default configuration.
3. Click on the Save button.

Next, you can save a Modem configuration to another Com port, such as Com Port 2:

1. Assign a Com Port Number that corresponds to the Com port assigned to the PC's modem.
2. Check the Use this connection box to make this the default configuration.
3. Click on the Save button.
4. Click on OK to exit RepeaterNet Admin.

5.4 Starting Craft

Double-click on the Craft icon.

The window in Figure 5-5 displays.

Craft connects to the repeater and displays the Craft Main Control screen for the repeater as shown in Figure 5-6.

NOTE: The defaul login ID and password have been left blank. See section 5.14.2, System Menu - Craft, for information on changing these values.

Figure 5-5 RepetaerNet Craft Start-up Window

5.5 Craft Main Control Screen

The Craft Main Control screen provides access to all monitor and control functions of the Network Repeater (NR).

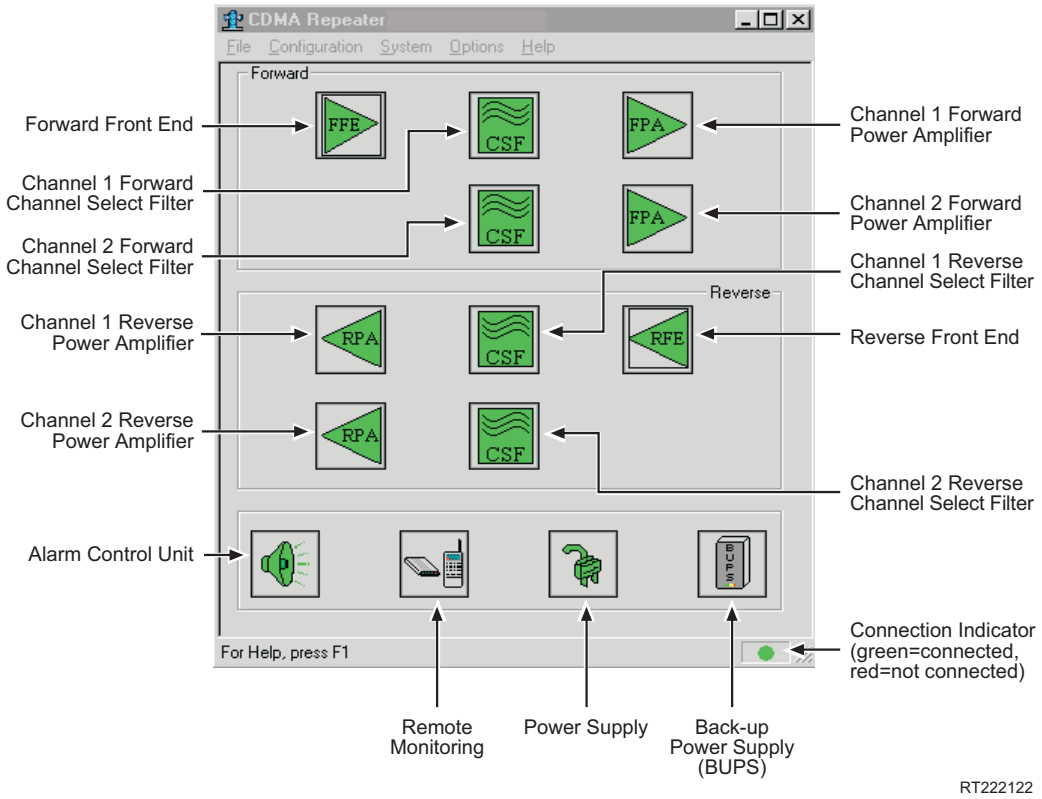
The Craft main control screen will appear when you launch Craft and it will retrieve the alarms and properties from your repeater.

Main Control screen icons (shown in Figure 5-6) provide access to both subsystem status screens and report alarms. Some icons may not appear for various hardware configuration.

The Craft main control screen is used to report status from the repeater sub systems.

NOTE: This can take several minutes depending on the connection speed.

Figure 5-6 Craft Main Control Screen



5.6 Status Reporting

After configuring the repeater, you can use the subsystem Status screens to monitor and control repeater system functions. For example, when a repeater alarm triggers, the appropriate subsystem icon for the type of alarm changes appearance, and starts blinking.

1. Click on the subsystem icon for the type of alarm that triggered.

   The appropriate status screen opens. The icon stops blinking and the audible alarm stops. This acknowledges that you are aware of the alarm condition. However, the icon remains the color of the alarm condition.

2. Fix the problem that triggered the alarm.

   After you clear the alarm condition the display of the icon reverts to normal.

The display of the Forward PA and Reverse PA icons indicate the operational status of the Power Amplifiers. If a PA is Off, a circle with a slash is displayed over the associated icon.

RT228101

If a subsystem is not installed in the repeater, Craft displays that subsystem as disabled. For example, if a repeater does not have the remote monitoring option installed, the remote monitor icon is light gray.

5.6.1 Alarm Status Reporting on the Main Control Screen

RepeaterNet uses a color system to report subsystem alarm status on the Main Control screen. Table 5-1 shows the meanings of the colors, and of any corresponding color-independent icons.

Table 5-1 Alarm Icons

Subsystem Alarm Statue	Icon Color	Color Independent Icon	Action
Normal - No Alarm	Green	N/A	N/A
Critical Alarm	Red	X through icon	Call Out
Major Alarm	Yellow	Back slash through icon	Call Out
Minor Alarm	Blue	Dotted line slash through icon	Call Out
Event	White	None	None
Disabled	Dark Gray*	N/A	None
System Not Available	Light Gray	N/A	N/A
* If all alarms in a subsystem are disabled or set to event severity, the icon color is dark gray.			

When an alarm is triggered, the icon color of the affected subsystem changes, from green (normal), to the color of the alarm definition, and the icon blinks.

RepeaterNet also offers two optional alarm features:

The Color Independent Icons feature is provided for operators who are unable to distinguish color.

If an individual subsystem triggers more than one alarm, the Main Control Screen reports the higher-severity alarm, in both the color and color-independent icons.

For example, if both a major and a minor Reverse PA alarm trigger, a yellow subsystem icon is reported. If you clear the major alarm while the minor alarm remains active, a blue subsystem icon is reported.

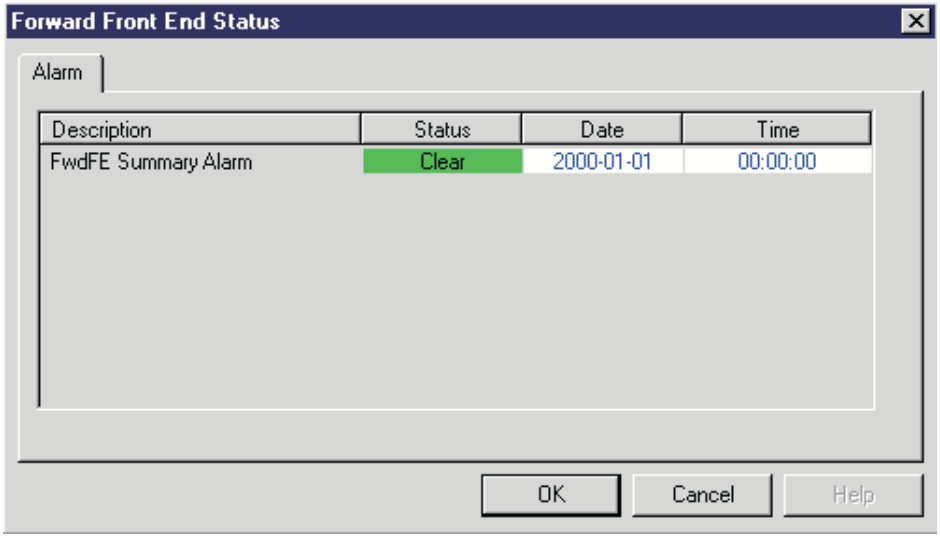
When a subsystem alarm triggers, click the icon (to open the status screen). This action terminates the icon blinking feature, and silences the audible alarm. However, icon color continues to report, and a color-independent icon (if applicable) continues to display until you clear the condition that triggered the alarm.

Forward Front End (FFE) Status Reporting

By clicking on the Forward Front End (FFE) icon you will bring up the FFE Alarm Status display shown in Figure 5-7:

RT222123

Figure 5-7 Forward Front End Status Window



RT221103

This display shows the status of the following alarms:

FwdFE Summary Alarm - This alarm activates when the forward front end is drawing either too much or too little current.

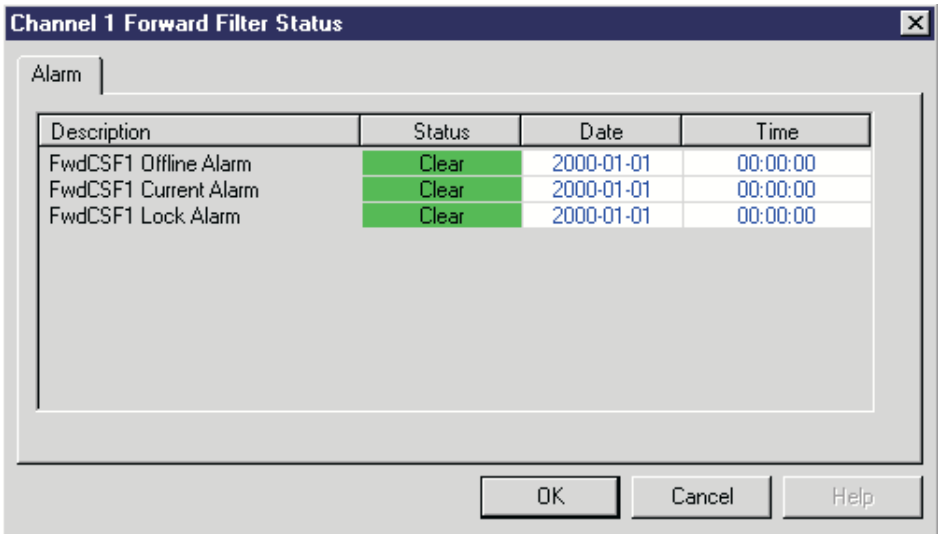
Forward Channel Select Filter (CSF) Channel 1 and 2 Status Reporting

NOTE: The alarm status and monitoring points are the same for both Forward CSF icons with the exception of the labeling of channel 1 versus channel 2.

By clicking on the Forward Channel Select Filter (CSF) icon you will bring up the CSF Alarm Status display shown in Figure 5-8:

RT222124

Figure 5-8 Forward Channel Select Filter (CSF) Status



RT221102

This display shows the status of the following alarms:

FwdCSF Offline Alarm - This alarm activates when the ACU cannot communicate to the CSF through the serial bus.

FwdCSF Current Alarm - This alarm activates when the CSF is drawing either too much or too little current.

FwdCSF Lock Alarm - This alarm activates when the phase locked loops that control the CSF up / down conversion circuitry lose lock. This alarm causes the CSF frequency to become unstable, so in order to prevent spurious outputs from the repeater the power amplifier associated with this CSF is shut down, therefore turning off the channel.

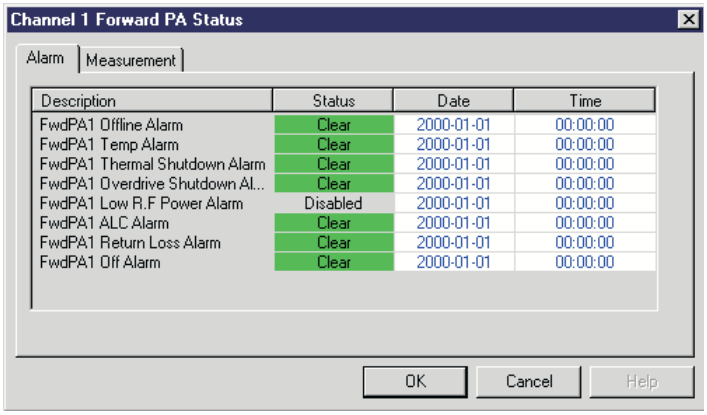
Forward Power Amplifier (FPA) Status Reporting

NOTE: The alarm status and monitoring points are the same for both FPA icons with the exception of the labeling of channel 1 versus channel 2.

By clicking on the FPA icon you will bring up the FPA Alarm Status display shown in Figure 5-9:

RT222125

Figure 5-9 Forward Power Amplifier (FPA) Status



RT221101

This display shows the status of the following alarms:

FwdPA Offline Alarm- Indicates that the ACU cannot communicate with the FPA over the serial bus

FwdPA Temp Alarm- Indicates that the FPA is getting too hot and will shut itself off if the condition causing the overheating is not rectified.

FwdPA Thermal Shutdown Alarm- Indicates that the FPA has been shut off (disabled) due to over heating conditions.

FwdPA Overdrive Shutdown Alarm- Indicates the FPA has been shut down due to an over drive condition.

FwdPA Low RF Power Alarm- Indicates that the forward power level coming out of the FPA has been low for a preset amount of time (default is 5 minutes, but is adjustable by

the user). This indicates either a problem in the FPA, repeater, or the base station feeding the repeater.

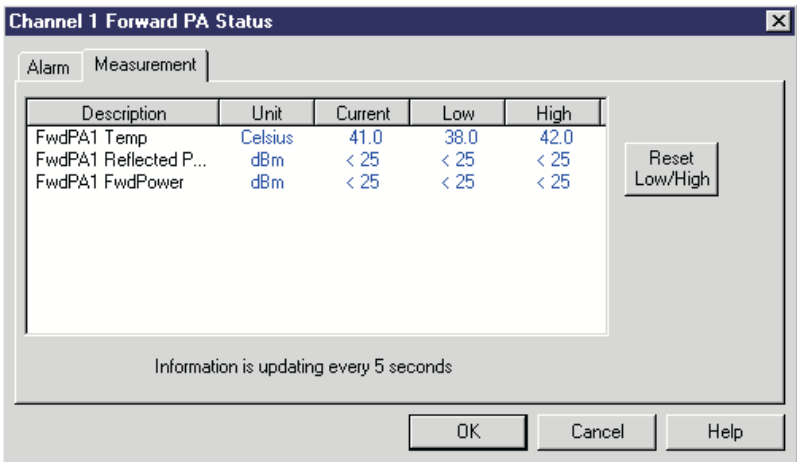
FwdPA ALC Alarm- Indicates that the forward gain of the repeater has been reduced in order to compensate for an RF over drive condition in the FPA.

FwdPA Return Loss Alarm- Indicates that a high VSWR condition exists on the output port of the FPA. This could either be caused by internal hardware or external antenna connections.

FwdPA Off Alarm - Indicates the forward PA has been shut off.

By pressing on the Measurement tab the measurement status window will be displayed as shown in Figure 5-10:

Figure 5-10 FPA Measurement



This window displays the following measurement data from the FPA:

FwdPA Temp - The temperature of the forward PA is displayed in degrees Celsius. Current, Low and High values are displayed.

FwdPA Reflected Power - The reflected power at the output of the repeater is displayed in dBm. Current, Low and High values are displayed.

FwdPA Fwd Power - The output power of the FPA is displayed in dBm. Current, Low and High values are displayed.

There is also a reset Low/High values button that will clear the minimum and maximum displays.

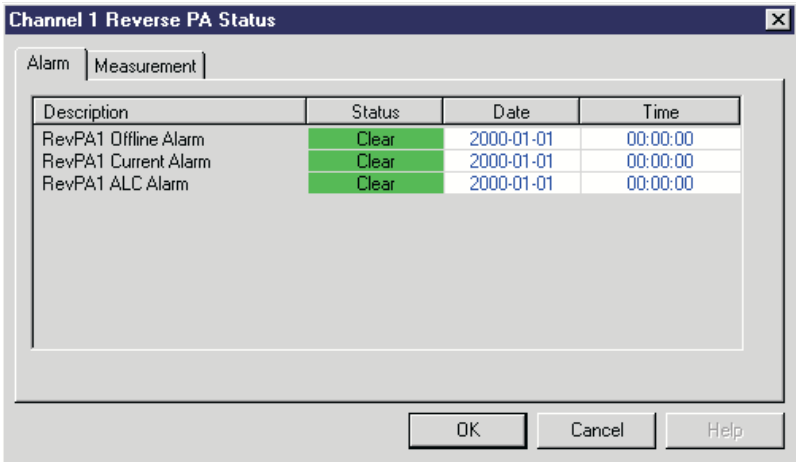
Reverse Power Amplifier (RPA) Status Reporting

NOTE: The alarm status and monitoring points are the same for both FPA icons with the exception of the labeling of channel 1 versus channel 2.

By clicking on the Reverse Power Amplifier (RPA) icon you will bring up the RPA Alarm Status display shown in Figure 5-11:

RT222126

Figure 5-11 Reverse Power Amplifier (RPA) Status



RT222102

This display shows the status of the following alarms:

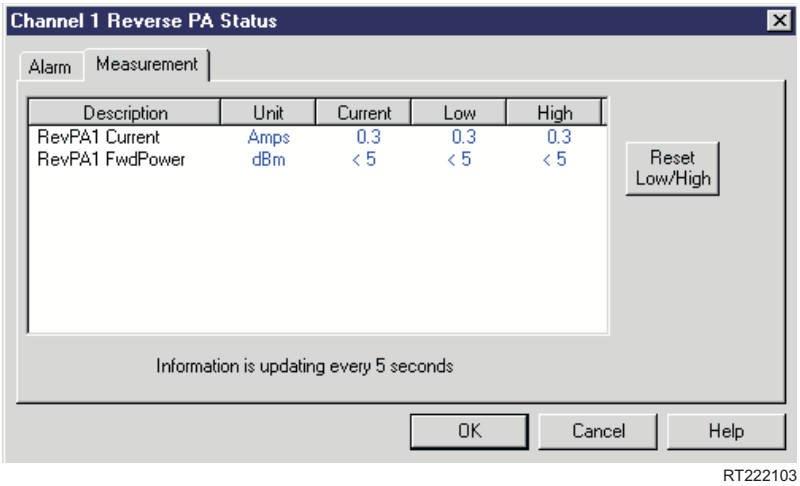
RevPA Offline Alarm - Indicates that the ACU cannot communicate with the RPA over the serial bus.

RevPA Current Alarm - This alarm activates when the RPA is drawing either too much or too little current.

RevPA ALC Alarm - Indicates that the reverse gain of the repeater has been reduced in order to compensate for an RF over drive condition in the RPA.

By pressing on the Measurement tab the measurement status window will be displayed as shown in Figure 5-12:

Figure 5-12 RPA Measurement



This window displays the following measurement data from the RPA:

RevPA Current - The RPA current is displayed in Amps. Current, Low and High values are displayed.

RevPA Fwd Power - The output power of the RPA is displayed in dBm. Current, Low and High values are displayed.

There is also a reset Low/High values button that will clear the minimum and maximum displays.

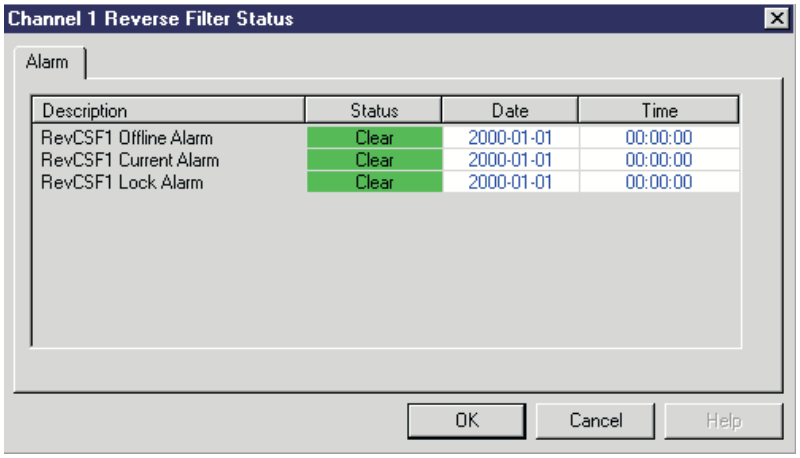
Reverse Channel Select Filter (CSF) Channel 1 and 2 Status Reporting

NOTE: The alarm status and monitoring points are the same for both Reverse CSF icons with the exception of the labeling of channel 1 versus channel 2.

By clicking on the Reverse Channel Select Filter (CSF) icon you will bring up the CSF Alarm Status display shown in Figure 5-13:

RT222127

Figure 5-13 Reverse CSF Status



RT222104

This display shows the status of the following alarms:

RevCSF Offline Alarm - This alarm activates when the ACU cannot communicate to the CSF through the serial bus.

RevCSF Current Alarm - This alarm activates when the CSF is drawing either too much or too little current.

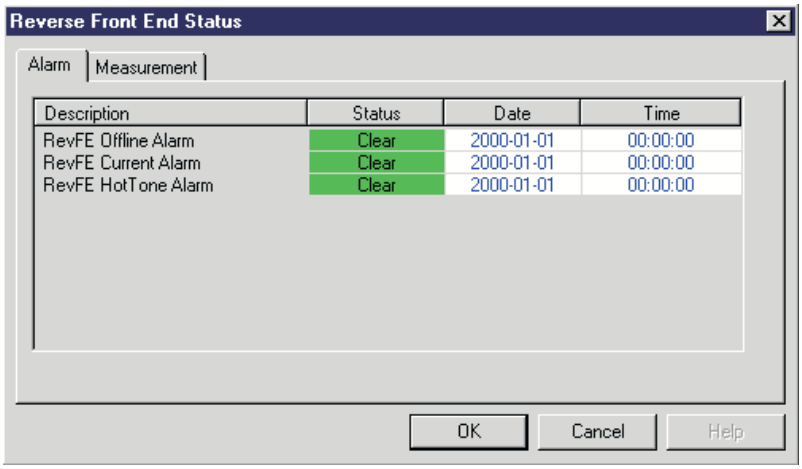
RevCSF Lock Alarm: This alarm activates when the phase locked loops that control the CSF up / down conversion circuitry lose lock. This alarm causes the CSF frequency to become unstable, so in order to prevent spurious outputs from the repeater the power amplifier associated with this CSF is shut down, therefore turning off the channel.

