RC1920C Repeater

Reference Manual

Issue 1

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Unpacking and Inventory

<div align="right">1</div>

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 lists, 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 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. Send a written report of the loss or damage to the Field Services Department of Repeater Technologies.

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 cellular/PCS network, or a damaged repeater might need to be returned to RTI.

1.1   Equipment Required, but Not supplied, 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.
3/16 inch Medium Flat Blade Bit Screwdriver	Use on the older entry box door and DC input power terminals.
¼ inch Hex driver	Detach security screws.
Voltmeter, Fluke 75 or equivalent VOM	Test voltage and power polarity.
Spectrum Analyzer	Test RF power output.
RF Signal Generator	Test antenna isolation.
Pilot scanner (optional)	Measure donor base station receiver power.
Type N (m) 50-ohm Termination, 10 W, (3 ea.)	Terminate antenna ports during off-air testing.
Mounting Hardware	Mount repeater, antennas and coax.
Electrical Wiring Equipment (as needed)	Connect external power to Repeaters.
Laptop Computer (Win95, 98, NT)	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.
Jumper Cables	Type N (male to male) calibrate cables for Test Equipment (length depends upon application).
Frequency Domain Reflectometer (Feed Line Sweep Tester) Wiltron 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

Part Number	Description	Quantity
129-0007-02	Wrench, Hex Key, 5/32" x 3-1/4" LG Short Arm	1
129-0008-01	Hex Bit, Pin-In Socket, 7/32"	1
519-1200-03	RepeaterNet Craft Software	1
187-0713-02	Cable Assembly, Comp (2M) 2X D-Sub 9-Pin, Male/Female	1
187-0929-01	Cable Assembly AC Power Cord	1
113-0015-01	Shipping Container (For OA1900C Only)	1
113-0016-01	Shipping Container (For OA850C Only)	1
550-5100-01	Repeater Reference Manual, Printed	1
550-5100-02	Repeater Reference Manual, CD-ROM (OA850C Only)	1
137-0446-01	Plug, Button, Recessed-Type Head (OA1900C Only)	1
137-0447-01	Fitting, Conduit, 1/2" LiquidTight	4
137-0447-02	Locknut, Standard Conduit 1/2"	1
129-0011-01	Hex Bit, 7/64" x 1" long Ball Point (1/4" Driver) For OA850C Only	1
519-5100-01	RTI Tools Disk (OA850C Only)	1

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Repeater Installation Check List

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2.0 Introduction

This chapter includes a check list, which summarizes all of the steps required for successfully installing a repeater. Repeater Technologies, Inc. (RTI) recommends a thorough review of the check list, both before and during installation of an RTI repeater.

2.1 Contacting Repeater Technologies

This section describes how to contact the Repeater Technologies corporate headquarters at anytime before, during, or after installing a repeater, for sales information or technical assistance for the RC1920C repeater, or for any of our communications or related products. Refer to the inside cover for contact information.

2.2 RepeaterNet Craft

Some of the steps in the installation process require using RepeaterNet Craft software. This software is provided on the appropriately-labeled diskettes. Those diskettes are included with this manual.

2.3 Checklist

The RC1920C Installation Checklist begins on the next page, and continues for a total of four pages. The remaining chapters of this manual provide detailed descriptions of each of the steps summarized in this checklist. The Installation Checklist is also included as a single-sheet fold-out, in the front binder-flap of the printed *Repeater Reference Manual*. An installer can take the fold-out sheet into the field, and consult it during the repeater installation process. The checklist includes spaces for recording details about the repeater site, and for checking off completion of each installations.

RC1920C Installation Checklist

Site Name_____

Location_____

Serial Number_____

Bts Name/sector_____

Bts Location_____

1. Equipment Installation

_____	1.1	Test Equipment Needed	Sweep Tester, Signal Generator, Spectrum Analyzer, Pilot Scanner (optional), and Voltmeter.
_____	1.2	Verify Bts Output Power	Verify that the donor BTS to the repeater site is running at rated output power.
_____	1.3	Install Antennas And Feed Lines	If a back-beam antenna is used, install a power divider.
_____	1.4	Run Sweep Test	Run a sweep test on all antennas and feed lines, upon completion of their installation.
_____	1.5	Mount Primary F1 Repeater Cabinet	(Cabinet with Type-N RF connectors on bottom.) Remove the mounting bracket from the cabinet, and mount the repeater on a pole, wall or uni-strut. Hang the repeater over the *outside* of the mounting bracket, and secure it. Leave room for the antenna feed connections, F2 Growth Cabinet, and BUPS, if applicable.
_____	1.6	Mount F2 Growth Cabinet	(Cabinet without Type-N connectors.) Mount to the left of (or above) the Primary F1 Repeater Cabinet. Interconnect the two cabinets, using the cables supplied. First connect the RF and alarm cables in one conduit, and then the power cable in another conduit. Remove unused AC or DC leads. (optional)
_____	1.7	Mount Back-up Power System (Bups)	Mount to the right of the Primary F1 Repeater Cabinet. This supplies DC power. (optional)
_____	1.8	Install Lightning Suppressors	for all antenna feed lines and cabinets.
_____	1.9	Ground Equipment	Connect repeater cabinet(s), BUPS, antenna feeds, lightning suppressors, and any other equipment, to external ground.
_____	1.10	Terminate Antenna Ports	Use Type-N 50-Ohm 20-Watt terminations. Two ports for non-diversity, three ports for diversity.
_____	1.11	Hook-up Electrical Power	Wire primary power to the dedicated 20-amp breaker. Open the entry box on the bottom of the Primary F1 Repeater Cabinet. Verify proper voltage & polarity (either +24 VDC or 117/230 VAC, not both). Connect the repeater and/or the BUPS to the power source. Connect the BUPS alarm cable to J2, if applicable. DO NOT TURN ON power.

2. Antenna Alignments

_____	2.1	Align Donor Antenna	Check RSL (Received Signal Level) from donor BTS. Connect Spectrum Analyzer or Pilot Scanner (optional) to the antenna feed of Repeater Donor antenna, and adjust the donor antenna position for maximum RSL (set for 1 MHz RBW). Confirm polarization of the Donor antenna. Measure at idle channel power. Donor Antenna Polarity (V/h)

Frequency 1

Frequency   _____MHz

Power   _____dBm

Desired Pn Scanner (If Using A Pn Scanner):_____

Ec/io   _____dB

Power   _____dBm

2nd Highest PN (if using PN Scanner):_____

Ec/io   _____dB

Power   _____dBm

Frequency 2 (If applicable)

Frequency   _____ MHz

Power   _____dBm

Desired Pn (If Using A Pn Scanner):

Ec/io   _____dB

Power   _____dBm

2nd Highest Pn (If Using A Pn Scanner):

Ec/io   _____dB

Power   _____dBm

_____	2.2	Align Mobile Antenna(s)	Using compass or topographic map mobile/subscriber antenna in accordance with network engineering site plan.
_____	2.3	Check Isolation	Using a signal generator, inject up to 4 CW signals across the channel (for Frequency 1) into the donor antenna feed (suggested power level is 0 dBm). Using a Spectrum Analyzer (set for 1 kHz RBW), measure the received level on each subscriber antenna feed. Note the worst case difference in power levels. **ISOLATION MUST BE GREATER THAN 80 dB,** 110 dB is ideal. Repeat for Frequency 2, if applicable. Adjust the antenna location, or introduce RF shielding, if more isolation is required.

Isolation

Tx1 / RXmain   _____dB dB

Tx2 / RXdiversity   _____dBdB (if applicable)

3.   Commissioning the Repeater

_____	3.1	Turn On Power	Open the entry box at the bottom of the Primary F1 Repeater Cabinet; turn ON system power. **THE RED "CRITICAL ALARM" LED ACTIVATES. THE REPEATER IS IN ALARMED STATE UNTIL POWER AMPLIFIERS (PAs) ARE TURNED ON.**
_____	3.2	Hook-up Internal Battery	Connect the black lead to the negative terminal of the internal battery backup—located in the entry-box.

_____	3.3	Update Software	Load RepeaterNet Craft Software, provided in the accessory kit (four floppy disks), onto an MS Windows 95/NT PC. (Even if RepeaterNet is loaded on PC, a new Revision might be included with the repeater.)
_____	3.4	Launch Repeaternet Craft	Connect a PC to the Craft port (9-pin DB9 connector) in the Primary F1 Repeater entry box. Use the cable in the accessory kit. Launch the RepeaterNet Craft program on the PC.
_____	3.5	Update Firmware	When adding F2 Growth Cabinet upgrades to existing (older) Primary F1 Repeater Cabinets, update the firmware. See Step 5.16.
_____	3.6	Update Configuration For 2 Channels	Using RepeaterNet Craft, select *"Configuration/Hardware Settings"* and click *"Growth Box"*. Click **APPLY**. Exit RepeaterNet Craft, and restart.
_____	3.7	TURN PAs OFF	Verify that Forward PA(s) and Reverse PA(s) are turned OFF. In RepeaterNet Craft, the FPA(s) and RPA(s) Icons should have a circle with a slash over them. If not, select *"Configuration/Channel 1/PA Control tab"* and turn OFF both FPA & RPA. Click **APPLY**. The FPA & RPA Icons should now have a circle with a slash over it. Repeat for Channel 2, if applicable.
_____	3.8	Set Channel Numbers	In RepeaterNet Craft, select *"Configuration/Channel 1/Channel #"*. Enter the Channel #. Click **APPLY**. Repeat for Channel 2, if applicable.

Frequency 1   _____ MHz

Forward (Downlink)   Channel #_____

Reverse (Uplink)   Channel # _____

Frequency 2 (If Applicable)   _____MHz

Forward (Downlink)   Channel #_____

Reverse (Uplink)   Channel #_____

_____	3.9	Set gains to 65 Db	Confirm that the repeater gain, under the *"Configuration/Channel 1/Gain tab"* screen, is set to 65 dB for the forward (downlink) and reverse (uplink) paths. Be sure to click **APPLY**. Repeat for Channel 2, if applicable. **Do not activate the PAs at this time.**
_____	3.10	Turn off power	Exit RepeaterNet and remove the antenna terminations.

4.   Repeater Alignment

*Requires two people: one at BTS, one at Repeater

_____	4.1	Repeater Site Set-up	Connect the Donor antenna feed and Diversity TX_2 / $RX_{Diversity}$ Mobile feed (if applicable) to the Repeater. Connect the signal generator to the Mobile TX_1 / RX_{Main} port.
_____	4.2	Bts Site Set-up	Disconnect the antenna feed from the diversity antenna port. Connect a spectrum analyzer to the diversity antenna feed (set for 10 kHz RBW).
_____	4.3	Turn On Repeater	Login using RepeaterNet Craft.
_____	4.4	Turn On Reverse Pa1	Using RepeaterNet Craft, turn ON RPA1. **Ensure that FPA1, FPA2 and RPA2 are turned OFF.** Click **APPLY**. See step 3.7.
_____	4.5	Inject Test Signal	Inject a –80 dBm signal at the Reverse (Uplink) frequency (Step 3.8). **Ensure that the input is –80 dBm, considering signal generator cable losses.** Activate signal generator (TRANSMIT).

_____	4.6	Set Reverse Gain	For outdoor coverage - At the Repeater site, increase the Reverse gain of Channel 1 in RepeaterNet Craft (see Step 3.9), until the spectrum analyzer at the BTS reads –82 dBm. Click **APPLY**.

If the BTS Donor Sector has a Tower-Top Low-Noise Amplifier (TTLNA), the reading should be –75 dBm, *if* TTLNA Gain is 12 dB & cable loss is 3 dB. (If gain is higher or loss is lower, add 1 dB for each 1 dB of improvement).

For indoor coverage, readings should be –92 dBm or –85 dBm, respectively. Repeat for Channel 2, if applicable. **DO NOT EXCEED THE ISOLATION IN STEP 2.3.**

Gain Setting - Reverse (Uplink)

Channel 1   _____ dB

Channel 2   _____ dB (if applicable)

Disconnect Test Equipment   At both sites, connect antenna feeds.

_____	4.8	Set Forward Gain	Set the Repeater Forward (Downlink) Gain setting so it is 2 dB higher than the Reverse (Uplink) Gain setting. **DO NOT EXCEED THE ISOLATION IN STEP 2.3.** Click **APPLY.**

Gain Setting - Forward (Downlink)

Channel 1   _____ dB

Channel 2   _____ dB (if applicable)

_____	4.9	Check For Oscillation	In *RepeaterNet Craft* click the upper (Channel 1) "*FPA icon/Channel 1 Forward PA Status/Measurement Tab"*. Click *Reset Low/High, and* observe the PA power levels. If the PA is consistently running *"Over Range",* turn the PA Gain down in 2 dB increments (see Step 3.9), until the PA is not regularly "Over Range". Repeat for Channel 1 (upper) RPA1 & Channel 2 (lower) FPA2 & RPA2, if applicable.
_____	4.10	Back-up System Settings	In RepeaterNet Craft, select *"File/Upload Properties"*, name a file. *"Save"*.
_____	4.11	Exit	RepeaterNet, close the repeater entry box, and seal the coax connections.
_____	4.12	Set Switch Translations	Modify the Cell Radius/Access Acquisition Search Windows, and the PAM_SZ, for new coverage. Modify SRCH_WIN_A, and SRCH_WIN_N, for hand-offs.

5. Customizing the Repeater Installation

_____	5.1	Launch Repeaternet Craft	Connect the PC to the Craft port (9 pin DB9 connector) in Primary F1 Repeater Cabinet entry box. Use the cable provided in accessory kit.
_____	5.2	Set-up Modem	Must have modem option. Select "Configure/Modem/Modem Properties". Enter the Setup string, phone number to dial for NOC access, and # of call attempts. Click **APPLY**. Select "Configure/Hardware Settings" and Click "modem attached". Click OK. Exit RepeaterNet Craft, and restart.
_____	5.3	Set-up Pager	Must have the modem option. Select "Configure/Modem/Pager Properties" and enter the pager number to dial, # of call attempts, and unique numeric ID message to be sent to the pager. Click **APPLY**.

_____	5.4	Set-up Cellular Phone	Must have the modem option. Select "Configure/Hardware Setting" and Click "cellular phone attached". Click OK. In the Primary F1 Repeater Cabinet entry box, remove the cell phone and activate. Re-install the cell phone in the entry box. Exit RepeaterNet Craft, and restart.
_____	5.5	Set-up Remote Or Direct Access	Must have the modem option. Use to define whether access is a direct or remote (via a modem) connection. Launch RepeaterNet Admin and Click "Direct Connection" (or "Modem Connection" for remote access). Click SAVE.
_____	5.6	Password Protection	Select "Systems/Properties/System Login". Enter the Login ID and Password. A zero indicates that the feature is not active. Click **APPLY**.
_____	5.7	Set-up Color Independent Icons	Select "Options/Independent Color Icons".
_____	5.8	Store Site Information	Select "System/Properties/System". Enter the System Name, Site Info, and Site Phone Number. Click **APPLY**.
_____	5.9	Connect External Alarms	Wire J2 for alarm info from the power source; J1 for 2 digital inputs & outputs and DC Voltage Input; J23 for 2 Form C Relay Contacts; J22 for Repeater Critical, Major and Minor Alarm Form C Relays.
_____	5.10	Name External Alarms	Select "Configuration/Alarm Control Unit". Select the "I/O Description" tab and fill-out the names. Click **APPLY**.
_____	5.11	Test External Outputs	Select "Configuration/Alarm Control Unit". Select the "I/O Controls" tab and toggle ON/OFF/ON. Click **APPLY** after each toggle.
_____	5.12	Set-up Dc Voltage Alarm	Select "Configuration/Alarm Control Unit". Select the "Ext. DC Voltage" tab and enter the min/max voltages. Click **APPLY**.
_____	5.13	Change Alarm Severity	To change the factory default settings, select submenus of "Configure/(item)" for each alarm severity change. Click **APPLY** for each change.
_____	5.14	View Alarm Log	Select "System/Alarm and Event Log".
_____	5.15	Back-up System Settings	In RepeaterNet Craft, select "File/Upload Properties", name a file. "Save".
_____	5.16	Update Firmware	Insert "Firmware" floppy disk in drive (A). Select "File/Update Repeater Firmware/". Click "OK". "Save" current firmware on (C). Select firmware file on Floppy (A). "Open". Follow the on-screen directions.

Figure 2-1　　　Typical Installation

TBD
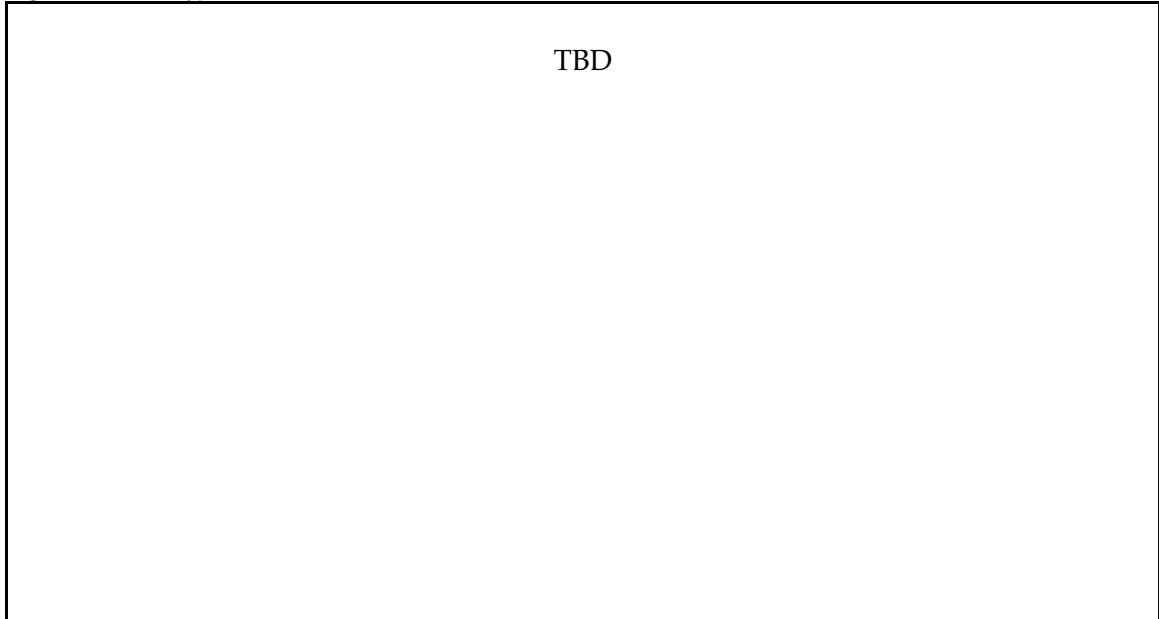
Figure 2-2　　　Checking Repeater Isolation
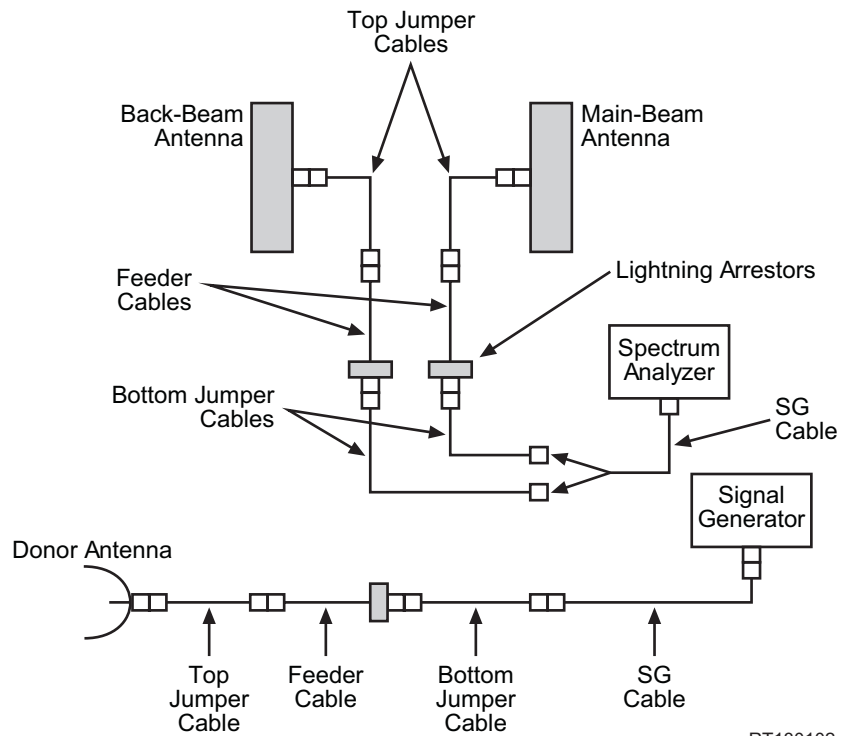
Figure 2-3   *Mounting the Repeater*

TBD
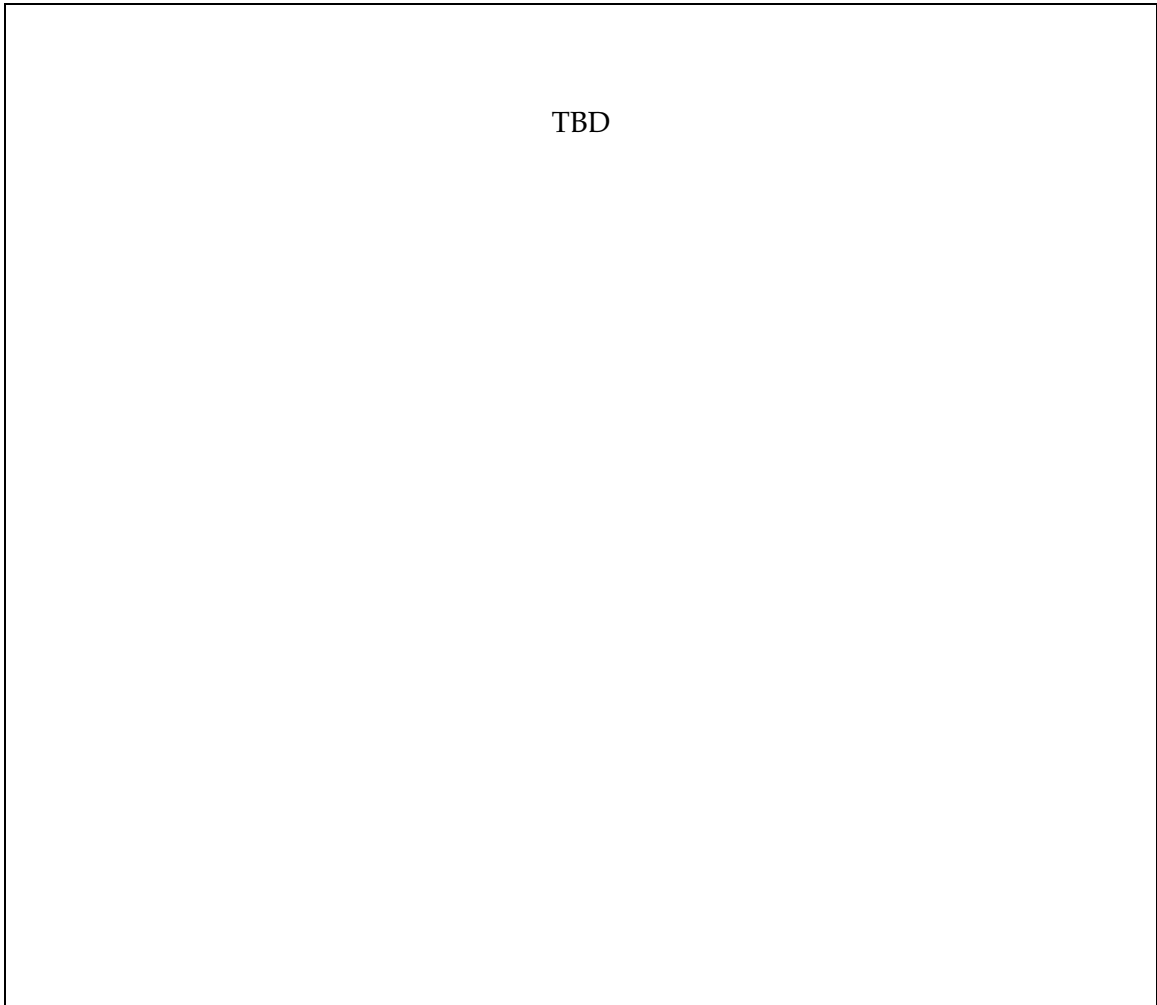
Repeater Installation Check List

3

3.0   Introduction

In a CDMA (IS95) network, the dynamic RF power output of a Base Transceiver Stations (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 overdriven, and it might enter into an alarm condition.

3.1   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 modul*e, or correct the measurement, for the resolution bandwidth of the spectrum analyzer.

For example, a CDMA Personality Module is available for Hewlett-Packard 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, so you must correct the measurement for bandwidth.

3.1.1   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.

Both methods use the same equipment configuration, as shown in Figure 3-1.

Figure 3-1   Equipment Configuration for Measuring Donor BTS Power
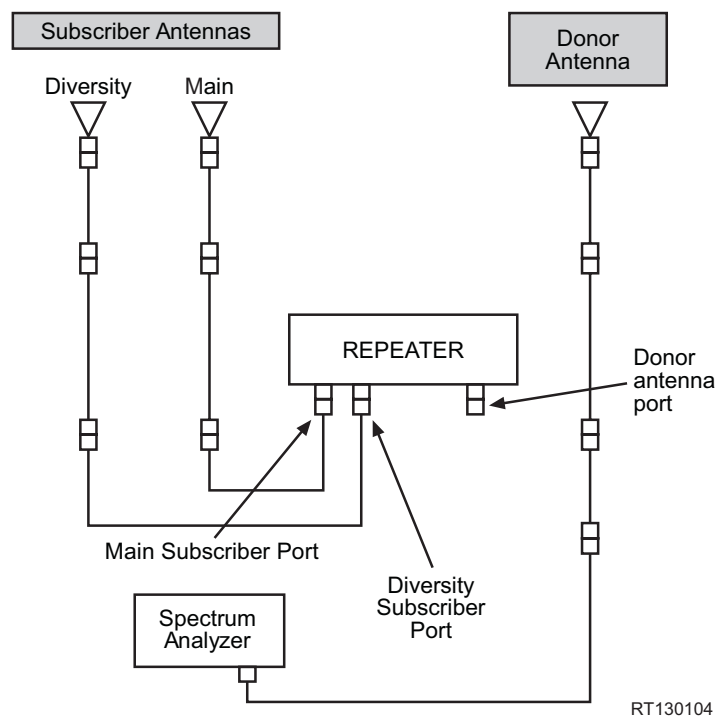
Measurement Using a Spectrum Analyzer

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 3-1.
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.

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.

3.1.2 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 3-1, 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.

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Installing Antennas

4

4.0   Installing Water Protection for Antenna Connections

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

The bottom of an RTI RC1900C repeater cabinet includes N-type connections to donor and subscriber antennas, as shown in Figure 4-1. RTI recommends that before installing the repeater and connecting it to antennas, you apply a tar-like Vapor Wrap, to seal these antenna connections against rain or other water sources.