Reverse Front End (RFE) Status Reporting

By clicking on the Reverse Front End (RFE) icon you will bring up the RFE Alarm Status display shown in Figure 5-14:

RT222128

Figure 5-14 RFE Status



RT222105

This display shows the status of the following alarms:

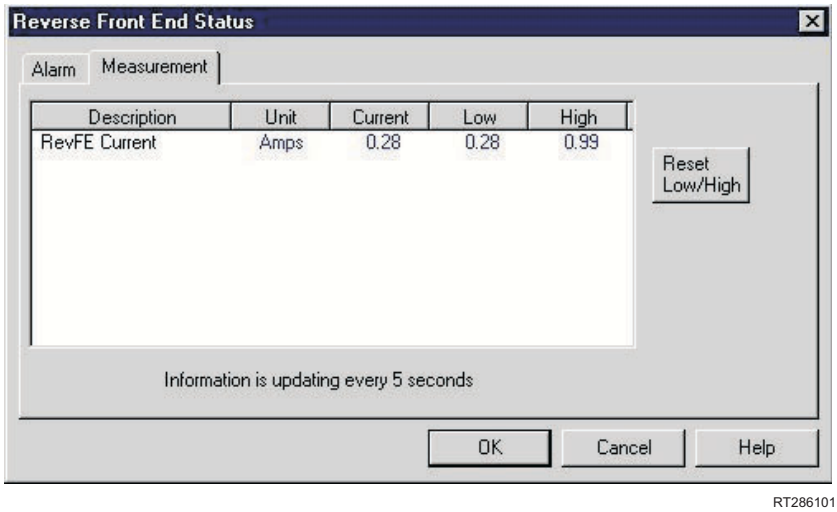
RevFE Offline Alarm - This alarm activates when the ACU cannot communicate to the RFE through the serial bus.

RevFE Current Alarm - This alarm activates when the reverse front end is drawing either too much or too little current.

RevFE HotTone Alarm - This alarm activates when the reverse signal power level is too strong, and is being attenuated to protect the repeater from possible damage.

By pressing on the Measurement tab the measurement status window will be displayed as shown in Figure 5-15:

Figure 5-15 RFE Measurement



This window displays the following measurement data from the RFE module:

Current - The RFE current is displayed in Amps. Current, Low and High values displayed.

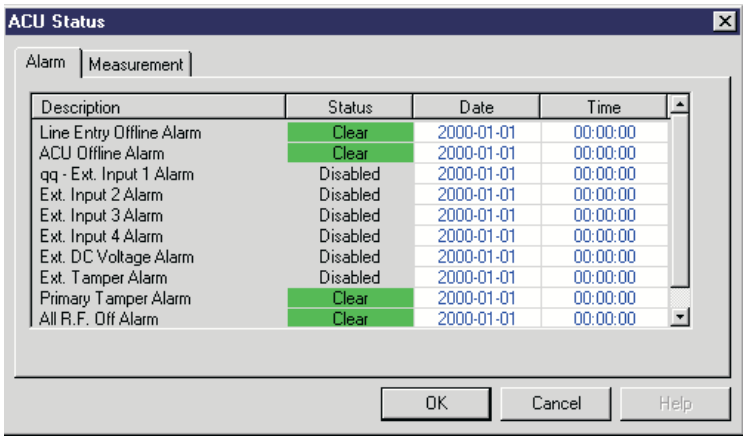
There is also a reset Low/High values button that will clear the minimum and maximum displays.

Alarm Control Unit (ACU) Status Reporting

By clicking on the Alarm Control Unit (ACU) icon you will bring up the RFE Alarm Status display shown in Figure 5-16:

RT222129

Figure 5-16 Alarm Control Unit (ACU) Status



RT222107

This display shows the status of the following alarms:

Line Entry Offline Alarm - Indicates the ACU cannot communicate with the line entry module over the serial bus.

ACU Offline Alarm - Indicates the ACU cannot communicate with its own I/O processor over the serial bus. Probably means that the bus is inoperative or shorted out.

Ext. Input 1 - 4 Alarms - Indicates that one of the 4 external input alarms are active. These alarms are user configured to communicate with devices external to the repeater.

Ext. DC Voltage Alarm - Indicates the voltage applied to this interface is out of the range specified by the user. This alarm is meant to monitor an external DC voltage supply and alarm on an out of range condition specified by the user.

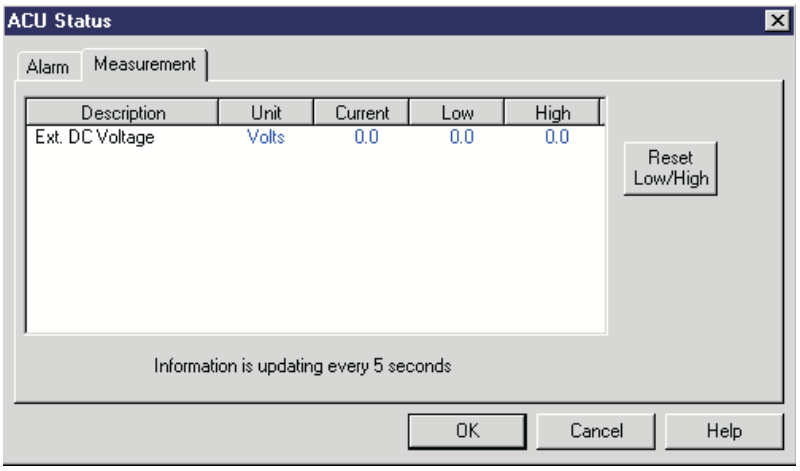
Ext. Tamper Alarm - Indicates that a tamper switch external to the repeater (storage closet door, system enclosure, base station door,…) has been opened indicating an entry into a restricted area. The default alarm state is disabled.

Primary Tamper Alarm - Indicates someone has opened the repeater door.

All RF Off Alarm - Indicates that the main power to the repeater has failed and the unit is now running on the small back up battery. All the RF modules have been disabled and there is no RF power being transmitted by the repeater.

By pressing on the Measurement tab the measurement status window will be displayed as shown in Figure 5-17:

Figure 5-17 ACU Measurement



This window displays the following measurement data from the ACU module:

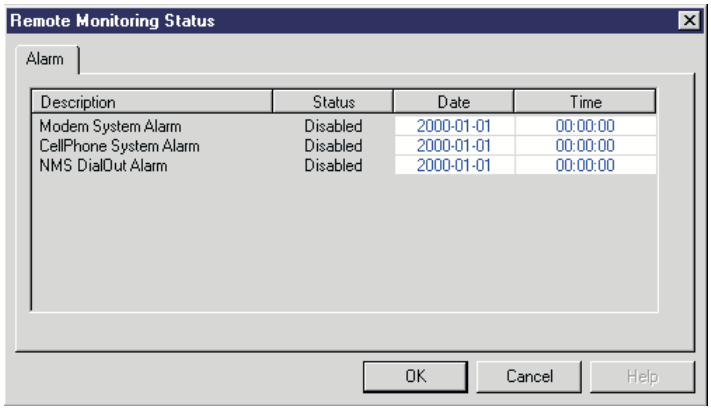
Ext. DC Voltage - The external DC voltage being monitored is displayed in volts. Current, Low and High values are displayed. There is a reset Low/High values button that will clear the minimum and maximum displays.

Remote Monitoring Status Reporting

By clicking on the Remote Monitoring icon you will bring up the Remote Monitoring Alarm Status display shown in Figure 5-18:

RT222130

Figure 5-18 Remote Monitoring Status



RT222109

This display shows the status of the following alarms:

Modem System Alarm - Indicates that the ACU cannot communicate with or configure the attached modem. This alarm is only active if the repeater has been provisioned with a modem.

CellPhone System Alarm - Indicates the ACU cannot communicate with or configure the attached cell phone. This alarm is only active if the repeater has been provisioned with a cell phone.

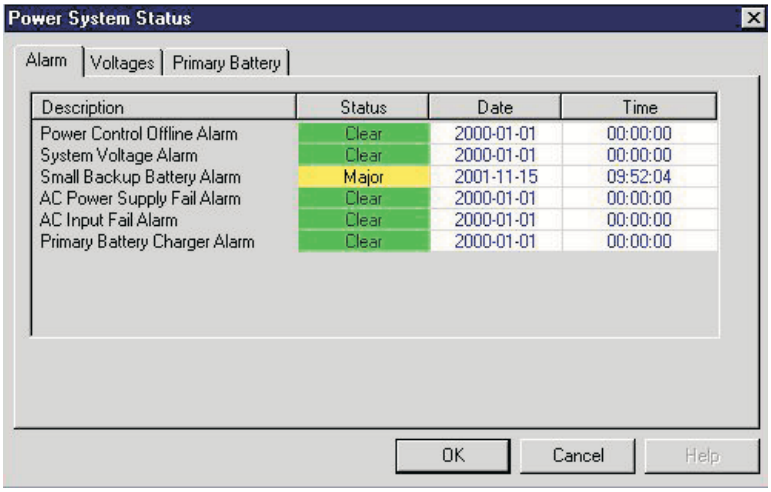
NMS DialOut Alarm - Indicates that the ACU has been unable to dial out an alarm to the Network Management system. This alarm is only active if the repeater has been provisioned with a monitoring kit and has had the NMS dial out options configured.

Power System Status Reporting

By clicking on the Power System icon you will bring up the Remote Monitoring Alarm Status display shown in Figure 5-19:

RT222131

Figure 5-19 Power System Status



RT330102

This display shows the status of the following alarms:

Power Control Offline Alarm - Indicates the ACU cannot communicate with the power control system over the serial bus.

System Voltage Alarm - Indicates the DC power rail inside the repeater (provided by the user on a DC powered system) has gone under 20 VDC or over 32 VDC (outside the specified limits).

Small Backup Battery Alarm - Indicates the small back up battery (located on the door of the repeater) has failed the load test and needs to be replaced.

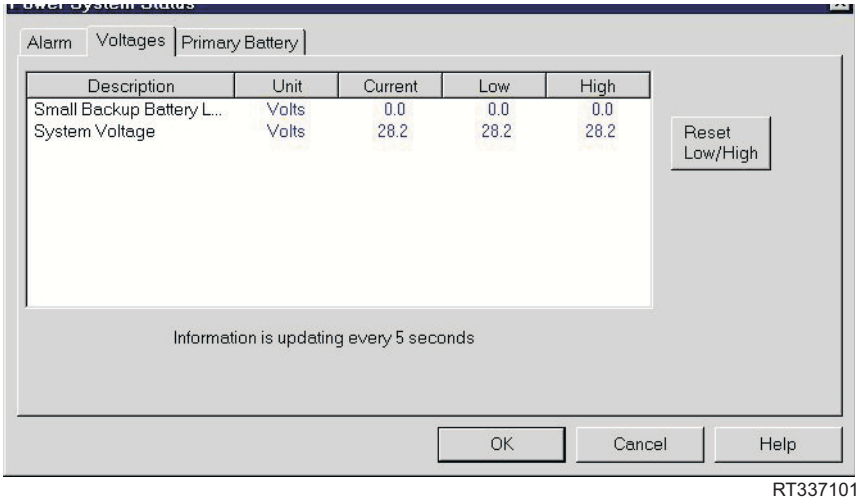
AC Power Supply Fail Alarm - DC output failure alarm from the AC/DC power supply. Only active in AC powered systems.

AC Input Fail Alarm - AC input voltage failure alarm from the AC power source. Only active in AC powered systems.

Primary Battery Charger Alarm - Indicates that the primary battery (large batteries located outside of the repeater) charging circuit has failed and is no longer charging the batteries.

By clicking on the Voltages tab (Figure 5-20) the following measurements are displayed:

Figure 5-20 Power System Voltages display here



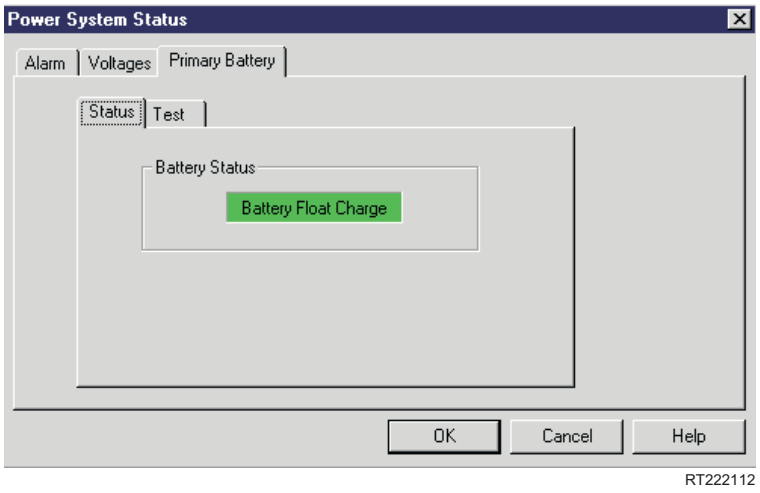
Small Back-up Battery Load Test Voltage - The results from a one minute load test performed on the small back-up battery is displayed in volts. The load test is run every hour (to prevent discharging the battery) and should show a result of over 11.5 VDC if the battery is good. Current, Low and High values are displayed.

System Voltage - The repeater's internal DC bus is displayed in volts. Current, Low and High values are displayed.

There is a reset Low/High values button that will clear the minimum and maximum displays.

NOTE: May be up to 700 mV lower than the voltage at the terminal block.

Figure 5-21 Power System Primary Battery



Status Tab - This shows the current state of the primary battery charger circuit. The states are as follows:

Start Charge - initial state where the charger is checking the state of battery.

Battery Fast Charge - The charger is providing up to 2 Amps of current into the batteries.

Transition - The charger has reached the top of the charging voltage range during fast charge and is cutting back the current to a float charge level.

Maintenance - Float charge level.

Discharge - Repeater is operating on battery supplied power.

Over Temp - Charger has been disabled due to the batteries being too hot.

Open Relay - Battery charger has been disabled due to either an open relay or open circuit breaker to the battery.

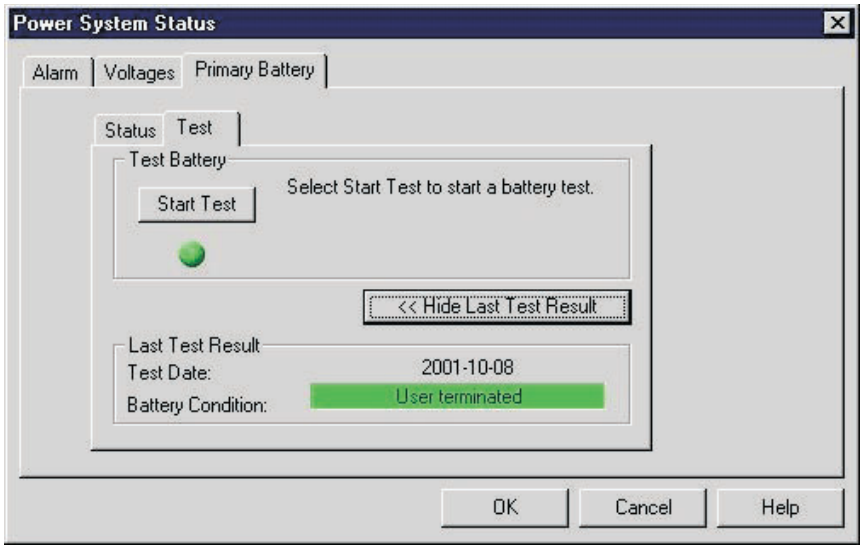
Charger Failed - Charger was unable to charge the batteries.

Disabled - Battery charger is disabled.

Test Tab - This tab allows the user to run a load test on the external batteries. The load test takes 24 hours to perform. The test opens the circuit to the battery for 24 hours and allows the battery's internal resistance to bleed off the charging voltage then measures the battery voltage to determine how much capacity the battery still has.

By clicking on the Primary Battery tab the following screen is displayed:

Figure 5-22 Primary Test Tab

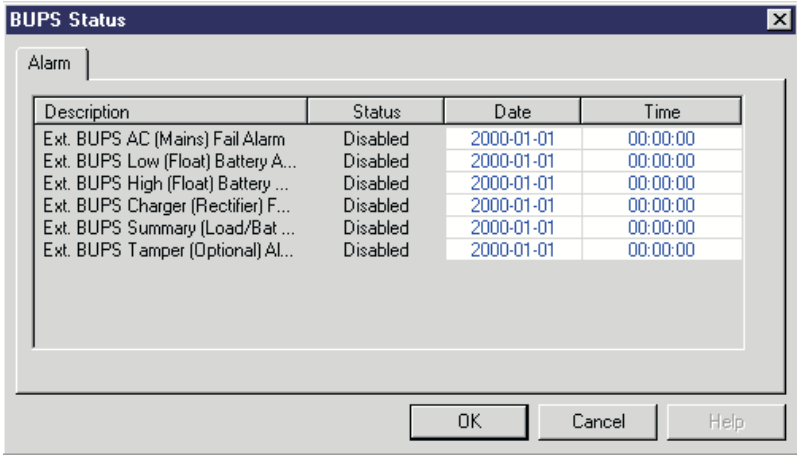


External Back Up Power System (BUPS) Status Reporting

By clicking on the BUPS icon you will bring up the BUPS Status display shown in Figure 5-23:

RT222132

Figure 5-23 BUPS Status



RT222114

This display shows the status of the following alarms:

Ext. BUPS AC (Mains) Fail Alarm - Indicates the external BUPS has lost AC power

Ext. BUPS Low (Float) Battery Alarm - Indicates the external BUPS has dropped down to a low float voltage on the batteries.

Ext. BUPS High (Float) Battery Alarm - Indicates the external BUPS has reached the high float voltage on the batteries.

Ext. BUPS Charger (Rectifier) Fail Alarm - Indicates the external BUPS rectifier circuit has failed.

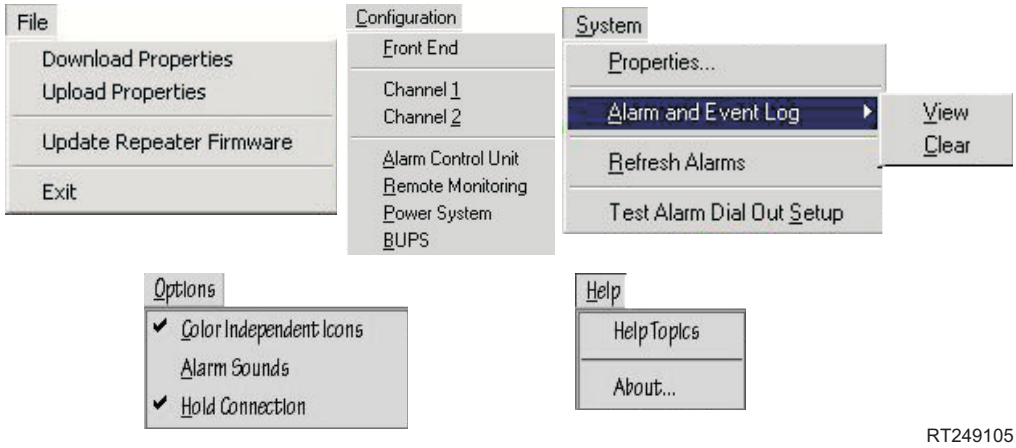
Ext. BUPS Summary (Load/Battery) Alarm - Indicates an alarm has activated in the external BUPS.

Ext. BUPS Tamper (Optional) Alarm - Indicates the door to the external BUPS is open.

5.7 Configuring Repeater Properties/Alarm Severities

Craft Pull-down menus are used to configure the repeater.

Figure 5-24 Craft Pull-down menus



All RTI repeaters are shipped with PAs (Power Amplifiers) turned Off. In this condition, the PA Off indicator (a circle with a slash through it) is displayed over each PA subsystem icon (FPA and RPA) in the Craft Main Control Screen. Keep each repeater's PA turned Off, until you have adjusted the gain for that repeater.

The appearance of the Main Control Screen (and the available menus) might vary from that shown in Figure 5-6 and on the following pages, depending on the repeater hardware configuration.

5.7.1 Subsystem Configuration

To configure the repeater, select the subsystem Properties screens from the Craft Configuration menu.

Table 5-2 lists the choices in the Configuration menu.

Table 5-2 Configuration Menu

Menu Selection	Description	Section
Front End	Configures the Forward, Reverse, and Diversity front ends	See “Front End Properties” .
Channel 1	Configures repeater channel 1.	See “Channel1 and Channel2 Properties” .
Channel 2	Configures repeater channel 2.	See “Channel1 and Channel2 Properties” .
Alarm Control Unit	Configures ACU.	See “Alarm Control Unit Properties” .
Remote Monitoring	Configures Internal Modem/UART and External cell phone.	See “Remote Monitoring Properties” .
Power System	Configures input, battery, and internal power.	See “Power System Properties” .
BUPS	Configure Back-up Power System (BUPS).	See “Back-up Power System (BUPS) Properties” .

Use the subsystem Properties screens to configure the repeater.

To open a Properties screen, select one of the following subsystems from the Configuration menu:

- Front End
- Channel 1
- Channel 2
- Alarm Control Unit
- Remote Monitoring
- Power System
- BUPS

The Properties screens display tabs that are specific to each subsystem. You can conduct two types of repeater settings:

1. Redefine alarm severity

   The levels of alarm severity are:

   - Critical
   - Major
   - Minor
   - Event
   - Disabled

   The Critical, Major, and Minor alarm levels are consistent with normal telecommunications definitions, and are ranked in that order. When an alarm is defined as an event it will be logged in the error log, but will not cause the repeater to dial the NMS or page a technician. When an alarm is disabled it is as if the alarm does not exist in the system at all.
2. Specify operational settings for the repeater.

   Some subsystem Properties screens include tabs for redefining alarm severity, and for specifying operational settings. Others have a single tab, for redefining alarm severity.

5.8 Front End Properties

The Front End Properties screen configures the Front End subsystems. This screen includes tabs that set the alarm severity for:

- Forward FE
- Reverse FE

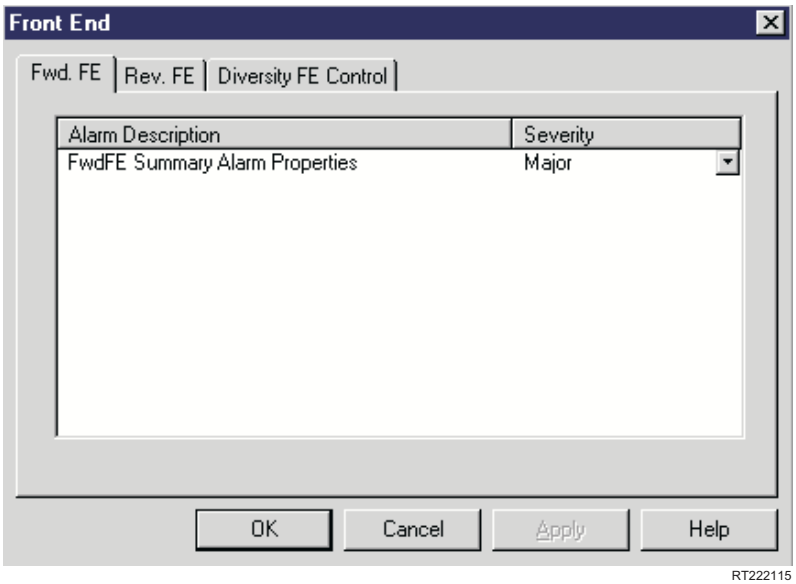
and a configuration tab in order to turn on or off the:

- Diversity FE

5.8.1 Forward FE Tab

The Forward FE tab (see Figure 5-25) sets the alarm severity of the Forward FE alarm.

Figure 5-25 Front End Properties Screen, Forward FE Tab



FwdFE Summary Alarm - This alarm activates when the forward front end is drawing either too much or too little current.

To redefine the alarm severity for the Forward FE subsystem:

1. Click the down arrow next to the alarm field to select a new alarm severity.
2. Click the Apply or OK button to change the alarm severity.
   - The Apply button changes the alarm severity and keeps the Channel Properties screen open.
   - The OK button changes the alarm severity and closes the Channel Properties screen.

5.8.2 Reverse FE Tab

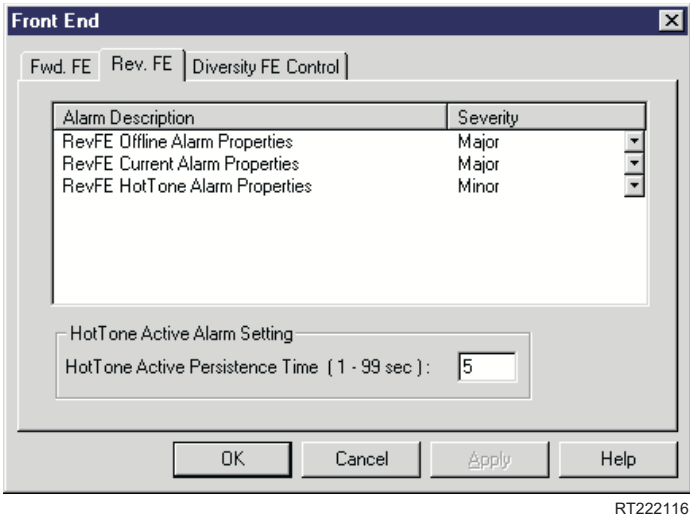
The Reverse FE tab (see Figure 5-26) sets the alarm severity of the Reverse FE alarms.

RevFE Offline Alarm - This alarm activates when the ACU cannot communicate to the RFE through the internal serial bus.

RevFE Current Alarm - This alarm activates when the reverse front end is drawing either too much or too little current.

RevFE HotTone Alarm - This alarm activates when the reverse signal power level is too strong, and is being attenuated to protect the repeater from possible damage.

Figure 5-26 Front End Properties Screen, Reverse FE Tab



HotTone Active Alarm Setting - Sets the duration in seconds for how long the HotTone condition needs to exist before the repeater declares an alarm.

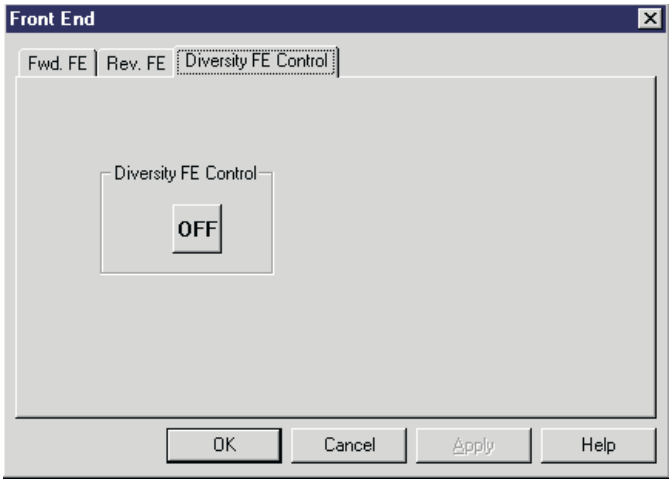
To redefine the alarm severity for the Reverse FE subsystem:

1. Click the down arrow next to the alarm field to select a new alarm severity.
2. Click the Apply or OK button to change the alarm severity.
   - The apply button changes the alarm severity and keeps the Channel Properties screen open.
   - The OK button changes the alarm severity and closes the Channel Properties screen.

5.8.3 Diversity FE Control Tab

The Diversity FE tab (see Figure 5-27) allows you to turn the Diversity FE on or off.

Figure 5-27 Front End Properties Screen, Diversity FE Tab



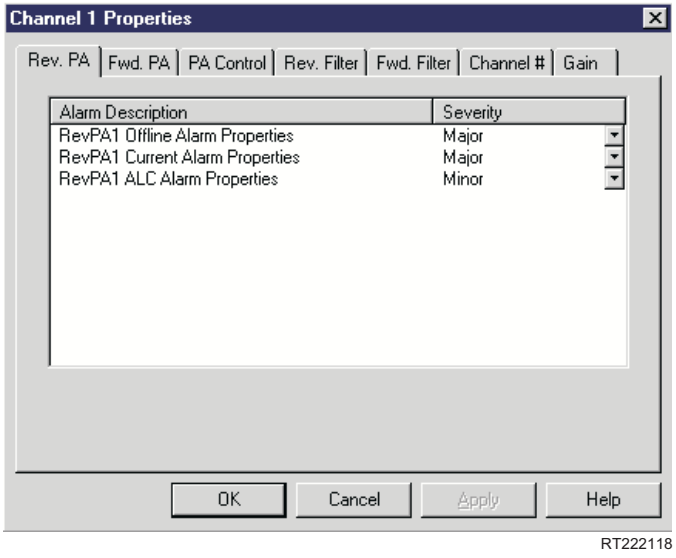
5.9 Channel1 and Channel2 Properties

From the Main Control screen menu bar, select Channel 1 or Channel 2 to open a Channel Properties screen. Channel properties include:

- Reverse PA
- Forward PA
- PA Control
- Reverse Filter
- Forward Filter
- Channel #
- Gain

5.9.1 Channel Reverse PA Tab

Figure 5-28 Channel Properties Screen, Reverse PA Tab



The Reverse PA tab sets the alarm severity for the following types of Reverse Power Amplifier alarms (see Figure 5-28):

RevPA Offline Alarm - Indicates that the ACU cannot communicate with the RPA over the serial bus.

RevPA Current Alarm - This alarm activates when the RPA is drawing either too much or too little current.

RevPA ALC Alarm - Indicates that the reverse gain of the repeater has been reduced in order to compensate for an RF over drive condition in the RPA.

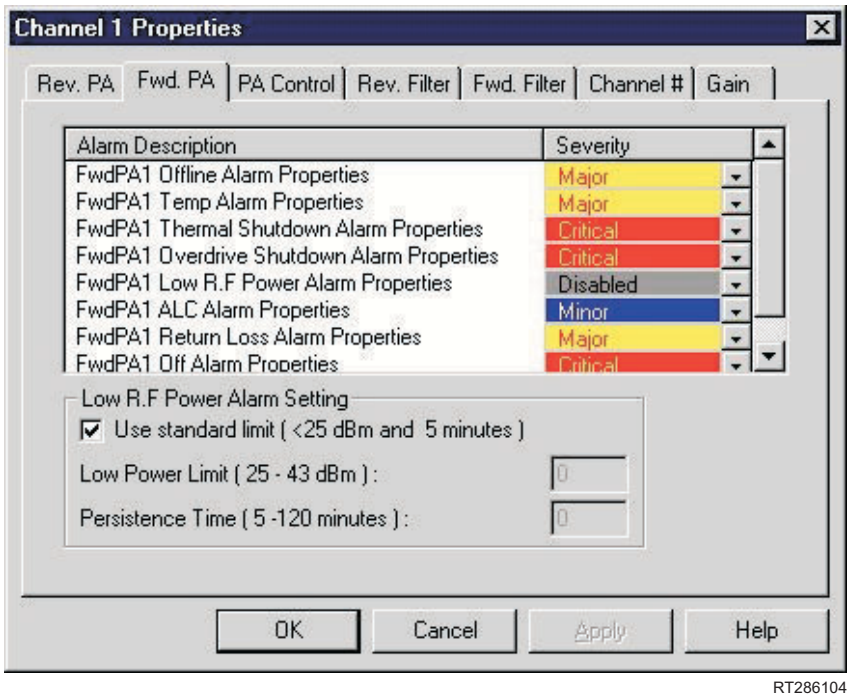
To redefine an alarm severity for the Reverse PA subsystem:

1. Click the down-arrow next to an Alarm field to select a new alarm severity.
2. Click the Apply or OK button to change the alarm severity.
   - The Apply button changes the alarm severity and keeps the Channel Properties screen open.
   - The OK button changes the alarm severity and closes the Channel Properties screen.

5.9.2 Channel Forward PA Tab

The Forward PA tab (see Figure 5-29) sets the alarm severity for the following types of Forward PA alarms:

Figure 5-29 Channel Properties Screen, Forward PA Tab



FwdPA Offline Alarm - Indicates that the ACU cannot communicate with the FPA over the serial bus.

FwdPA Temp Alarm - Indicates that the FPA is getting too hot and will shut itself off if the condition causing the overheating is not rectified.

FwdPA Thermal Shutdown Alarm - Indicates that the FPA has been shut off (disabled) due to over heating conditions.

FwdPA Overdrive Shutdown Alarm - Indicates the FPA has been shut down due to an over drive condition.

FwdPA Low RF Power Alarm - Indicates that the forward power level coming out of the FPA has been low for a preset amount of time (default is 5 minutes, but is adjustable by the user). This indicates either a problem in the FPA, repeater, or the base station feeding the repeater.

FwdPA ALC Alarm - Indicates that the forward gain of the repeater has been reduced in order to compensate for an RF over drive condition in the FPA.

FwdPA Return Loss Alarm - Indicates that a high VSWR condition exists on the output port of the FPA. This could either be caused by internal hardware or external antenna connections.

FwdPA Off Alarm - Indicates that the forward PA is off.

To redefine an alarm severity for the Forward PA subsystem:

1. Click the down-arrow next to an Alarm field to select a new alarm severity.
2. Click the Apply or OK button to change the alarm severity.
   - The Apply button changes the alarm severity and keeps the Channel Properties screen open.
   - The OK button changes the alarm severity and closes the Channel Properties screen.

Low RF Power Alarm Setting - Allows a user to adjust the low RF Power Alarm in order to make it useful in the network. This alarm will monitor the forward power out of the repeater and alarm if it is below the low power limit for the persistence time.

5.9.3 Channel PA Control Tab

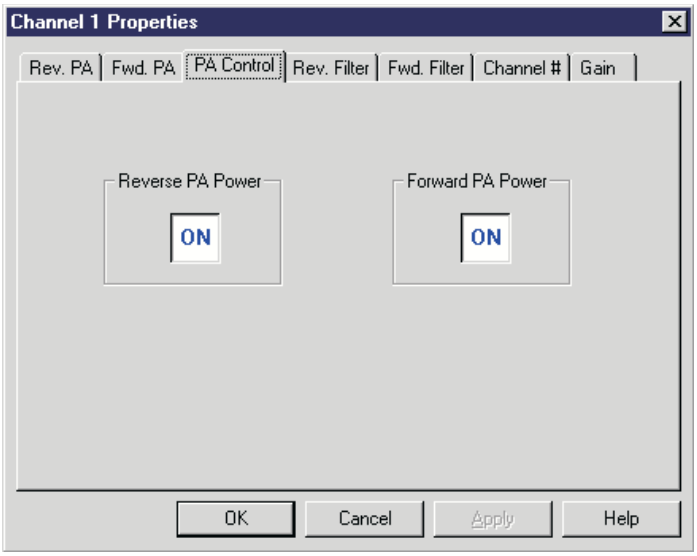
The PA Control tab provides a switch to turn PA power On or Off (see Figure 5-30).

1. Click on the Reverse PA Power box, or the Forward PA Power box to change the on or off state of the PA.

   The icon toggles between On and Off.

2. Click on the Apply or OK button for the setting to take effect.
   - The Apply button changes the PA value and keeps the Channel Properties screen open.
   - The OK button changes the PA value and closes the Channel Properties screen.

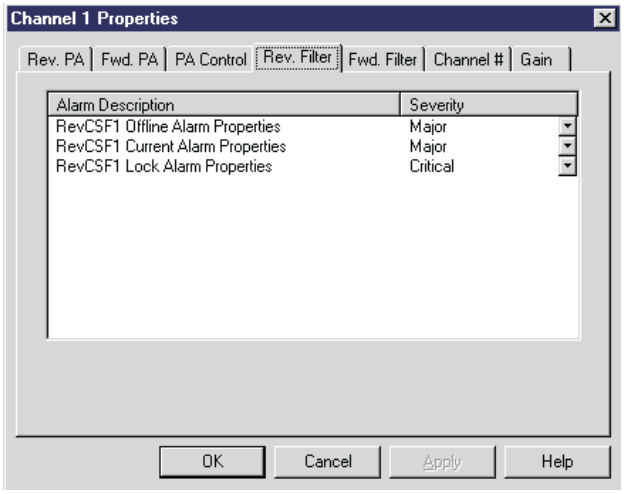
Figure 5-30 Channel Properties Screen, Channel PA Tab



5.9.4 Channel Reverse Filter Tab

The Channel Reverse Filter tab sets the alarm severity for the following alarms:

Figure 5-31 Channel Properties Screen, Reverse Filter Tab



RevCSF Offline Alarm - This alarm activates when the ACU cannot communicate to the CSF through the serial bus.

RevCSF Current Alarm - This alarm activates when the CSF is drawing either too much or too little current.

RevCSF Lock Alarm: This alarm activates when the phase locked loops that control the CSF up/down conversion circuitry lose lock. This alarm causes the CSF frequency to become unstable, so in order to prevent spurious outputs from the repeater the power amplifier associated with this CSF is shut down, therefore turning off the channel.

To redefine an alarm severity for the Reverse Filter subsystem:

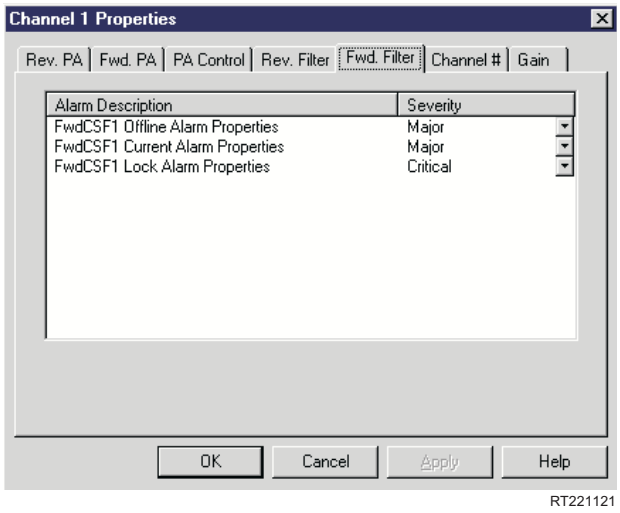
1. Click the down-arrow next to an Alarm field to select a new alarm severity:
2. Click the Apply or OK button.
   - The Apply button changes the alarm severity setting and keeps the Channel Properties screen open.
   - The OK button changes the alarm severity setting and closes the Channel Properties screen.

NOTE: The Channel Reverse Filter tab is similar to the Channel Forward Filter tab, shown in Figure 5-32.

5.9.5 Channel Forward Filter Tab

The Channel Forward Filter tab (see Figure 5-32) sets the alarms severity for the following alarms:

Figure 5-32 Channel Properties Screen, Channel Forward Filter Tab



FwdCSF Offline Alarm - This alarm activates when the ACU cannot communicate to the CSF through the serial bus.

FwdCSF Current Alarm - This alarm activates when the CSF is drawing either too much or too little current.

FwdCSF Lock Alarm: This alarm activates when the phase locked loops that control the CSF up / down conversion circuitry lose lock. This alarm causes the CSF frequency to become unstable, so in order to prevent spurious outputs from the repeater the power amplifier associated with this CSF is shut down, therefore turning off the channel.

To redefine an alarm severity for the Forward Filter subsystem:

1. Click the down-arrow next to an Alarm filed to select a new alarm severity:
2. Click the Apply or OK button.
   - The Apply button changes the alarm severity setting and keeps the Channel Properties screen open.
   - The OK button changes the alarm severity setting and closes the Channel Properties screen.

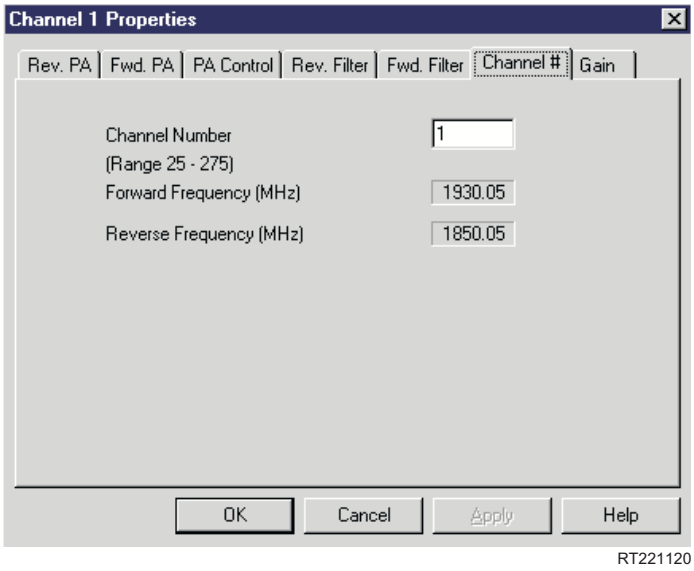
5.9.6 Channel # Tab

The Channel # tab (see Figure 5-33) sets the operating channel, for either Channel 1 or Channel 2.

After you select a channel, the Channel Properties screen displays the corresponding frequencies.

NOTE: Consult your RF engineer, or the system Site Plan, for the proper channel setting.

Figure 5-33 Channel Properties Screen, Channel # Tab



5.9.7 Channel Gain Tab

The RepeaterNet software detects the configuration of the repeater, and displays the applicable gain range on the Gain tab (see Figure 5-34). You can adjust the Forward and Reverse gain for the selected channel.

The adjustable gain range depends on the type of repeater, and the power level of the repeater's power amplifiers. RepeaterNet limits your choice of gain adjustments to selections that are valid for the specific repeater type and power level.

NOTE: Carefully balance the gain in any repeater application to ensure proper hand-off and system operation.

To adjust Forward PA or Reverse PA gain:

1. Select Configuration -> Channel 1 or Configuration -> Channel 2 to open the Channel Properties screen.
2. Click the Gain tab (see Figure 5-34).
3. Press, hold and drag the mouse across the horizontal sliders to define forward and reverse gains.

NOTE: Gain is adjustable in 1 dB increments.

   The gain value box (centered under each slider) displays the selected gain.
4. Click the Apply or OK button.
   - The Apply button changes the gain setting and keeps the Channel Properties screen open.
   - The OK button changes the gain setting and closes the Channel Properties screen.

NOTE: The ALC setting needs to be turned off in order to adjust the gain. Turn the ALC settings to off, adjust the gain, then turn it back on.

Figure 5-34 Channel Properties Screen, Channel Gain Tab ALC On

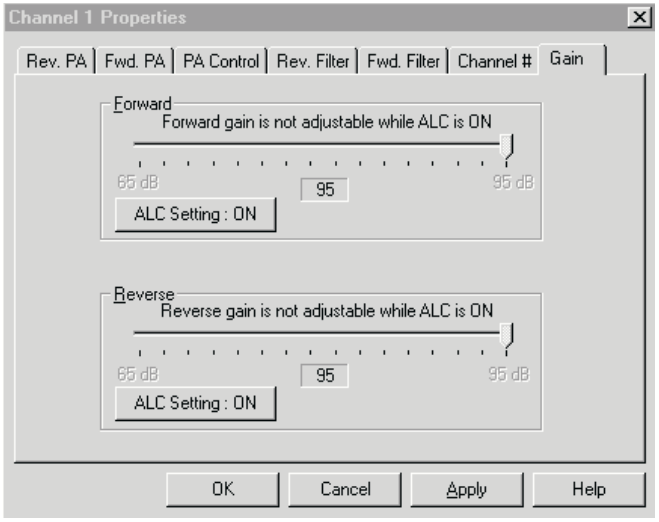
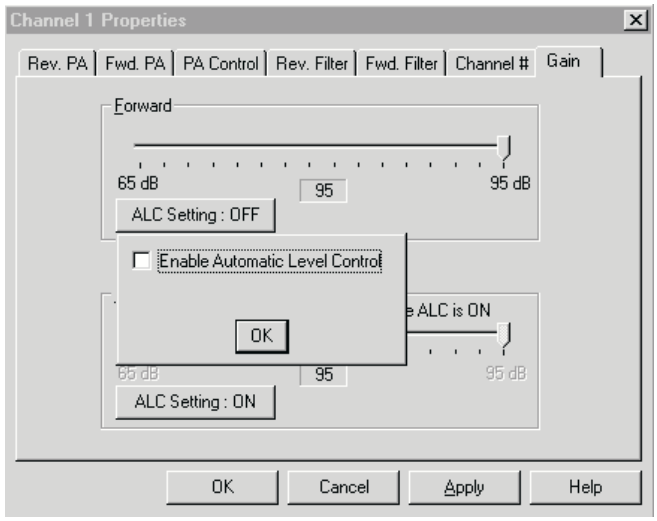


Figure 5-35 Channel Properties Screen, Channel Gain Tab ALC Off



5.10 Alarm Control Unit Properties

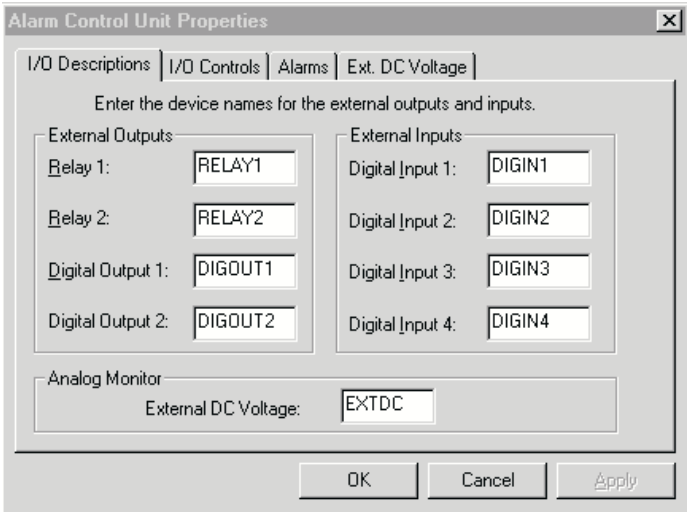
The Alarm Control Unit (ACU) subsystem provides alarm and control functions for the repeater. The ACU monitors all repeater subsystems, and reports the status of a subsystem, either to a directly-connected device, or to remote devices (through a dial-up modem connection).