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, water 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

TBD
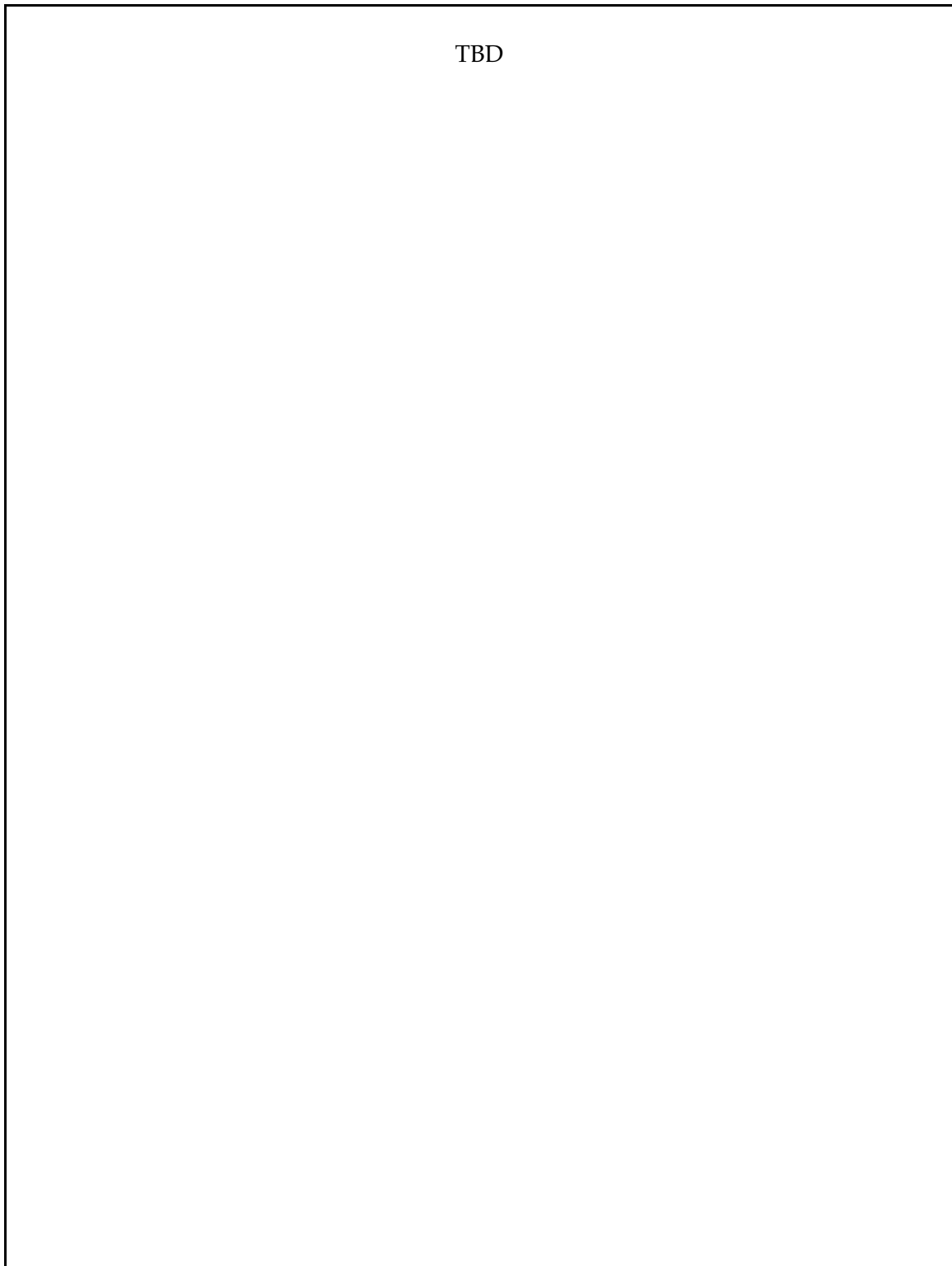
4.1   Antenna Configurations

RTI repeaters can use any one of four basic antenna configurations:

- Donor antenna, and one dual-polarized subscriber antenna (see Figure 4-2)
- Donor antenna, and two vertically-polarized subscriber antennas (see Figure 4-3)
- Donor antenna, and two dual-polarized subscriber antennas (one for main-beam and one for back beam; see Figure 4-4)
- Donor antenna, and one vertically-polarized subscriber antenna (see Figure 4-5)

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 4-2   Dual-Polarized Subscriber Antenna Configuration

+45" Port

-45" Port

Subscriber
Antenna

Top Jumper Cable
(TX1/RX Main Receive)

18 - 20

Feeder Cable
(TX/Main Receive)

Top Jumper Cable
(TX2/RX Diversity)

Donor
Antenna

Feeder Cable
(Diversity Receive)

Top Jumper
Cable (Donor)

Feeder Cable
(Donor)

To Lightning Arrestor Assembly

RT295904
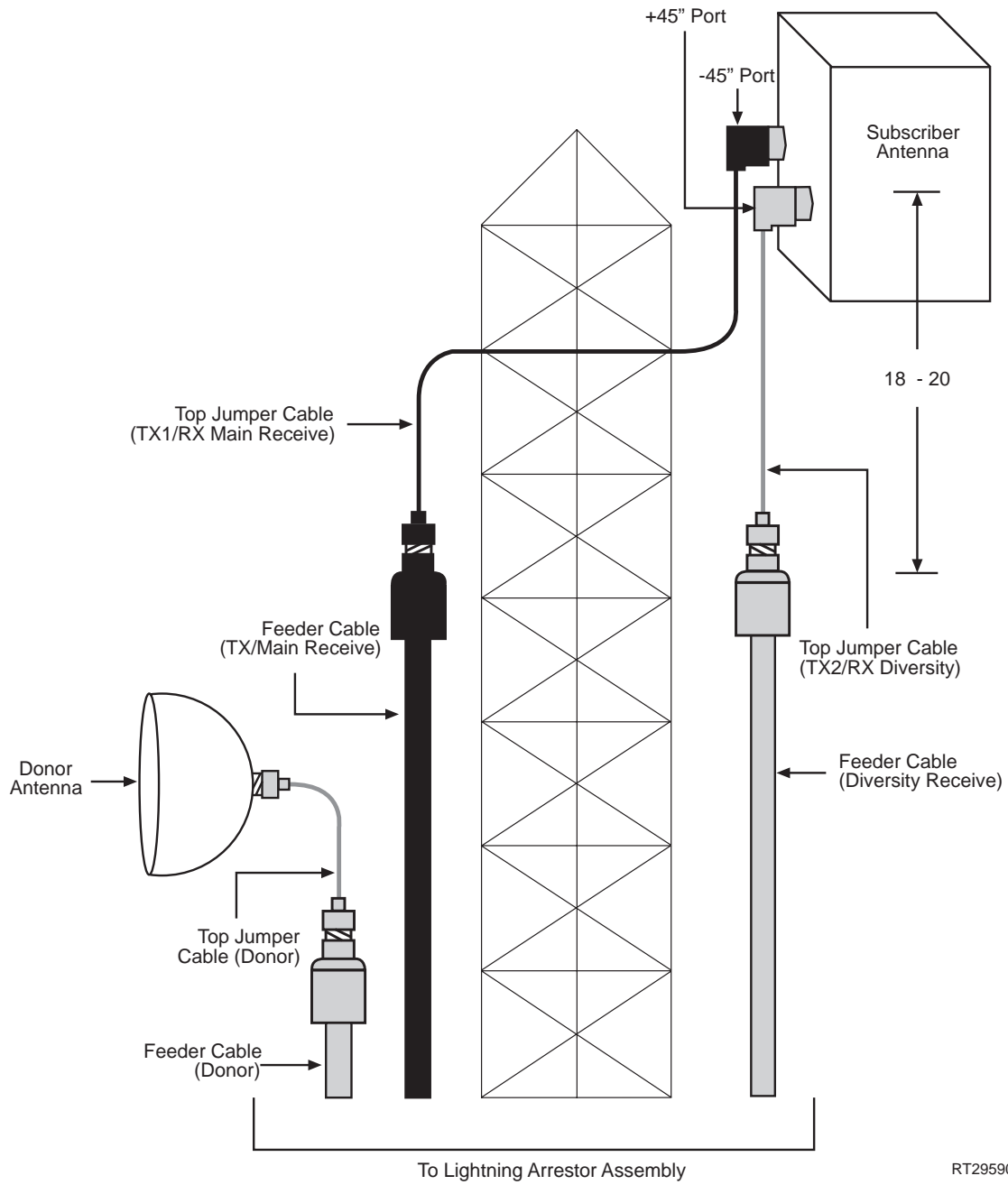
Figure 4-3   Two Vertically-Polarized Subscriber Antennas

Vertically
Polarized
Antennas

TX/RX
Main Antenna

RX Diversity
Antenna

18 - 20

Top Jumper Cable
(TX/Main Receive)

Feeder Cable
(TX1/RX Main Receive)

Top Jumper Cable
(TX2/RX Diversity)

Donor
Antenna

Feeder Cable
(Diversity Receive)

Top Jumper
Cable (Donor)

Feeder Cable
(Donor)

To Lightning Arrestor Assembly

RT295901
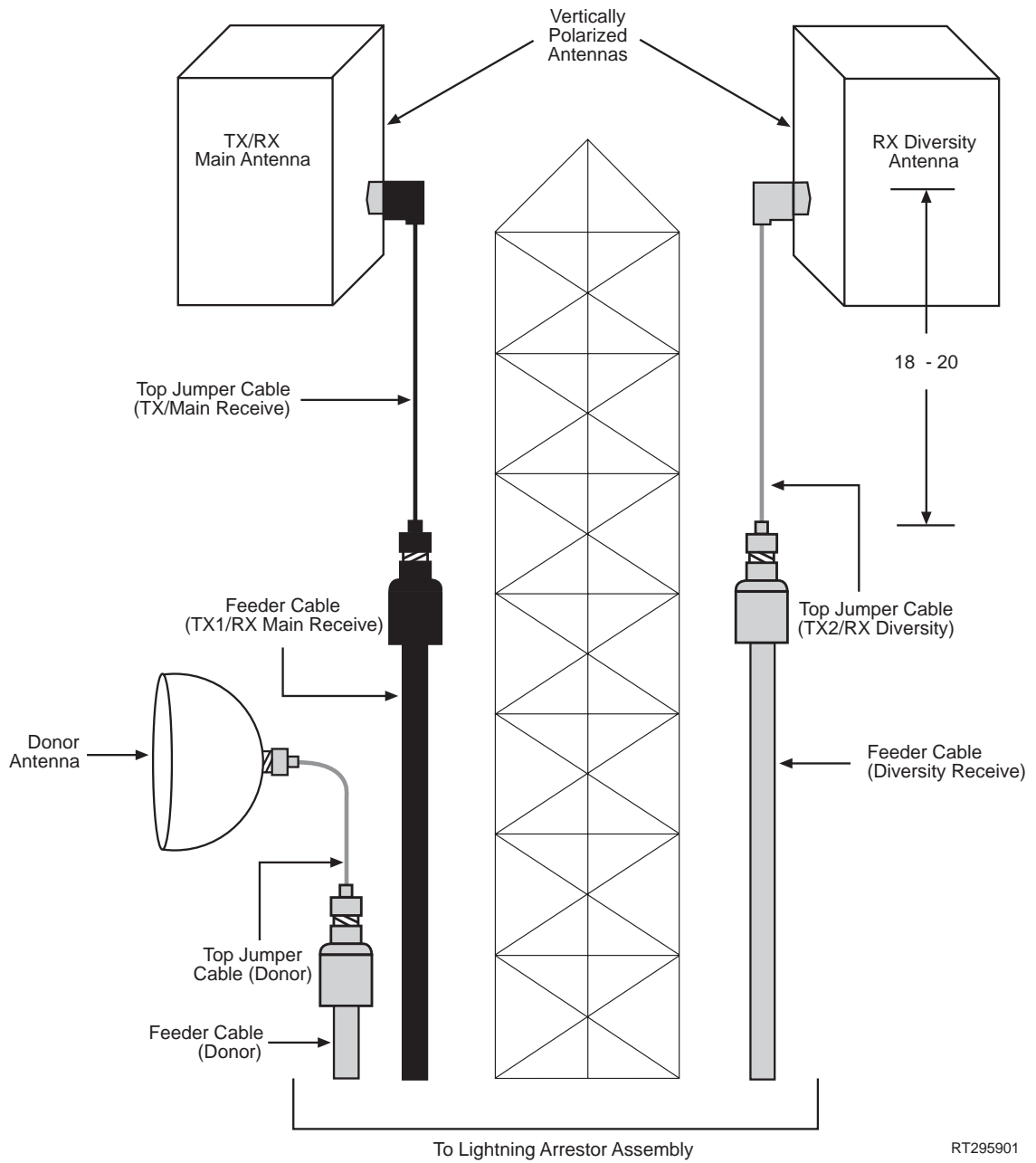
Figure 4-4   *Back-Beam Antenna Configuration*

ca. 4ft.

+45" Port

-45" Port

+45" Port

-45" Port

Back-Beam
Antenna

Main-Beam
Antenna

18 - 20

Top Jumper Cable
(Back-Beam Diversity Receive)

Top Jumper Cable
(Main-Beam TX
/Main Receive)

Top Jumper Cable
(Back Beam TX Main Receive)

Top Jumper Cable
(Main Beam
Diversity Receive)

Direct Port

Direct Port

Coupled Port

Coupled Port

Power Divider

Power Divider

Feeder Cable
(TX1/RX Main Receive)

Donor
Antenna

Feeder Cable
(Diversity Receive)

Top Jumper
Cable (Donor)

Feeder Cable
(Donor)

To Lightning Arrestor Assembly

RT295902

Figure 4-5   Non-Diversity Antenna Configuration

TBD
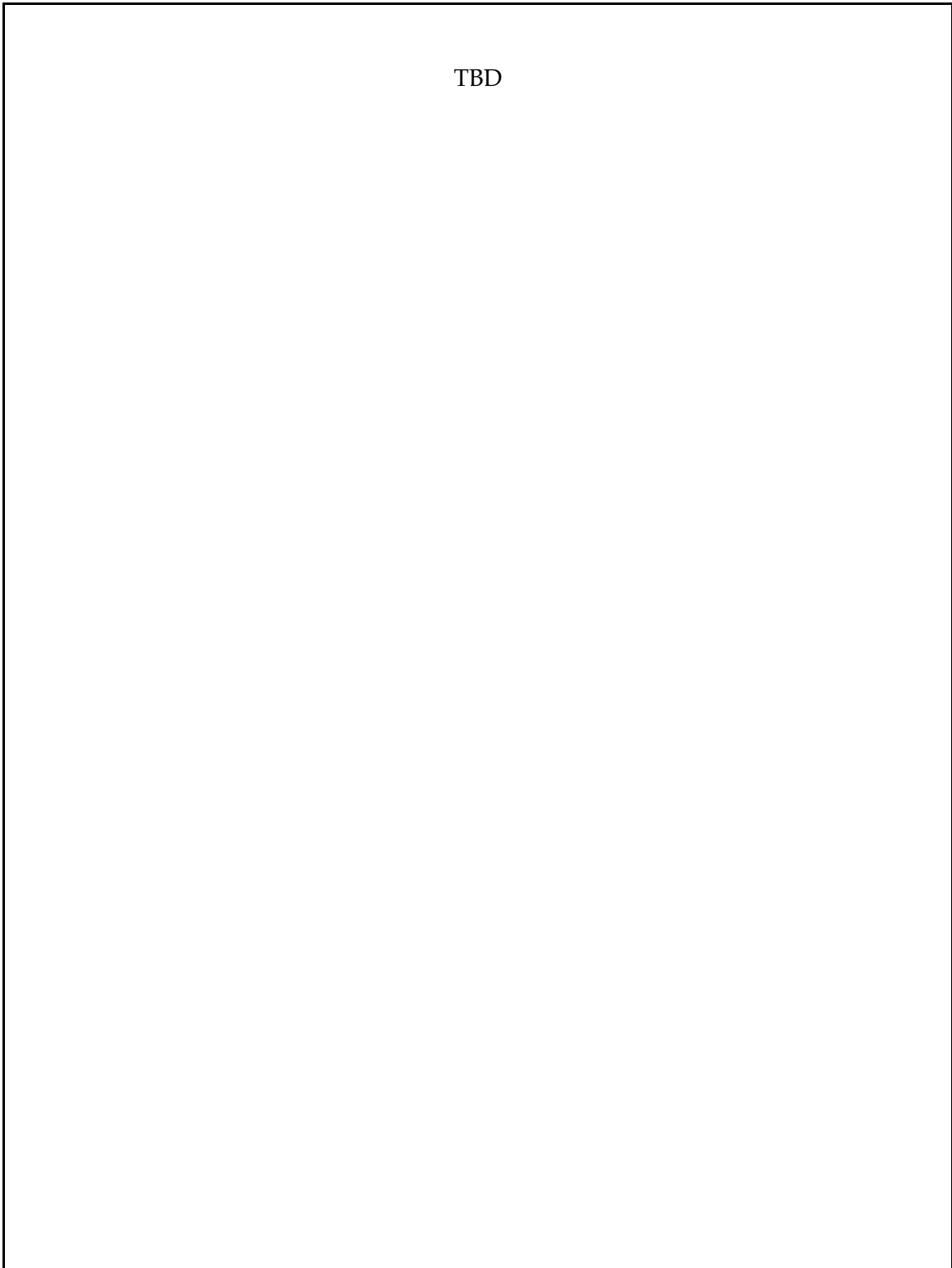
4.2   Antenna RF Cables

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 4-2, Figure 4-3, and Figure 4-4) require three(3) RF lines:

- One for the donor antenna
- One for the main subscriber antenna
- One for the diversity subscriber antenna, if applicable

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.

RTI further recommends installing CSX (800 MHz) or PCX (1900 MHz) PolyPhaser (or equivalent), micro lightning protection, which attaches directly to the type-N connectors of the repeater (see Figure 4-6). After the PolyPhaser is attached, water-proof both the arrestor and connector with Vapor Wrap and electrical tape as described in Section 4.0, "Installing Water Protection for Antenna Connections" on page 4-1.

Figure 4-6   *PSX PolyPhaser, for Lightning Protection*

RT130106

Figure 4-7 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 4-7   Lightning Arrestor, Grounding, and Repeater RF Cabling

TBD
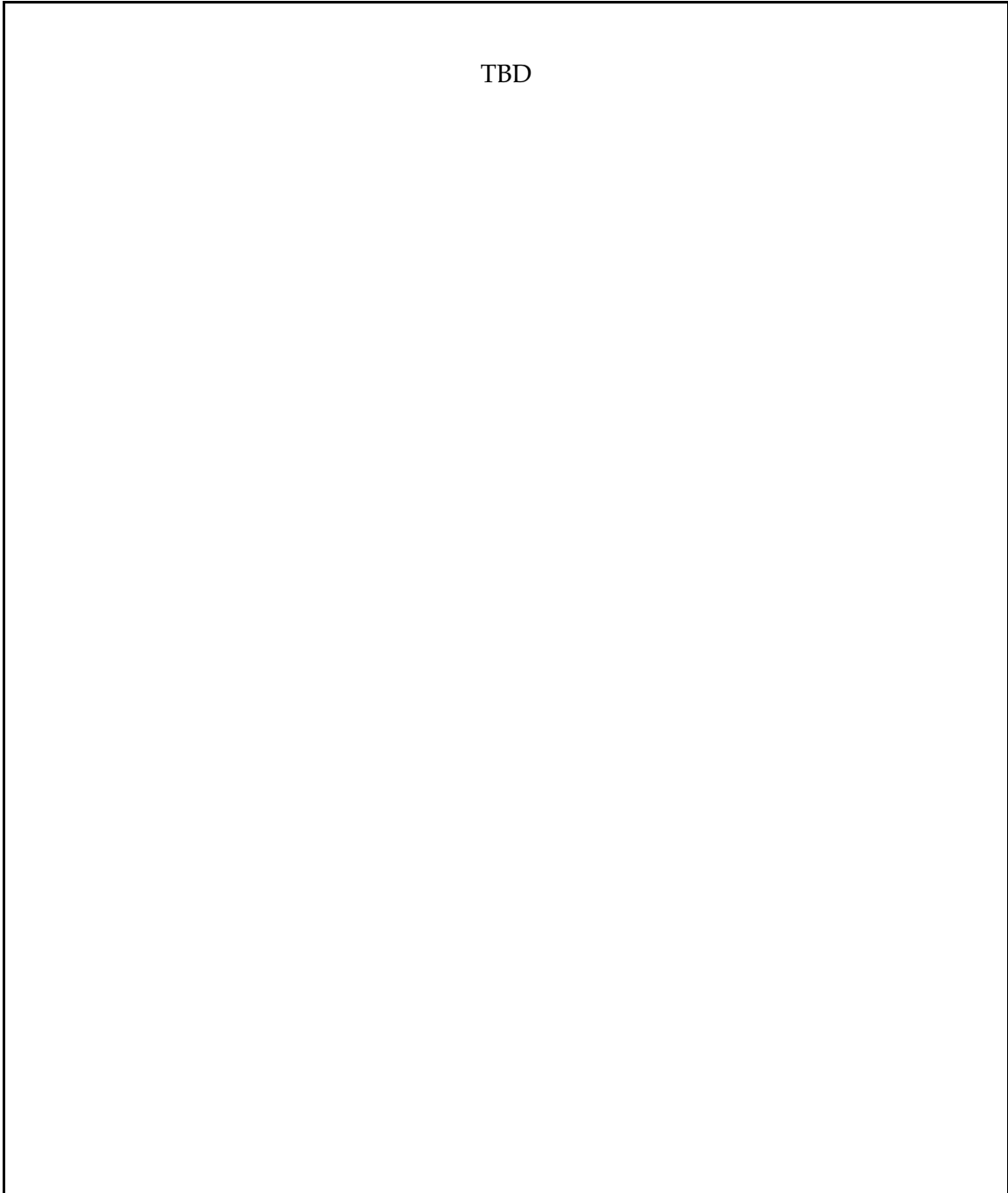
4.4   Back-Beam Antennas and Directional Couplers

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 4-4, 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.

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 4-8   *Equipment Setup for Measuring Antenna Isolation*
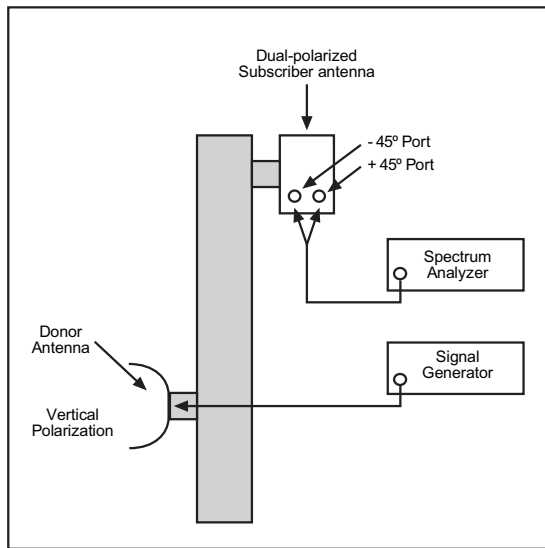
A: Full Receive Diversity
with Main-Beam Subscribe Antenna Only
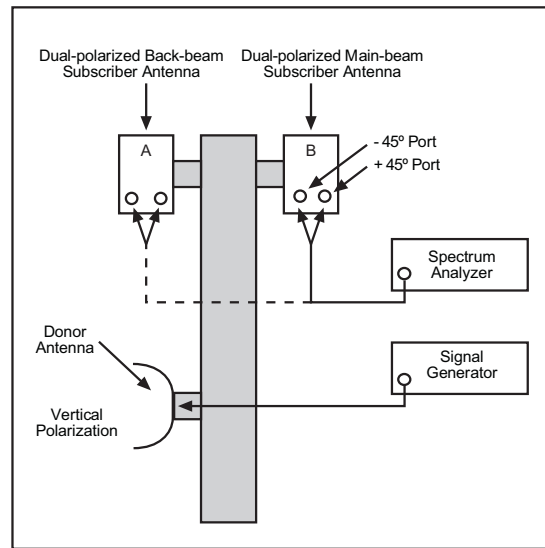
B: FULL RECEIVE DIVERSITY
WITH MAIN AND BACK-BEAM SUBSCRIBER ANTENNAS
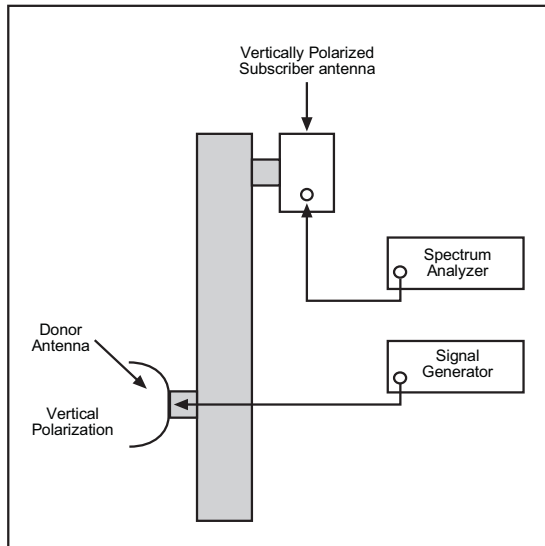
C: NON-DIVERSITY RECEIVE
WITH SINGLE VERTICALLY POLARIZED SUBSCRIBER ANTENNA
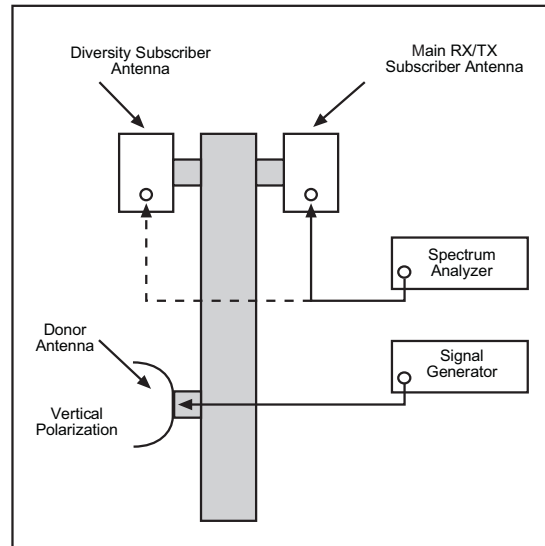
D: FULL RECEIVE DIVERSITY
WITH TWO VERTICALLY POLARIZED SUBSCRIBER ANTENNAS

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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 4-8 shows the equipment set-up for each antenna configuration.

Figure 4-8 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. So 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 4-9 shows all cables and equipment in place for measuring actual antenna isolation.

Figure 4-9   Antenna Isolation Measurement - Equipment Configuration
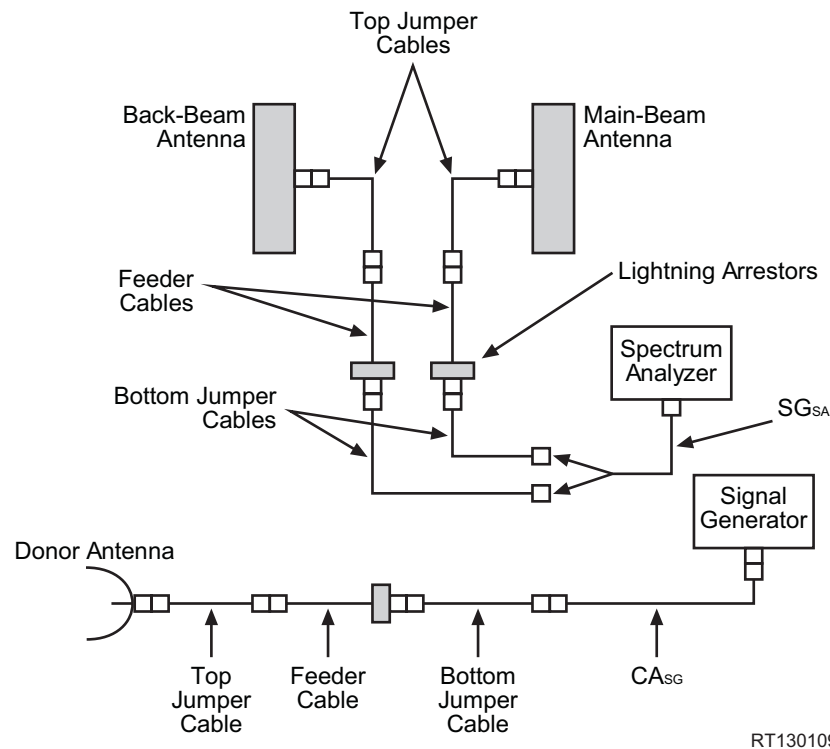
NOTE: If the repeater uses a back-beam antenna, you must measure antenna isolation from both ports of both antennas (four measurements). If the repeater uses only one antenna, only two isolation measurements are needed: one from the left port, and one from the right port, of the subscriber antenna.
In 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
PGEN	=	Output level of the signal generator (dBm)
LC-GEN	=	Loss of the signal generator cable (dB)
PSA	=	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	=	PGEN - LC-GEN + LC-SA - MAX(PSA(L), PSA(R))

Where:

PSA(L)	=	Spectrum analyzer level measured on the left antenna port.
PSA(R)	=	Spectrum analyzer level measured on the right antenna port.

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

PGEN	=	0 dBm
LC-GEN	=	1.0 dB
C-SA	=	1.0 dB
PSA(L)	=	-90 dBm
PSA(R)	=	-88 dBm
ISO	=	0 - MAX(-90 or -88) = 98 dB

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

In this example, the usable antenna isolation is 98 dB.

To help you calculate the minimum required antenna isolation, RTI provides a simple tool called Isolation Calculator, which is Tab 4 in the RTI Tools Design 97 Workbook.

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

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Mounting the Repeater 5

5.0   Installation Overview

RTI repeaters are designed for indoor or outdoor installation, and can be mounted onto 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.

RepeaterNet Craft software is required, throughout the physical installation of the repeater. Before installing the repeater, do the following:

1. Pre-load the Craft software onto the laptop computer that you will use at the installation site.

    See RepeaterNet Craft for the OA850C NR, for information about installing and using RepeaterNet software.

2. Retrieve the DB-9 cable from the Repeater Accessory Kit. Use this cable to connect the laptop with the repeater.

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

Figure 5-1 shows a typical repeater installation, with installed components.

Figure 5-1   *Typical Repeater Installation*

TBD
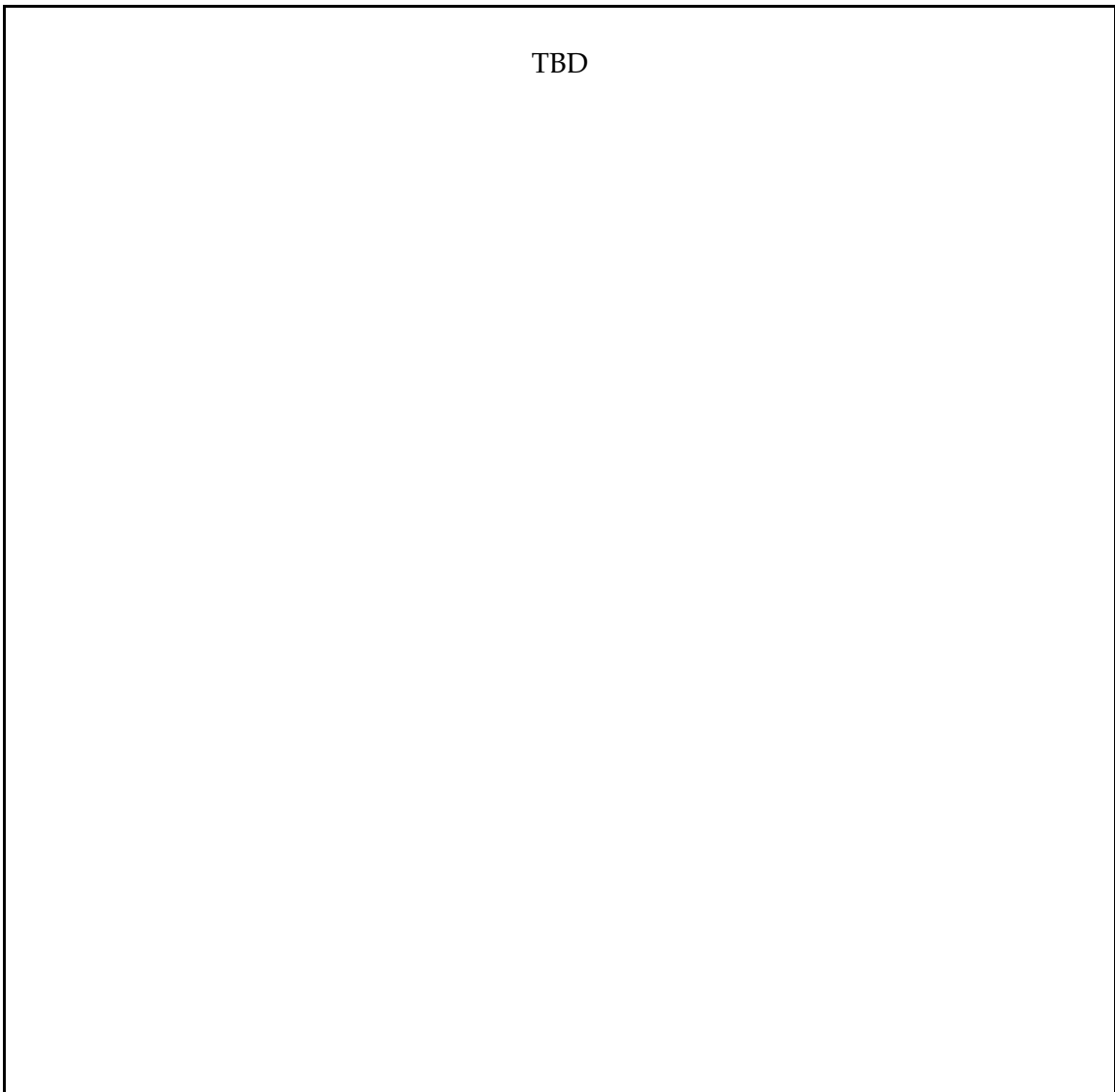
5.1 Planning and Mounting Associated Equipment and Planning

Mount the donor and subscriber antennas, the antenna coaxial cabling, and the optional Back-Up Power Supply (BUPS), before mounting and wiring the repeater.