In addition to monitoring the repeater system, the ACU contains a number of external inputs and outputs for monitoring and controlling external devices.

To monitor and control a repeater's alarms:

1. Select Alarm Control Unit from the Configuration menu, in the Main Control Screen. The Alarm Control Unit Properties screen opens.
2. Select one of the following ACU tabs:
   - I/O Descriptions
   - I/O Control, Alarms
   - Alarms
   - Ext.DC Voltage

Figure 5-36 Alarm Control Unit



5.10.1 ACU I/O Descriptions Tab

RepeaterNet can monitor four digital alarm inputs and one external DC voltage input from external devices. Up to four external devices (two relay outputs and two digital outputs) can also be active.

Use the I/O Descriptions tab (see Figure 5-37) in the Alarm Control Unit Properties screen to identify external equipment that is connected to the repeater's inputs and outputs.

External equipment could be a security light, or any other site equipment.

NOTE: For information about connecting inputs and outputs to a repeater, see chapter 6, Connecting External Alarms and Relays.

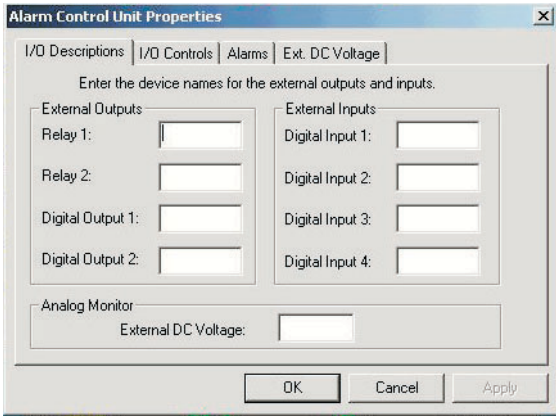
To add I/O descriptions for the Alarm Control Unit, use the following procedure.

1. Select Configuration-> Alarm Control Unit.

   The ACU Properties screen opens (see Figure 5-37). The I/O Descriptions tab is active.
2. Provide I/O Descriptions in the screen's date fields.

   Enter names for any or all of the following types of repeater inputs and outputs:
   - Two different relay outputs
   - Two different digital outputs
   - One DC input
   - Four different digital inputs
3. Click the Apply or OK button.
   - The Apply button adds the repeater input or output and keeps the ACU Properties screen open.
   - The OK button adds the repeater input or output and closes the ACU Properties screen.

Figure 5-37 ACU Properties Screen, I/O Descriptions Tab



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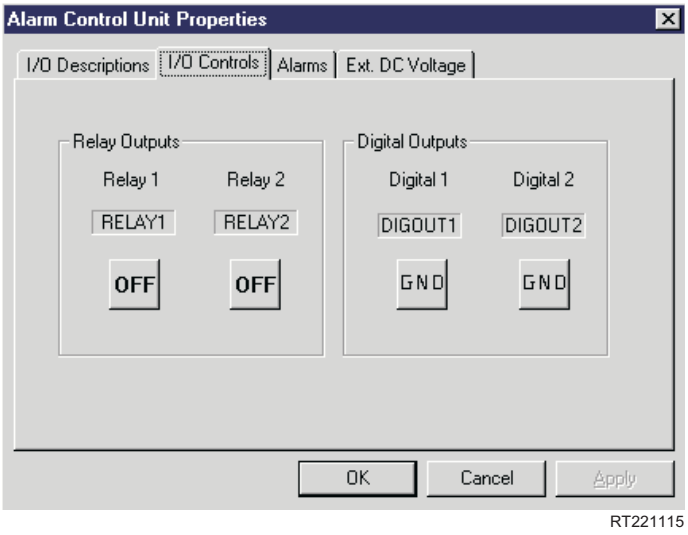
5.10.2 ACU I/O Controls Tab

The I/O Controls tab (see Figure 5-38) turn the 2 relay outputs and 2 digital outputs On or Off.

1. Toggle the relay outputs either On or Off or the Digital Outputs to GND or Open Status.
2. Click the Apply or Ok button.
   - The Apply button turns the selected outputs either On or Off and keeps the ACU Properties screen open.
   - The OK button turns the selected outputs either On or Off and closes the ACU Properties screen.

Figure 5-38 ACU Properties Screen, I/O Controls Tab



5.10.3 ACU Alarms Setting Tab

The Alarms tab (see Figure 5-39) redefines alarm severity for the ACU subsystem.

1. Click the down-arrow next to an Alarm field to select a new alarm severity:

NOTE: Alarm settings for External Input 1 through External Input 4 are default to Disabled.

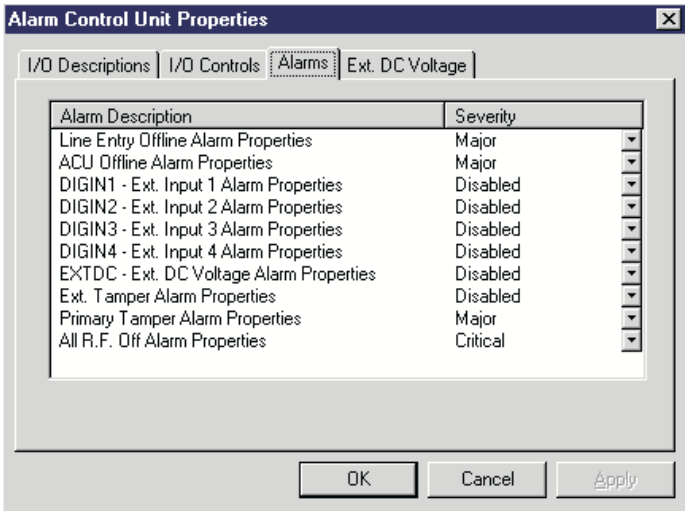
---

2. Click the Apply or OK button.
   - The Apply button changes the alarm severity and keeps the ACU Properties screen open.
   - The OK button changes the alarm severity and closes the ACU Properties screen.

You can set the following alarms:

- Line Entry Offline Alarm - Indicates the ACU cannot communicate with the line entry module over the serial bus.
- ACU Offline Alarm - Indicates the ACU cannot communicate with its own I/O processor over the serial bus. Probably means that the bus is inoperative or shorted out.
- Ext. Input 1 - 4 Alarms - Indicates that one of the 4 external input alarms are active. These alarms are user configured to communicate with devices external to the repeater.
- Ext. DC Voltage Alarm - Indicates the voltage applied to this interface is out of the range specified by the user. This alarm is meant to monitor an external DC voltage supply and alarm on an out of range condition specified by the user.
- Ext. Tamper Alarm - Indicates that a tamper switch external to the repeater (storage closet door, system enclosure, base station door,…) has opened indicating an entry into a restricted area. The default alarm state is disabled.
- Primary Tamper Alarm - Indicates the repeater door has been opened.
- All RF Off Alarm - Indicates that the main power to the repeater has failed and the unit is now running on the small back up battery. All the RF modules have been disabled and there is no RF power being transmitted by the repeater.

Figure 5-39 ACU Properties Screen, Alarms Tab



5.10.4 External DC Voltage Alarm Threshold Tab

RepeaterNet can monitor an external DC voltage power source (a battery) from a range of 0 to 60 volts, in 1 volt increments. In addition to monitoring the voltage level, you can define upper and lower limits for the voltage. Exceeding these limits activates the DC voltage alarm in the ACU subsystem.

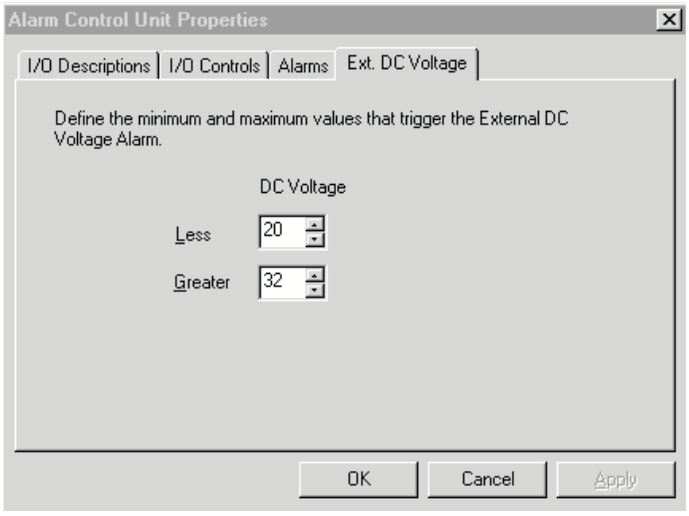
Use the Ext. DC Voltage tab to monitor the voltage of a user-supplied DC power source used to power external site equipment. An alarm triggers if the voltage fluctuates outside of a defined operating range.

To define an operating range for DC voltage:

1. Select Configuration -> Alarm Control Unit.

   The ACU Properties screen opens.
2. Click the Ext. DC Voltage tab (see Figure 5-40).
3. Define (type in or arrow-click) the normal operating range for the DC power source, in the Less Than and Greater Than data fields.
4. Click the Apply or OK button.
   - The Apply button turns the selected outputs either On or Off and keeps the ACU Properties screen open.
   - The OK button turns the selected outputs either On or Off and closes the ACU Properties screen.

Figure 5-40 ACU Properties Screen, External DC Voltage Tab



5.11 Remote Monitoring Properties

From the menu bar in the Main Control Screen, select Configuration -> Remote Monitoring.

The Remote Monitoring Properties screen opens (see Figure 5-41). This screen has four tabs:

Alarm Setting Tab - Sets the alarm severity for:

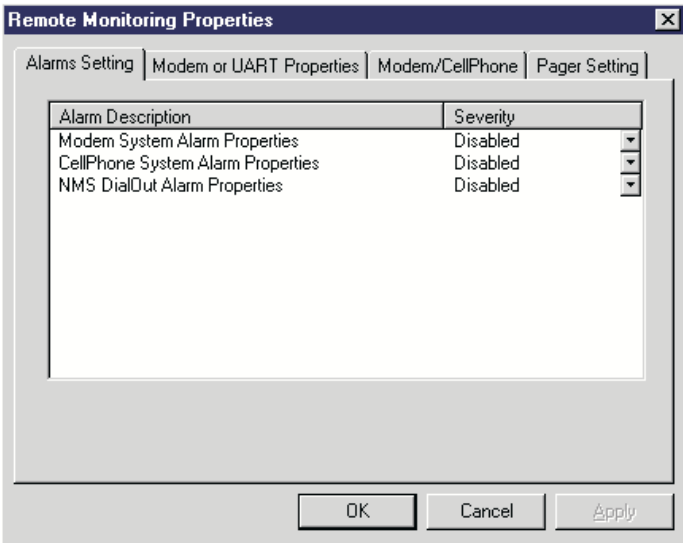
- Modem System Alarm
- Cell Phone System Alarm
- NMS Dial Out Alarm

Modem or UART Properties Tab - Defines the port settings for the internal modem or UART.

Modem/Cell Phone Properties Tab - Defines the type of remote access for the Repeater.

Pager Setting Tab - Configures a pager, which is notified when an alarm (of a specified severity level) occurs.

Figure 5-41 Modem Properties Screen



5.11.1 Alarm Setting Tab

Use the Alarms tab to redefine an alarm severity for the repeater's Remote Monitoring system (see Figure 5-41).

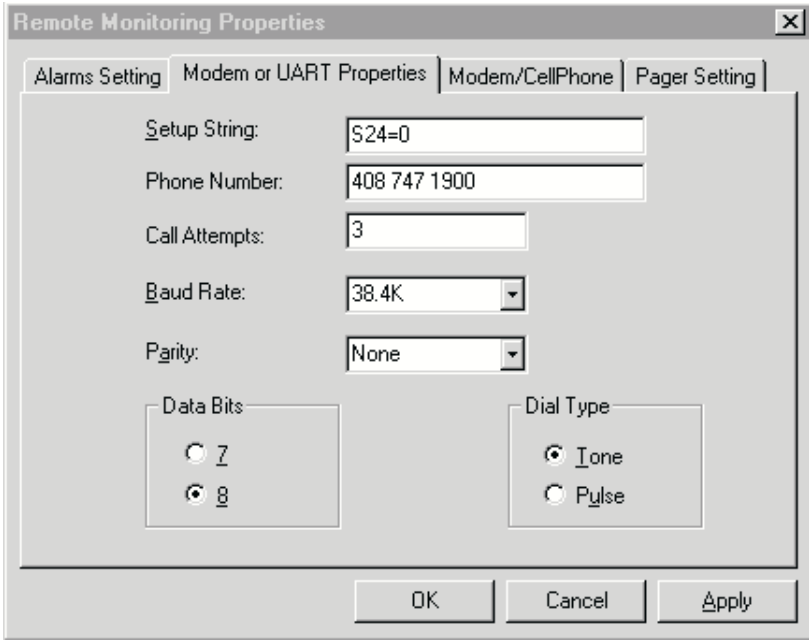
- Modem System Alarm - Indicates that the ACU cannot communicate with or configure the attached modem. This alarm is only active if the repeater has been provisioned with a modem.
- CellPhone System Alarm - Indicates the ACU cannot communicate with or configure the attached cell phone. This alarm is only active if the repeater has been provisioned with a cell phone.
- NMS DialOut alarm - Indicates that the ACU has been unable to dial out an alarm to the Network Management system. This alarm is only active if the repeater has been provisioned with a monitoring kit and has had the NMS dial out options configured.

1. Click the down-arrow next to an Alarm field to select a new alarm severity:
2. Click the Apply or OK button.
   - The Apply button changes the alarm severity and keeps the Modem Properties screen open.
   - The OK button changes the alarm severity and closes the Modem Properties screen.

5.11.2 Modem Properties Tab

To define proper settings for the repeater's internal modem or UART, use the Modem Properties tab (see Figure 5-42).

Figure 5-42 Remote Monitoring Properties Screen



NOTE: The Craft software uses the values for Setup String, Phone Number, and Call Attempts, only if you are using the RepeaterNet Network Management System. If you do not have an NMS, skip to Section 5.11.4, “Pager Setting Tab” on page 5-57.

To define modem properties, use the following procedure:

1. Select Remote Monitoring Properties from the Configuration menu in the Main Control Screen.

   The Remote Monitoring Properties screen opens (see Figure 5-42).

2. Click the Modem Properties tab.

   If you are using RepeaterNet NMS, verify the Setup String, Phone Number and Call Attempts.

NOTE: Use the Setup String defaults.

- Setup String configures a modem or UART and is automatically set when a remote monitoring device is chosen.
- The Phone Number is the phone number of a remote computer that the repeater calls.
- Call Attempts defines the number of calls the repeater attempts when reporting an alarm.

NOTE: A "Call Attempts" value of zero (0) disables calling.

3. Set the Baud Rate for the modem. (Leave at default.)

   The Baud Rate is the communication speed between the modem and the cell phone. This speed must be greater than 2400. The modem automatically adjusts the Baud Rate downward, when necessary.
4. Verify Parity is None.
5. Verify Data Bits is 8.
6. Verify Dial Type is Tone.
7. Click the Apply or OK button.
   - The Apply button sets the modem properties and keeps the Remote Monitoring Properties screen open.
   - The OK button sets the modem properties and closes the Remote Monitoring Properties screen.

5.11.3 Modem/Cell Phone Properties Tab

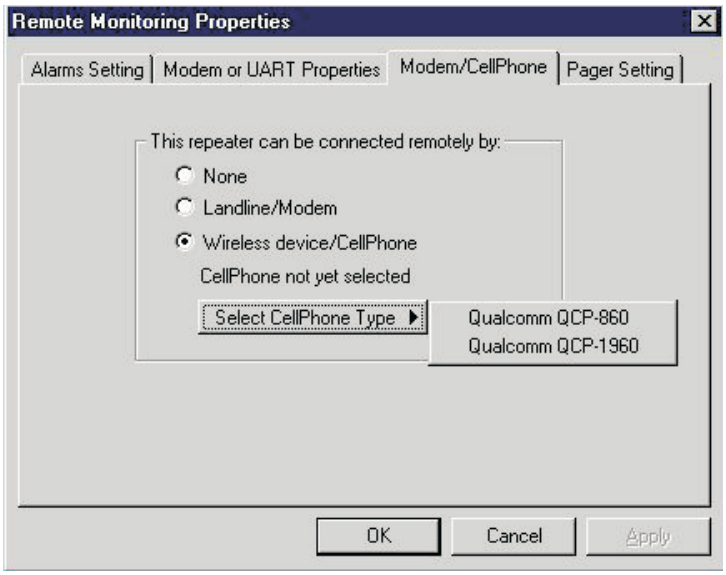
Modem/Cell phone properties define the type of device to be used for remote monitoring. Repeaters may be monitored via:

- Landline
- CDMA phone

Select the radio button which matches the type of remote monitoring device attached to the repeater.

- None - No remote monitoring capability
- Landline/modem - Hardwire Landline (POTS)
- Wireless Device - CDMA phone

Figure 5-43 Remote Properties Screen



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5.11.4 Pager Setting Tab

The Pager Setting tab allows the Repeater to dial a pager when an alarm occurs. It also assigns a specified minimum severity level to the alarm. Table 5-3 describes the Alarm Severity settings.

NOTE: Use the most basic service for the pager.

RepeaterNet generates a page if the summary alarm severity is greater than or equal to the selected Minimum Severity setting. The page format consists of the repeater number, followed by the severity level. For example:

1920-2

where 1920 is the repeater number and 2 is the severity level of the alarm.

If RepeaterNet detects a change in the current alarm severity, it does the following:

- If you set the Minimum Severity to Major, the RepeaterNet software generates a page with a severity of 2.
- If the RepeaterNet software detects a Critical alarm, it generates a new page with a severity of 3.
- If you clear the Major alarm, but the Critical alarm remains, the RepeaterNet software generates a new page with a severity level of 1, indicating that the Critical alarm remains.
- If you then clear the Critical alarm, the RepeaterNet software generates a page with a severity of 0.
- If the RepeaterNet software detects a Minor or Event alarm, it does not generate a page.

NOTE: Repeater pager function dials a specified number. When the remote connection answers it goes off hook. The repeater outputs the alarm and disconnects. It is a one-way communication.

Figure 5-44 Remote Monitoring Properties, Pager Settings

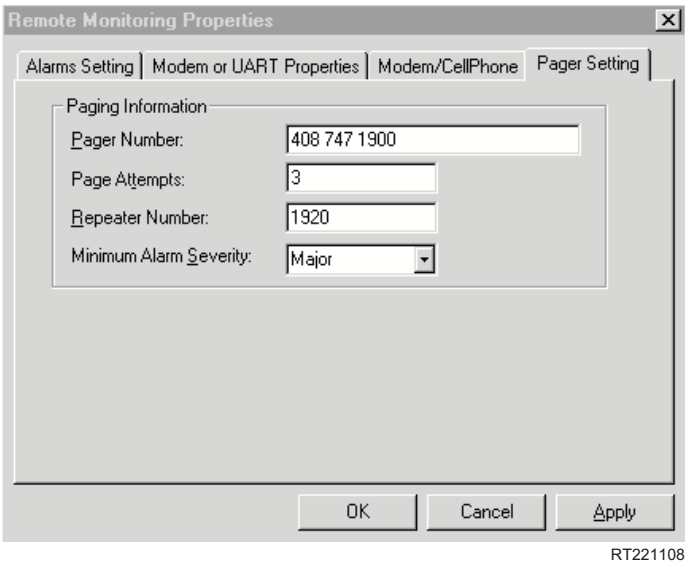


Table 5-3 Alarm Severity Numbers

Alarm Type	Severity Number
No Alarms	0
Critical Alarm	1
Major Alarm	2
Critical + Major	3
Minor Alarm	4
Critical + Minor	5
Major + Minor	6
Critical + Major + Minor	7

Use the following procedure to set a pager.

1. Click on the Pager Setting tab of the Remote Monitoring Properties screen.
2. Enter the Pager Number.

   The Pager Number is the phone number the repeater will dial. This phone number must include the networking access number (example 9), 1 and the area code (if needed).

Normally, several commas must follow the phone number. Each comma generates a delay of one second. Generally, a pager company requires about three seconds to pick up the line, and allows a maximum of five seconds before they drop the connection.

A good delay setting is five seconds - that is, add five commas. For example:

9 1 408 555-1212,,,,,

NOTE: RepeaterNet ignores any characters used for clarity, such as spaces, dashes, and parentheses.

3. Enter the number of times RepeaterNet should attempt to dial the pager number (Page Attempts). The repeater will page the number of times specified.

Example: If attempts is set to one, the repeater will page once, if set to three, then three attempts will be made.

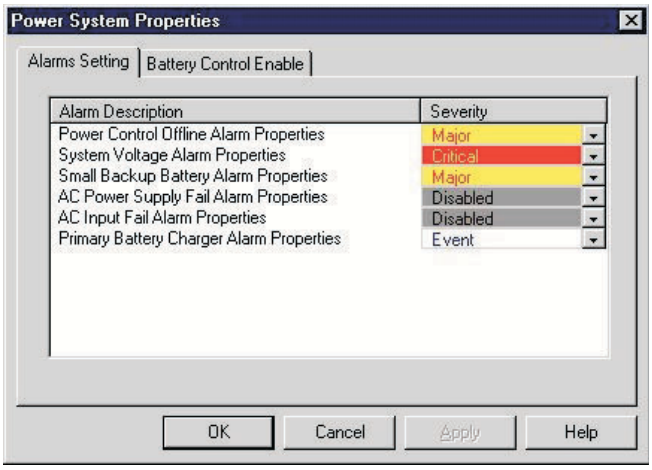
NOTE: A value of zero (0) in this field disables paging.

5.12 Power System Properties

From the Configuration menu in the Main Control screen, select Power System.

The Power System Properties screen opens (see Figure 5-45). This screen provides access to initial configuration settings for the power subsystem.

Figure 5-45 Power System Properties Screen, Alarm Setting



Use the Alarm Setting tab to redefine alarm severity for the power systems.

The Alarm Setting tab sets the alarm severity for the following alarms:

Power Control Offline Alarm - The ACU cannot communicate with the power control module.

System Voltage Alarm - The internal system voltage of the repeater is out of it's specified range.

NOTE: The internal battery does not provide power for RF components. The repeater cannot provide RF coverage during a power failure without a Back-up Power System (BUPS).

Small Backup Battery Alarm - Indicates the small backup battery (located on the door of the repeater) has failed the load test and needs to be replaced.

Power Supply AC Fail Alarm - The AC/DC converter is no longer providing DC current. Disable this alarm in DC power systems.

Power Supply AC Input Fail Alarm - The input AC voltage is too low (or off). Disable this alarm in DC powered systems.

Primary Battery Charge Alarm - The internal BUPS cannot charge the large external batteries. Disable this alarm if the Primary Battery Charger option is not installed.

1. Click the down-arrow next to an Alarm field to select a new alarm severity:
2. Click the Apply or OK button.
   - The Apply button changes the alarm severity setting and keeps the Power System Properties screen open.
   - The OK button changes the alarm severity setting and closes the Power System Properties screen.

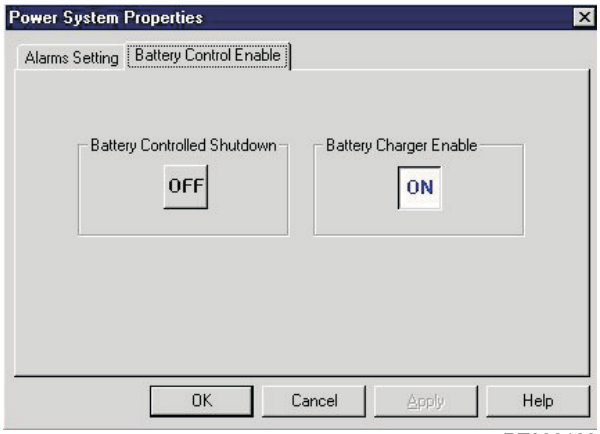
Use the Battery Alarm Control Enable Tab to turn on or off the battery backup features.

1. The battery controlled shutdown affects how the repeater turns off due to a power failure.

   When turned on, the repeater will use the small backup battery to power the ACU and remote monitoring kit during a power failure. This is the normal setting for the repeater.

   When turned off, the battery will not be discharged. This position is intended for use while the repeater is being stored and not to be used for normal operations.

Figure 5-46 Power System Properties Screen, Battery Control Enable



2. Battery Charge Enable - The button turns on and off the primary battery charger function for the externally mounted batteries.

5.13 Back-up Power System (BUPS) Properties

The BUPS Properties screen provides the configuration settings of alarms for the optional Back-up Power Supply (BUPS), which is external to the repeater.

1. From the menu bar in the Main Control screen, select Configuration -> BUPS.

   The BUPS Properties screen opens (see Figure 5-47).
2. Use the Alarm Setting tab to redefine an alarm severity for the back-up power systems.

   The Alarm Setting tab sets the alarm severity for the following alarms:

Ext. BUPS AC (Mains) Fail Alarm - Indicates that the input power to the BUPS has failed. Depending on which BUPS model is installed at the repeater site, the BUPS will then provide 40 or 80 amp-hours of backup power for the repeater, before shutdown. The AC source powers the charger.

Ext. BUPS Low (Float) Battery Alarm Properties - Indicates that the battery voltage for the BUPS is below operating tolerances, and the BUPS cannot power the repeater.

Ext. BUPS High (Float) Battery Alarm Properties - Indicates that the battery voltage of the BUPS is above operating tolerances, and the BUPS cannot power the repeater.

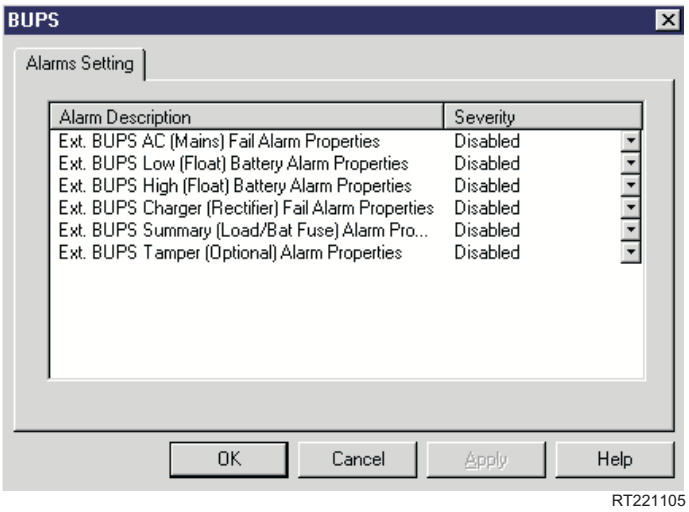
Ext. BUPS Charger (Rectifier) Fail Alarm - Indicates that the internal charger of the BUPS has failed, and the BUPS is unable to recharge its batteries.

Ext. BUPS Summary (Load/Battery) Alarm - Indicates that one or more of the BUPS alarms have triggered.

Ext. BUPS Tamper (Optional) Alarm - Indicates that the door of the BUPS is open. (Not currently used.)

3. Click the down-arrow next to an Alarm field to select a new alarm severity:
4. Click the Apply or OK button.
   - The Apply button changes the alarm severity setting and keeps the BUPS Properties screen open.
   - The OK button changes the alarm severity setting and closes the BUPS Properties screen.

Figure 5-47 BUPS Properties Screen



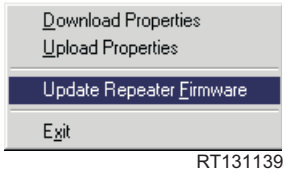
5.14 RepeaterNet Menu Commands

This section describes commands that you can run from the menu bar in the RepeaterNet Main Control screen.

5.14.1 File Menu - Craft

From the Main Control screen, open the File menu. Figure 5-48 shows the RepeaterNet commands in this menu.

Figure 5-48 Craft, File Menu



Download Properties

Use the Download Properties command to download a previously saved configuration file or a master configuration file used on several repeaters in a network:

- Restore repeater configuration settings. Restoring overwrites existing configuration settings. Use this option if you previously used the Upload Properties command to store repeater configuration settings.

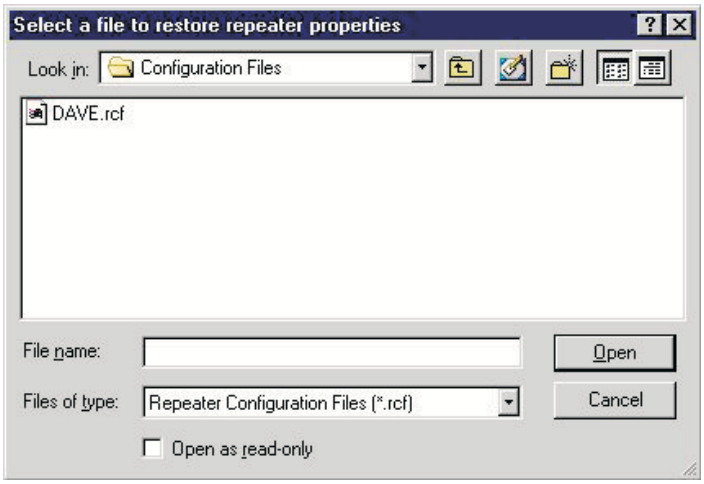
Use the following procedure to download settings to a repeater, from a repeater configuration file.

1. From the Craft Main Control File menu, select Download Properties.
2. Select the appropriate file to download to the repeater. (See Figure 5-49).

   Select open.
3. Click on the Open button to proceed with the download.

   The writing properties to repeater dialog box will open. Progress bar indicates status of download. When the download is complete, a confirmation message box displays.

Figure 5-49 Downloading Repeater Configuration Files



Upload Properties

RepeaterNet stores system settings, such as alarm severities, in a repeater configuration (.rcf) file. You can upload all settings from one repeater, and download these settings to additional repeaters in a network. You also can use existing configuration files to configure a replacement unit.

To upload the configuration from repeater, use the Upload Properties command. You can then use the Download Properties command to copy the configuration to individual repeaters in the CDMA network.

Use the following procedure to upload system settings, and to create repeater configuration files.

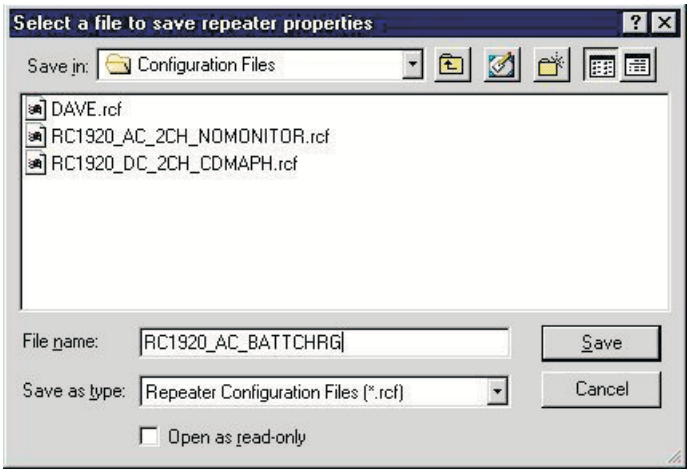
1. Select File -> Upload Properties.
2. Select a File to Save Repeater Properties To dialog box opens (see Figure 5-50).
3. Enter a name for the file without a file extension.

   Craft automatically adds a .rcf extension to the file name; for example:

   Filename.rcf
4. Click Save to initiate the upload.

   When the upload is complete, a message box displays.
5. Click the OK button.
6. Save a copy of the repeater configuration file onto a floppy disk for safe keeping.

Figure 5-50 Saving Repeater Properties to a File



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Update Repeater Firmware

Use the Update Repeater Firmware command to install a firmware upgrade.

Firmware updates include:

- A detailed description of the update
- A CD containing the firmware update
- Installation instructions

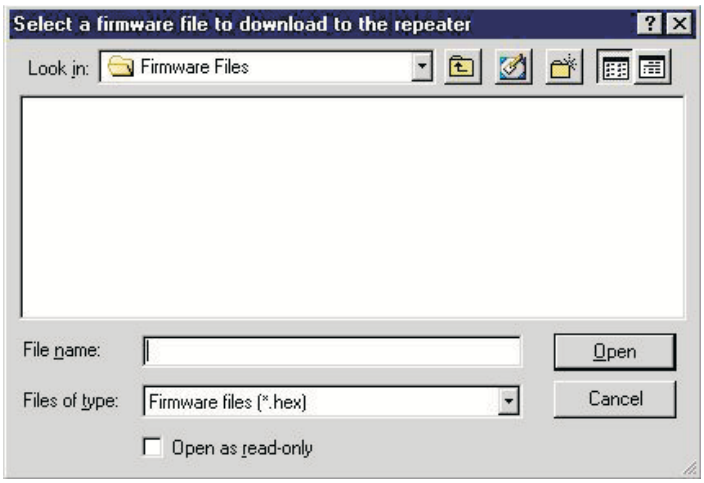
Direct any questions concerning the firmware upgrade to the Repeater Technologies Customer Service Department.

To install a firmware upgrade:

1. Read the documentation provided with the firmware upgrade.
2. Connect to the repeater to be upgraded.
3. Insert the upgrade CD into the computer's CD-rom drive.
4. From the menu bar in the Main Control screen, select File -> Update Repeater Firmware.

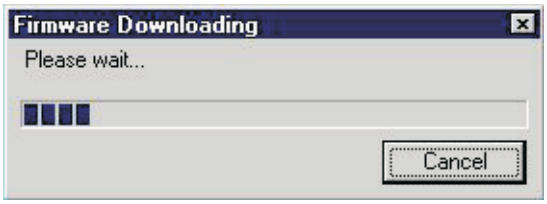
   A file selection screen displays (see Figure 5-51).

Figure 5-51 Selecting File Names for Saving Firmware Updates



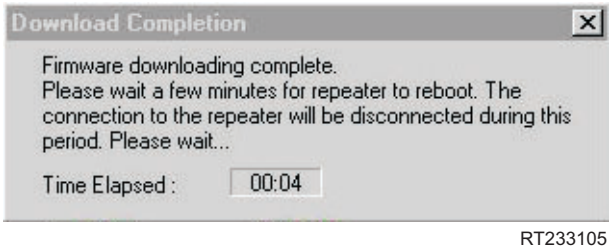
5. Select the new firmware file and click the open button.
6. There will be displayed a status bar that indicates how much time is left for the upgrade. (Figure 5-52)

Figure 5-52 Firmware Download Window



7. When the firmware upgrade is complete the repeater will reboot. Craft will display Figure 5-53.

Figure 5-53 Download Completion Window



8. When all is complete Craft will display the dialog box stating that the upgrade is completed. Click okay.

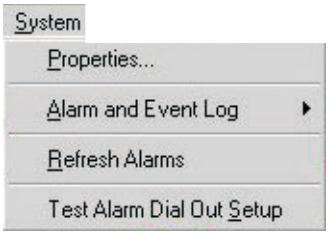
Exit

The Exit command ends an active session in the RepeaterNet software.

5.14.2 System Menu - Craft

This section describes commands in the System menu, as shown in Figure 5-54.

Figure 5-54 Craft, System Menu Pull-down Menu



Properties

Select Properties from the System menu.

The System Properties screen opens.

System Tab

The System tab includes data fields for storing site-specific information (see Figure 5-55):

- The system name (name of the repeater)
- Brief site information (such as network name, or a city location)
- The repeater phone number, if the repeater has a modem option
- The system time and date

Entering summary data (on the System tab) is optional, but RTI recommends entering this data.

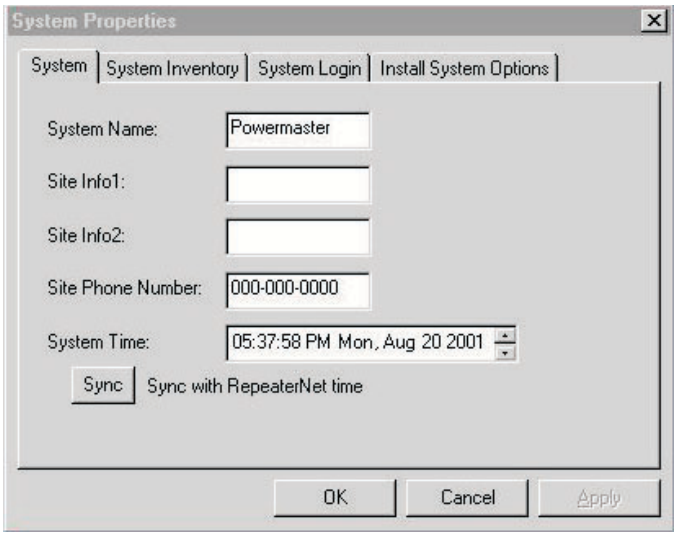
To record system data:

1. Type the required information in each data field:
   - System (Repeater) Name - up to 12 characters
   - During automatic reporting, the repeater name displays in the title bar of the Main Control screen, identifying the selected repeater.
   - Site Information, Field 1 - up to 14 characters. Typically, identifies the cell phone network (optional)
   - Site Information, Field 2 - up to 14 characters. Typically, identifies the repeater location (optional).
   - Site Phone Number - phone number of the repeater, up to 12 characters (optional)

- System Time - can be updated manually by clicking on the up/down buttons and the field entries (hour, minute, second, am/pm, month, day, and year), or by clicking on the sync button synchronized with the computer's time.

2. Click the Apply or OK button.
   - The Apply button sets the system properties and keeps the System Properties screen open.
   - The OK button sets the system properties and closes the System Properties screen.

Figure 5-55 System Properties Screen, System Tab



System Inventory Tab

The System Inventory tab (see Figure 5-56) displays information about the repeater to which the PC or laptop is connected.

After you successfully login, RepeaterNet reads this information directly from the repeater.

NOTE: You cannot edit data in any field of this tab.

Table 5-4 summarizes the data displayed in the information-only fields of this tab.

Figure 5-56 System Properties Screen, System Inventory Tab

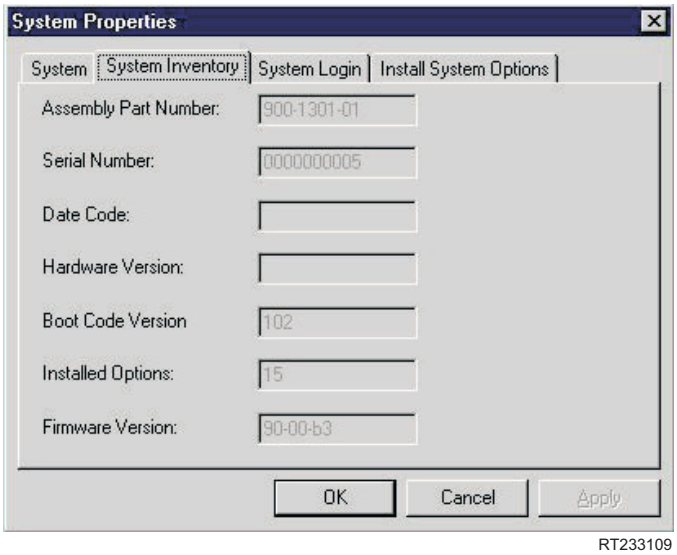


Table 5-4 Description of System Inventory Fields

Field Name	Description
Assembly Part Number	The part number of the repeater (for example: 900-1300-01)
Serial Number	The 9-digit serial number of the repeater
Date Code	The date when the repeater was built
Hardware Version	The repeater hardware revision (such as Rev. A)
Boot Code Version	The version number of the boot code installed in the repeater.
Installed Options	Optional internal equipment in the repeater (such as cell phone)
Firmware Version	The version number of the firmware installed in the repeater

System Login Tab

The System Login tab (see Figure 5-57) includes fields to do the following:

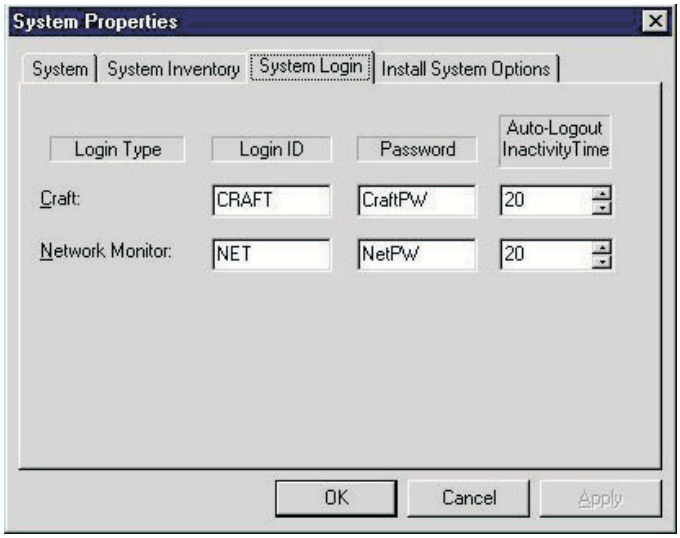
- Edit login IDs
- Edit passwords
- Configure the Auto-logout function

In the Auto-Logout Inactivity Time field, define how long RepeaterNet should wait, during a period of inactivity, before it terminates a session.

You can define a separate time interval in minutes, between 1 and 60, for each access level. If you enter a zero in a time field, this feature becomes disabled.

NOTE: When the repeater is part of a network, the time field must be zero(0).

Figure 5-57 System Properties Screen, System Login Tab



To change a login ID or password:

1. Login to the repeater (as an administrator).
2. Select Properties from the System menu.
3. Click the System Login tab.
4. Type the new login ID or password into the appropriate fields.

NOTE: The login ID and the password must each consist of six or fewer characters.

5. Write down the login Ids and passwords, and secure them in a safe place.
6. Click the Apply or OK button to set the new information.
   - The Apply button sets the login information and keeps the System Properties screen open.
   - The OK button sets the login information and closes the System Properties screen.
7. Notify affected operators about the ID and password changes.

NOTE: When the repeater is networked, only the network monitor needs to reside in the NMS Database.

Initial System Install

The Install Systems Option Tab allows a user to enable optional features to the repeater given the proper options password.