If the repeater site requires two channels, install both a main (primary channel or F1) repeater, and a growth cabinet or F2 (to house the second channel). Be sure to allow enough space, either above or to the left of the main repeater, for mounting the growth cabinet. See Figure 5-12, Figure 5-13, and Figure 5-14.

5.2   Mounting the Repeater

Figure 5-2 shows a side view of the repeater, with the rear mounting bracket attached, as shipped from RTI. Use this detachable mounting bracket when installing a repeater on either a wall or a pole.

Figure 5-2   Rear Mounting Bracket with Unit - Side View

TBD

Figure 5-3 illustrates the bracket for mounting the repeater, and shows its dimensions. In both the wall-mounting and pole-mounting installation instructions that follow, this bracket is detached from the repeater, attached to the wall or pole, and then reattached to the repeater.

Figure 5-3   *Rear Mounting Bracket*

TBD
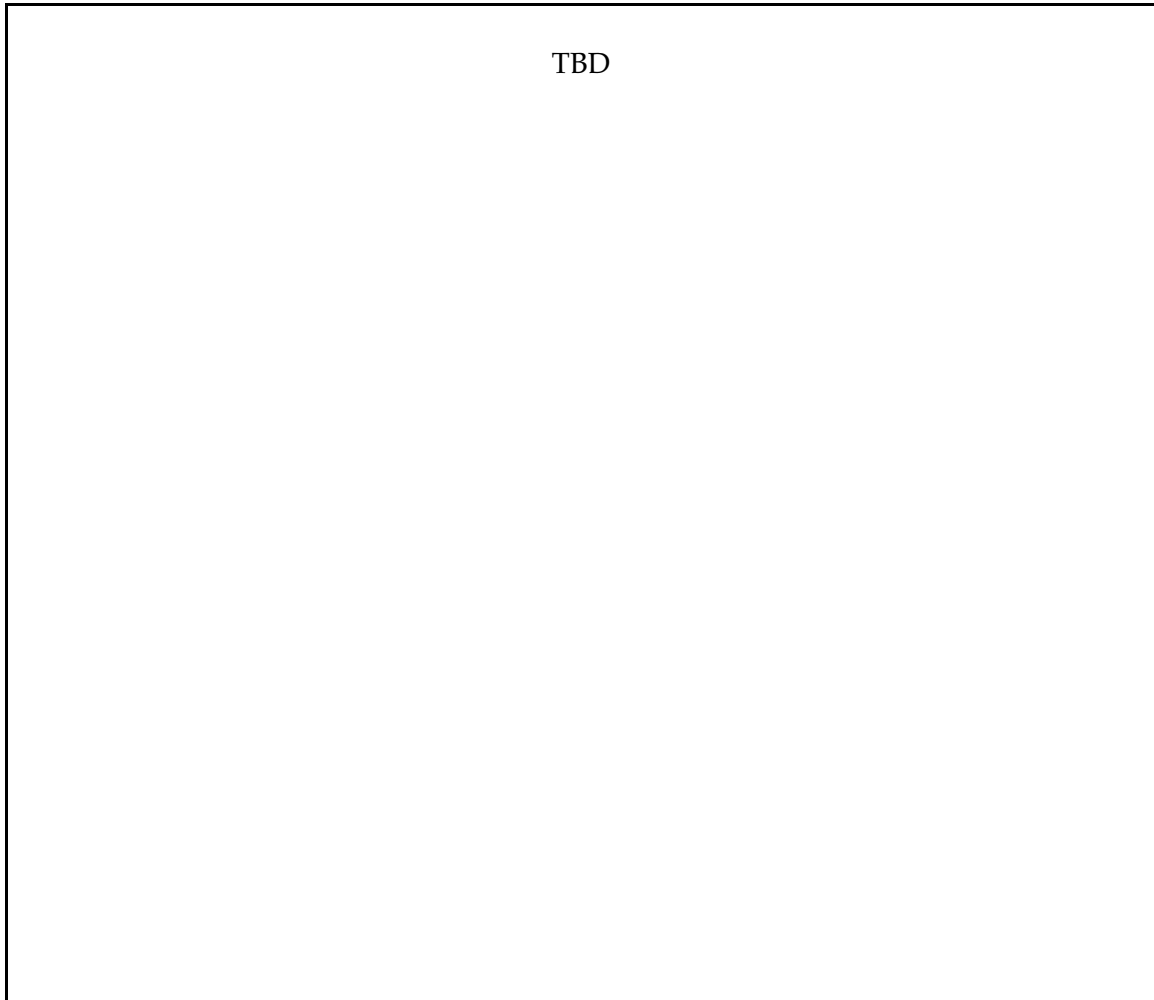
5.2.1 Wall Mounting

Hardware for wall-mounting a repeater includes the following:

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

To mount the repeater on a wall:

1. To separate the rear mounting bracket from the repeater, remove 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 (see Figure 5-2).

2. Using the mounting hardware (hex-head lag bolts, lock washers, and flat washers), secure the bracket to a wall, as shown in Figure 5-4.

Figure 5-4   Installing Rear Mounting Bracket on a Wall

TBD
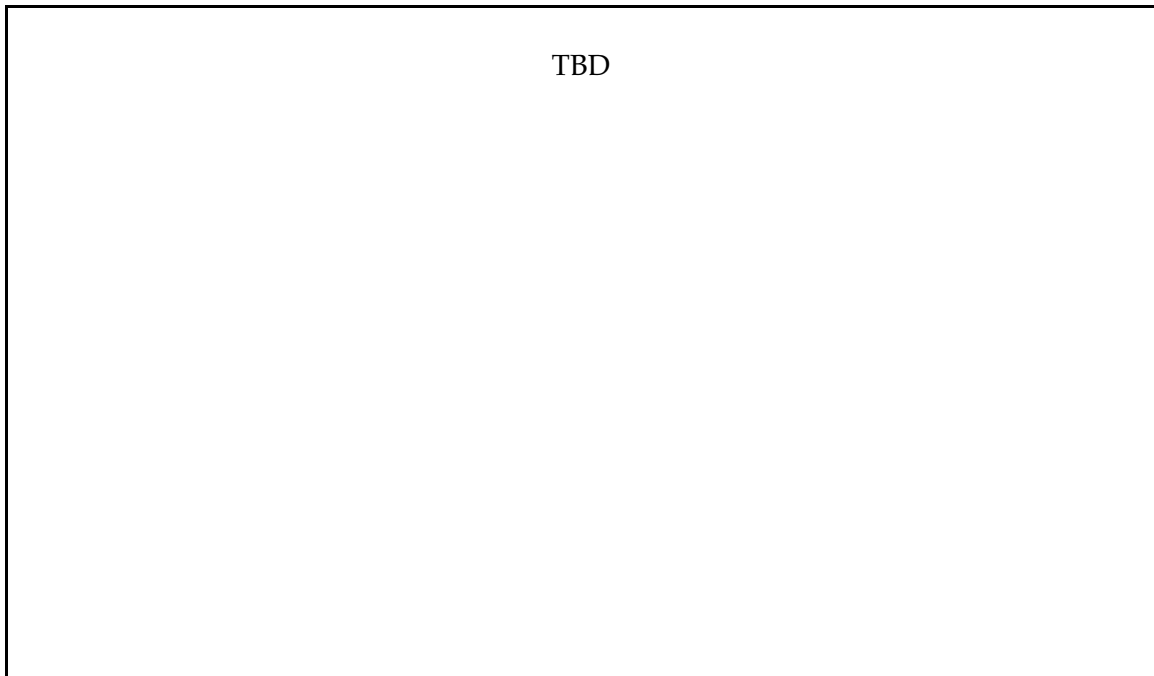
3. To set the repeater into the bracket, align the top of the repeater cabinet just above the top of the mounting bracket, so that the mounting bracket will fit inside the left and right walls of the repeater cabinet.
4. Slide the repeater cabinet downward, so that the guide bolt (on the repeater cabinet) slips into the guide slot (on the mounting bracket), as shown in Figure 5-5.

Figure 5-5   Guide Bolt and Slot

TBD
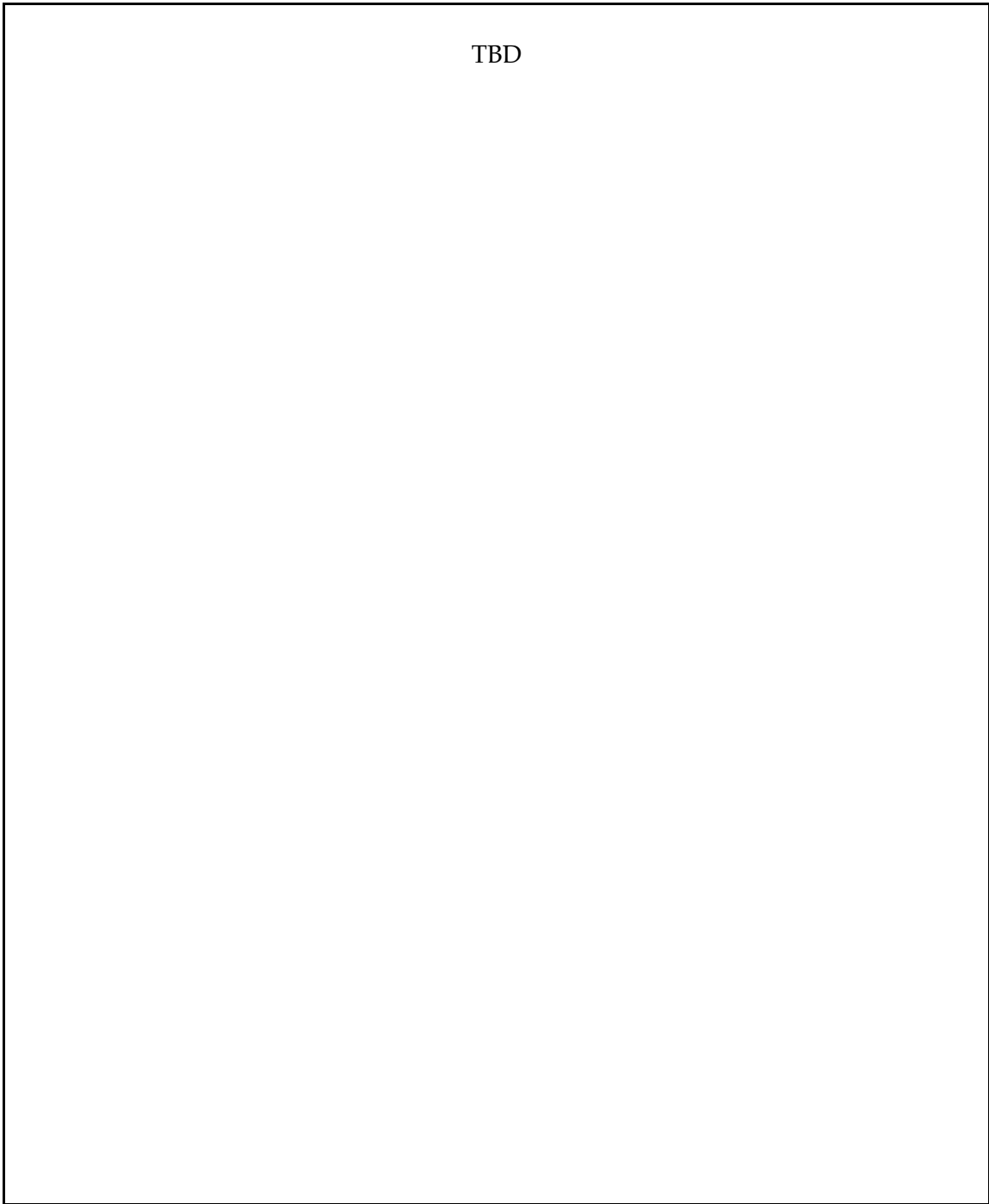
5. Replace the attachment bolts and washers, removed in Step 1. See Figure 5-6.

Figure 5-6   *Repeater Mounting and Hardware Placement*

TBD
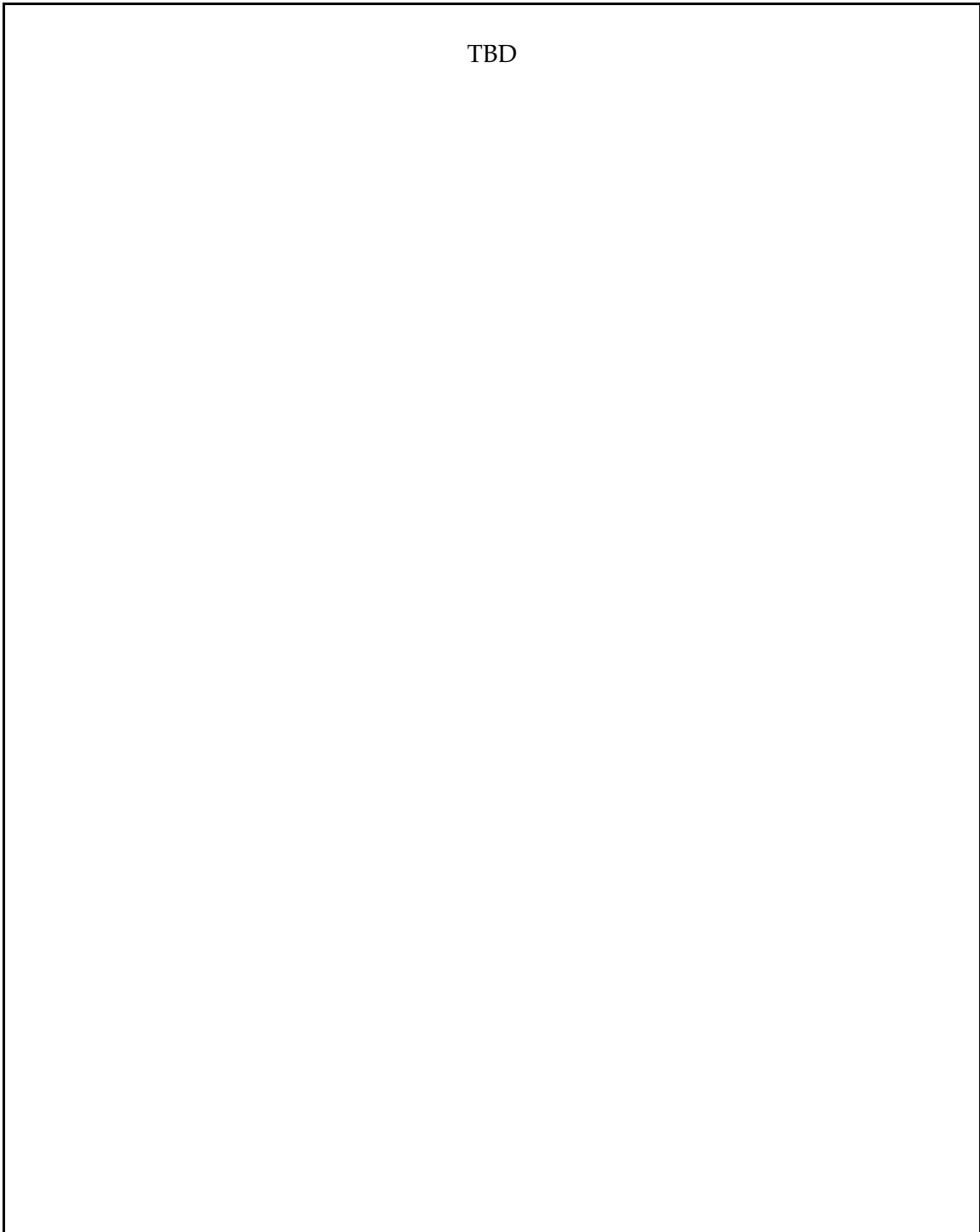
5.2.2   Pole Mounting

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

Pole installation requires the following materials:

- Pole mounting kit (available from Repeater Technologies). See Table 5-1.
- Banding kit (purchased separately; available from McMaster-Carr), for mounting the repeater on a concrete or metal pole. See Table 5-1.
- 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 usually 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 5-1 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.

NOTE: The process of pole-mounting a repeater requires two people.

Table 5-1   *Pole Mounting and Banding Kits*

Quantity	Item
Pole Mounting Kit (091-0215-01)	
1	Pole Mounting Channel
4	Bolts
4	Lock (Split) Washers
4	Flat Washers
4	Tapered Plug, .312D Hole
3/4-inch Banding Kit (Part No. 5653K12) (McMaster-Carr Supply Co., Los Angeles, CA, USA, Tel. # (562) 692-5911)	
1	Tightening-Crimping Tool
100 ft.	3/4-inch, Type 201 Stainless Steel Band
100	Stainless Steel Buckles
25	Stainless Steel Scru-Lockt Buckles
1	Carrying Case

To mount the repeater to a pole:

1. To separate the rear mounting bracket from the repeater, remove 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 (see Figure 5-2).

2. Using the hardware provided with the accessory kit, secure the rear mounting bracket to the two(2) pole brackets - see Figure 5-7.

Figure 5-7   Pole Mounting Hardware

Two 7/9" dia. holes for 3/4"
lag of thru-pole bolts

Pole
Mounting
Channel

4 x Plug

4 x Flat Washer

4 x Lock Washer

4 x Bolt
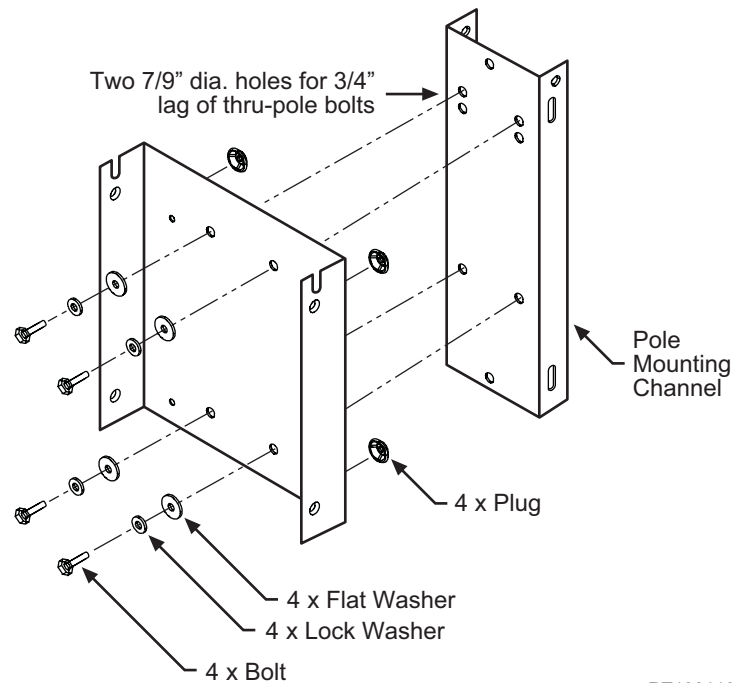
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3. Insert the four plugs provided, into the four outer holes in the rear mounting bracket.

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.

6. To set the repeater into the bracket, slide the guide bolt into the guide slot.

7. Secure the repeater to the bracket, using the security screws and washers, removed in Step 1.

Figure 5-8   Pole Mount - Side View

Lifting
Assist
Hole

3/4" Thru-pole
Bolts with Flat
Washers and
Locking Aero Nut

Pole
Mounting
Channel

Repeater
Mounting
Bracket

Banding
Straps

Pole or Mast

RT130117
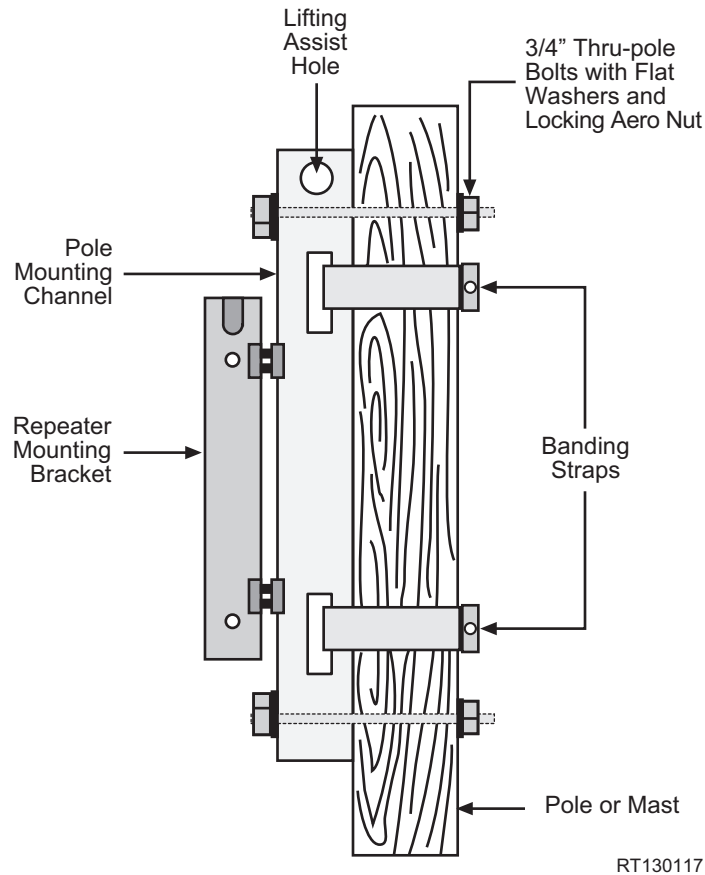
5.2.3   Grounding the Repeater

A Repeater Technologies application note, titled Installation Standards for Grounding Requirements (Document Number 650-0002-01, Rev. 2), provides detailed grounding information for RTI repeaters. Contact Repeater Technologies to receive a copy of this application note.

Installing the input power to the repeater includes installing the standard electrical service grounds. However, you must also make sure that the RC1920C Cabinet/Chassis is properly grounded to a water pipe or earth ground.

Each repeater cabinet (F1/Primary and F2/Growth) includes two external grounding lugs: one on the repeater cabinet, and one on the Entry Box under the cabinet, as shown in Figure 5-9.

Figure 5-9   *Location of Ground Lug on Primary Cabinet*
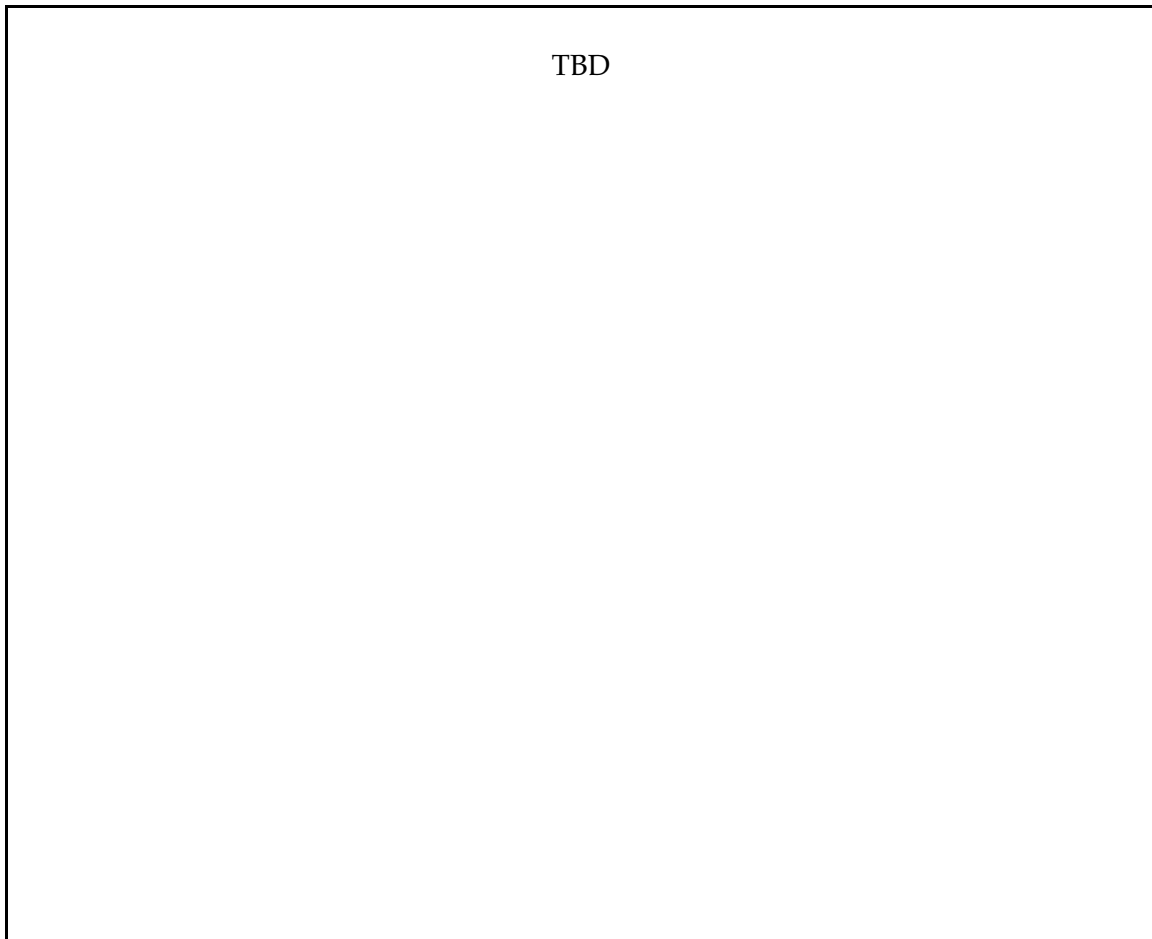
TBD

1. Connect number 6 (or larger) gauge AWG solid wire, to each 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 grounding wire, and forming it around corners, avoid making sharp bends in the wire. Use a generous radius for each wire bend.

Connect the screw-compression ground lug (located on the left exterior of the repeater's Entry Box) to a suitable earth ground - for example, to a copper ground rod, copper pipe, grounded steel building frame, or similar ground point. Use 2 to 7 mm, No. 6 to 2 AWG, copper wire - see Figure 5-10.