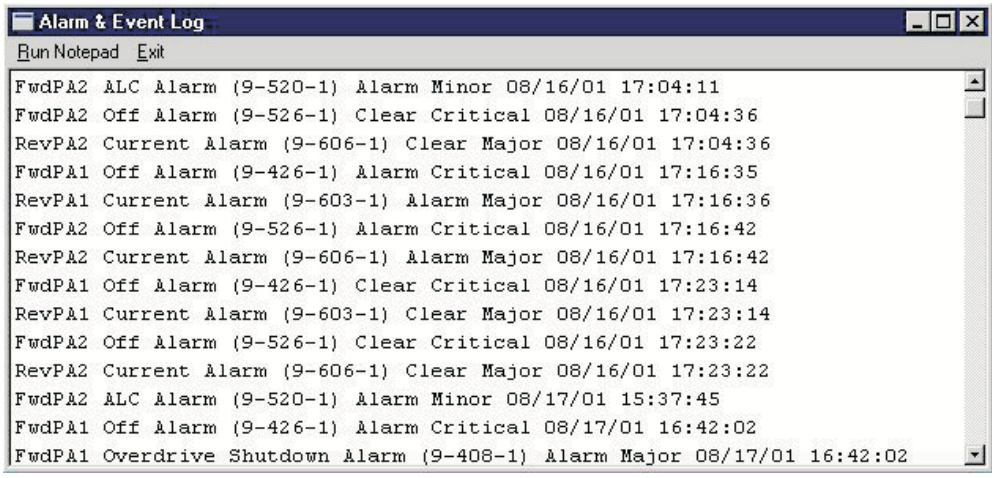
- Secondary Channel - Enables the second channel in the repeater
- Diversity - Enables the diversity option
- Battery Charger - Enables the internal BUPS feature to charge external batteries
- Monitoring Kit - Enables the remote monitoring (cell phone, landline) options.

NOTE: Without the proper passwords a user will not be able to install these options.

Alarm and Event Log

Open the Alarm and Event Log from the System menu (Figure 5-58), to view the alarm and event history. This log dynamically updates during viewing. Use the clear option to delete all alarm entries in the log.

Figure 5-58 Alarm and Event Log



Line entries in the Alarm and Event Log are organized as follows:

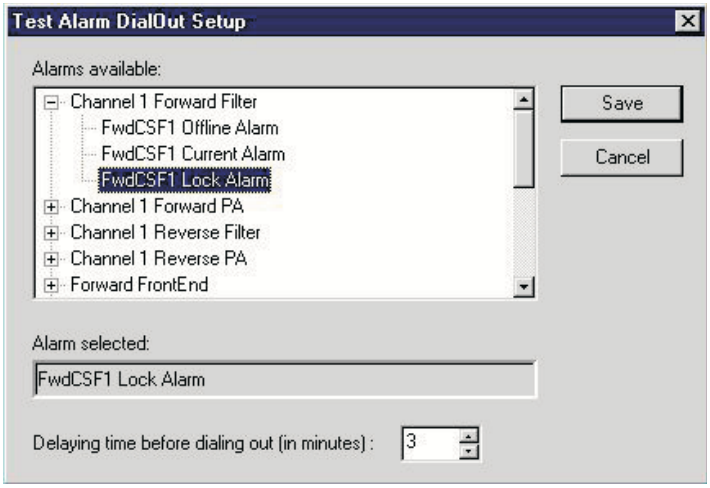
1. Subsystem affected by an alarm or event
2. Alarm severity
3. Date and time stamp

You can use Notepad to print or save Alarm and Event Log entries.

Refresh Alarms - By clicking on the refresh Alarms pull-down menu Craft will obtain the latest state of the alarms in the repeater.

Test Alarm Dialout Setup - By clicking on the Test Alarm Dialout Setup menu item (Figure 5-59) appears. This window allows a user to create an artificial alarm and have this alarm reported to the NMS. This is a useful tool in verifying NMS (Network Management System) dialout capabilities.

Figure 5-59 Test Alarm DialOut Setup



5.14.3 Options Menu - Craft

Figure 5-60 shows the RepeaterNet commands in the Options menu.

Figure 5-60 Craft, Options Menu

Color Independent Icons

Color Independent Icons are special graphic indicators, designed to assist operators who are unable to distinguish colors. As part of the alarm reporting system, Color Independent Icons display on the Main Control screen for a Critical, Major, or Minor alarm.

By default, the Color Independent Icons feature is Off.

From the Main Control screen menu bar, select Options -> Color Independent Icons, to turn On this feature. Table 5-5 describes each of the color-independent icons.

Table 5-5 Description of Color Independent Icons

Alarm Type	Color Independent icon	Symbol
Critical	X through the subsystem icon	X
Major	Back slash (\) through the subsystem icon.	\
Minor	Dotted-line back slash through subsystem icon	\ (Dotted)

Alarm Sounds

The Alarm Sounds feature allows an intermittent audible alarm to activate, when a subsystem triggers an alarm.

By default, the Alarm Sounds feature is Off.

From the Main Control screen menu bar, select Options -> Alarm Sounds, to turn On this feature.

To silence an audible alarm, either click a subsystem icon (to open the Status screen), or clear the alarm.

Hold Connection

The hold connection option causes Craft to re-dial the repeater 5 times if the phone line connection is lost.

5.14.4 Help Menu - Craft

RepeaterNet on-line help provides quick access to information related to the operation of the repeater. Figure 5-61 shows the Help menu.

- To open RepeaterNet Help, select Help -> Help Topics.
- To learn about the version of Craft, installed, select About… from the Help menu of any program window.

Figure 5-61 Craft, Help Menu

Figure 5-62 shows a typical about screen. Clicking on okay makes the screen go away.

Figure 5-62 About Screen

Connecting External Alarms and Relays

6

6.0 Overview

This chapter describes how to connect external alarms and relays.

- Use the connector labeled UPS to wire alarms from the Back-Up Power Supply (BUPS) to the repeater.
- Use the connector labeled IN/OUT for digital inputs to custom external alarms, or for digital outputs to remotely-controlled devices at the repeater site.
- The connector labeled USER RELAY provides two independently-controlled dry contact relays, each with standard 1C contact sets. RepeaterNet software can use these relays to control devices at the repeater site.
- The connector labeled ALARM RELAY provides three independent relays, each with contact sets in standard 1C form (SPDT). Each relay is driven by specific summary alarms that the repeater generates. For example, one relay might activate whenever the repeater generates a critical alarm. Similarly, a second relay might activate whenever the repeater generates a major alarm, and a third might activate on a minor alarm

Table 6-1 lists all of the input and output connections, pin numbers, and functions, for all repeater's external alarm connectors.

NOTE: The ground reference for IN/OUT and BUPS inputs and/or outputs is the chassis ground terminal.

Table 6-1 Input/Output Pin Descriptions

Connector	Pin #	Signal Name	Function
UPS	1	External Tamper Input	Secondary Door Open
	2	BUPS Tamper Input	External Input Alarm
	3	BUPS AC Fail Input	External Input Alarm
	4	BUPS Low Battery Voltage Input	External Input Alarm
	5	BUPS High Battery Voltage Input	External Input Alarm
	6	BUPS Charger Failure Input	External Input Alarm
	7	BUPS Summary	External Input Alarm
	8	GND	GND
In/Out	1	Digital Output 1 Low Active	
	2	Digital Output 2 Low Active	
	3	DC Voltage Input (Ext)	0-60 V Input Voltage
	4	Digital Input 1	External Input Alarm
	5	Digital Input 2	External Input Alarm
	6	Digital Input 3	External Input Alarm
	7	Digital Input 4	External Input Alarm
User Relay	1	User 1 NO	Normally Open
	2	User 1 NC	Normally Closed
	3	User 1 COM	Common
	4	User 2 NO	Normally Open
	5	User 2 NC	Normally Closed
	6	User 2 COM	Common
Alarm Relay	1	Critical Relay NO	Normally Open
	2	Critical Relay NC	Normally Closed
	3	Critical Relay COM	Common
	4	Major Relay NO	Normally Open
	5	Major Relay NC	Normally Closed
	6	Major Relay COM	Common
	7	Minor Relay NO	Normally Open
	8	Minor Relay NC	Normally Closed
	9	Minor Relay COM	Common

6.1 Back-up Power System (BUPS) Monitoring

Refer to section 3.3 for information on connecting external alarms from a BUPS.

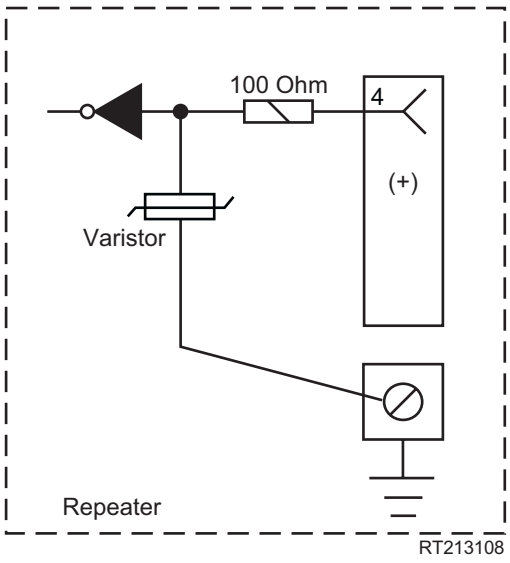
6.2 User Controlled Inputs and Outputs

6.2.1 Digital Inputs

You can use the four digital inputs to monitor equipment or events that are external to the repeater. You can control and process these external alarms through the RepeaterNet software.

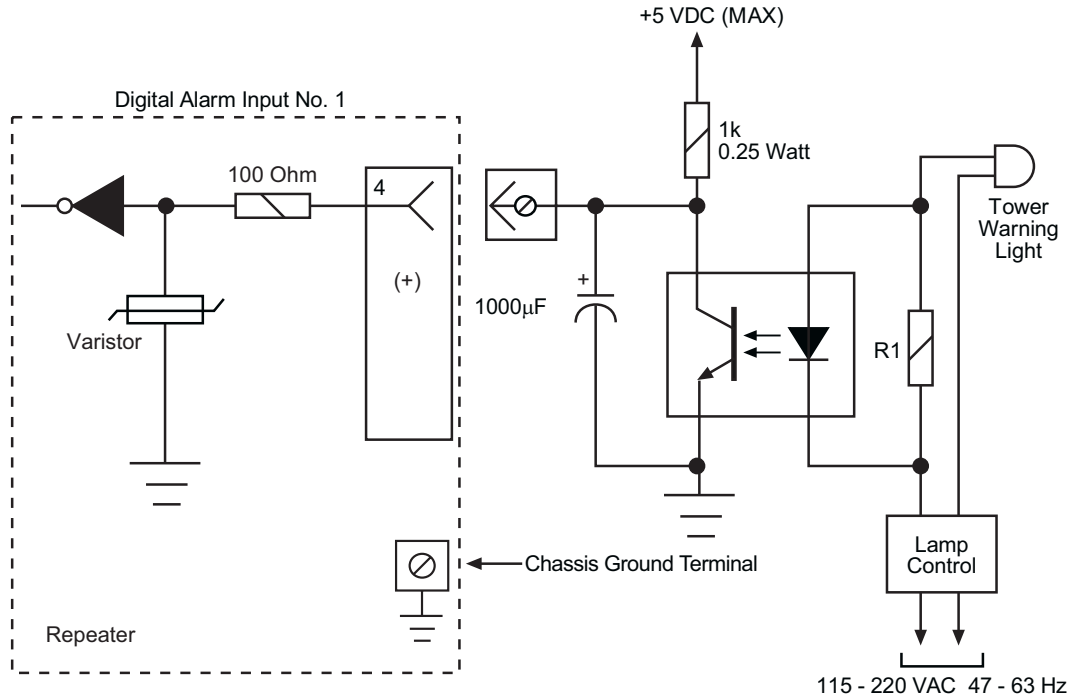
Figure 6-1 shows the basic circuit for the external alarm inputs. The digital inputs are accessible through the IN/OUT connector on the Line Entry Module.

Figure 6-1 Digital Input Circuit - Typical



One of the most common external alarms, at a base station or a repeater site, is the failure of a tower hazard warning light. This light, used for warning aircraft of the existence of a tower, must be replaced immediately if it fails. Figure 6-2 shows how the external digital alarm inputs can monitor a tower light.

Figure 6-2 Monitoring a Tower Hazard Light



VALUE FOR R1 (Ohms)				LAMP SIZE
115 VAC		220 VAC		(WATTS)
3.9	2W	8.2	2W	50
2.2	5W	4.7	5W	100
1.5	5W	3.3	5W	150
1.2	10W	2.7	5W	200
1.0	10W	1.8	10W	250
0.5	20W	1.0	10W	500

Do not exceed the following specifications when connecting digital inputs:

Input Voltage for Logic 0	<0.3 Volts
Input Voltage for Logic 1	>4.0 Volts
Maximum Input Voltage	5.0 Volts
Minimum Input Voltage	0.0 Volts
Maximum Input Current	8 mA

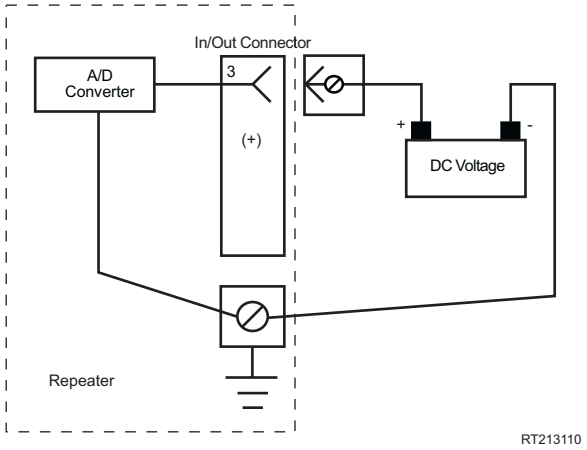
6.2.2 Analog Input

The repeater has one analog input, to monitor an external DC voltage. The monitoring range is from 0 to 60 volts, with a resolution of 250 mV.

1. Connect the positive lead to pin 3 of the In/Out connector as shown in Figure 6-3.
2. Connect the negative lead to the repeater's chassis-ground terminal.

CAUTION: Do not allow any input to exceed the 60-Volt limit.

Figure 6-3 Typical DC Monitoring



6.2.3 Digital Outputs

The repeater includes two digital outputs, each with one lead for an open-collector-transister. When the RepeaterNet software sets one of these digital output switches to On, the repeater sends a voltage of zero with 20 mA current.

VOL	0.6 V maximum
lOL	20 mA
VOH	4.20 V minimum
lOH	-3 mA

Figure 6-4 depicts the output circuitry of each user-controlled digital output.

Figure 6-4 User-Controlled Digital Output - Typical

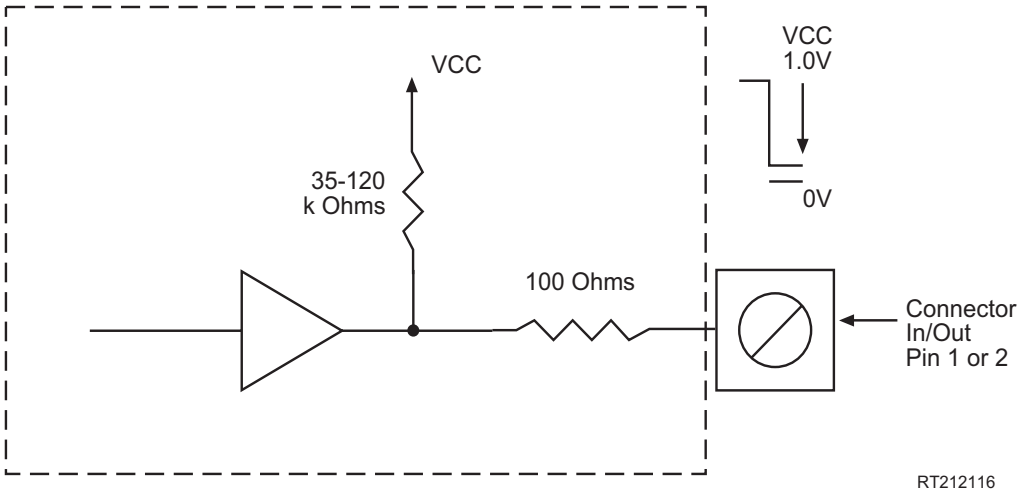
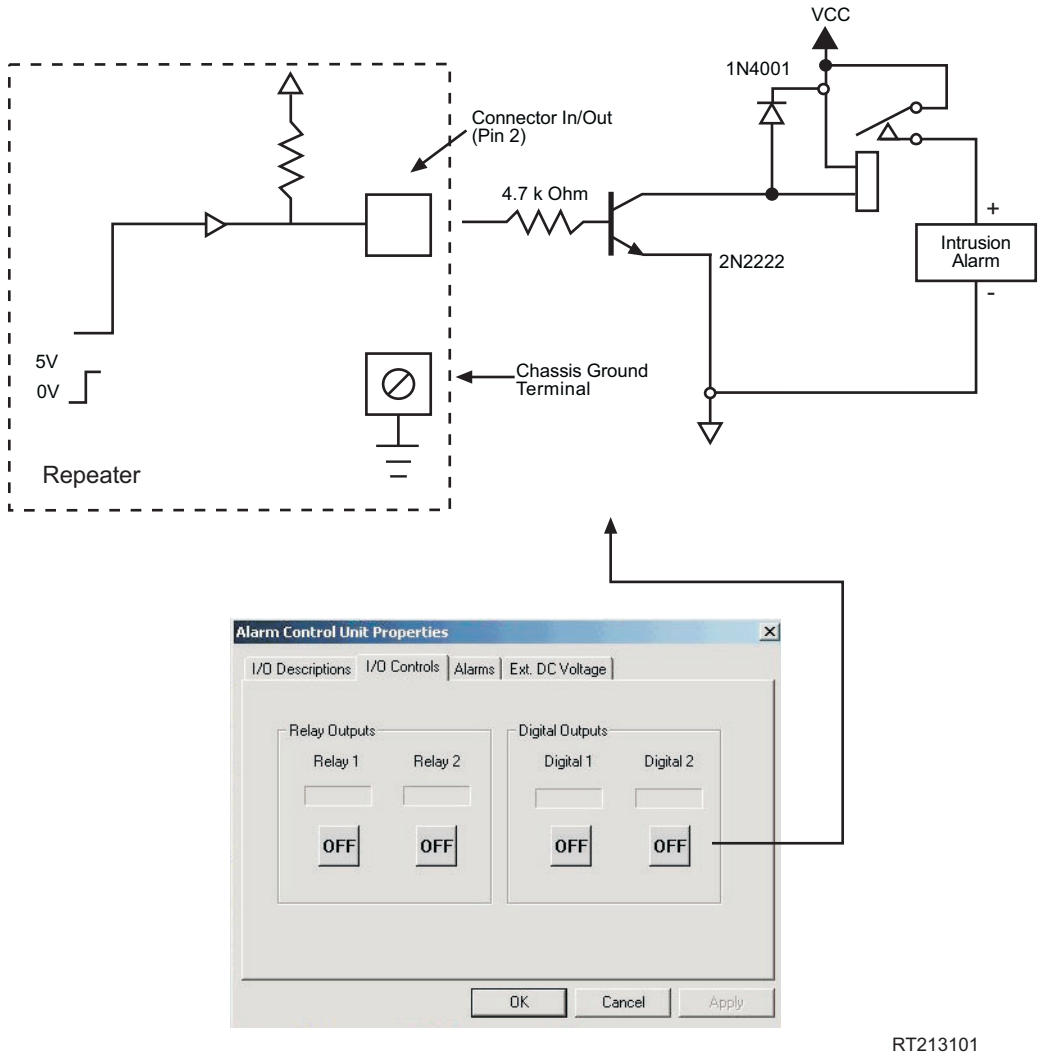


Figure 6-5 shows a typical application for a digital output.

Refer to the Alarm Control Status Screen in Chapter 5, Configuring the Repeater, for instructions about activating digital outputs.

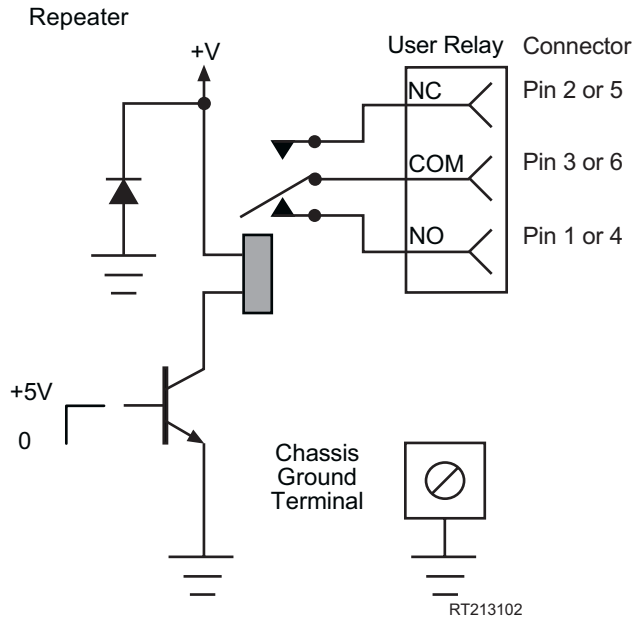
Figure 6-5 Switching an Intrusion Alarm On and Off, Using Digital Output Number 2



6.3 User Controlled Relays

The repeater provides two user-controlled relay outputs with form C contacts (SPDT). These relays respond to user commands through the RepeaterNet or Craft software, similar to those described above for digital outputs. When the RepeaterNet software sets one of these relay switches to On, the transistor saturates, and energizes the relay. Figure 6-6 shows the relay in the energized or On state.

Figure 6-6 Typical Relay Output



The maximum switching characteristics for each of the user-controlled relays are:

Maximum current	30 VDC @ 2 Amperes or 125 VAC @ 0.5 Amps rms
Maximum switching voltage	220 VDC

Figure 6-7 shows a circuit that uses user-controlled relay output number 2 to control a lamp at the repeater site.

Figure 6-8 shows a circuit that uses user-controlled relay output number 1 to control a fan or blower at the repeater site.

Figure 6-7 Controlling a Lamp, Using Relay Output Number 2

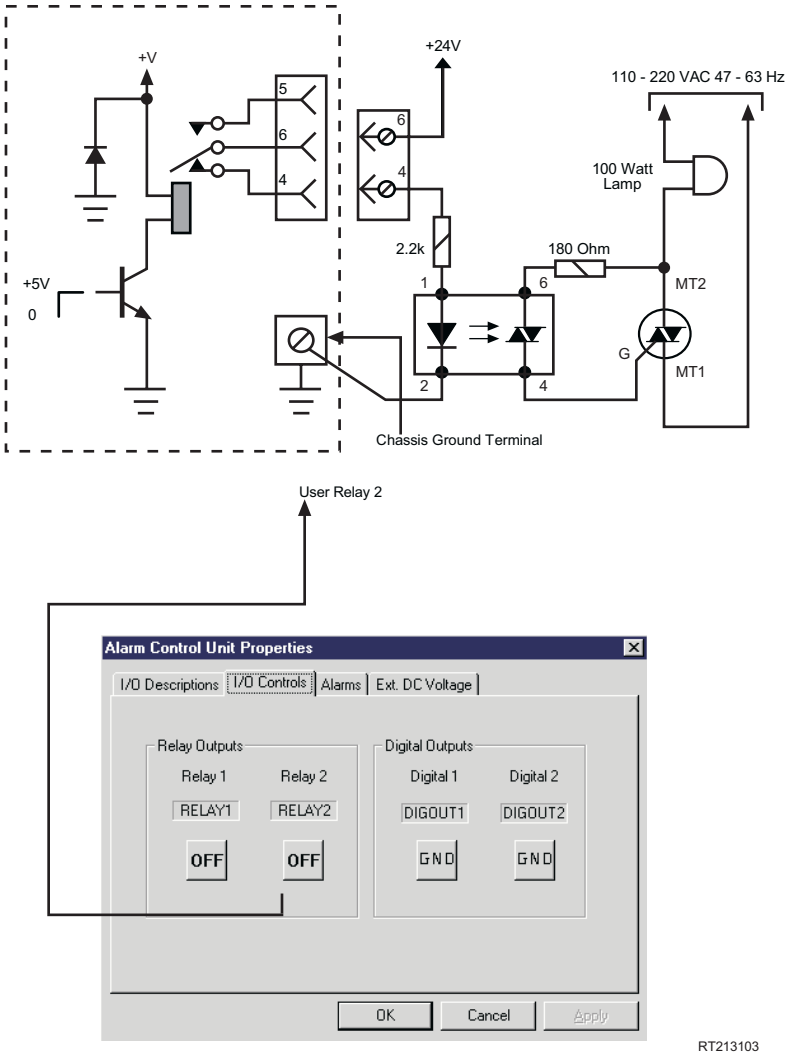
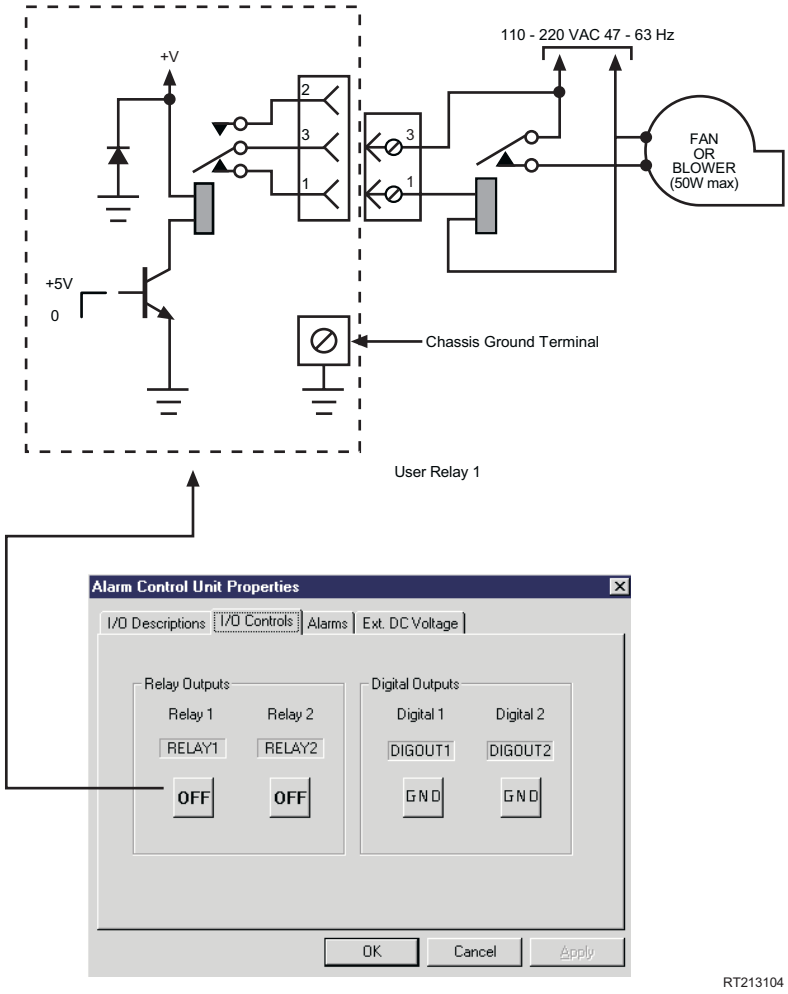


Figure 6-8 Controlling a Fan or Blower, Using Relay Output Number 1



6.4 Alarm Controlled Relays

You can use the alarm control relay contacts to activate external alarms or other equipment in the event of a repeater alarm.

Whenever the repeater generates an alarm, it also generates a summary alarm for that severity. For example, if the repeater generates a critical alarm, it also generates a critical summary alarm. The repeater generates similar summary alarms for major and minor alarms.

Each summary alarm is connected to a relay. Figure 6-9 shows the basic internal circuit. When the repeater generates an alarm, the transistor saturates and energizes the relay as shown in Figure 6-9.

Figure 6-9 Alarm Summary Relay Output - Typical

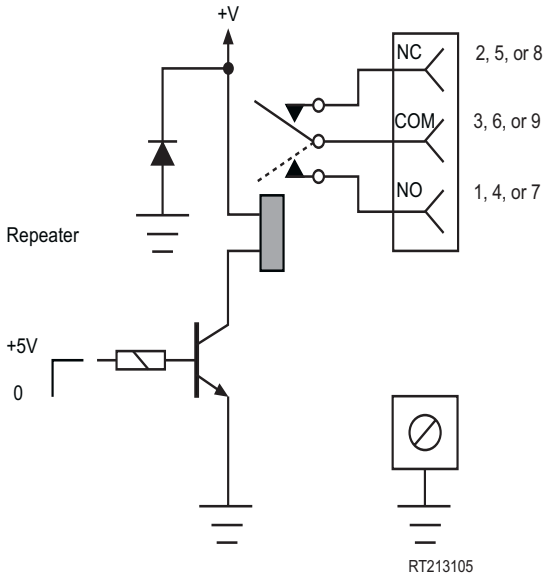


Figure 6-10 shows the critical alarm summary output relay, which is controlling an external, dual-color (green/red) LED. Normally, the relay is open, and the green LED is biased on. When an alarm occurs, the relay closes, and the LED turns red.

Figure 6-10 Critical Alarm Summary Relay, Controlling an External LED

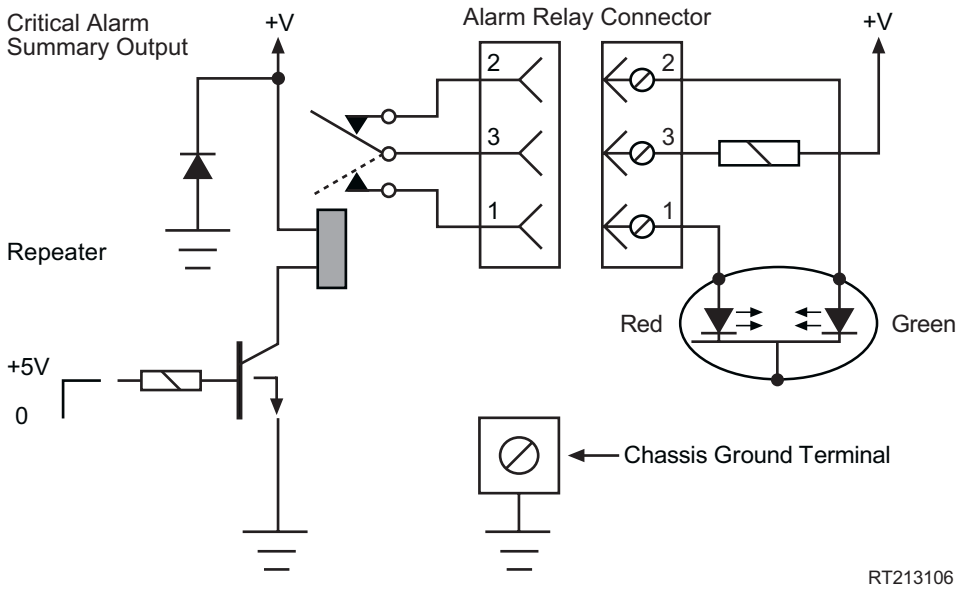
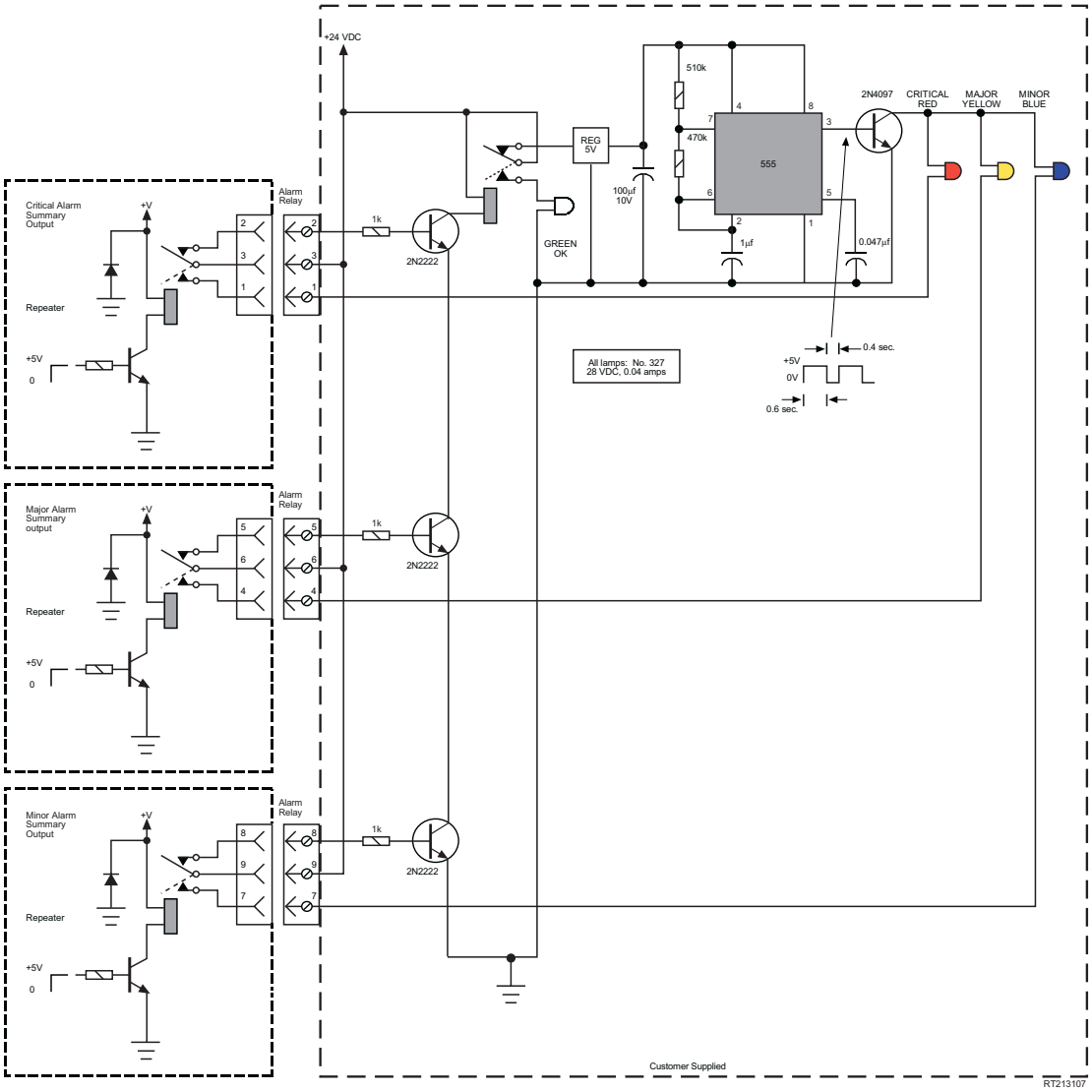


Figure 6-11 shows circuitry that connects all alarm summary relays to external lamps, through a flasher. This circuit provides an external indication of any internal alarm in the repeater.

Figure 6-11 External, Flashing Alarm Lamps



Final Testing and Optimization 7

7.0 Link Engineering Considerations

7.0.1 Ensuring Adequate Isolation for a Repeater Application

Compare the maximum forward and reverse gain settings, to the available isolation.

- If the available isolation is at least 15 dB higher than the maximum gain setting, then the repeater will operate with good stability.
- If the isolation is less than 15 dB higher than the maximum gain setting, then some oscillation might result.

For CDMA systems, pre-oscillation begins at about 15 dB margin over gain, and becomes very problematic at about 10 dB margin-over-gain. Therefore, you should strictly follow the 15 dB margin-over-gain rule.

7.1 System Timing Issues

7.1.1 Worst-case Position for Active Search Window Width

This process estimates the required width setting for the active search window, to ensure that the repeater properly covers a transition zone (between the base station and the repeater).

The typical value required for SRCH_WIN_A=8. This value is more than sufficient for most applications, where the repeater is less than three miles from the donor site, and the repeater radius is two miles or less.

For additional information regarding system timing issues, call RTI.

7.1.2 Worst-case Position for Neighbor Search Window Width

This process estimates the required width setting for the neighbor search window, to ensure that the repeater properly covers a soft hand-off zone (between the base station and the repeater).

The worst-case position is wherever the greatest differential delay exists, between the cell that the mobile uses for timing and a hand-off candidate cell.

NOTE: This relationship is symmetrical and reciprocal for neighboring cells, if those cells are candidates for the donor sector. That is, the neighbor cells also need wider search windows.

Wider search windows can search the TOA (Time Of Arrival) of the specific pilot that is associated with the donor sector (the pilot is accessible via the repeater).

The following equation calculates the differential delay:

$$\Delta(\text{Chips}) = \text{D+R+S-N(Chips)}$$

Where:

Δ(Chips) = Differential_Delay(Chips)

D = Donor_Path_Length(Chips)

R = Repeater_Delay(Chips)

S = Subscriber_Path_Length(Chips)

N = Neighbor_Path_Length(Chips)

The typical process is:

1. Determine the place where the differential delay is greatest and where a mobile is likely to be operating.
2. Calculate the differential delay.

   This worst-case differential delay determines the SRCH_WIN_N parameter setting.

The typical value required for SRCH_WIN_N (for repeater operation in the transition zone) is about $\pm$ 40 chips. This corresponds to SRCH_WIN_N = 9. This value is more than sufficient for most applications where the repeater is less than three miles from the donor site and the repeater radius is two miles or less.

7.1.3 Channel Search Window Width for Reverse Link Access

The mobile station searches the forward link TOA probability space for new pilot offsets. A similar search process occurs at the base station.

The base station modem chip (CSM) also contains a searcher. Both the access channel and the traffic channel use this searcher to determine the TOA of the mobile's energy. Because the access channel does not know how far an originating mobile is from the base station, it must search the entire TOA probability space associated with the cell's maximum radius.

For example, if the cell has a maximum radius of 20 chips, then the searcher must search the range of relative TOA, from near zero chip delay (for very close mobiles), to delays as great as 40 chips.

NOTE: The round trip delay is the important variable, because the mobile is "phase locked" to the PN sequence of the down-link (forward link) path. Also, the TOA (round-trip delay) of the base station is twice the one-way delay.

The cell radius plays a central role in determining the required width for the access-channel search window. Most CDMA network manufacturers derive all of the required search window parameters from a simple parameter, called Cell_Radius or something similar. Usually, if you set this parameter to the maximum cell radius, the Method Of Repeater Engineering (M.O.R.E.) automatically calculates and updates all corresponding parameters (such as preamble size, PROBE_RAN_N, and so on).

NOTE: You must set this parameter properly. An incorrect setting can limit the range of access to the base station via the repeater.

The setting for this parameter is simply the sum of the donor link radius, the repeater delay in miles, and the maximum repeater coverage range as shown in the following equation:

Cell_Radius(miles) =
Donor_Path_Length(miles)+[Repeater_Delay(μs)]*0.186+Repeater_Radius(miles)

If the equipment manufacturer does not provide a Cell Radius type parameter, or if you need more information on this subject, please contact the Repeater Technologies Application Engineering Group.

7.1.4 Setting Radius of Traffic Channel Search Window

The new base station must acquire the reverse traffic channel during a soft hand-off attempt. The search process is similar to the one that the access channel performs during initial system access.

The Primary Base Station (initial base station) receives the Pilot PN Phase information in the Pilot Strength Measurement Message. You can use this information to estimate the Time of Arrival (TOA) at the new base station. This can significantly reduce the acquisition time of the reverse traffic channel. Due to the dynamic nature of the mobile propagation environment, and the delay associated with hand-off processing, the search window must be wider than a single-point Time of Arrival (TOA) set. Typically, the reverse traffic channel search window centers around the estimated TOA, and its width depends on two factors:

- The accuracy of the TOA estimate.
- The maximum expected variation of the TOA during hand-off processing.

If the CDMA equipment manufacturer uses the Pilot PN Phase to estimate the TOA at the neighbor base station, then the search window width needs to be only a few tens-of-chips wide (± 20 chips). This is typically the case; however, some manufacturers might not use the Pilot PN Phase data to estimate the TOA.

If the TOA estimate is not available for the neighboring base station, then you must run a complete search of all possible Times of Arrival, just as you do during the access channel search process. In this case, the search process takes longer, and therefore the hand-off is slower. The required width of he search window, used in this process, depends on the TOA of the mobile's energy at the new base station.

The equation that calculates the TOA is similar (but not identical to) setting the neighbor search window:

TOA (Chips) = D+R+S+N(Chips)

Where:

TOA(Chips)	=	Differential_Delay(Chips)
D	=	Donor_Path_Length(Chips)
R	=	Repeater_Delay(Chips)
S	=	Subscriber_Path_Length(Chips)
N	=	Neighbor_Path_Length(Chips)

After calculating the worst-case TOA, you can set the search window width accordingly.

7.1.5 Updating an MTSO Data Base Using New Timing Parameters

After you determine all of the parameters, you can update both the Mobile Telephone Switching Office (MTSO) data base, and the repeater data base, using the proper parameters. Do not perform this update until you are ready to activate the repeater.

7.2 Drive Testing Requirements

7.2.1 Collecting Data

To ensure proper repeater operation, drive test all of the following areas:

- Repeater Coverage area
- Transition zone between the donor base station coverage area and the repeater coverage area
- Soft hand-off zones between the repeater and adjacent cell sites

For CDMA networks, RTI recommends that you accumulate data for both the forward and reverse link, at the same time. Usually, this requires invoking "call trace," or some similar function within the switch. Once invoked, the switch logs the test call by time stamp. You can later correlate this to the forward link data.

This method helps you to more-accurately analyze the link balance and identify areas of high RFER and/or high Mobile_TX parameters.

7.2.2 Collection Equipment

- The minimum equipment required for drive testing is:
- CDMA phone
- Serial data cable
- Laptop or notebook computer, running collection software
- GPS receiver

This equipment is available from a variety of sources, such as:

- Qualcomm, Incorporated
- Agilent
- Grayson
- LCC, Inc.
- Berkeley Veritronics

Analyzing the drive test results might require a change in network timing parameters, and/or adjustment of the repeater subscriber antenna. That is, you must optimize repeater, using the same methods as you use for a base station.

CDMA Overview 8

8.0 Introduction

In a CDMA (IS95) network, the dynamic RF power output of a Base Transceiver Station (BTS) depends on the number of subscribers assigned to the BTS.

The IS-95 specification, for CDMA networks, describes four different channel types, all contained within the forward channel:

- One pilot channel (measures power and performs initial synchronization)
- One sync channel (passes parameters during initial synchronization)
- 0 to 6 paging channels (passes parameters during operation)
- 0 to 62 traffic channels

The total number of channels cannot exceed 64.

Usually, a portion of the base station's total power is assigned to the pilot channel, the paging channel, and the sync channel. The traffic channels use the remaining power. For example, within an IS-95 network, the power allocations usually adhere to the following convention:

Pilot Channel Power:	15 – 20%, depending on the requirements of the specific equipment manufacturer or service provider
Paging Channel Power:	6%
Sync Channel Power:	2%

The remaining 72-77% of the BTS power is available for communications traffic channels.

For each repeater installed into a CDMA network, you must determine the received power level from the donor BTS, so that you can accurately set the repeater gain. If you do not know the received power level, or if you use an inaccurate value, then the repeater might become over driven, and it might enter into an alarm condition.

8.1 Measuring the Donor BTS Signal Strength

If the donor BTS is idle (not carrying any subscriber traffic), you can assume that the repeater is radiating only pilot, paging, and sync power. If this is the case, connect a spectrum analyzer to the bottom jumper cable of the repeater's donor antenna, and measure the BTS power. Either use a spectrum analyzer that is equipped with a *CDMA module*, or correct for the resolution bandwidth of the spectrum analyzer.

For example, a CDMA Personality Module is available for Agilent spectrum analyzers to measure CDMA power within a 1.25 MHz band. For spectrum analyzers that do not have such a module, however, the closest measurement bandwidth is 1.0 MHz, and you must correct the measurement for bandwidth.