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

Figure 5-10   Typical System Ground

System

5 feet (2m) minimum
(soil type is a factor in
grounding depth
requirements)

Standard Ground Rod,
1/2 - inch diameter

RT130118
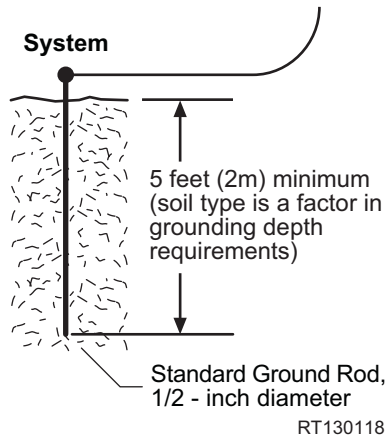
Figure 5-11   Wiring and Ground Connections, At Left Interior of Repeater Entry Box

TBD
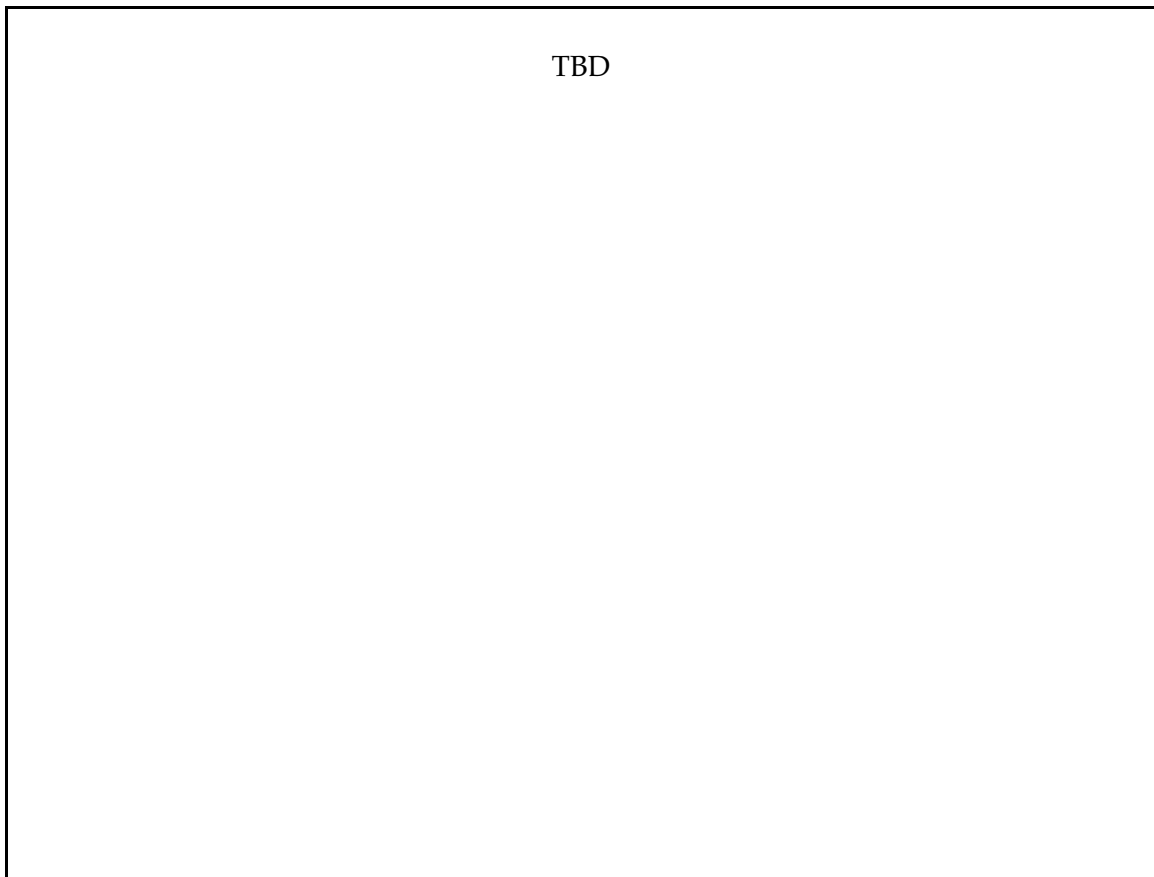
Figure 5-12   Vertically-Mounted Growth Cabinet Example

TBD
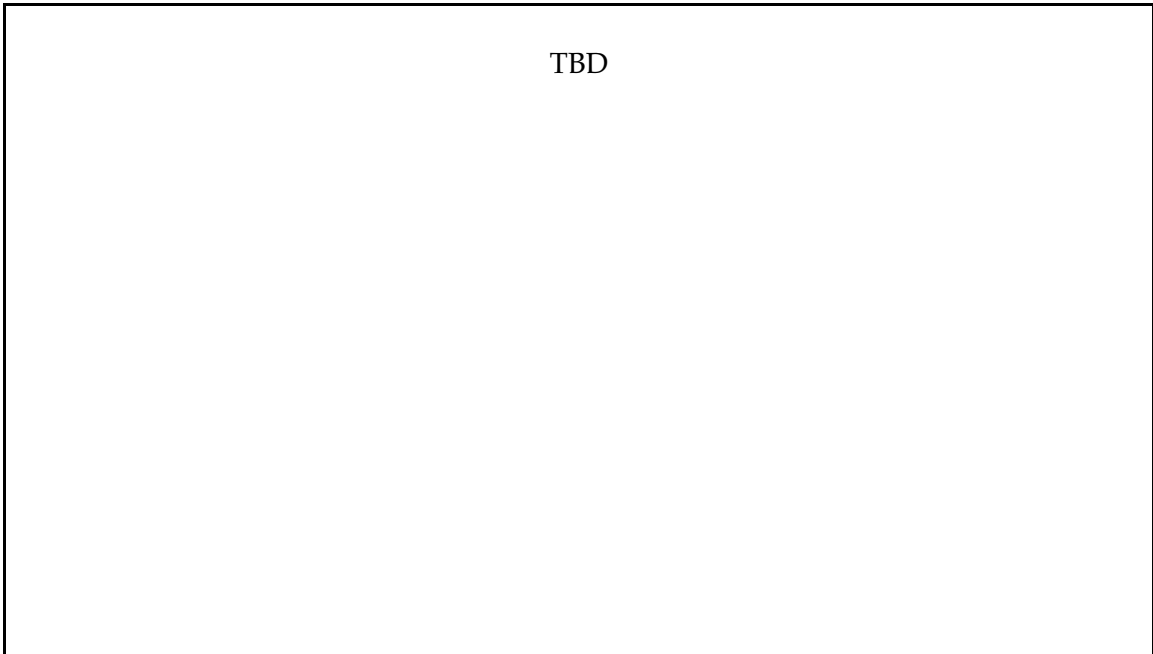
Figure 5-13   Horizontally-Mounted Growth Cabinet Example

TBD
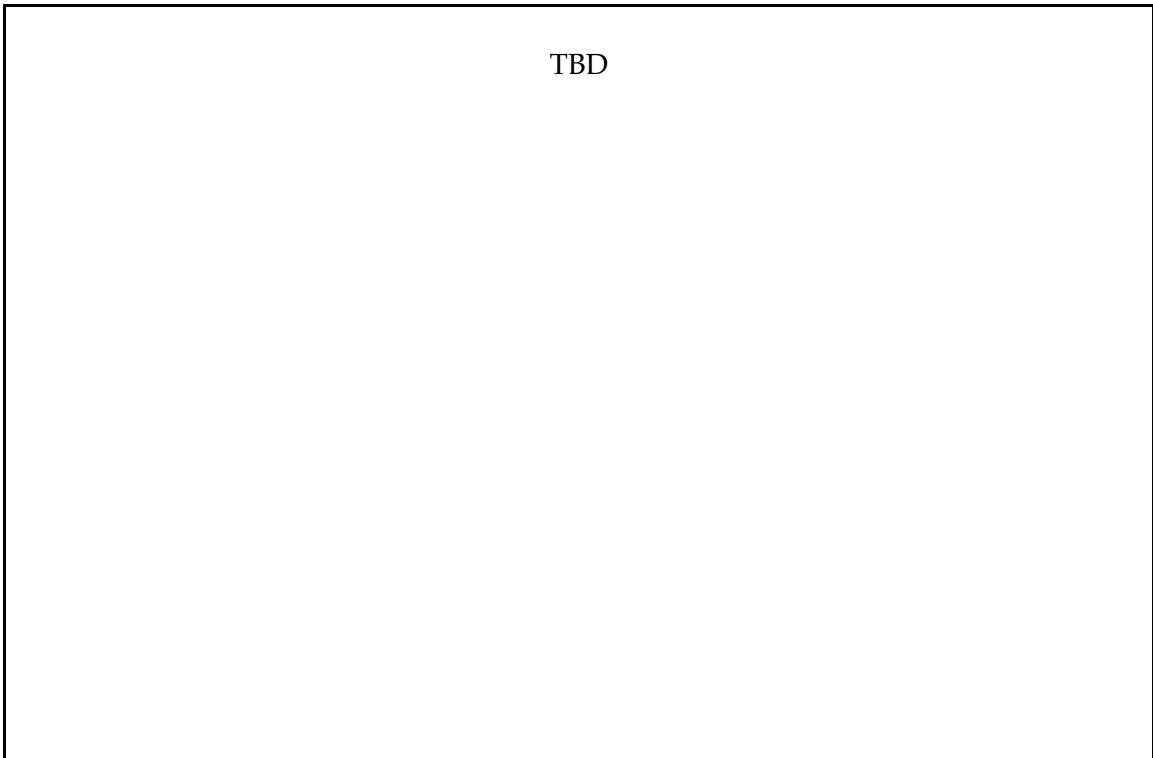
Figure 5-14   *Growth Cabinet Example with BUPS-25/80*

TBD
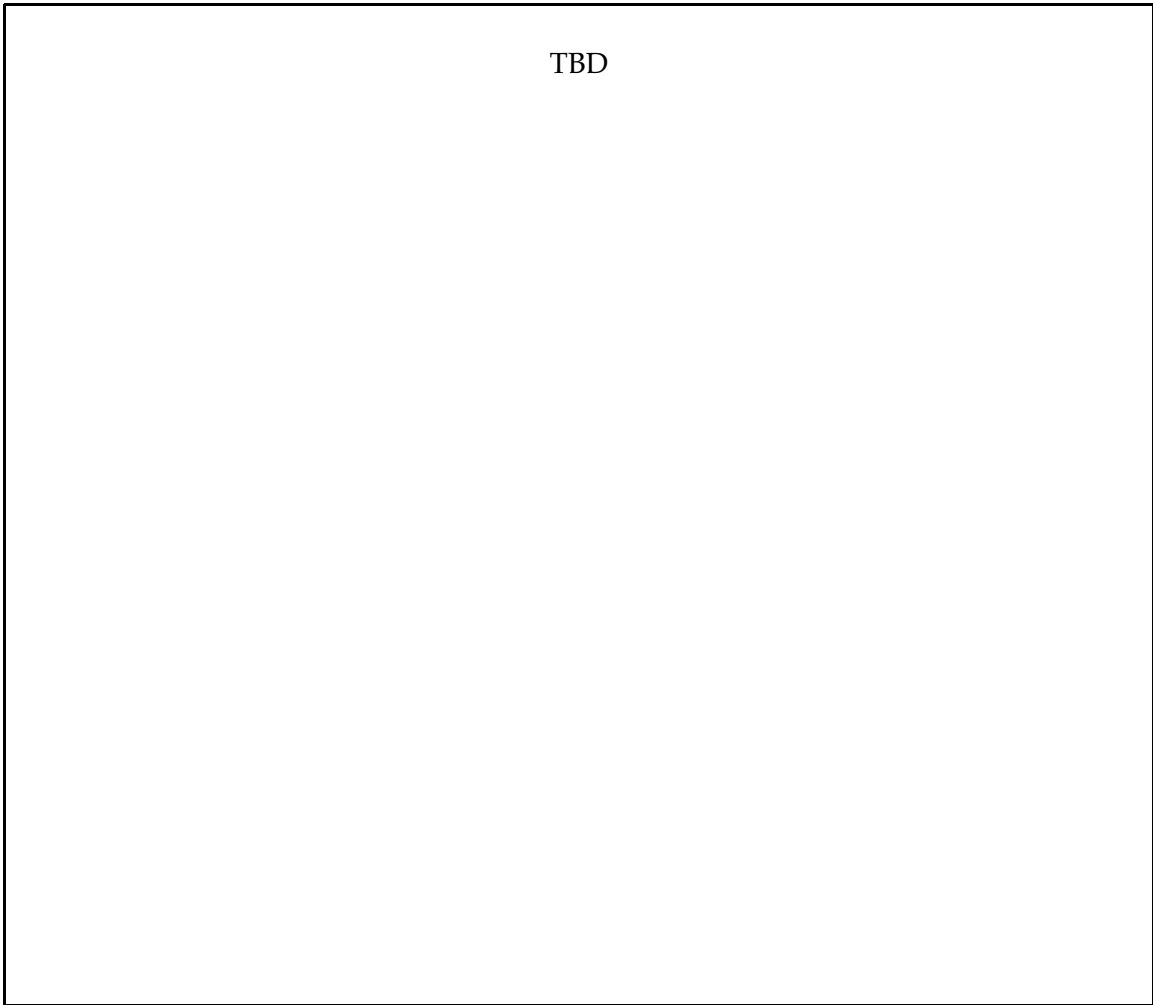
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Functional Repeater Test

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6.0 Overview

This chapter describes how to test a repeater from Repeater Technologies, Inc. (RTI), to verify that it is operating properly. You must perform these tests, before connecting the repeater to an antenna system.

6.1 Test Equipment Required

Table 6-1 lists test equipment and tools required for testing RTI repeaters. You can substitute equivalent equipment.

Table 6-1   Required Equipment for Testing Repeaters

Item	For Testing
Voltmeter, Fluke 75	Electrical Power
Type N (m) 50 ohm termination, 20 W (2 ea.)	Off Air
Laptop computer	RepeaterNet Configurations
Screwdriver, 1/4-inch, 6 mm blade	Wiring
Screwdriver, #1 Phillips	Wiring

6.2 Applying Power to the Repeater

NOTE: When RTI ships the repeater from the factory, the Forward and Reverse Power Amplifiers (PAs) are left in the Off position, and the secondary battery inside the repeater's Entry Panel is disconnected.

1. Remove the antenna cables, and terminate the repeater's antenna ports, using Type-N (male) 50 ohm terminations.

2. Apply primary power, AC or DC, as required.

Refer to Chapter 8, Connecting the Power Source, for detailed instructions.

NOTE: The Critical and Minor LEDs, located on the Repeater Entry Panel, should be On (illuminated).

3. Measure the AC/DC voltage at the Input Power connector in the Entry Panel.

Make sure that the voltage is within the operating parameters of the repeater:

- 110/230 Volts AC or +24 Volts DC

6.3 Checking Repeater Properties

NOTE: When the Repeater is shipped from the factory, the Subsystem Properties alarms are configured to the Default setting.

1. Connect the laptop computer to the Craft port, O1.
2. Start RepeaterNet.
3. Use the RepeaterNet Craft Admin program to connect the Repeater.

NOTE: You must perform this step before you can access the RepeaterNet Craft software.

Figure 6-1   *RepeaterNet Craft Software Start-up Screen*

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4.   Use the subsystem Properties screen to check the repeater.

To open a Properties screen, select a subsystem from the ***Configuration*** menu selections listed below:

- Front End
- Channel 1
- Channel 2
- Alarm Control Unit (ACU)
- Modem
- Cellular Phone
- Power System
- UPS
- Hardware Setting

6.3.1 Checking the Power System Properties

1. Select *Power System* from the *Configuration* menu, in the Main Control screen.

The *Power System Properties* screen opens, and lets you view or redefine the settings of the power system.

2. Select the *Alarm Setting* tab.

Table 6-2 shows the types of power system alarms, and their default severity settings.

Figure 6-2   Power System Properties Screen
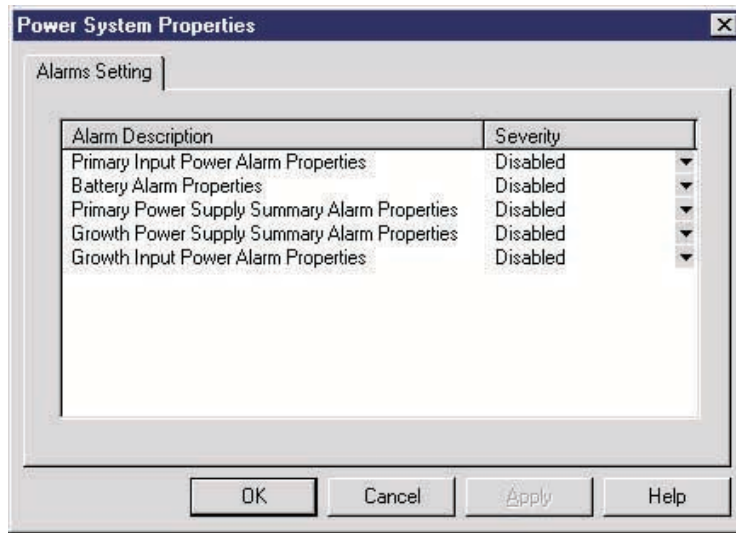
RT130132

Table 6-2   Power System Alarm Types and Default Settings

Alarm	Default Severity Setting
Input Power Alarm	Critical
Power Supply Alarm	Critical
PS Battery Alarm	Minor
Growth Box Input Power Alarm	Major
Growth Box Power Supply Alarm	Major

6.3.2 Checking the Front End Subsystem

1. Select *Front End* from the *Configuration* menu, in the Main Control screen.

The ***Front End Properties*** screen opens, and lets you view or redefine the settings of the front-end system. The Front End subsystem consists of the Forward Front End, Reverse Front End, and Diversity Front End.

Figure 6-3   Forward Front End Status Screen
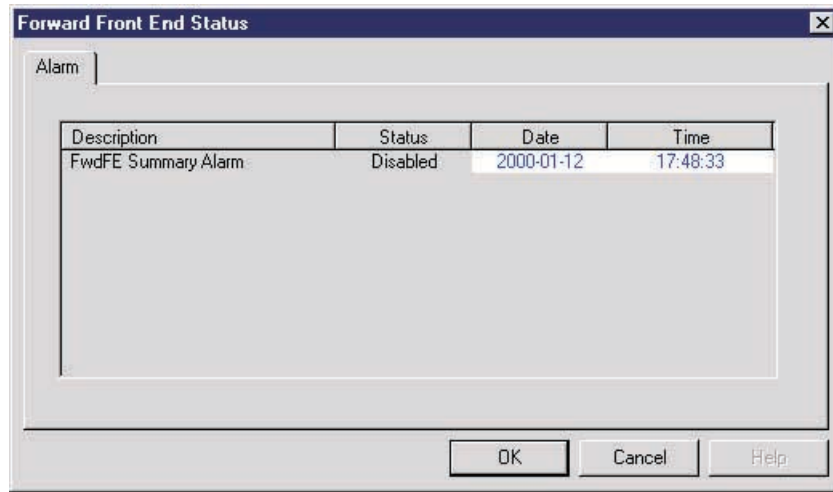
2.   Select the Alarm Setting tab.

Table 6-3 shows the types of front-end alarms, and their default severity settings.

Table 6-3   Front End Alarm Types, and Default Settings

Alarm	Default Severity Setting
Forward Front End Alarm	Critical
Reverse Front End Alarm	Critical
Diversity Front End Alarm	Critical

6.3.3 Checking Channel 1 or Channel 2

1. Select *Channel 1* (for standard repeaters) or *Channel 2* (for Growth-Box units only) from the *Configuration* menu, in the Main Control screen.

The *Channel Properties* screen opens, and lets you view or redefine one of the Channel Properties.

2. Select one of the following Channel Properties tabs:
   - Reverse PA
   - Forward PA
   - PA Control
   - Channel Reverse Filter
   - Channel Forward Filter
   - Channel #
   - Channel Gain

Figure 6-4   Channel Properties Screen, Reverse PA Tab
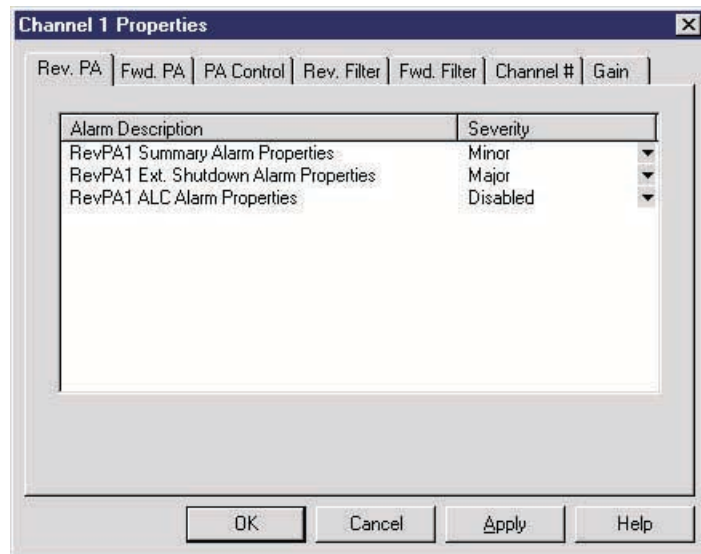
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Reverse PA Tab

Table 6-4 shows the types of Reverse Power Amplifiers alarms, and their default severity settings.

Table 6-4   Reverse Power Amplifier Alarm Types, and Default Settings

Alarm	Default Severity Setting
Reverse PA Alarm	Critical
Reverse PA1 Thermal	Major
Reverse PA Ext. Shutdown Alarm	Disabled

Forward PA Tab

Table 6-5 shows the types of Forward Power Amplifier alarms, and their default severity settings.

Figure 6-5   Channel Properties Screen, Forward PA Tab
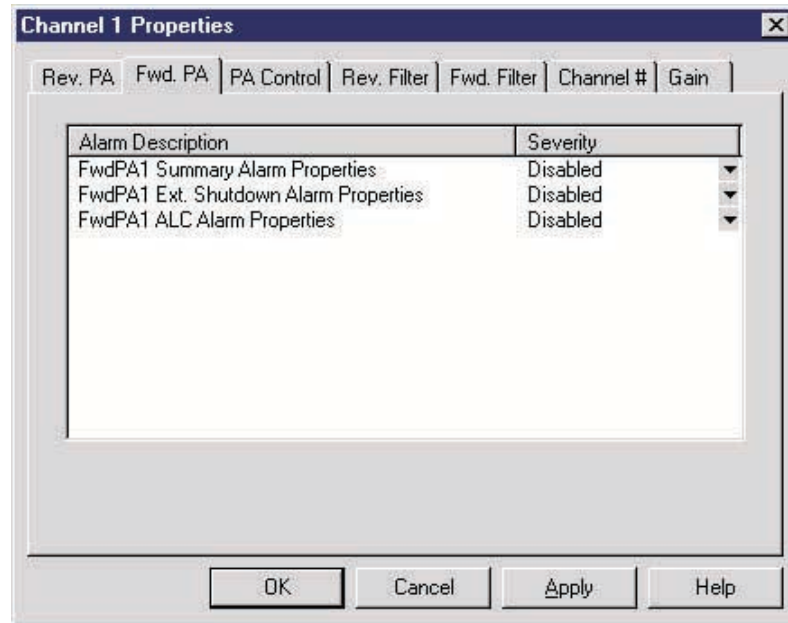
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Table 6-5   Forward Power Amplifier Alarm Types, and Default Settings

Alarm	Default Severity Setting
Forward PA Alarm	Critical
Forward PA1 Thermal	Major
Forward PA Ext. Shutdown Alarm	Disabled

PA Control Tab

The **Channel Control** tab provides a switch to turn **PA** (Power Amplifier) power either **On** or **Off**.

1. Set both the **Forward PA** and **Reverse PA** to **On**.
2. Check that the **Channel 1 Forward** and **Channel 1 Reverse** Power Amplifier icons, on the Main Control screen, both turned **Green**.

Figure 6-6   Channel Properties Screen, Channel PA Tab
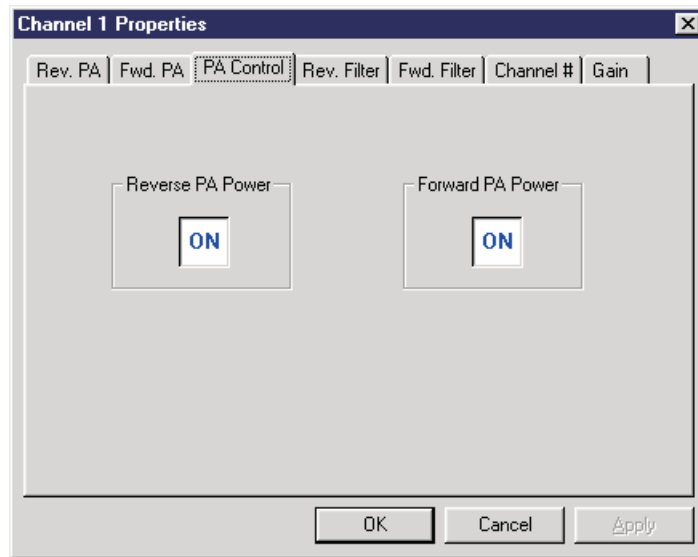
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Channel Reverse Filter Tab

Table 6-6 shows the types of Channel Reverse Filter alarms, and their default severity settings.

Table 6-6   *Channel Reverse Filter Alarm Types, and Default Settings*

Alarm	Default Severity Setting
CSF 1 Rev Alarm	Event

Channel Forward Filter Tab

Table 6-7 shows the types of Channel Forward Filter alarms, and their default severity settings.

Figure 6-7 Channel Properties Screen, Channel Forward Filter Tab
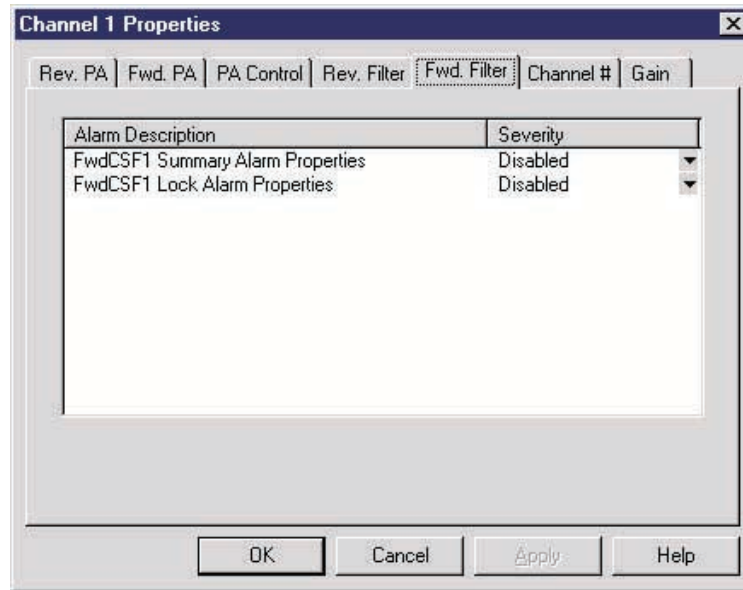
RT130137

Table 6-7 Channel Forward Filter Alarm Types, and Default Settings

Alarm	Default Severity Setting
CSF 1 Fwd Alarm	Event

Channel # Tab

The *Channel #* tab lets you check the operating channel for either Channel 1 or 2. After you select a channel, the *RepeaterNet Craft* software displays the corresponding frequencies.

Figure 6-8   Channel Properties Screen, Channel # Tab
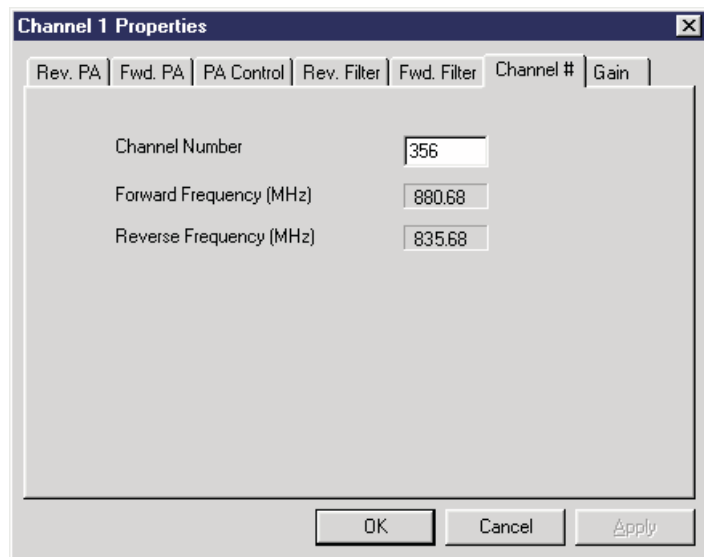
RT130138

Channel Gain Tab

The ***Channel Gain*** tab lets you change the Forward and Reverse gain of the currently-selected channel. Use the following procedure to adjust Forward PA or Reverse PA Gain.

1. Click the *Gain* tab.
2. Press and hold the mouse button, and drag the horizontal sliders to the defined forward and reverse gain.
3. Click Apply (to set the channel gain and leave the form open) or OK (to set the channel gain and close the form).

The Gain value box (centered under each slider) displays the selected value.

Figure 6-9   Channel Properties Screen, Channel Gain Tab
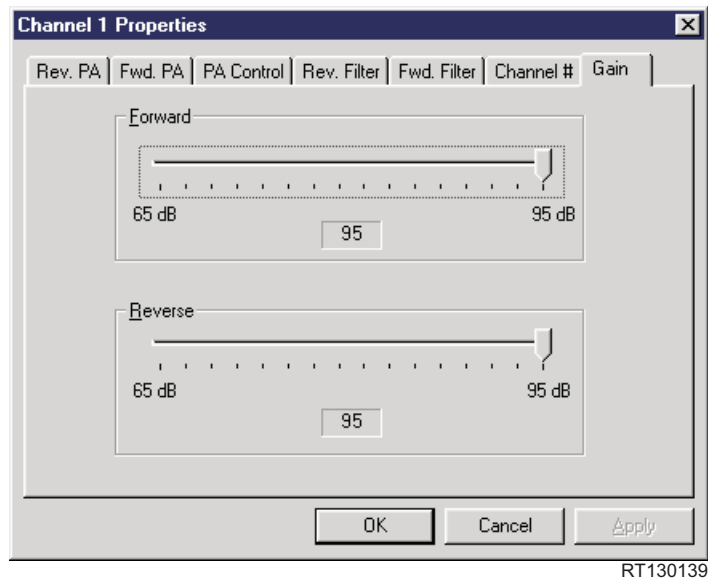
RT130139

6.3.4   Checking the Alarm Control Unit (ACU)

1. From the *Configuration* menu in the Main Control screen, select *ACU*.

The ACU Properties screen opens. This screen includes the following tabs:

- I/O Descriptions
- I/O Control
- Alarms
- DC Voltage Alarm Threshold

2. Use the *I/O Description* and *I/O Control* tabs, to check external equipment that is connected to the RTI repeater.

Figure 6-10   ACU Properties Screen, Alarms Tab
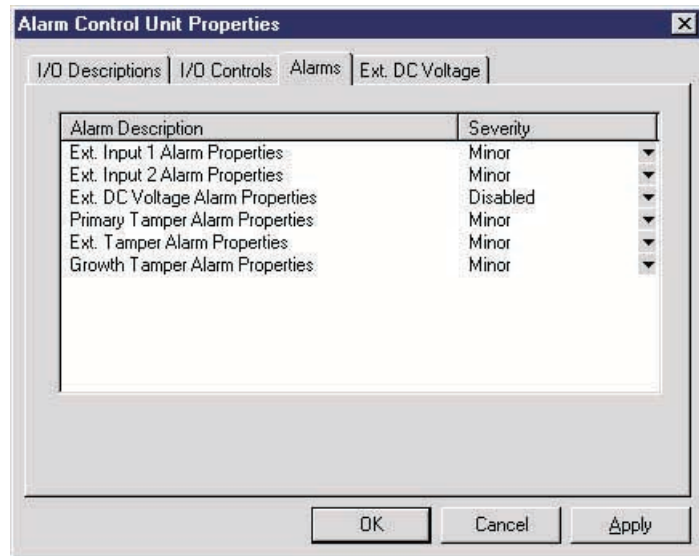
RT130140

ACU Alarm Tab

Table 6-8 shows the types of Alarm Control Unit alarms, and their default severity settings.

Table 6-8   Alarm Control Unit Alarm Types, and Default Settings

Alarm	Default Severity Setting
Ext. Input 1 Alarm	Disabled
Ext. Input 2 Alarm	Disabled
Temp Alarm	Minor
Tamper Alarm	Major
Analog Input Alarm	Disabled
External Growth Box Alarm	Major

NOTE: If the repeater does not have a Growth Box attached, all Growth Box alarms are disabled.

Open the Repeater Main door, to cause a Tamper alarm. The ACU icon changes from Green to Yellow.

6.3.5 Checking Modem Properties

1. From the Main Control screen, select the *Configuration* menu.
2. From the *Configuration* menu, select *Modem*.

The *Modem Properties* screen opens. This screen includes the following tabs:

- Alarm Setting
- Modem Properties
- Pager Setting

Alarm Setting Tab

Table 6-9 shows the types of Modem alarms, and their default severity settings.

Figure 6-11   Modem Properties Screen, Alarms Tab
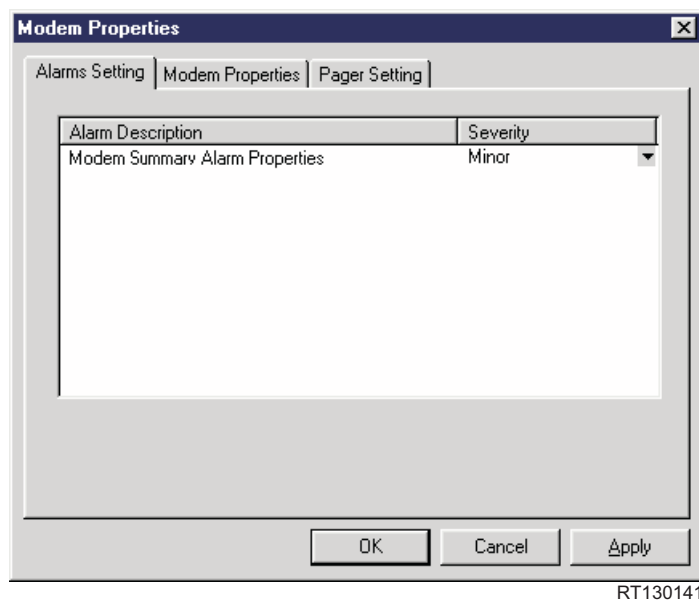
RT130141

Table 6-9   Modem Alarm Types, and Default Settings

Alarm	Default Severity Setting
Modem Alarm	Minor

NOTE: If the repeater does not have a modem, the Modem Properties alarm is disabled.

Modem Properties Tab

The *Modem Properties* tab lets you check the values for the *Setup, Phone Number,* and *Call Attempts*. You can use these values only if you are using RepeaterNet Network Management System (NMS).

Figure 6-12   Modem Properties Screen, Modem Properties Tab
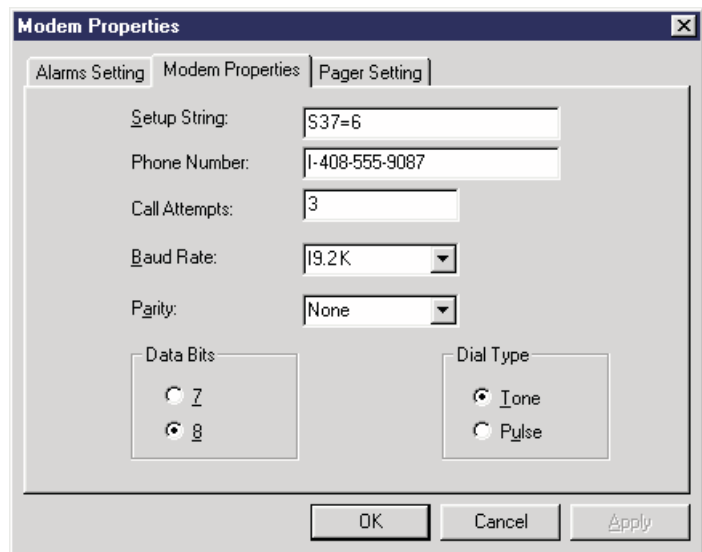
RT130142

Pager Setting Tab

The ***Pager Setting*** tab lets you check the value for the ***Pager Number, Call Attempts, Repeater Number,*** and ***Minimum Alarm Severity.***

Figure 6-13   Modem Properties Screen, Page Setting Tab

RT130143
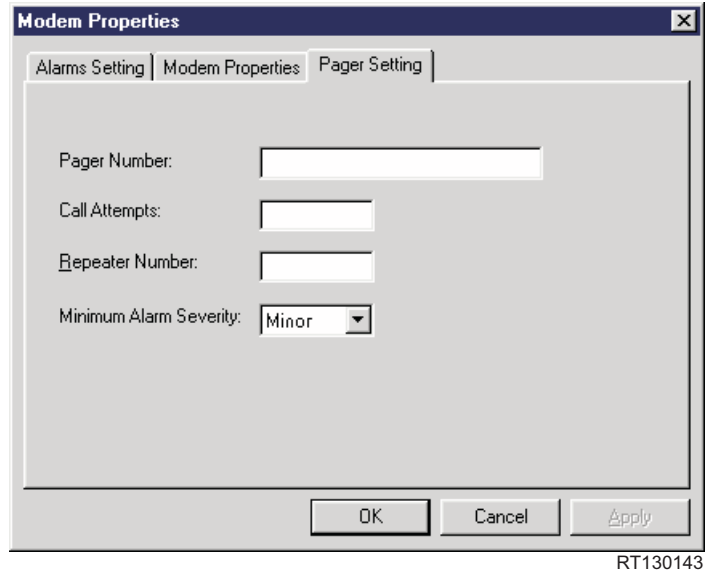
6.3.6   Checking Cell Phone Properties

1. From the Main Control screen, select the **Configuration** menu.
2. From the **Configuration** menu, select **Cell Phone**.

The *Cell Phone Properties* screen opens. Table 6-10 shows the types of Cell Phone alarms, and their default severity settings.

Figure 6-14   Cellular Phone Properties Screen

RT130144
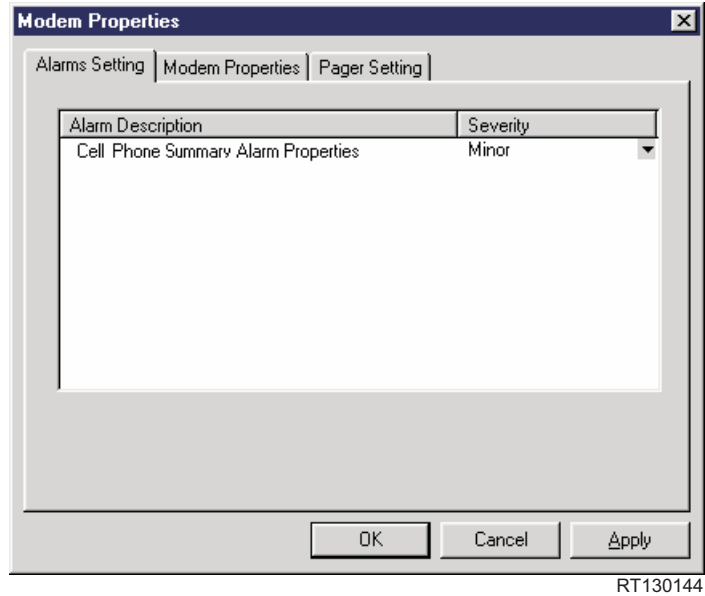
Table 6-10   Cell Phone Alarm Types, and Default Settings

Alarm	Default Severity Setting
Modem Alarm	Minor

NOTE: If the repeater does not have a cellular phone, the Cell Phone Properties alarm is disabled.

6.3.7   Checking Back-Up Power System (UPS) Properties

1. From the Main Control screen, select the *Configuration* menu.

2. From the *Configuration* menu, select *UPS*.

The *UPS Properties* screen opens.

Table 6-11 lists the Back-Up Power System alarm types, and their default severity settings.

Table 6-11   Back-Up Power System Alarm Types, and Default Settings

Alarm	Default Severity Setting
AC Fail Alarm	Disabled
Low Battery Alarm	Disabled
High Battery Alarm	Disabled
Charger Fail Alarm	Disabled
UPS Summary Alarm	Disabled
UPS Tamper Alarm	Disabled

6.4   Preparing the Repeater for Operation

After you successfully complete all of the foregoing steps, the repeater is ready to place into service. Proceed as follows:

1. Enter the PA control screen, and turn off the forward and reverse Power Amplifiers (see Figure 7-16).

2. Remove the terminations from the repeater's antenna ports.

3. Reconnect the antenna cables.

Proceed to chapter 7, Connecting External Alarms, for information about connecting external alarms. Then see chapter 8, Connecting the Power Source, for the final connection of primary power (final configuration of the repeater).

NOTE: The output power of the repeater can approach 7 to 8 Watts (39 dBm), under some circumstances. The directional couplers used must have at least 30 dB coupled ports, to allow direct connection to a spectrum analyzer.

Figure 6-15   PA Control Screen

RT130136
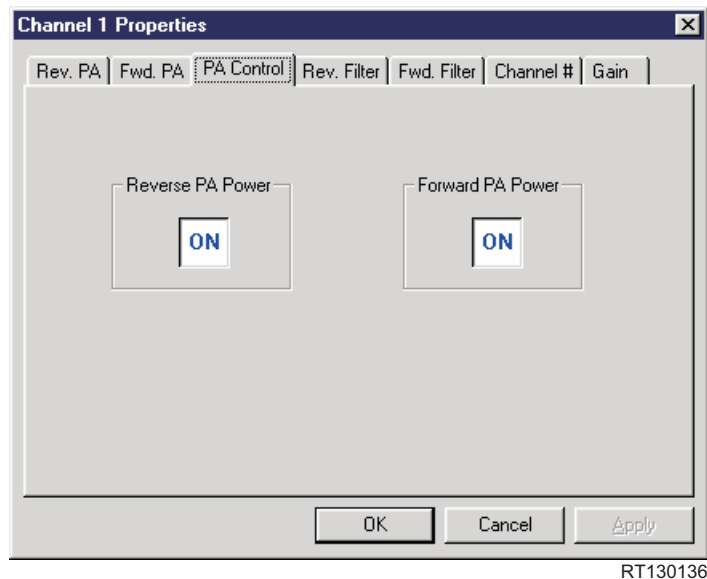
Connecting External Alarms

7

7.0   Overview

This chapter describes how to connect external equipment that sends a visual or audible signal, whenever an alarm condition occurs at a repeater site.

7.1   Alarm and Control Wiring

Figure 7-1 shows the external alarm inputs and outputs connectors for an RTI repeater.

- Use Connector J2 to wire alarms from the Back-Up Power Supply (BUPS) to the repeater.
- Use Connector J1 for digital inputs to custom external alarms, or for digital outputs to remotely-controlled devices at the repeater site. You can also use this connector for external shutdown of the forward and reverse power amplifiers, if required.
- Connector J23 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.
- Connector J22 provides three independent relays, with contact sets in standard 1C form. Each relay is driven by specific summary alarms that the repeater generates.

  For example, one relay activates whenever the repeater generates any critical alarm. Similarly, the second relay activates whenever the repeater generates any major alarm, and the third activates on any minor alarm.

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

Figure 7-1 shows the location of these connectors on the repeater. The plugs are actually removable terminal blocks. To connect to these terminals, use the following procedure.

1. Remove the appropriate terminal block.

Figure 7-1 shows connector (terminal block) J1 removed.

Figure 7-1   Input/Output Terminals

TBD
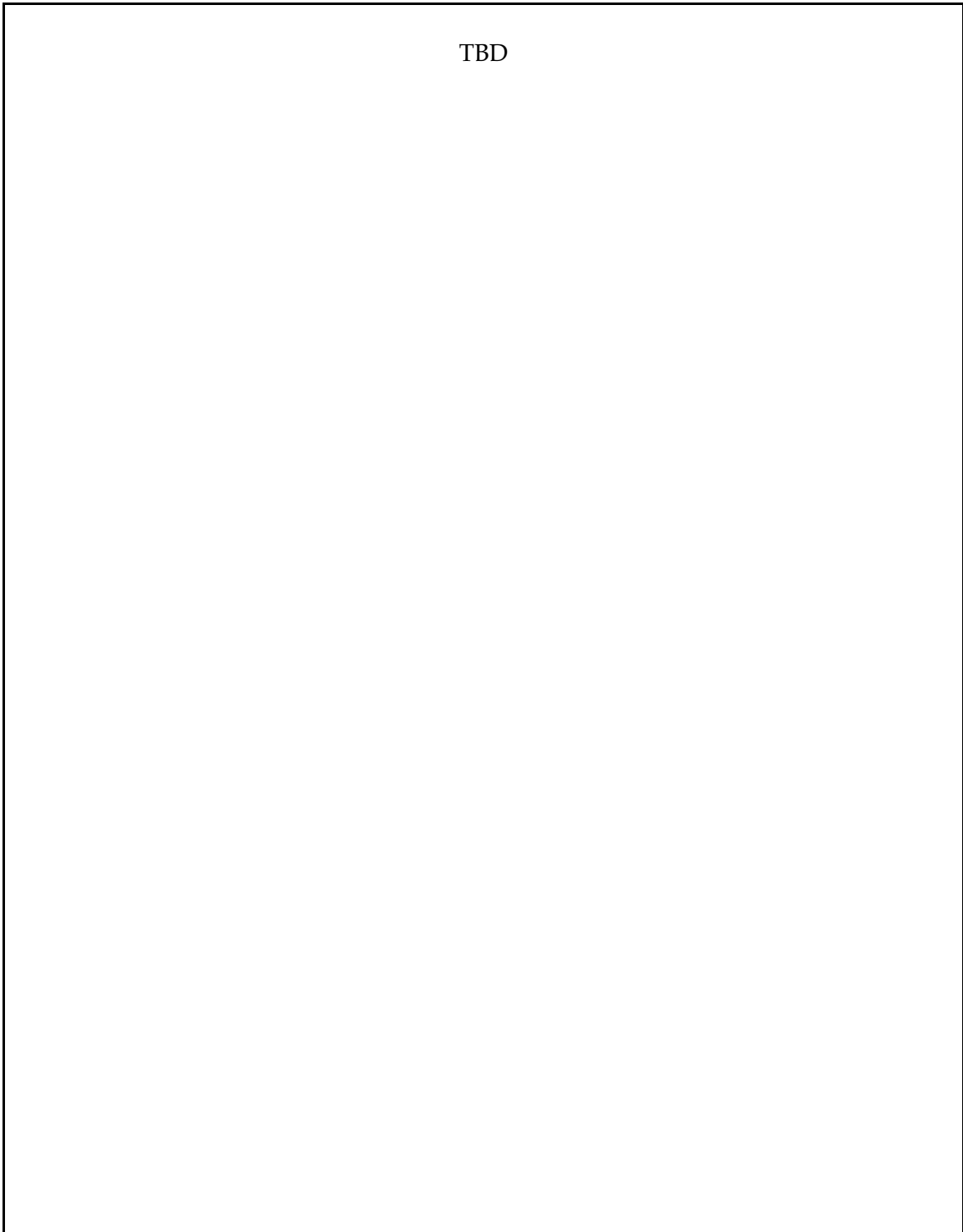
2. Insert wires into the appropriate input and output pins.

3. Secure each wire to its pin, using the screws provided, as shown in Figure 7-2.

Figure 7-2   Wire Connected to Terminal 1
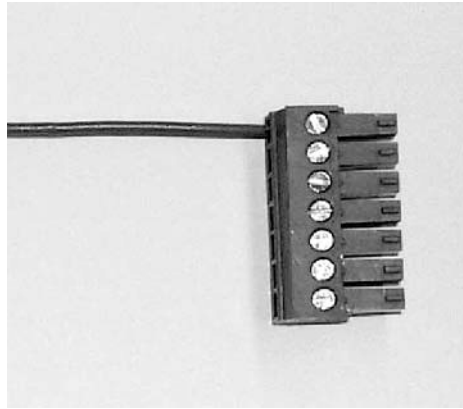
RT130147

4. Repeat Steps 2 and 3 to connect wires to all input and output pins.
5. Reinsert (plug in) the terminal blocks to the appropriate slot on the repeater.

The plugs are polarized; you cannot insert them incorrectly.

CAUTION: Do not exceed the specified voltage and current limits of the alarm outputs and inputs. Excessive voltage or current can damage the repeater.

External Alarm Pins

Table 7-1 lists all of the input and output connections, pin numbers, and functions, for all repeater's external alarm connectors.

NOTE: The ground reference for J1 and J2 inputs and/or outputs is the chassis ground terminal.

Table 7-1   Input/Output Pin Descriptions

Block	Pin #	Signal Name	Function
J1 In/Out	1	Digital Output 1	User Controllable Open Collector Driver
	2	Digital Output 2	User Controllable Open Collector Driver
	3	DC Voltage Input	0-60 V Input Voltage
	4	Digital Input 1	External Input Alarm
	5	Digital Input 2	External Input Alarm
	6	Forward PA Shutdown	External PA Control
	7	Reverse PA Shutdown	External PA Control
J2 UPS	1	External Tamper Input	Secondary Door Open
	2	UPS Tamper Input	External Input Alarm
	3	UPS AC Fail Input	External Input Alarm
	4	UPS Low Battery Voltage Input	External Input Alarm
	5	UPS High Battery Voltage Input	External Input Alarm
	6	UPS Charger Failure Input	External Input Alarm
	7	UPS Summary Normally Closed	External Input Alarm
	8	N/C	No Connection
J22 Alarm Relay	1	Critical Relay NO	Normally Open Output
	2	Critical Relay NC	Normally Closed Output
	3	Critical Relay COM	Common Input
	4	Major Relay NO	Normally Open Output
	5	Major Relay NC	Normally Closed Output
	6	Major Relay COM	Common Input
	7	Minor Relay NO	Normally Open Output
	8	Minor Relay NC	Normally Closed Output
	9	Minor Relay COM	Common Input
J23 User Relay	1	User 1 NO	Normally Open Output
	2	User 1 NC	Normally Closed Output
	3	User 1 COM	Common Input
	4	User 2 NO	Normally Open Output
	5	User 2 NC	Normally Closed Output
	6	User 2 COM	Common Input

7.1.1   Digital User-Controlled Outputs

The repeater includes two digital outputs, each with one lead for an open-translator collector. When the RepeaterNet software sets one of these digital output switches to On, the repeater sends a voltage to the input resistor of the transistor pair, as shown in Figure 7-3.

This voltage causes the transistor to saturate. Because the transistors are configured in a Darlington pair, the on-state saturation voltage is about 1 volt. This makes these outputs unsuitable for driving TTL loads directly. However, these two outputs can drive any other type of DC load, within their maximum ratings. Outputs are not isolated from the repeater's power subsystem, and the repeater's chassis ground terminal is the ground reference point for all inputs and outputs. Each of the digital outputs has the following maximum characteristics.

Forward Current (IC) continuous	500 mA
Maximum collector-to-emitter voltage (VCE)	50 Volts
Collector-to-emitter saturation voltage (VCE(SAT))	1.0V
Leakage Current in Off State (maximum)	50 µA

Figure 7-3 depicts the output circuitry of each user-controlled digital output.

Figure 7-3   User-Controlled Digital Output - Typical
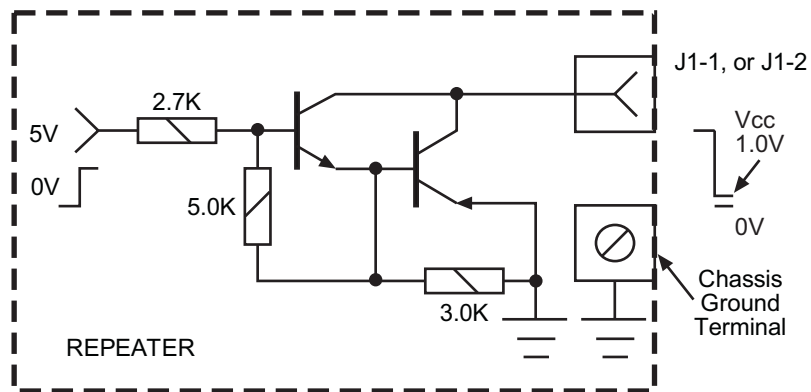
RT130148

Figure 7-4 and Figure 7-5 show two typical applications for digital outputs.

Refer to the Alarm Control Status Screen in Chapter 10, Configuring the Repeater, for instructions about activating digital outputs.

Figure 7-4   *Switching an Intrusion Alarm On and Off, Using Digital Output Number 2*
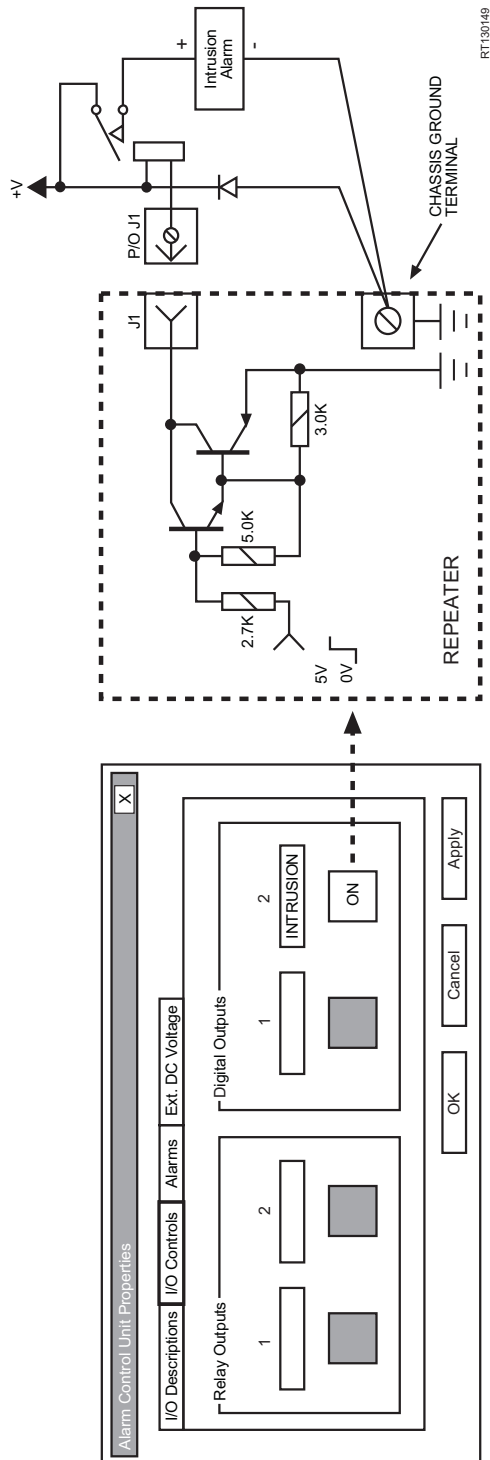
Figure 7-5   *Controlling an Electronic Door Lock, Using Digital Output Number 1*
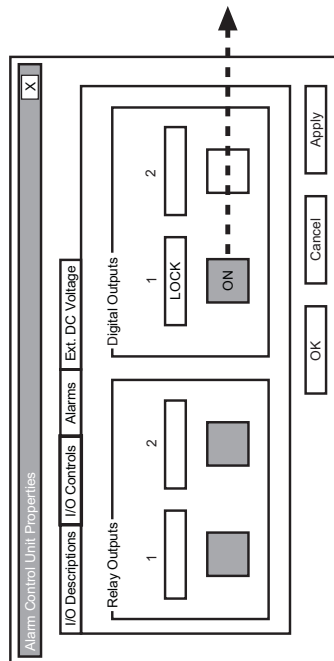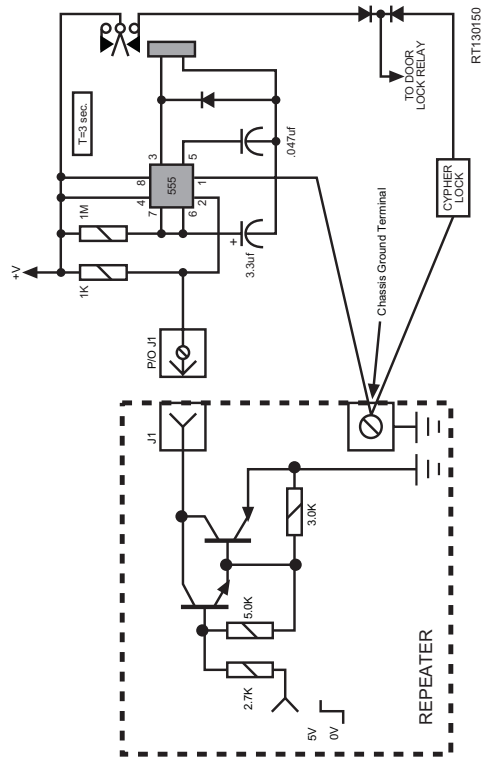
7.1.2   User-Controlled Relay Outputs

The repeater also provides two user-controlled relay outputs, with form C contacts. These relays respond to user commands through the RepeaterNet 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 7-6 shows the relay in the energized or On state.

Figure 7-6   Typical Relay Output
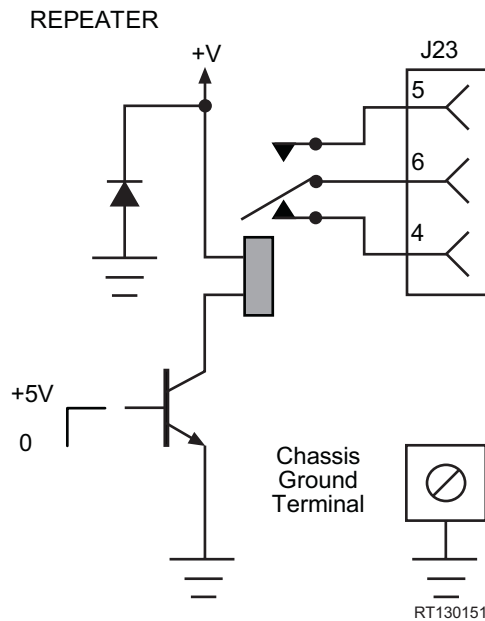
The maximum switching characteristics for each of the user-controlled relays are:

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

- Figure 7-7 shows a circuit that uses user-controlled relay output number 2 to control a lamp at the repeater site.
- Figure 7-8 shows a circuit that uses user-controlled relay output number 1 to control a fan or blower at the repeater site.

Refer to the ACU Status Screen in RepeaterNet Craft, for instructions about activating the digital outputs of a repeater.

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

Figure 7-8   Controlling a Fan or Blower, Using Relay Output Number 1
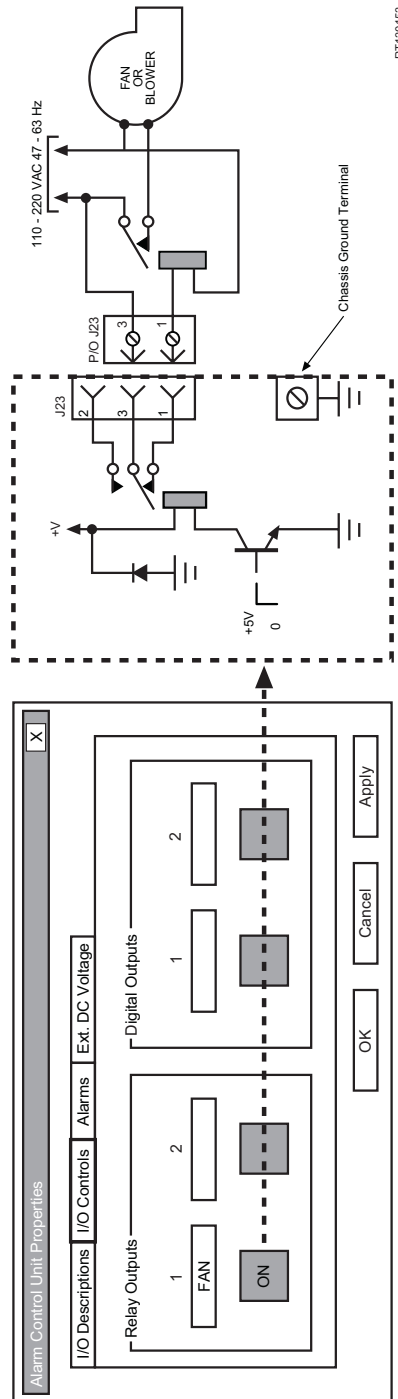
7.1.3   Alarm Relay Outputs

You can use the RepeaterNet software t set the severity of all internal and external alarms. The choices of severity settings are:

- Critical
- Major
- Minor
- Event
- Disable

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 also generates similar summary alarms for major and minor alarms.

Each summary alarm is connected to a relay. The contacts of these alarm relays are accessible through J22 on the repeater's connector panel. Figure 7-9 shows the basic internal circuit, which is similar to the circuit for the user-controlled alarm relay outputs (see section 7.1.2, "User-Controlled Relay Outputs" on page 7-8). When the repeater generates an alarm, the transistor saturates and energizes the relay, as shown in Figure 7-9.

Figure 7-9   Alarm Summary Relay Output - Typical
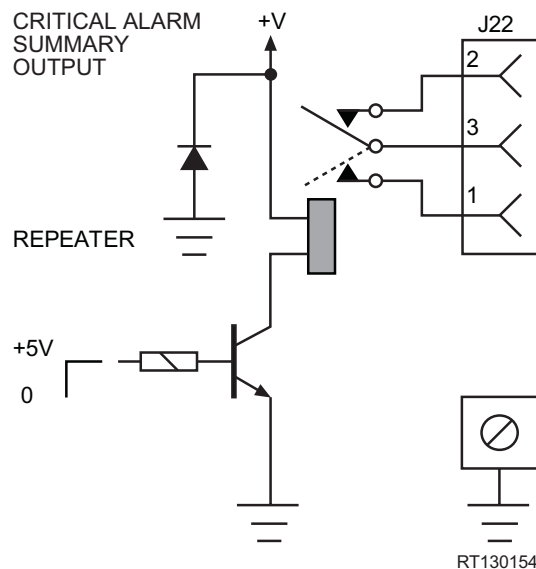
Figure 7-10 shows the critical alarm summary output relay, which is controlling an external, dual-color (green/red) LED. Normally, the relay is open, and the green LED is biased on. When an alarm occurs, the relay closes, and the LED turns red.

Figure 7-10   Critical Alarm Summary Relay, Controlling an External LED
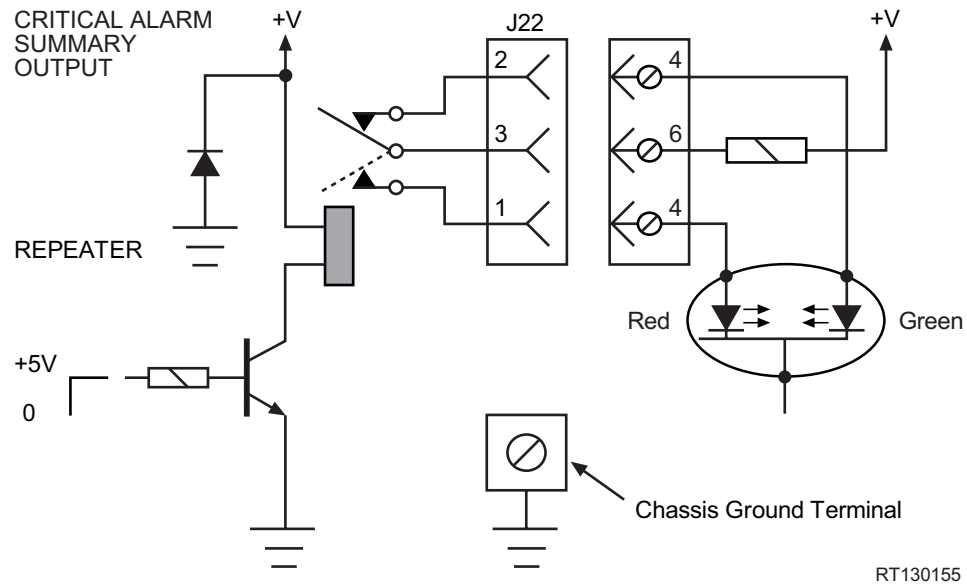
Figure 7-11 shows circuitry that connects all alarm summary relays to external lamps, through a flasher. This circuit provides an external indication of any internal alarm in the repeater.