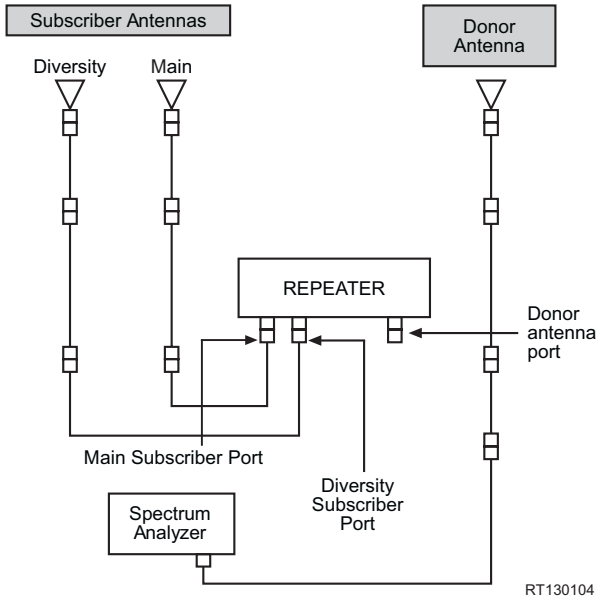
8.1.1 Measuring Donor BTS Idle Power

If the donor BTS is idle (no subscribers), then the only power that the BTS transmits is pilot, paging, and sync. If this is the case, you can use either of two measurement methods:

- Spectrum analyzer
- Pilot Scanner (CDMA)

Both methods use the same equipment configuration, as shown in Figure 8-1.

Figure 8-1 Equipment Configuration for Measuring Donor BTS Power



Measurement Using a Spectrum Analyzer

Use the following procedure with a spectrum analyzer, to measure power from the Donor BTS to the repeater.

1. Connect the spectrum analyzer to the output end of the bottom jumper cable on the repeater donor antenna, as shown in Figure 8-1.
2. Ensure that the donor BTS is idle (no subscribers), and that only the pilot, paging and sync channels are active.

NOTE: If the spectrum analyzer does not have a CDMA measurement module, skip to step 4.

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3. If the spectrum analyzer has a CDMA measurement module or capability, configure the analyzer to measure the CDMA signal. Then record the signal strength, and skip to step 5.
4. If the spectrum analyzer does not have a CDMA measurement module, proceed as follows:
   a. Configure the spectrum analyzer for a resolution bandwidth of 1.0 MHz, and for a video resolution of 30 kHz.
   b. Set Video averaging to ON.
   c. Note and record the signal strength.
   d. To correct the reading for a 1.25 MHz bandwidth, add 0.9 dB to the reading. For example, if the spectrum analyzer indicates –55 dBm, the corrected reading is -54.1 dBm (-54 dBm, for all practical purposes).
5. Move the antenna for maximum signal strength.

8.1.2 Measuring donor BTS Loaded Power

If the donor BTS is active (carrying subscriber traffic), you cannot use a spectrum analyzer to obtain an accurate measurement of the donor BTS signal strength. In this case, you must use a Pilot Scanner and measure Pilot power directly.

Measurement Using a Pilot Scanner

1. Configure equipment as shown in Figure 5-1, but substitute a pilot scanner for the spectrum analyzer.
2. Configure the pilot scanner to measure ONLY the pilot channel of the donor BTS.
3. Move the antenna for maximum signal strength.

Technical Specifications 9

9.0 Specifications

Table 9-1 PCS Frequencies

Block	Bandwidth	Reverse Link (Mobile Tx)	Forward Link (Base Tx)
A	15 MHz	1850-1865	1930-1945
B	15 MHz	1870-1885	1950-1965
C	7.5/15 MHz	1895-1910	1975-1990
D	5 MHz	1865-1870	1945-1950
E	5 MHz	1885-1890	1965-1970
F	5 MHz	1890-1895	1970-1975

Table 9-2 RF Characteristics

Link	RF Output Power at the Antenna Port		Gain	Frequency Range
	Channel 1	Channel 2		
Forward	RC19-1X10 +40.0 dBm RC19-1X15 +41.8 dBm RC19-2X10 +40.0 dBm RC19-2X15 +41.8 dBm	RC19-2X10 +40.0 dBm RC19-2X15 +41.8 dBm	65-95 dB	Block Specific
Main	+18 dBm	+18 dBm	65-95 dB	Block Specific
Diversity	+18 dBm	+18 dBm	65-95 dB	Block Specific

Table 9-3 Mechanical Characteristics

Size	Weight	Temperature
RC19-1X10 16"(W) x 21(H)" x 16"(D) RC19-1X15 20"(W) x 30(H)" x 16"(D) RC19-2X10 16"(W) x 21(H)" x 16"(D) RC19-2X15 20"(W) x 30(H)" x 16"(D)	RC19-1X10 70 lbs. RC19-1X15 107 lbs. RC19-2X10 74 lbs. RC19-2X15 111 lbs.	-40° to 55° C Ambient

Table 9-4 Noise Figure

Reverse Link (Independent Main & Diversity Paths)	Reverse Link (Combined Main & Diversity Paths)
3.2 dB typical 6.7 dB typical (Dual Direction option)	7.0 dB typical 10.5 dB typical (Dual Direction Option

Table 9-5 Additional Characteristics

Waveform Quality Factor (ρ)	Spurious Response	Channel Bandwidth	Group Delay	Maximum Input Signal	VSWR
>0.96	Per TIA-95D & IS-2000	<1.25 MHz	<2 µsec forward & reverse main links	+10 dBm	<1.8:1
			<4 µsec diversity link		

Table 9-6 Alternate Power Options

Type	Description
BUPS	5 - 9 hours of backup power without AC
Solar Power	Photovoltaic (PV) with regulated charging batteries
Hybrid Solar and TEG	PV with thermal electric propane generation assistance
Hybrid Solar and MG	PV with propane or diesel generation assistance

Table 9-7 RepeaterNet Alarm, Monitoring, and Control

Access Options	GUI	Functions
• RS-232 (local) • POTS (dial-up) • Wireless Modem (CDMA)	• Craft - Win95/98/NT/2000/ME • NMS - WinNT	• Fault Notification • Interrupt Reporting • Definable Threshold • Remote Control: Gain, Channel, PA On/Off

Table 9-8 Inputs and Outputs

Local I/O	Type
Critical Alarm	Form C Relay
Major Alarm	Form C Relay
Minor Alarm	Form C Relay
Remote Control Relay (2)	Form C Relay
Digital Input (4)	Open Collector TTL
Digital Output (4)	Open Collector TTL
External Voltage Monitor	Analog
BUPS Monitor	6 Alarms

Table 9-9 LED Indicators

LED	Color
System Ready	Green
Critical Alarm	Red
Major Alarm	Red
Minor Alarm	Red

Table 9-10 Electrical Characteristics

Voltage	Current (Typical)	Lightning Protection	Connectors
100 to 264 VAC	RC19-1X10 2.2 Amps @ 115 VAC RC19-1X15 2.9 Amps @ 115 VAC RC19-2X10 3.5 Amps @ 115 VAC RC19-2X15 4.1 Amps @ 115 VAC	• Internal - All interface cables	• RF - Type N (f)
22 to 32 VDC	RC19-1X10 9.0 Amps @ 24 VDC RC19-1X15 11.0 Amps @ 24 VDC RC19-2X10 13.0 Amps @ 24 VDC RC19-2X15 15.0 Amps @ 24 VDC	• External - Optional	

9.1 Ordering Information

The tables that follow provide information about ordering from RTI; specifically:

- Ordering Considerations
- Repeater Configurations and Part Numbers
- Optional Equipment Available from Repeater Technologies
- Back-up Power Systems (BUPS)
- Accessory Kit Items

When ordering, specify a shipping destination and a billing address. Repeater Technologies will return an order acknowledgment and the scheduled shipping date. Each shipment includes an equipment list, showing the equipment ordered, and the equipment shipped. This list includes details about system equipment options. Contact the Repeater Technologies Sales Department for ordering information.

Table 9-11 Spare Parts and Accessory Items

Description	Part Number
Antennas*	Call for information
Connectors	Call for information
Coaxial Cable	Call for information
AC Power Cord	103-0137-01
Pole Mounting Kit	091-0215-01
McMaster-Carr ¾-inch Banding Kit	Part No. 5653K12, McMaster-Carr Supply Co., Los Angeles, CA, USA, Tel.# (562) 692-5911
Internal Lead Acid Back-Up Battery	149-1028-01
PC Interface Cable DB9, 9-pin, and Serial Straight Through Male-to-Female	187-0713-02
BUPS-25/80 (AC Power System) for RC19-1X10 or RC19-2X10	250-1011-07
BUPS-25/80 (AC Power System) for RC19-1X15 or RC19-2X15	TBD
Surge Protector - N(M) to N(F) Lightning	Call RTI
Operations Manual (Hard Copy)	550-1300-01
Alarm, Power, and Button Plugs (7/8″)	126-0062-01
Conduit Fitting	137-0447-01
Back Mounting Plate	020-1339-02
Stainless Steel 3/8″ Locking Washer	125-0059-07
Stainless Steel 3/8″ x 1" Flat Washer	125-0068-07

Table 9-11 Spare Parts and Accessory Items (Continued)

Description	Part Number
Stainless Steel Pin-in-Head Security Bolts	125-0212-13
Stainless Steel Hex Head Bit Pin-in-Head, 7/32"	129-0008-01
RepeaterNet Craft Software	519-1200-03
BUPS Power & Alarm Cable Assy (Kit)	187-0188-01
*Typical antennas include parabolic reflectors, corner reflectors, circular, linear, directional co-linears, cross or slant polarization, log periodic array, or Yagi.	

To select a BUPS (Back-up Power System) for the repeater application, match the repeater with the amount of back-up time required. See appropriate BUPS manual.

Table 9-12 Contents of Accessory Kit

Quantity	Item
1 each	PC Interface Cable DB9, Serial Straight Through Male-to-Female
1 each	Hex bit, Pin-in-Socket, 7/32"
1 each	Operations Manual (Hard Copy)
1 each	RepeaterNet Craft Software

9.2 Technical Services

Repeater Technologies offers technical services to supplement the manpower resources of its customers. RTI will provides quotations for the following services upon request:

- Site and Construction surveys
- Network Design
- Design Verification
- Training
- Installation
- Accessories (antenna, coaxial cabling, etc.)
- Alignment and Optimization

9.3 Customer Support

Repeater Technologies, Inc.
Corporate Headquarters (8 a.m. to 5 p.m. Pacific Standard Time, Monday-Friday)
1150 Morse Avenue
Sunnyvale, CA 94089 USA

Customer Service (7 days a week, 24 hours per day)
(408) 747-1946
(800) 747-1515 (USA and Canada only)

www.repeaters.com

Default Settings

A

Table A-1 Default Settings

Subsystem	Option	Setting	Default
Front End	Fwd FE	FwdFE Summary Alarm	Major
	Rev FE	RevFE Offline Alarm RevFE Current Alarm RevFE HotTone Alarm	Major Major Minor
	Diversity FE Control	Diversity FE Control	On
	Diversity FE Attn	Attenuation	6 dB

Table A-1 Default Settings (Continued)

Subsystem	Option	Setting	Default
Channel 1	Rev PA	RevPA1 Offline Alarm	Major
		RevPA1 Current Alarm	Major
		RevPA1 ALC Alarm	Minor
	Fwd PA	FwdPA1 Offline Alarm	Major
		FwdPA1 Temp Alarm	Major
		FwdPA1 Thermal Shutdown Alarm	Critical
		FwdPA1 Overdrive Shutdown Alarm	Critical
		FwdPA1 Low RF Power Alarm	Event
		FwdPA1 ALC Alarm	Minor
		FwdPA1 Return Loss Alarm	Major
		FwdPA1 Off Alarm	Critical
	PA Control	Reverse PA Power	Off
		Forward PA Power	Off
	Rev Filter	RevCSF1 Offline Alarm	Major
		RevCSF1 Current Alarm	Major
		RevCSF1 Lock Alarm	Critical
	Fwd Filter	FwdCSF1 Offline Alarm	Major
		FwdCSF1 Current Alarm	Major
		FwdCSF1 Lock Alarm	Critical
	Channel #	Channel Number	Block Specific
	Gain	Forward Gain	65 dB
		Forward ALC	On
		Forward ALC Duration	10 sec.
		Reverse Gain	65 dB
		Reverse ALC	On
		Reverse ALC Duration	10 sec.

Table A-1 Default Settings (Continued)

Subsystem	Option	Setting	Default
Channel 2*	Rev PA	RevPA2 Offline Alarm	Major
		RevPA2 Current Alarm	Major
		RevPA2 ALC Alarm	Minor
	Fwd PA	FwdPA2 Offline Alarm	Major
		FwdPA2 Temp Alarm	Major
		FwdPA2 Thermal Shutdown Alarm	Critical
		FwdPA2 Overdrive Shutdown Alarm	Critical
		FwdPA2 Low RF Power Alarm	Event
		FwdPA2 ALC Alarm	Minor
		FwdPA2 Return Loss Alarm	Major
		FwdPA2 Off Alarm	Critical
	PA Control	Reverse PA Power	Off
		Forward PA Power	Off
	Rev Filter	RevCSF2 Offline Alarm	Major
		RevCSF2 Current Alarm	Major
		RevCSF2 Lock Alarm	Critical
	Fwd Filter	FwdCSF2 Offline Alarm	Major
		FwdCSF2 Current Alarm	Major
		FwdCSF2 Lock Alarm	Critical
	Channel #	Channel Number	Block Specific
	Gain	Forward Gain	65 dB
		Forward ALC	On
		Forward ALC Duration	10 sec.
		Reverse Gain	65 dB
		Reverse ALC	On
		Reverse ALC Duration	10 sec.

*Two channel repeaters only

Table A-1 Default Settings (Continued)

Subsystem	Option	Setting	Default
Alarm Control Unit	I/O Controls	Relay 1	Off
		Relay 2	Off
		Digital 1	Off
		Digital 2	Off
	Alarms	Line Entry Offline Alarm	Major
		ACU Offline Alarm	Major
		Ext Input 1 Alarm	Disabled
		Ext Input 2 Alarm	Disabled
		Ext Input 3 Alarm	Disabled
		Ext Input 4 Alarm	Disabled
		Ext DC Voltage Alarm	Disabled
		Ext Tamper Alarm	Disabled
		Primary Tamper Alarm	Major
		All RF Off Alarm	Critical
	Ext DC Voltage	Less Than Threshold	0 V
		Greater Than Threshold	60 V
Remote Monitoring	Alarm Setting	Modem System Alarm	Disabled
		CellPhone System Alarm	Disabled
		NMS DialOut Alarm	Disabled
Power System	Alarm Setting	Power Control Offline Alarm	Major
		System Voltage Alarm	Critical
		Small Backup Battery Alarm	Major
		AC Power Supply Fail Alarm	Disabled
		AC Input Fail Alarm	Disabled
		Primary Battery Charger Alarm	Event
	Battery Control Enable	Battery Controlled Shutdown	On
		Battery Charger Enable	Off
BUPS	Alarm Setting	Ext BUPS AC (Mains) Fail Alarm	Disabled
		Ext BUPS Low (Float) Battery Alarm	Disabled
		Ext BUPS High (Float) Battery Alarm	Disabled
		Ext BUPS Charger (Rectifier) Fail Alarm	Disabled
		Ext BUPS Summary (Load/Bat Fuse) Alarm	Disabled
		Ext BUPS Tamper (Optional) Alarm	Disabled

Glossary

B

This glossary defines communications industry acronyms, symbols, and terms. Hardware-related and software-related acronyms are also included. Because this glossary supplements all operations manuals from Repeater Technologies, not all items listed here necessarily appear in this manual.

A	Amp or Amps.
ACU	Alarm Control Unit.
ALC	Automatic Level Control.
AMPS	Advanced Mobile Phone System.
API	Application Programming Interface.
Back-beam	A back-beam antenna transmits energy backward, towards the donor BTS. This increases the allowable distance between the donor BTS and repeater sites in CDMA networks.
BNC	Bayonet Naval Connector. Type of connector.
BTS	Base Transceiver Station.
BUPS	Back-Up Power Supply.
CDMA	Code Division Multiple Access.
C/E	Carrier-to-Echo Ratio.
C/I	Carrier-to-Interface Ratio. The ratio between the mean signal level of the desired radio signal, and the signals from other (interfering) sources. Typically expressed in dB.
CPC	Circular Plastic Connector.
CRC	Cyclical Redundancy Check.
CSM	Cell Site Modem.
DAMPS	Digital Advanced Mobile Phone System (equivalent of TDMA).

Darlington Pair	Two transistors, arranged so that the emitter of one drives the base of the other, and connects the collectors together. The result is an increase in gain compared to a single transistor, because the gains of the two transistors are multiplied together. The trade-off for this increased gain is reduced speed, because of the very high gain's effect on the collector-to-base capacitance. You can use this pair of transistors as a single transistor: common emitter, emitter follower, and so on.
dB	Decibel or decibels.
dBC	Decibels, referenced to the carrier level.
dBi	Decibels, referenced to an isotropic antenna.
dBm	Decibels, referenced to one milliwatt.
DF, DFB	Distributed Feedback (Laser).
Donor	An antenna that communicates between a repeater and a BTS.
DSN	Data Source Name. A name that represents the database file (or connection).
DVM	Digital Voltmeter.
EM	Electromagnetic.
EMI	Electromagnetic Interference.
ERP	Effective Radiated Power.
F/B	Front-to-Back Ratio.
FCC	Federal Communications Commission (USA).
FE	Front End.
FIFO	First In First Out.
Forward Direction	Direction of transmission from the base station, through the repeater, and on to Mobile or hand-held units. Downlink transmission.
Forward Gain	Gain setting for Forward (downlink) transmissions.
FRU	Field Replaceable Unit
FSK	Frequency-Shift Keying.
Gain	The amount of signal amplification between the repeater input and output.
GSM	Global System for Mobile Communications, or Groupe Speciale Mobile.
GUI	Graphical User Interface.
Hand-off	On a cellular system, the act of transferring a call in progress, from one cell or sector to another. Typically also involves changing to a different voice channel.
HBW	Horizontal Beam Width of an antenna.
Hot Tone	A large RF signal at the input of the repeater which is not under control of the BTS.
HPP	Half Power Point of an antenna.
IF	Intermediate Frequency.

IM	Intermodulation.
IMD	Intermodulation Distortion.
LED	Light-Emitting Diode.
LNA	Low Noise Amplifier.
LO	Local Oscillator.
LOS	Line-Of-Sight.
Microcell	Any small, low-power cell site.
M.O.R.E.	Method Of Repeater Engineering. Controls signal noise and gain between the base transceiver station (BTS) and the repeater.
Morphology	The structure (layout) of the repeater coverage area. Morphology factors include natural signal-path obstructions (trees and hills), man-made obstacles (buildings and billboards), distance between the repeater and the base station, number of cell-phone users within the repeater coverage area, and coverage inside buildings and tunnels.
MPRL	Maximum Power Radiation Limit of an antenna.
MSC	Mobile Switching Center (equivalent to MTSO).
MTSO	Mobile Telephone Switching Office (equivalent to MSC).
Multipath	Radio propagation between a transmitter and receiver, where the received signal contains multiple rays. Each ray has undergone one or more reflections and/or refractions. Cellular coverage is usually multipath, especially in high-density city areas.
NIM	Noise Injection Margin. The amount of noise (dB) that a repeater injects into the CDMA air interface.
NR	Network Repeater.
ODBC	Open DataBase Connectivity. An Application Programming Interface (API) in Windows, that lets a programmer abstract a program from a database.
OLE	Object Linking and Embedding. Integrates applications, and permits copying objects from one application to another. Uses the first application's editing techniques, when editing a copied object in the second application.
OTU	Optical Transceiver Unit.
PA	Power Amplifier.
Paging Channel	Passes parameters over a CDMA network, during operation.
PEP	Peak Envelope Power.
Pilot Channel	Measures power and performs initial synchronization over a CDMA network.
PLL	Phase Locked Loop.
PSTN	Public Switched Telephone Network.
QCCB	Quick-Connect Connecting Block.
RBS	Radio Base Station. *See also* BTS.

Reverse Direction	Direction of transmission from the Mobile or portable, through the repeater, and on to the BTS. Uplink transmission.
Reverse Gain	Gain setting for Reverse (uplink) transmissions.
RF	Radio Frequency.
RFI	Radio Frequency Interference.
RMA	Returned Materials Authorization. Issued before you return a repeater to RTI for upgrading.
ROT	Rise Over Thermal. The amount of increase in noise level (dB) at the BTS, that the repeater creates.
RPE	Radiation Pattern Envelope. Defines the attenuation of side-lobe energy from an antenna.
RSL	Receive Signal Level.
RSA	Rural Service Area.
RSSI	Receive Signal-Strength Indicator.
RTI	Repeater Technologies, Inc.
RX	Receive.
SID	System ID. A five-digit number that the FCC assigns for system identification.
Simulcast	The process of transmitting the same signal from two or more sites simultaneously.
SMA	Sub Miniature A (a type of connector).
SMB	Sub Miniature B (a type of connector).
Subscriber	An antenna that communicates between a repeater, and either a cellular phone or another repeater.
Sync Channel	Passes parameters during initial synchronization of a CDMA network.
TDMA	Time Division Multiple Access (equivalent to DAMPS).
Traffic Channel	Carries communications traffic over a CDMA network.
TSA	Traffic Service Area.
TX	Transmit.
UCU	Universal Control Unit.
UHF	Ultra High Frequency.
UPS	Uninterruptable Power Supply. The BUPS is a type of UPS.
V	Volt or Volts.
VAC	Voltage, Alternating Current.
VDC	Voltage, Direct Current.

Vocoder	A *vocoder*, or voice coder, divides speech signals into various bands of the audio spectrum, compresses and encrypts the resulting audio segments, and transmits the digitized speech over a cellular (wireless) network. The cellular phone (receiver) decrypts, decompresses, and reassembles the transmitted audio segments, to sound like normal (analog) speech again.
VSWR	Voltage Standing Wave Ratio.
W	Watt or Watts.
XPD	Cross Polarization.