Figure 7-11   External, Flashing Alarm Lamps
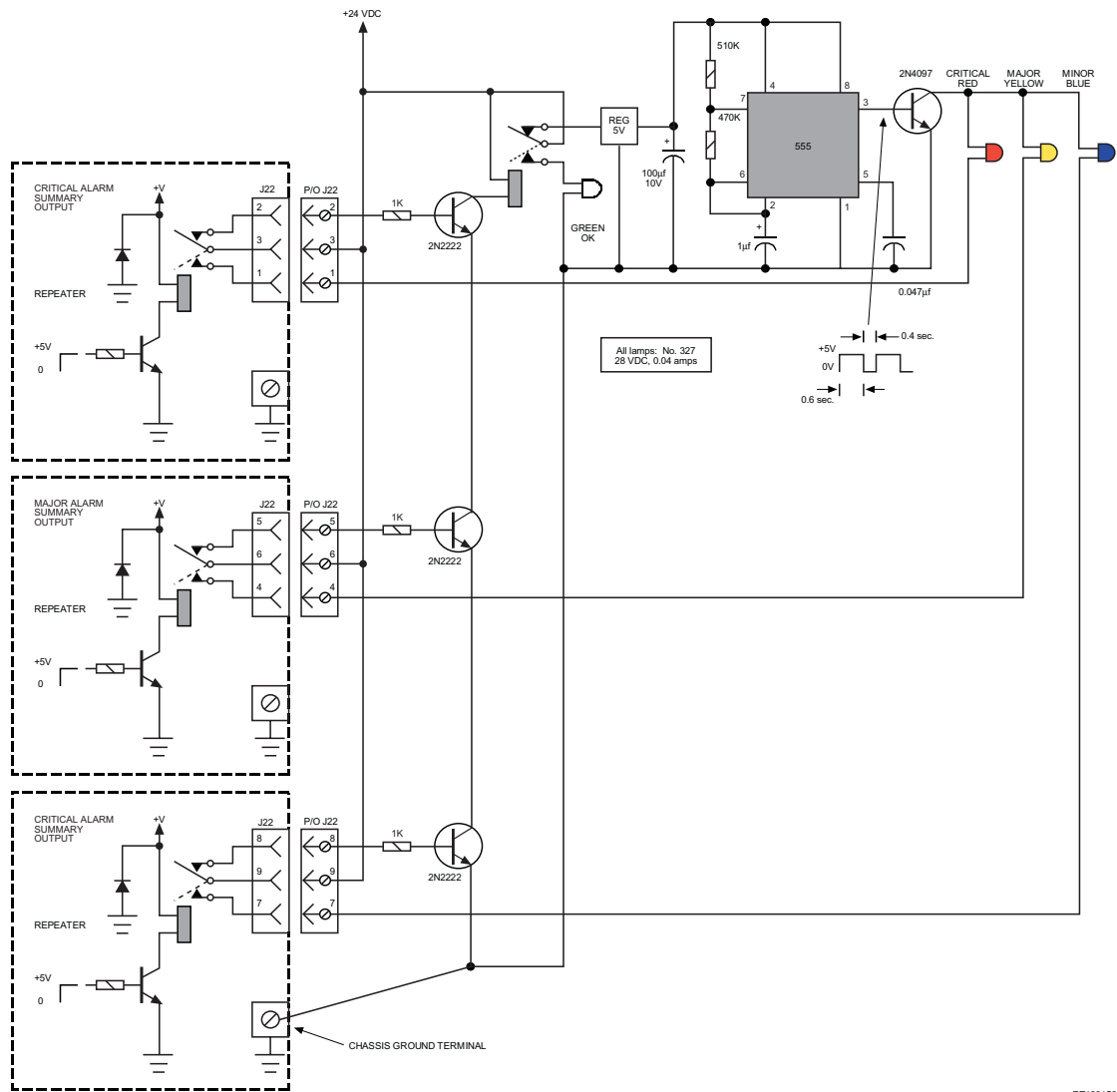
7.1.4   Digital Inputs

The repeater has two digital inputs, and one battery monitor input.

You can use the two 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, in the same way you do for internal alarms (see section 7.1.3, "Alarm Relay Outputs" on page 7-11). You can set the severity of each external alarm input.

Figure 7-12 shows the basic circuit for the external alarm inputs. The digital inputs are accessible through connector J1 on the repeater's connector panel.

Figure 7-12   Digital Input Circuit - Typical
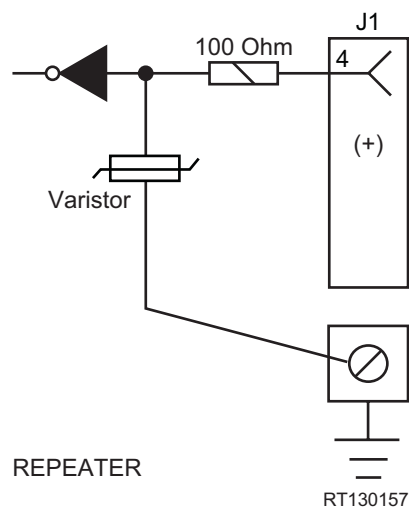
One of the most common external alarms, at a base station or a repeater site, is the failure of a tower hazard warning light. This light, used for warning aircraft of the existence of a tower, must be replaced immediately if it fails. Figure 7-13 and Figure 7-14 show two ways that the external digital alarm inputs can monitor a tower light.

Figure 7-13   Monitoring a Tower Hazard Light - Configuration 1
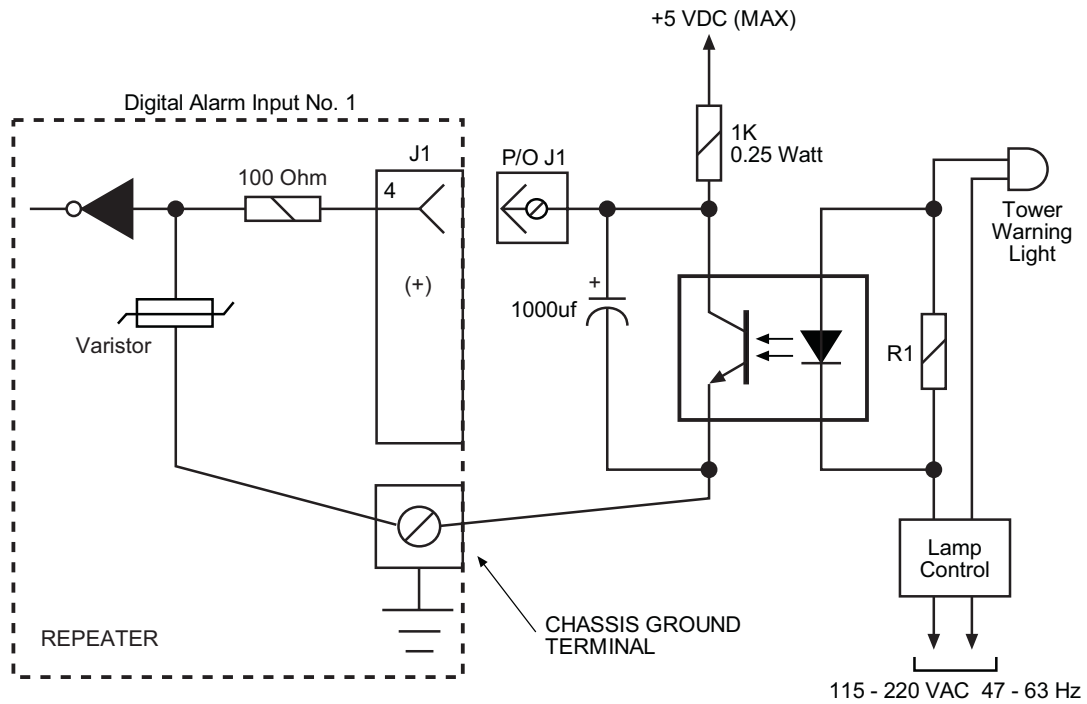
VALUE FOR R1 (Ohms)				LAMP SIZE
115 VAC		220 VAC		(WATTS)
3.9	2W	8.2	2W	50
2.2	5W	4.7	5W	100
1.5	5W	3.3	5W	150
1.2	10W	2.7	5W	200
1.0	10W	1.8	10W	250
0.5	20W	1.0	10W	500

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Do not exceed the following specifications when connecting digital inputs:

Input Voltage for Logic 0	<0.5 Volts
Input Voltage for Logic 1 (active alarm/disable PA)	>4.0 Volts
Maximum Input Voltage	5.0 Volts
Minimum Input Voltage	0.0 Volts
Maximum Input Current	2 mA

Figure 7-14   Monitoring a Tower Hazard Light - Configuration 2
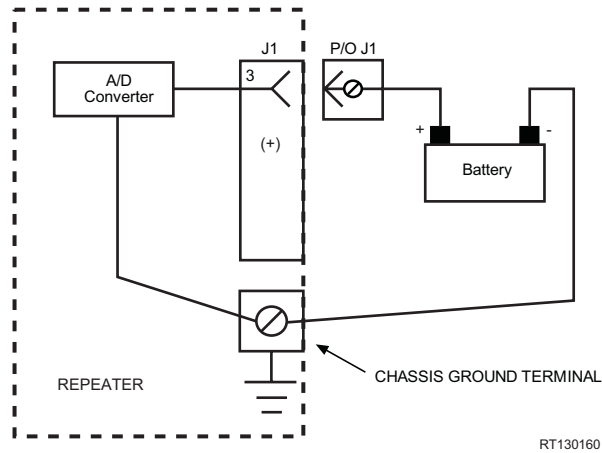
7.1.5   External DC Input Voltage

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

1. Connect an external DC power source to the repeater, using a single lead from the positive line/terminal of the battery to Connector J1, as shown in Figure 7-15.

2. Connect the negative lead of the battery to the repeater's chassis-ground terminal.

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

Figure 7-15   Typical DC Monitoring Configuration
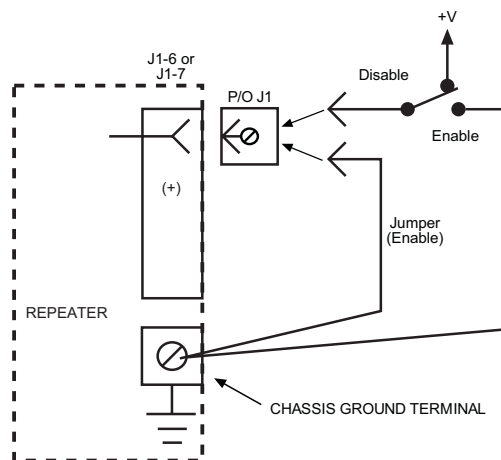
7.1.6 Power Amplifier (PA) External Disable Input

To disable the forward and reverse power amplifiers of the repeater, use terminal 6 (for forward PA) and pin 7 (for reverse PA) of connector J1. If these inputs are open, or are connected to a voltage of at least 5 VDC, the corresponding power amplifier is disabled. If you return these pins to ground, the external disable function, itself, becomes disabled.

Figure 7-16 shows the Power Amplifier disable function.

Figure 7-16   External Power Amplifier Disable Function

TBD
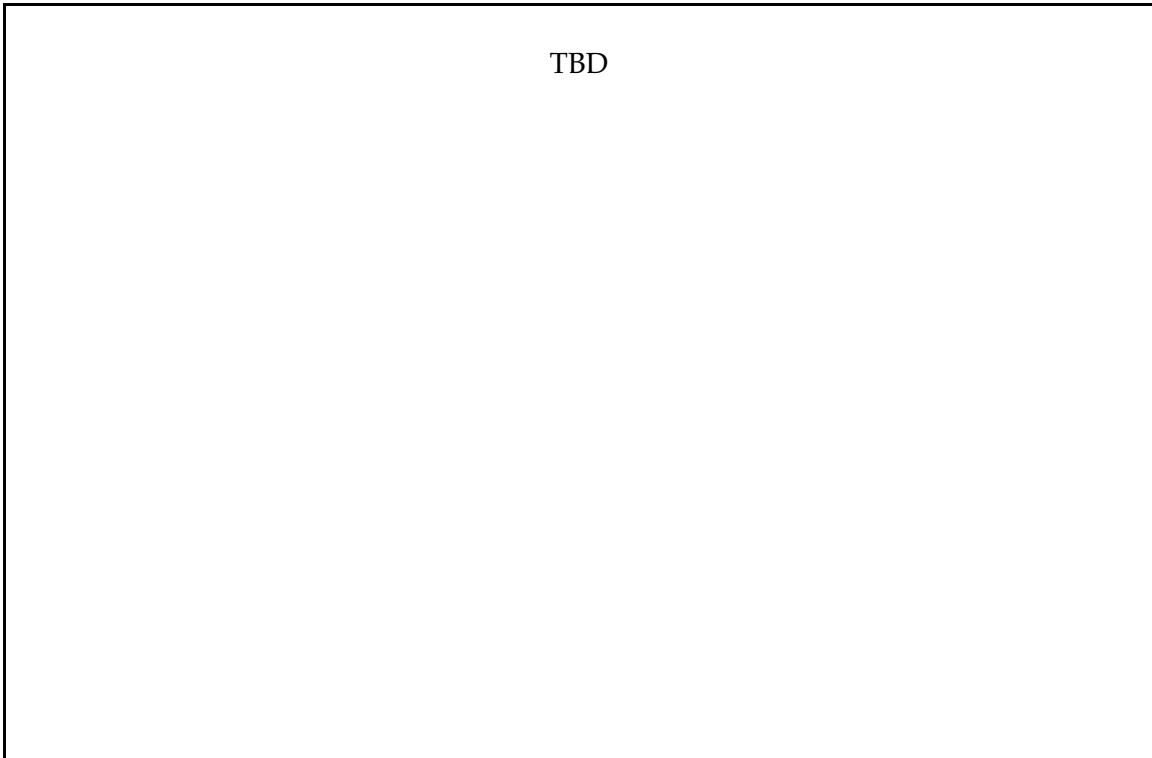
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Connecting External Alarms

8

8.0   Introduction

Power connects to the RC1920C Primary Repeater, and to the RC1920C Growth cabinet, through the Entry Box of the Primary Cabinet.

Table 8-1 shows the specifications for the input power.

Table 8-1   Input Power Specifications

Current Type	Power Specification
Alternating Current	115/230 Volt AC Auto-ranging, 47 to 63 Hz (Operating Range: 86 to 268 Volt AC)
	1-Channel = 1.5/0.9 Amps, typical 2-Channel = 2.6/1.5 Amps, typical
Direct Current	24 Volt DC, -3/+6 Volts
	1-Channel = 6.0 Amps, typical 2-Channel = 10.2 Amps, typical

NOTE: The RC1920C Repeater is available, from the factory, as either an AC-powered or DC-powered unit. Repeater Technologies does not supply any AC to DC, or DC to AC, field conversion options.

8.1 AC Power Wiring for Primary Cabinet

The following sub-sections describe how to connect AC power to the primary repeater cabinet.

8.1.1 Inside Wiring

For installations that are located inside of a building (in a protected area), connect the AC input power to the Repeater. A standard 8-foot long North American NEMA 15-5 (three prong) AC line cord is included with the Repeater Accessory Kit. You can substitute a longer cord if needed. Figure 8-1 shows a typical installation.

WARNING: If the line cord is not connected, and plugged into the repeater receptacle, exactly as described and illustrated in this section, the repeater can be physically damaged, and anyone operating or servicing the repeater can be injured by electrical shock.

Figure 8-1   Typical 2-Channel Horizontal Wall Installation

TBD
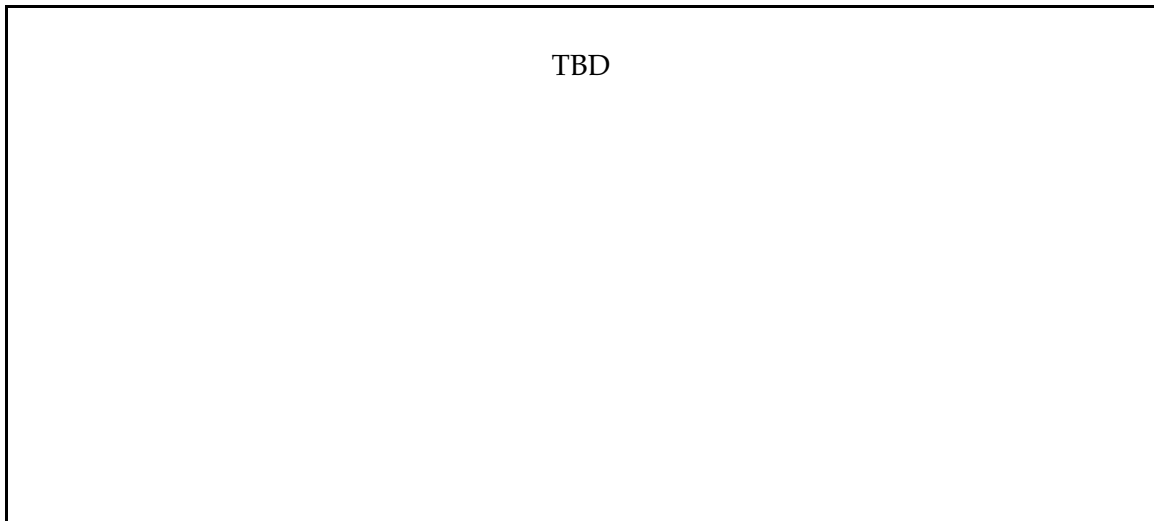
1.   Feed the power cord through the 1/2" plastic strain-relief.

The strain-relief is a water-tight plastic connector, provided to relieve strain on the AC power cord. This connector is included in the Repeater Accessory Kit. Figure 8-2 shows how to install the strain-relief.

Figure 8-2   *Installing the Plastic Strain-Relief Conduit*

To entry box

To AC commercial
power plug
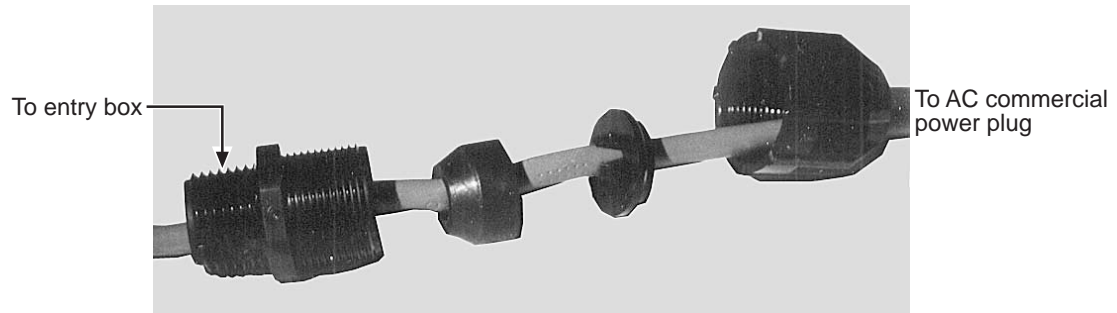
RT113907

2. Insert the strain-relief for the AC power cord, into the Entry Box of the main repeater cabinet, as shown in Figure 8-3.

Insert the cord into the upper-left conduit opening, as shown in Figure 8-3 and Figure 8-4.

Feed the stripped and tinned end of the line cord through the plastic strain-relief, so that approximately 6 inches of line cord is inside the Entry Box opening.

Figure 8-3   *Installing AC Power Cord and Strain Relief into Entry Box*

TBD
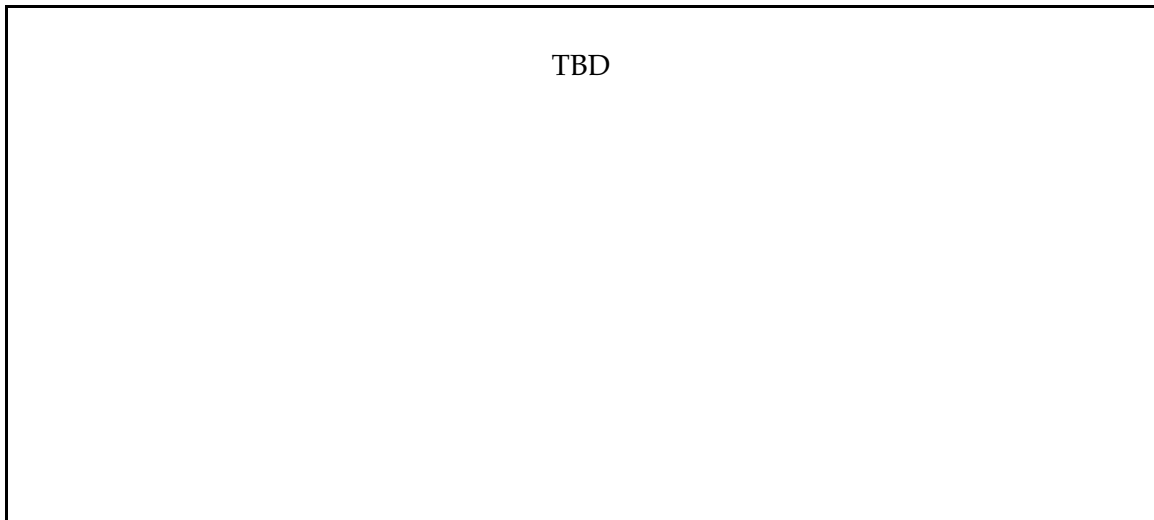
Figure 8-4   Power Cord Installation

TBD
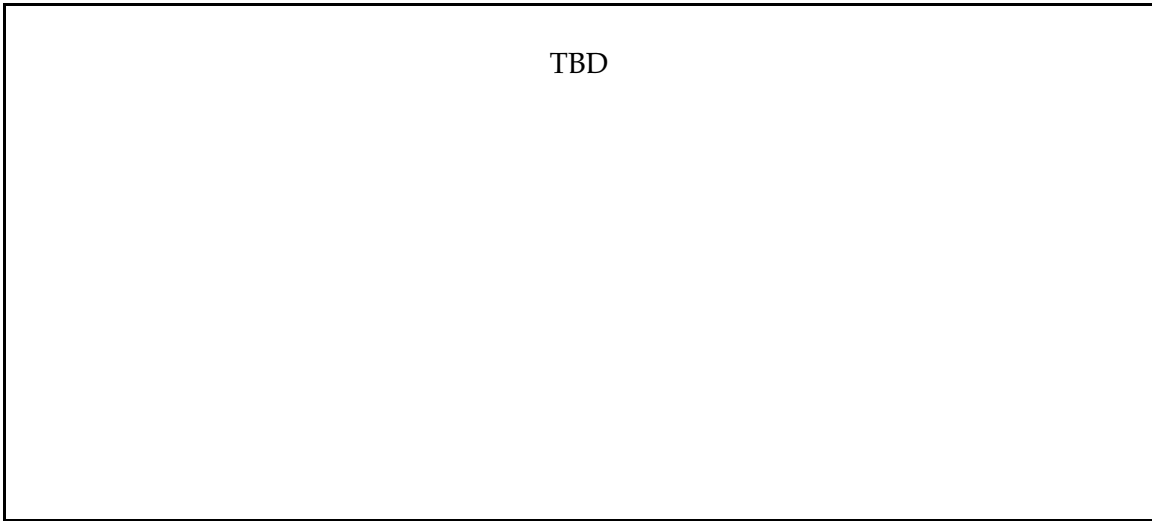
3.   Slide the 1/2" Lock Nut for the conduit onto the strain relief. Tighten it until it is snug, but still fits loosely. Refer to Figure 8-5.

Figure 8-5   Lock Nut Installation

TBD
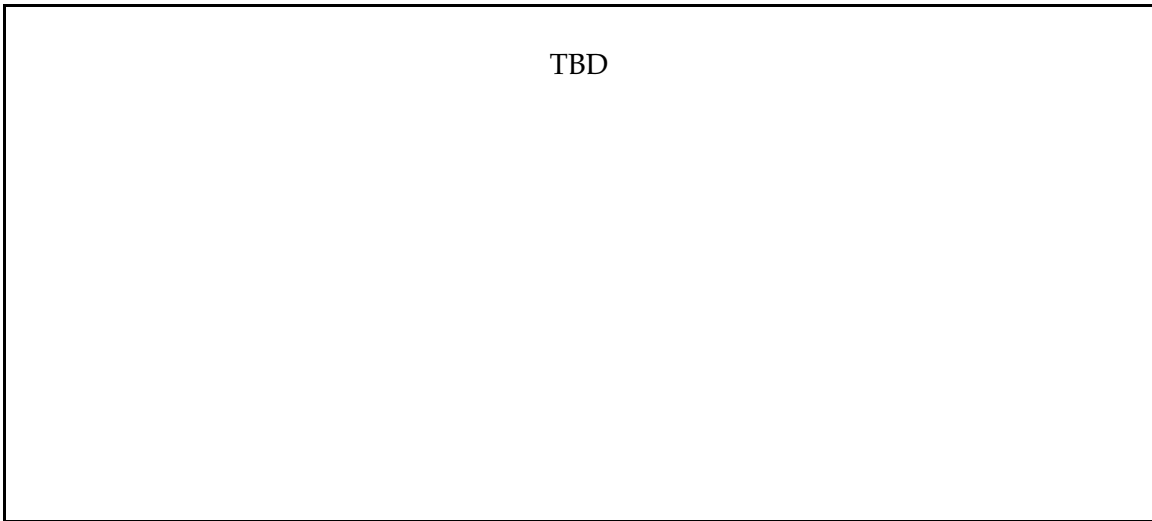
4.   Install the AC In power plug onto the power cord, as shown in Figure 8-6.

Use the small screwdriver to terminate the black (hot) and white (neutral or common) stripped leads, on the AC line-cord plug.

Figure 8-6   AC In Power Plug for Primary Cabinet

Green (or Green-Yellow) - Spade terminal

Top Connector is
not used

White (neutral or common)
wire is in the middle

Black (Hot wire)
is in the bottom
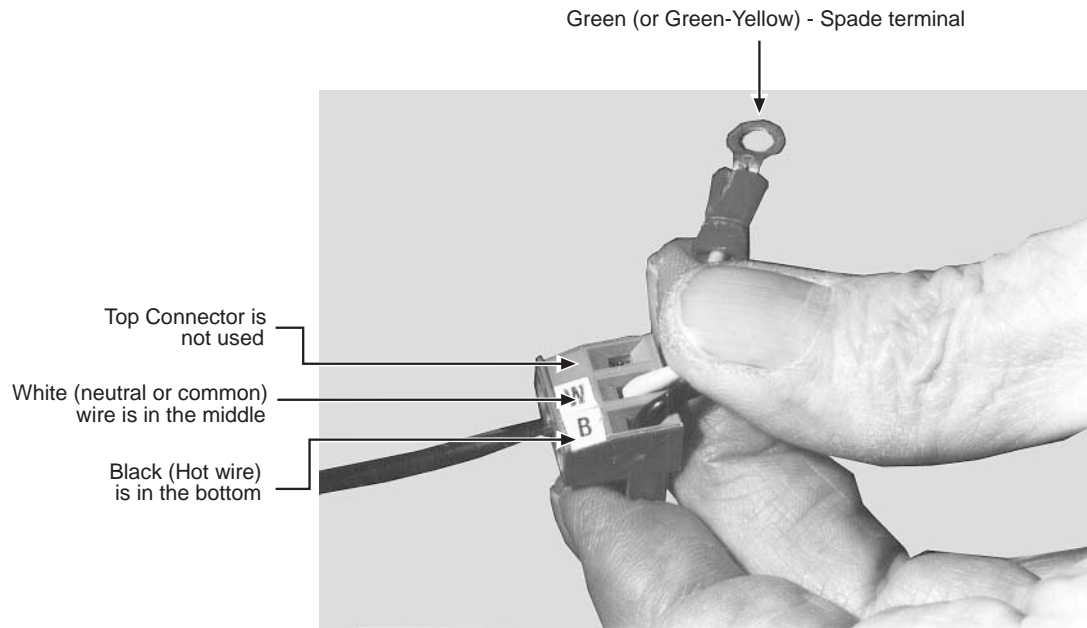
RT113908

5. Connect the green (ground) wire spade-terminal to the ground lug.

6. Plug the AC In power plug into the J18 receptacle (see Figure 8-5, Figure 8-7 and Figure 8-8).

NOTE: Plug the power cord into a dedicated wall outlet that is hard-wired to a circuit breaker. The circuit breaker must be 10 to 15 Amps for 115-Volts AC service, or 7.5 to 10 Amps for 230-volt service, and must be dedicated exclusively to the repeater.

Figure 8-7   Location of J18

TBD
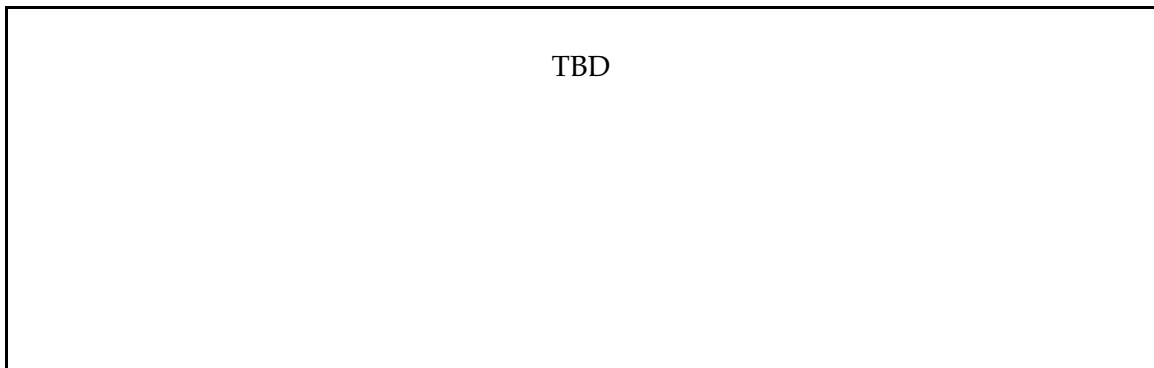
Figure 8-8   *Entry Box for RC1920C Primary Cabinet*

TBD
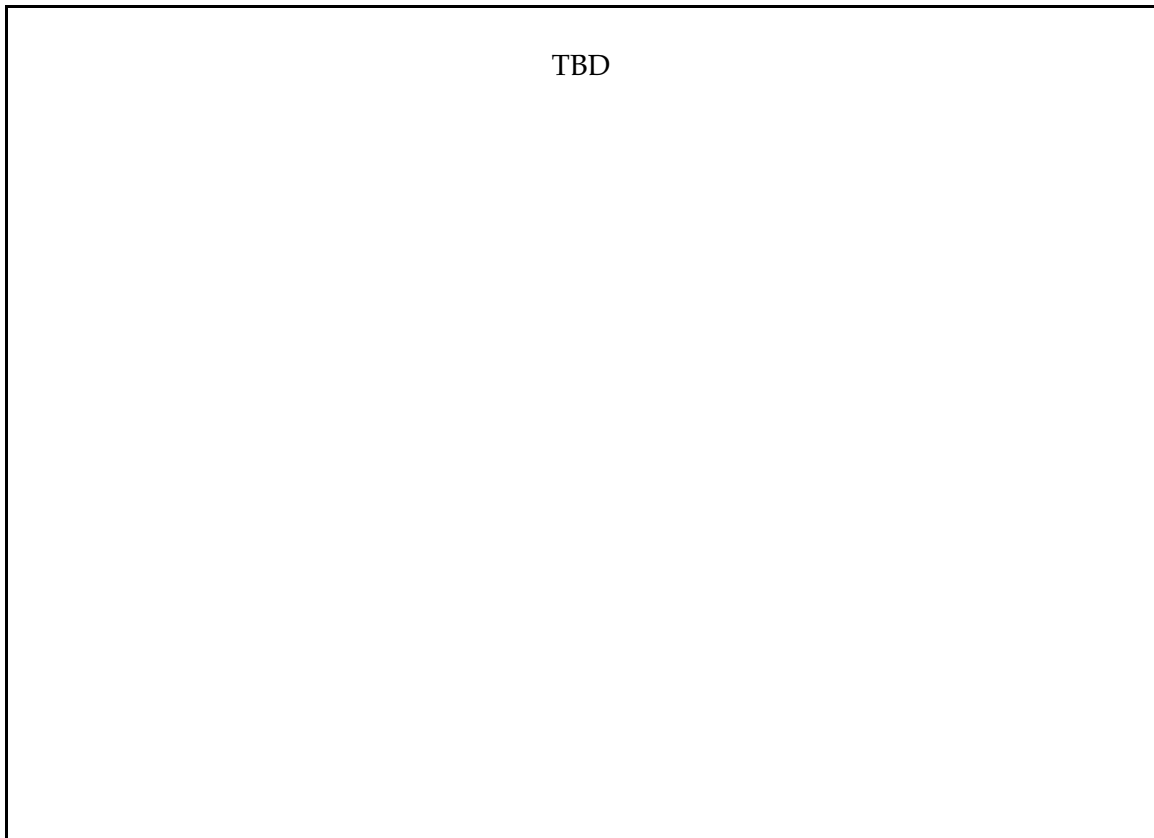
7. After connecting the repeater and closing the circuit breaker, turn the repeater On, using the Repeater Power Switch.

NOTE: RTI provides standard North American color-coded wires (white, black, and green). For international 230-Volt AC, 50 Hz applications, if local code requires the use of an international color-coded line cord (blue, green, and green-yellow), and requires the use of a country-specific power plug, you must obtain the wiring and plug locally. RTI does not provide international color-coded wiring or country-specific power plugs.

Table 9-2 lists the conversions from North American to international wiring color-codes.

Table 8-2   *Power Cord Conversion*

Wire Description	North America	International
AC (Hot)	Black	Brown
Neutral (Common)	White	Blue
Ground (Grd)	Green	Green-Yellow

8.1.2   Outside Wiring

If the repeater is outside, use the following procedure:

1. Install the repeater power, using 1/2" Liquidtight flexible conduit, and the appropriate Liquidtight conduit fittings.

2. Wire the repeater using #16 AWG (or larger) stranded PVC wire.

Number 16 Gauge wire complies with most local and national electrical codes, because the Repeater Power Switch is also a thermal-magnetic circuit breaker, which limits current to a maximum of 10 Amps.

NOTE: You can use larger-gauge wire, but it might be difficult to install the larger wire into the AC plug, provided with the repeater.

8.2   DC Power Wiring

You can connect 24-Volt nominal Direct Current power to the repeater, from either of the following DC power sources:

*   A fixed 24-Volt DC Cell Site-type power system
*   A Repeater Technologies BUPS-25/80 Back-up Power System (RTI part number 250-1011-01), or equivalent

8.2.1   DC Supply From a Fixed Cell-Site Power Plant

If a fixed power plant provides DC power to the repeater, use the following procedure:

1. Connect the repeater to the DC power via a dedicated fuse or circuit-breaker.
    *   Use a 10-Amp fuse or circuit breaker for a single-channel system.
    *   Use a 15-Amp fuse or circuit-breaker for a two-channel system.
2. To plan for growth, wire the Primary cabinet to support future addition of a Growth Cabinet.

To support this growth, use #10 AWG stranded wire for power cables under 20 feet long, or a larger wire gauge for runs of 20 feet or more. Consult your local or national electrical safety codes for the appropriate wire sizing.

3. Use 1/2" flexible PVC conduit to bring the wire into the Repeater Entry Box, through the left-most 1/2" conduit knockout.

NOTE: You must provide the junction box, from which the DC cable leads into the repeater.

Figure 8-9 and Figure 8-10 show the typical DC Entry Box layout, and the recommended wiring.

Figure 8-9   RC1920C DC Entry Box, Front View, with Cover Removed

TBD
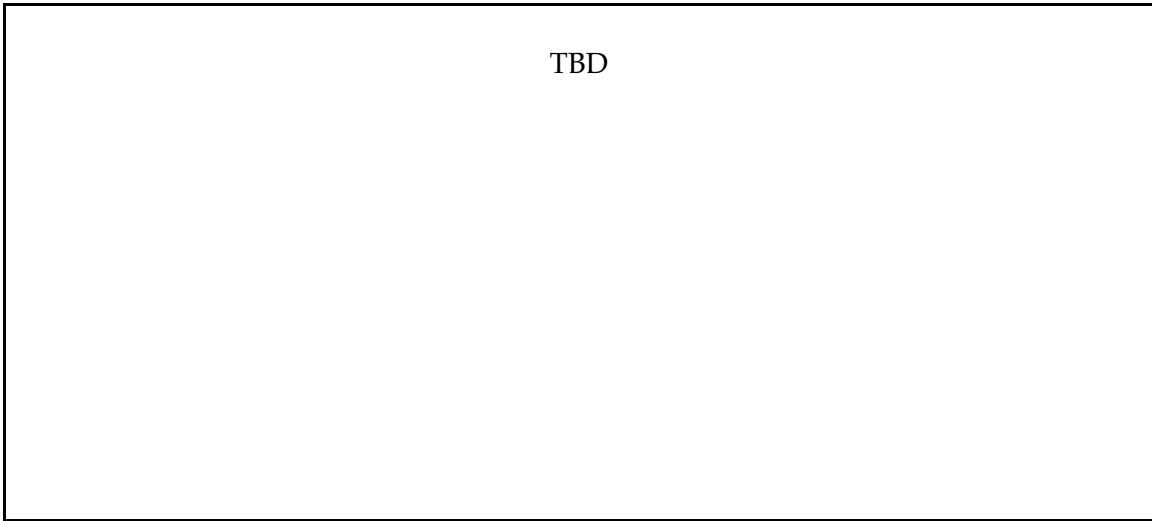
Figure 8-10   RC1920C DC Entry Box, Front View, with Cover Removed

TBD
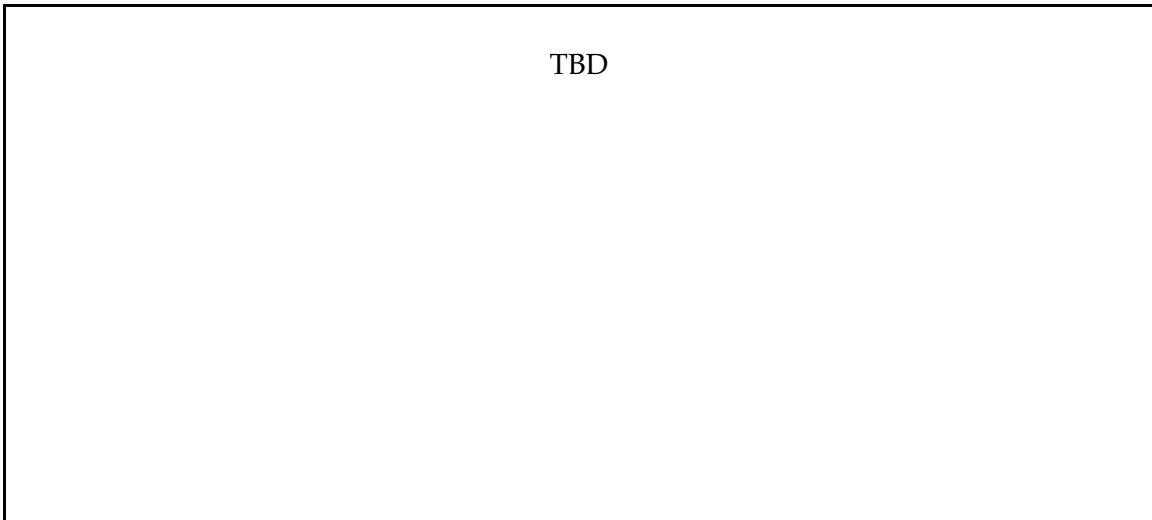
8.2.2   Back-up Power Supply

A typical Back-up Power Supply (BUPS) consists of a charger/rectifier, and has 24-Volt batteries floated across the charger/rectifier output. The capacity of the BUPS should be sufficient to handle the addition of a Second Channel or Growth Cabinet.

Figure 8-11 shows a block diagram of the BUPS from Repeater Technologies, Inc. (RTI).

- The RTI BUPS-25/80 rectifier supplies 25 Amperes of continuous current at 24 Volts DC.
- The two internal 100 Amp-Hour batteries are sized to provide 80 Amp-Hours of service without AC power.
- For a one-channel RC1920C, the BUPS-25/80 provides approximately 13 hours of back-up without AC power.
- For a two-channel system, the BUPS-25/80 provides approximately 8 hours of back-up.

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

Figure 8-11   Simplified BUPS-25/80 Block Diagram, RTI P/N 250-1011-07
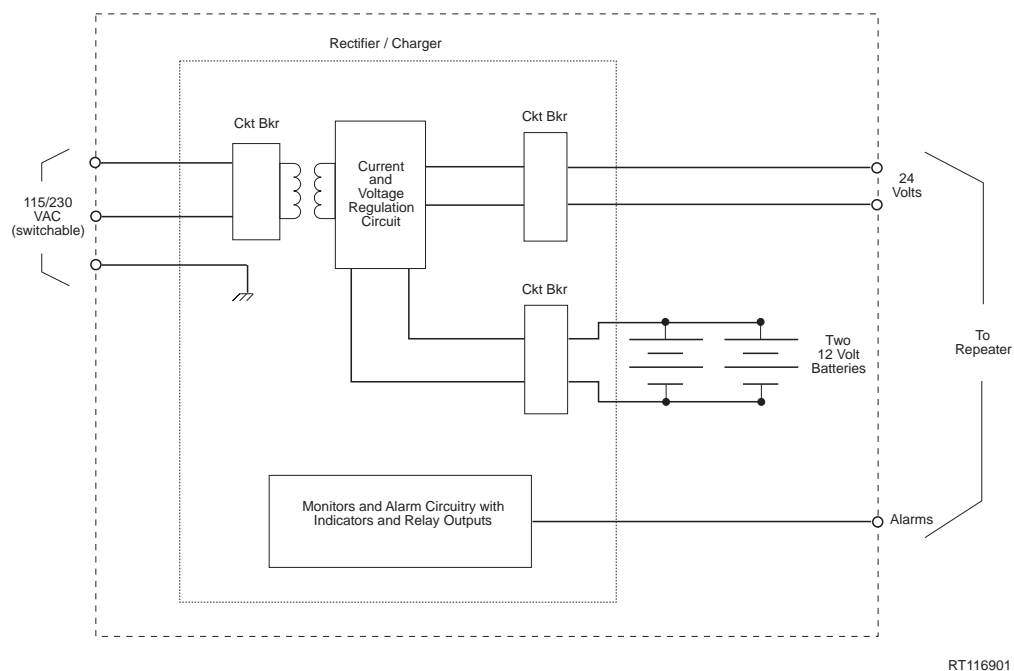
Position the BUPS, and the RC1920C Network Repeater, with sufficient spacing for hardware access, and to allow the addition of a Growth Cabinet. Figure 8-12 shows the layout that RTI recommends.

Figure 8-12   Recommended Mounting of Primary/Growth Cabinets, with BUPS-25/80

TBD
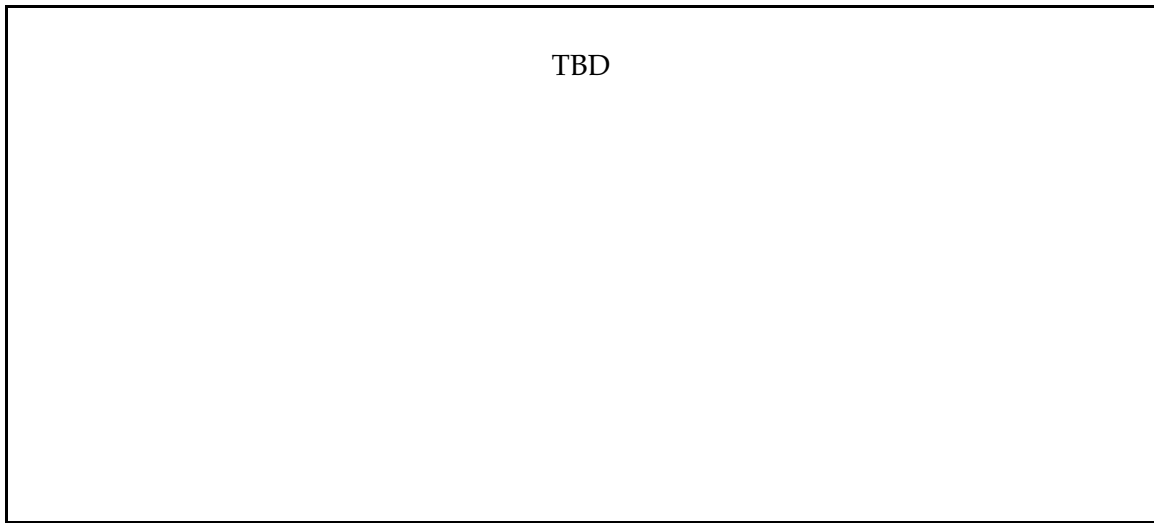
Figure 8-13 shows how to connect the BUPS-25/80 to the RC1920C repeater. Figure 8-15 shows the dimensions of the RTI BUPS-25/80 unit.

NOTE: The RTI BUPS-25/80 Back-up Power Supply includes the 1/2" Liquidtight flexible steel conduit, the power and alarm wiring, and the necessary Liquidtight conduit fittings to connect the repeater to the BUPS.

Figure 8-13   Wiring Connections from RC1920C Network Repeater to BUPS-25/80

OA850C/OA1900C Network Repeater to BUPS-25/80 Wiring Kit
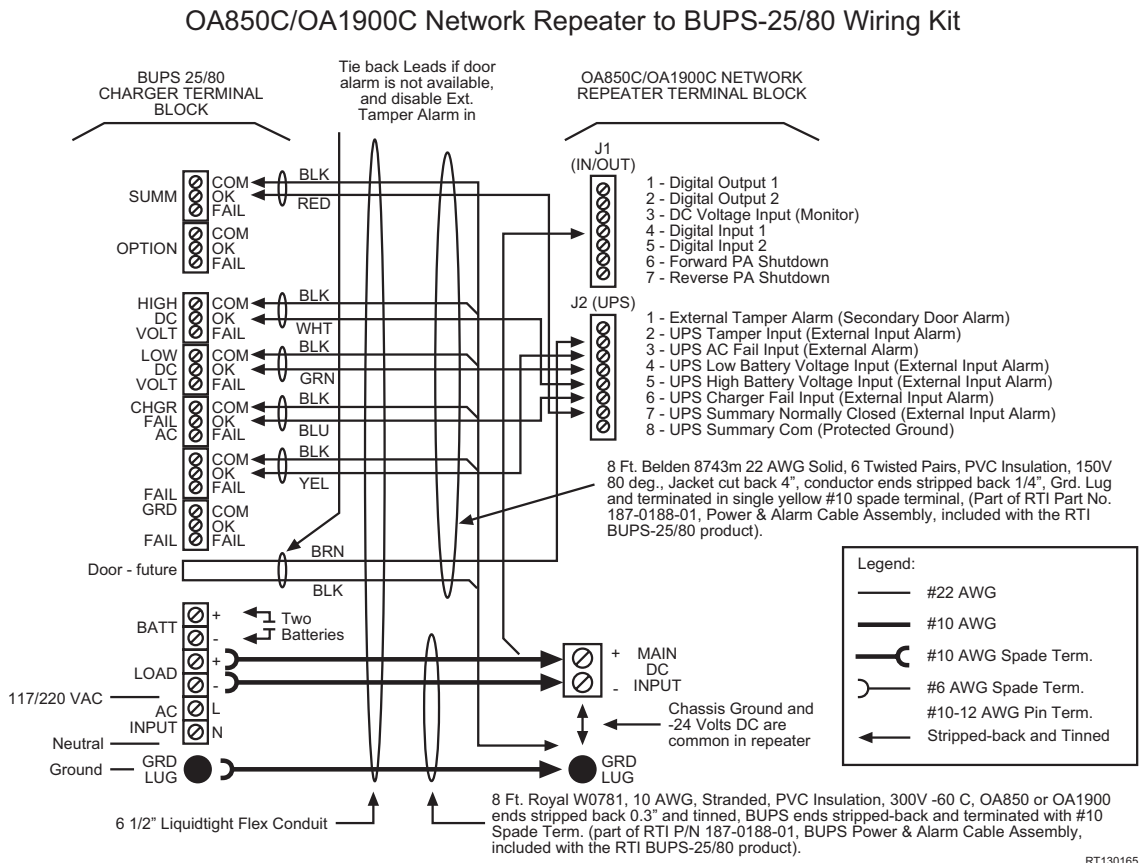
You must locally obtain the AC input conduit and wiring for the BUPS. Make sure that the conduit and wire size comply with local electrical and safety codes. The following are typical BUPS-25/80 input voltage and current specifications:

    115 Volts AC @ 9 Amps

    230 Volts AC @ 4.5 Amps

CAUTION: Before starting to wire the BUPS, verify that all input power and circuit breakers are in the Off position, for both the RC1920C repeater and the BUPS.

Circuit Breaker Sequence for Using the BUPS with an RC1920C Repeater

1. Install the two 12-volt Gel Cell batteries.
2. Use the wires provided with the BUPS, to connect the batteries to the BUPS Rectifier. Figure 8-14 shows the front panel of the BUPS Charger-Rectifier.
3. Verify the battery voltage at the BUPS Rectifier terminal block, using a multi-meter. The multi-meter should read approximately 25 to 27 Volts.
4. Close the **BUPS AC Input Breaker**.
5. Close the **BUPS Charger Circuit Breaker**.
6. Close the **Battery Circuit Breaker**.

Figure 8-14   Front Panel of the BUPS-25/80 Charger-Rectifier
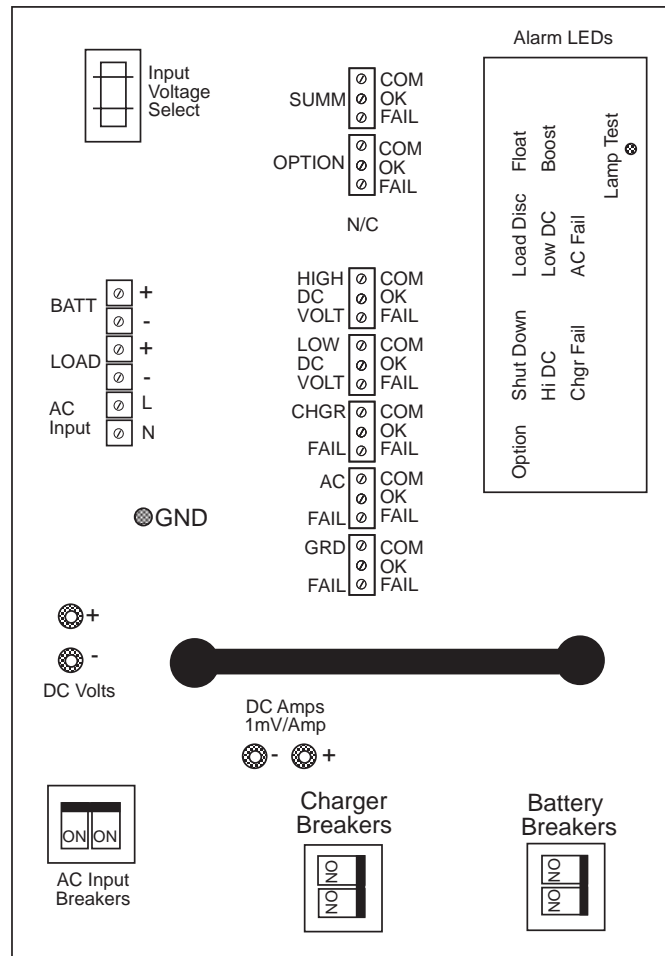
RT117902

7.   Verify the voltage using the BUPS Test Terminals.

     The multi-meter should read approximately 27 Volts.

8.   Close the **RC1920C Power Switch**.

9.   Observe the Repeater load (Amps), using the BUPS Load Test Terminals.

Under normal conditions, the load should be approximately 6.0 Amps for a Primary Channel, and 10.2 Amps with a two-channel system (Primary and Growth Cabinets).

Figure 8-15   RTI BUPS-25/80 Dimensions

TBD
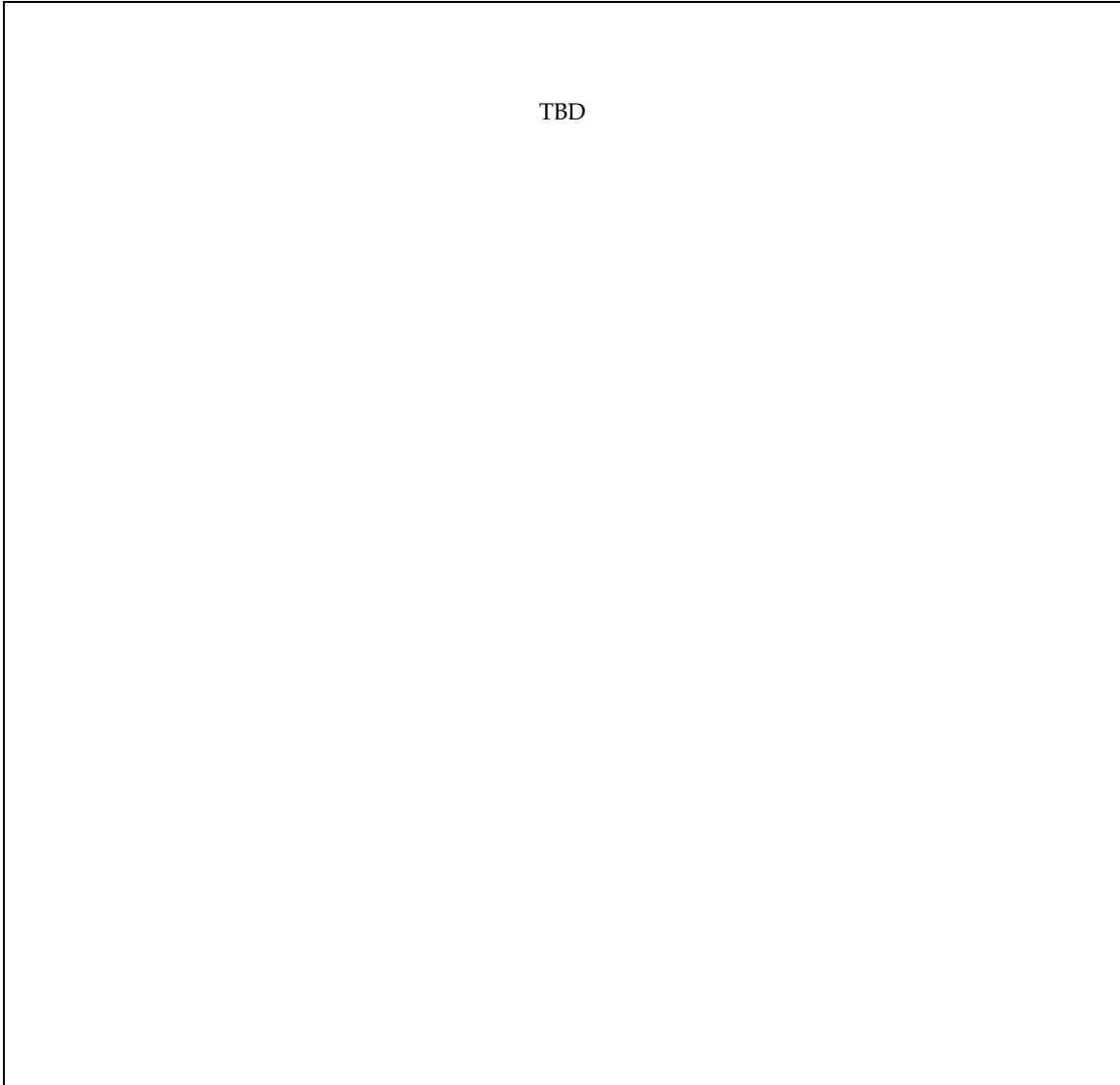
Table 8-3 provides the typical back-up time that a repeater can operate without AC. The worst-case battery recharge time, as measured from the low-voltage (below 21 volts) cut-off-point of a rectifier, is 8 to 9 hours.

Table 8-3   *Back-up Power Support, Using RTI BUPS-25/80 Back-up Power System*

Typical RTI RC Repeater Back-up Time, Without AC/Commercial Power

Repeater Configuration	RF Output Power	AC Input Power	DC Input Current	Back-up Time	Back-up Power System	
	ACP @ Antenna Port	Watts @ 117 volts AC	Amps @ 24V	Hours	Model	RTI Part#
OA850C, 1 channel	7	180	6	13.3	BUPS-25/80	250-1011-07
OS850C, 2 channels	14	310	10.2	7.8	BUPS-25/80	250-1011-07
OA1900C, 1 channel	6.3	205	7.5	10.6	BUPS-25/80	250-1011-07
OA1900C, 2 channels	12.6	350	12.8	6.3	BUPS-25/80	250-1011-07

NOTE: For solar-power applications, whenever the repeater is not handling any CDMA traffic (only pilot, paging, and sync channels), the repeater enters Power-Save Mode, reducing power consumption by 20%.

Additional Back-up Without AC Power

If the repeater requires longer electrical-power back-up time, contact the Customer Service Department at Repeater Technologies, for more information.

8.3   Grounding

Installing the input power to the repeater includes installing the standard electrical service grounds. However, you must also make sure that the RC1920C Cabinet/Chassis is properly grounded to a water pipe or earth ground.

Each repeater cabinet (Primary/F1 and Growth/F2) includes two external grounding lugs: one on the repeater cabinet, and one on the Entry Box under the cabinet, as shown in Figure 8-16.

Figure 8-16   Location of Ground Lug on Primary Cabinet
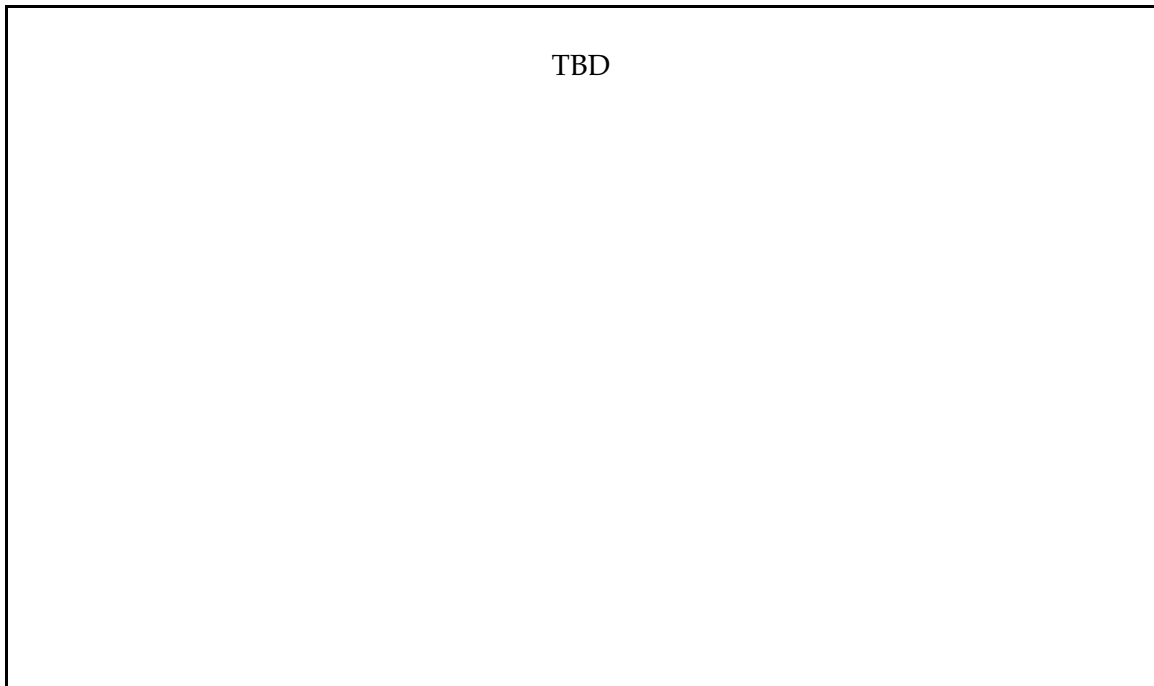
TBD

1. Connect number 6 (or larger) gauge AWG solid wire to each 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 grounding wire, and forming it around corners, avoid making sharp bends in the wire. Use a generous radius for each wire bend.

For more information about grounding repeaters, consult the RTI Application Note titled Installation Standards for Ground Requirements, Document Number 650-0002-01, Rev. 2.

8.3.1   Grounding the BUPS-25/80

Ground the Back-up Power Supply (BUPS) in a manner similar to a repeater cabinet. However, you must also add an external chassis ground lug to the BUPS-25/80, at the same time that you install the electrical service.

Configure the Repeater 9

9.0 RepeaterNet Craft Software

The RepeaterNet **Craft** software (Craft) provides configuration management and alarm monitoring capabilities for individual repeaters from Repeater Technologies, Inc. (RTI). It also dynamically manages repeater maintenance sessions in real time, through one of these connections:

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

The Craft software can operate under either Windows 95 or WindowsNT. The Craft user interface varies, depending on the model of repeater that the software is configuring or monitoring.

9.1 Minimum System Requirements

- Craft system requirements include:
- Pentium 120 MHz, running Windows 95, 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.
- Approximately 10 Mb of free disk space
- Modem (if a modem connects the laptop to the repeater)

NOTE: Use Hayes-compatible modems only. RTI repeaters are Connect with Rockwell certified, for modems of 56k or above. 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.

9.2 Installation Procedure

The RepeaterNet Craft software is distributed on 4 High Density (HD) floppy disks. To install this software, use the following procedure.

1. Insert Disk 1 into the a: drive.
2. From the Windows Start menu, select Run.
3. Type a:\setup and click on the OK button.
4. Follow the online instructions to install the Craft software.

The Craft software includes default configuration files, which you can download to the repeater. You can download the appropriate file for the repeater type, and for the number of channels, instead of manually configuring the repeater's properties.

9.3 Configuring the Repeater Connection

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

Follow the path in Figure 9-1 to invoke the RepeaterNet Administrator from the Start menu.

Figure 9-1   Starting the RepeaterNet Administrator

When you invoke the Administrator, RepeaterNet displays the window shown in Figure 9-2.

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 RepeaterNet Craft software uses the selected connection to connect to the repeater.

Figure 9-2   RepeaterNet Admin

RT131102
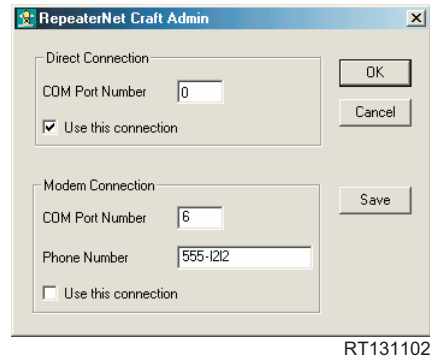
For example, you might do the following:

1. Assign the connection type as Direct through Com Port 1.
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 is different from the Com Port Number used for the direct connection.
2. Click on the Save button.
3. Click on OK to exit RepeaterNet Admin.

9.4   Starting Craft

Double-click on the Craft icon.

The window in Figure 9-3 displays.

RepeaterNet connections to the repeater, and displays the Craft Main Control screen for the repeater, as shown in Figure 9-3.

Figure 9-3   *RepetaerNet Craft Window*

RT131103

9.5   RepeaterNet Craft Main Control Screen

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

Main Control screen icons (shown in Figure 9-4) provide access to both subsystem status screens, and report alarms.

Figure 9-4   RepeaterNet Craft Main Control Screen
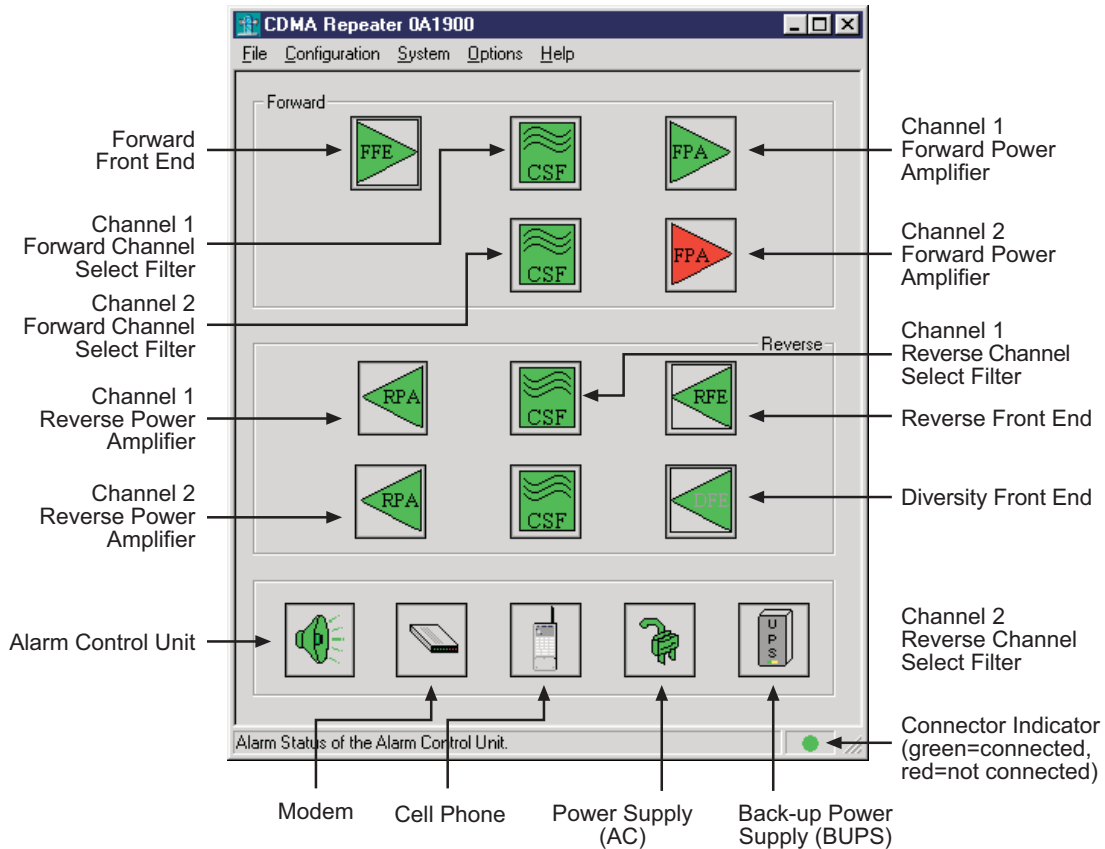
Figure 9-5 *RepeaterNet Craft Pull-down menus*
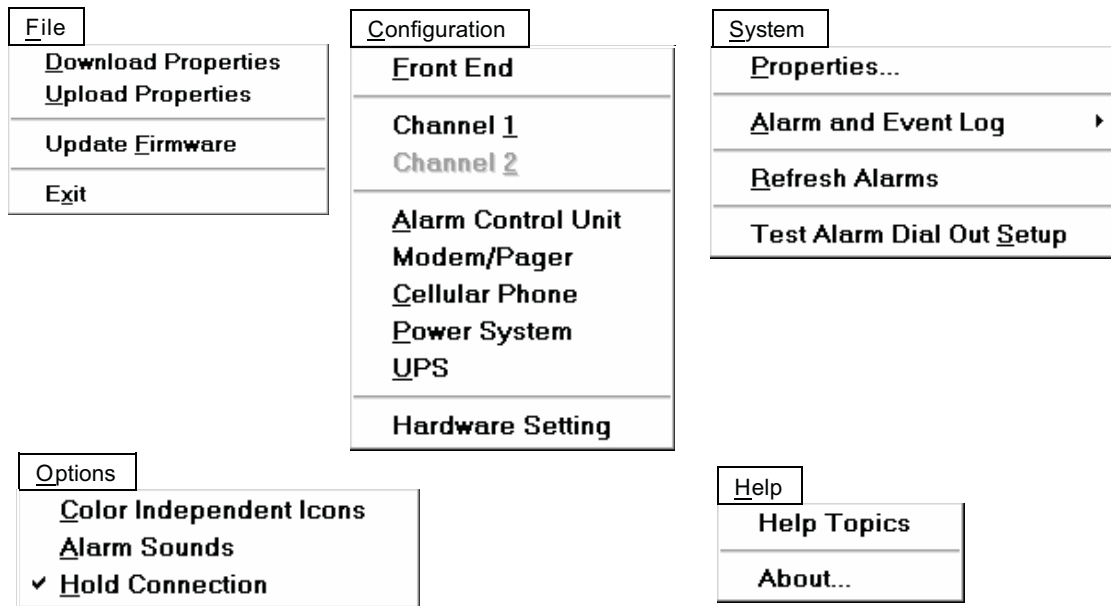
RT131105

NOTE: 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) displays over each PA subsystem icon (FPA and RPA) in the RepeaterNet Craft Main Control Screen (not shown in Figure 9-4). Keep each repeater's PA turned Off, until you have adjusted the gain for that repeater.

NOTE: The appearance of the Main Control Screen might vary from that shown in Figure 9-4, depending on the hardware configuration of the repeater unit. For example, Channel 2 icons are grayed-out (unavailable) for a single-channel repeater.

9.5.1 Subsystem Configuration

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

Table 9-1 lists the choices in the Configuration menu.

Table 9-1   Configuration Menu

Menu Selection	Description	See Section
Hardware Setting	To configure the repeater for adding a growth cabinet, a mode or a cell phone	Section 9.9, "Hardware Settings" on page 9-12.
Front End	Configures the Forward, Reverse, and Diversity front end	Section 9.10, "Front End Properties" on page 9-12.
Channel 1	Configures repeater channel 1. Available on all units.	Section 9.11, "Channel Properties" on page 9-14.
Channel 2	Configures repeater channel 1. Available on 2-channel units only.	Section 9.11, "Channel Properties" on page 9-14.
Alarm Control Unit	Configures ACU.	Section 9.12, "ACU Properties" on page 9-22.
Modem	Configures internal or external modem.	Section 9.13, "Modem Properties" on page 9-29.
Cellular Phone	Configures internal cell phone, if the repeater has the Cellular option.	Section 9.14, "Cell Phone Properties" on page 9-36.
Power System	Configures input, battery, and internal power.	Section 9.15, "Power System Properties" on page 9-38.
Uninterruptable Power Supply (UPS)	Configure Back-up Power System (BUPS).	Section 9.16, "Back-up Power System (UPS) Properties" on page 9-40.
Hardware Setting	Configures Growth Box Modem Cell Phone	

9.6   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. An audible alarm also activates.

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 changed to its alarm configuration.

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 displays over the associated icon.

If a subsystem is not available to the repeater, RepeaterNet displays that subsystem as disabled. For example, if a repeater has no cellular phone, the cellular icon is light gray.

9.6.1   Alarm Status Reporting on the Main Control Screen

RepeaterNet uses a color system to report subsystem alarm status on the Main Control screen. Table 9-2 shows the meanings of the colors, and of any corresponding color-independent icons.

Table 9-2   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.
- The Alarm Sounds feature adds an audible alarm.

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 required.

NOTE: 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.
Color reporting does not apply to subsystems that are set to Event severity.

9.7   Defining Alarm Severity

The repeater is factory-configured with a standard set of alarm severity settings. You can use the subsystem Properties screens to adjust alarm severity, from these defaults. See Section 9.8, Configuring Repeater Properties, for more information about alarm severity and the factory configuration.

The levels of alarm severity are:

- Critical
- Major
- Minor
- Event
- Disabled

To define alarm severity, use the following procedure.

1. Login to a session with the repeater.
2. Select Configuration from the Main Control menu bar, then select a subsystem, to open its Properties screen.

   For example, select Configuration -> Channel 1. The Alarms tab displays.

   For actual screen examples, see Section 9.8, "Configuring Repeater Properties" on page 9-11.
3. Click the down-arrow next to an Alarm field, to select a new alarm severity.
4. 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.

9.8   Configuring Repeater 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
- Modem
- Cellular Phone
- Power System
- UPS
- Hardware Settings

The Properties screens display tabs that are specific to each subsystem.

NOTE: Screens shown in this manual might not exactly match what you see on the PC or laptop.

You can configure two types of repeater properties:

- Redefine alarm severity
- Specify operational settings for the repeater

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

9.9   Hardware Settings

Use the Configure -> Hardware Setting screen (see Figure 9-6) to inform RepeaterNet when you add one or more of the following to the repeater configuration:

- Growth Box
- Modem
- Cellular Phone

Figure 9-6   Hardware Setting Screen

RT131106

9.10   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
- Diversity FE

NOTE: Do not adjust power amplifier gain while any of these alarms are active.

9.10.1 Forward FE Tab

The Forward FE tab (see Figure 9-7) sets the alarm severity of the Forward FE alarm.

The Forward FE alarm becomes activated when the forward signal power level is too strong, and is being attenuated to protect the repeater from possible damage.

Figure 9-7   Front End Properties Screen, Forward FE Tab
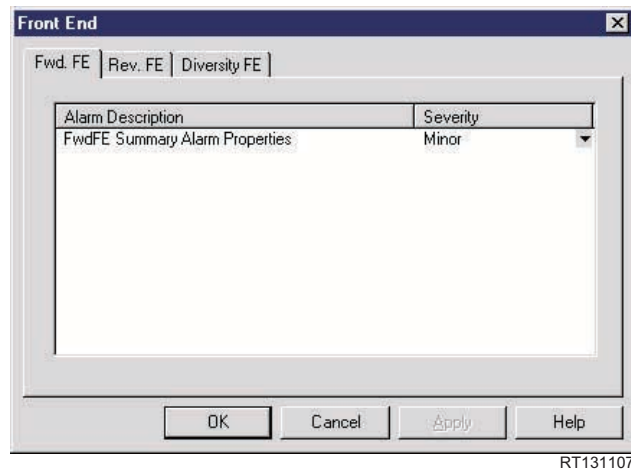
9.10.2 Reverse FE Tab

The Reverse FE tab (see Figure 9-8) sets the alarm severity of the Reverse FE alarm.

The Reverse FE alarm becomes activated when the reverse signal power level is too strong, and is being attenuated to protect the repeater from possible damage.

Figure 9-8   Front End Properties Screen, Reverse FE Tab
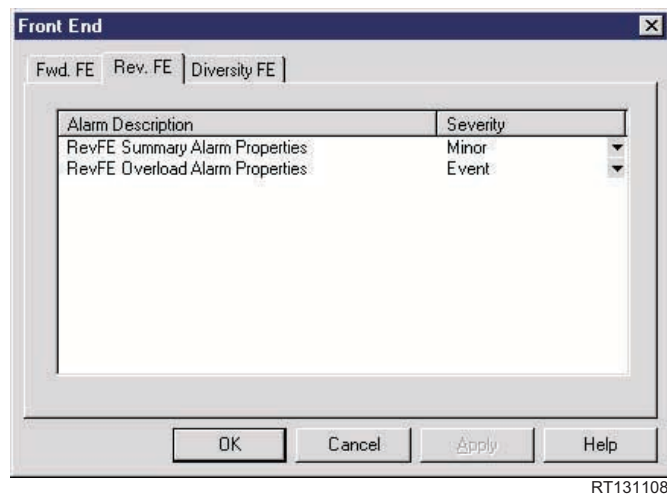
9.10.3 Diversity FE Tab

The Diversity FE tab (see Figure 9-9) sets the alarm severity of the Diversity FE.

The Diversity FE alarm becomes activated when the Diversity Receive signal power level is too strong, and is being attenuated to protect the repeater from possible damage.

NOTE: Do no adjust power amplifier gain while this alarm is active.

Figure 9-9   Front End Properties Screen, Diversity FE Tab
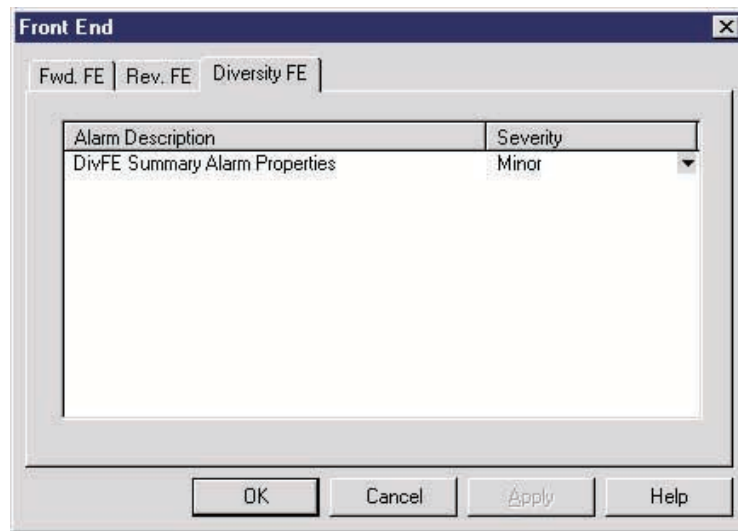
RT131109

9.11 Channel Properties

From the Main Control screen menu bar, select Channel 1 or Channel 2 (for two-channel repeater units only), to open a Channel Properties screen. Channel properties include:

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

9.11.1 Channel Reverse PA Tab

The Reverse PA tab set the alarm severity for the following types of Reverse Power Amplifier alarms (see Figure 9-10):

Reverse PA Alarm - Indicates a failure in the power amplifier. The PA is inoperative and the repeater is off the air.

Reverse PA Thermal Alarm - Indicates that the system temperature has exceeded the alarm threshold. The repeater has shut down the Power Amplifier. When the temperature is again within subsystem tolerances, the repeater automatically reactivates the PA.

Reverse PA External Shutdown Alarm - Indicates that the repeater has shut down the Power Amplifier, and has activated one RPA (Reverse Power Amplifier) alarm. RTI recommends disabling this alarm.

To redefine alarm severity for the Reverse PA subsystem, using this tab:

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.

Figure 9-10   Channel Properties Screen, Reverse PA Tab
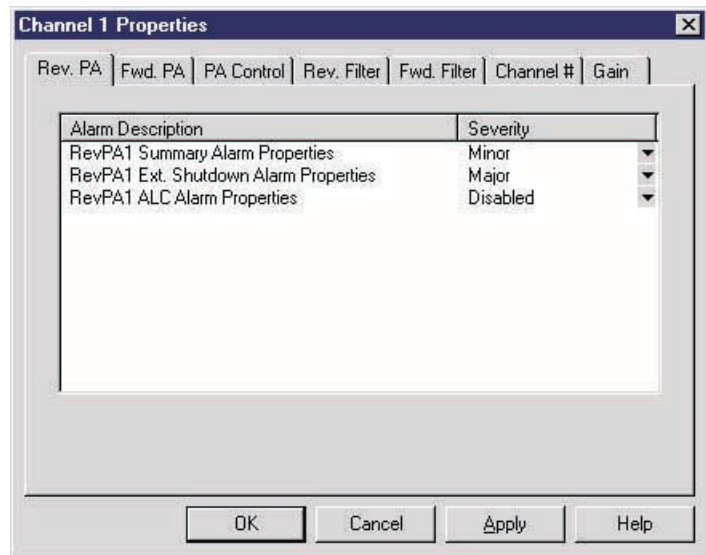
9.11.2 Channel Forward PA Tab

The Forward PA tab (see Figure 9-11) sets the alarm severity for the following types of Forward PA alarms:

Forward PA Alarm - Indicates a failure in the power amplifier. The PA is inoperative, and the repeater is off the air.

Forward PA Thermal Alarm - Indicates that the system temperature has exceeded the alarm threshold. The repeater has shut down the Power Amplifier. When the temperature is again within subsystem tolerances, the repeater automatically reactivates the PA.

Forward PA External Shutdown Alarm - Indicates that the repeater has shut down the Power Amplifier, and has activated one FPA (Forward Power Amplifier) alarm. RTI recommends disabling this alarm.

To redefine 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.

Figure 9-11   Channel Properties Screen, Forward PA Tab

RT131111
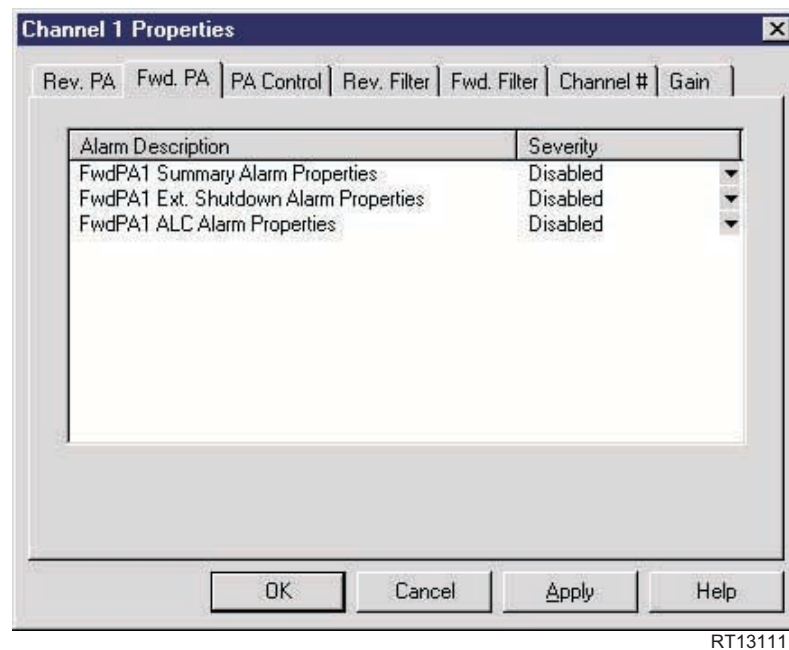
9.11.3 Channel PA Control Tab

The PA Control tab provides a switch to turn PA power On or Off (see Figure 9-12).

1. Click on the value in the Reverse PA Power box, and in the Forward PA Power box to change the value.

    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 9-12   Channel Properties Screen, Channel PA Tab

RT131112
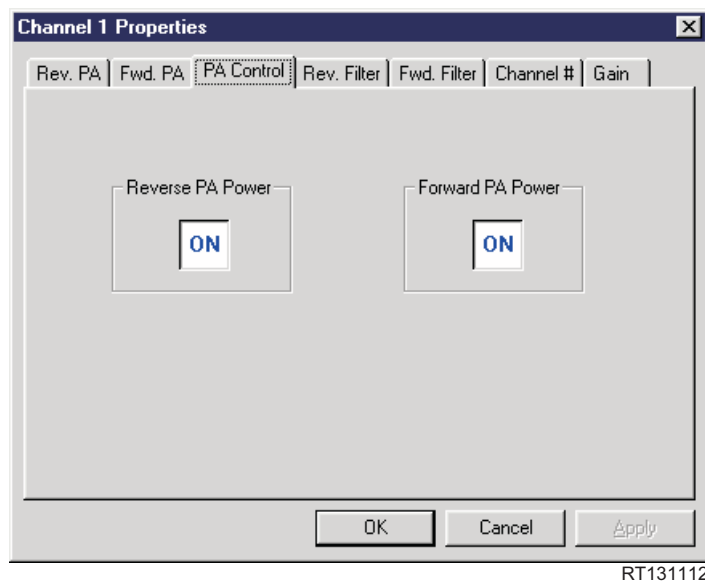
9.11.4 Channel Reverse Filter Tab

The Channel Reverse Filter tab sets the alarm severity for the Channel Reverse Alarm. A failure in the Reverse Filter assembly triggers a CSF Reverse Filter alarm, and the filter becomes inoperative.

To redefine alarm severity for the Reverse Filter subsystem:

1. Click the down-arrow next to an Alarm field to select one of the following alarm severity settings:
    *   Disabled
    *   Event
    *   Minor
    *   Major
    *   Critical
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 9-13.

9.11.5 Channel Forward Filter Tab

The Channel Forward Filter tab (see Figure 9-13) sets the alarms severity for the Channel Forward Alarm. A failure in the Forward Filter assembly triggers a CSF Forward Filter alarm, and the filter becomes inoperative.

To redefine alarm severity for the Forward Filter subsystem:

1. Click the down-arrow next to an Alarm filed to select one of the following alarm severity settings:
   - Disabled
   - Event
   - Minor
   - Major
   - Critical
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.

Figure 9-13   Channel Properties Screen, Channel Forward Filter Tab
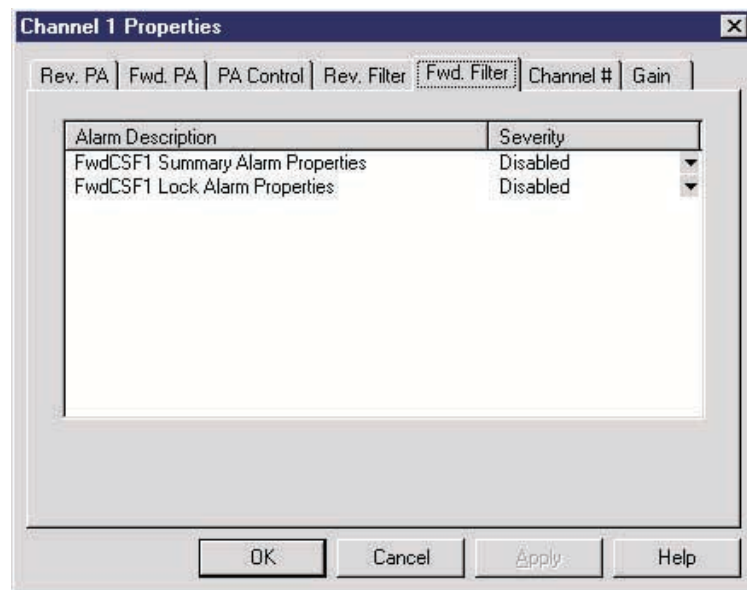
RT131113

9.11.6 Channel # Tab

The Channel # tab (see Figure 9-14) sets the operating channel (or band), for either Channel 1 or Channel 2.

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

NOTE: Consult your network administrator, or the system Site Plan, for the proper channel or band setting.

Figure 9-14   Channel Properties Screen, Channel # Tab
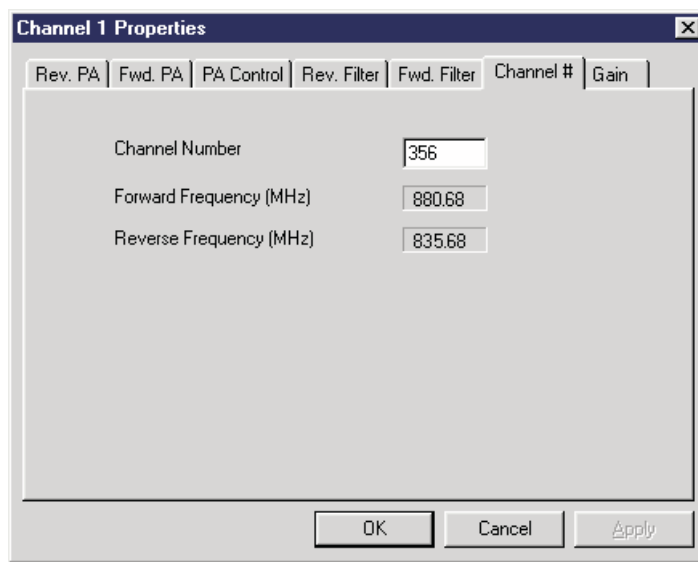
RT131114

9.11.7 Channel Gain Tab

The RepeaterNet software detects the configuration of the repeater, and displays the applicable gain range on the Gain tab (see Figure 9-15). 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 9-15).
3. Press, hold and drag the mouse across the horizontal sliders to define forward and reverse gain.

NOTE: Gain adjusts in 2 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.

Figure 9-15   Channel Properties Screen, Channel Gain Tab
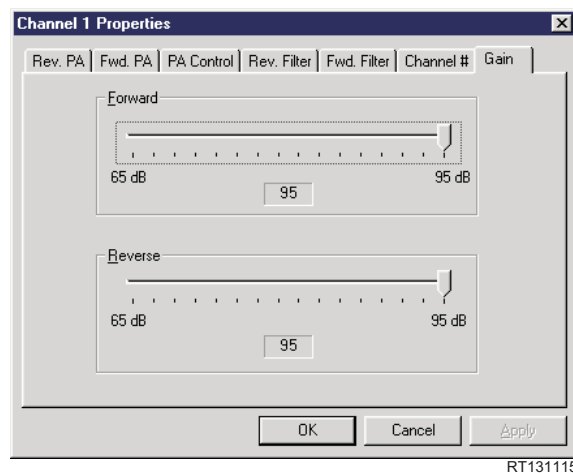
9.12 ACU Properties

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 sub-system, 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
    - I/O Voltage Alarm Threshold

9.12.1 ACU I/O Descriptions Tab

RepeaterNet can monitor two digital alarm inputs, and one 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 9-16) 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 8, Connecting External Alarms.

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 9-16). 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
   - Two 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 9-16   ACU Properties Screen, I/O Descriptions Tab

RT131116
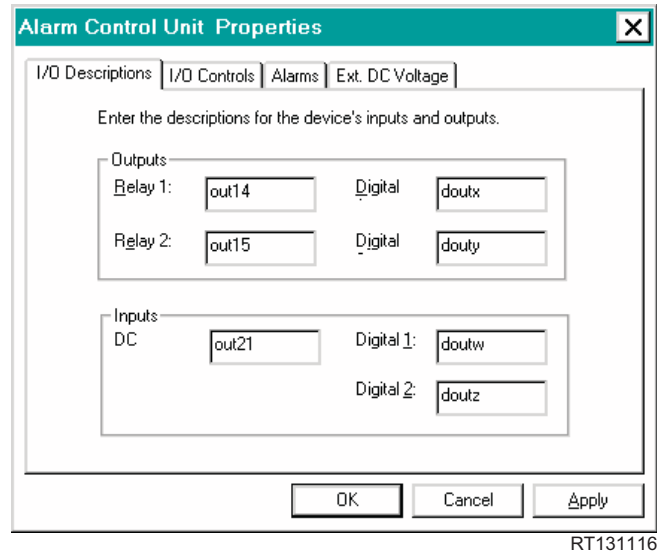
9.12.2 ACU I/O Controls Tab

The I/O Controls tab (see Figure 9-17) turns the 2 relay outputs and digital outputs On or Off.

1. Toggle the appropriate output either On or Off.
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 9-17   ACU Properties Screen, I/O Controls Tab
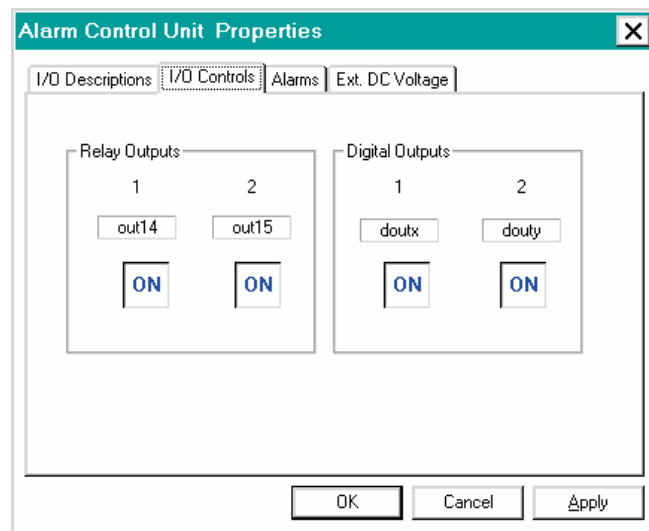
9.12.3 ACU Alarms Setting Tab

The Alarms tab (see Figure 9-18) redefines alarm severity for ACU subsystems.

1. Click the down-arrow next to an Alarm field to select one of the following alarm severity settings:

    • Disabled

    • Event

    • Minor

    • Major

    • Critical

NOTE: Alarm settings for External Input 1 and External Input 2 are initially set 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 types of alarms:

- External Input Alarms (1 and 2) - An alarm generated from optional, external equipment.
- Temperature Alarm - The temperature threshold of the repeater system has been exceeded.
- Tamp Alarm - The repeater door is open.
- Analog Input Alarm - The upper or lower voltage limits have been exceeded from the DC voltage source for the analog input.
- External Growth Alarm - The physical growth box connection to the primary box is detached.
- Growth Temperature Alarm - The temperature threshold of the growth box system has been exceeded.
- Growth Tamper Alarm - The growth box door is open.

Figure 9-18   ACU Properties Screen, Alarms Tab
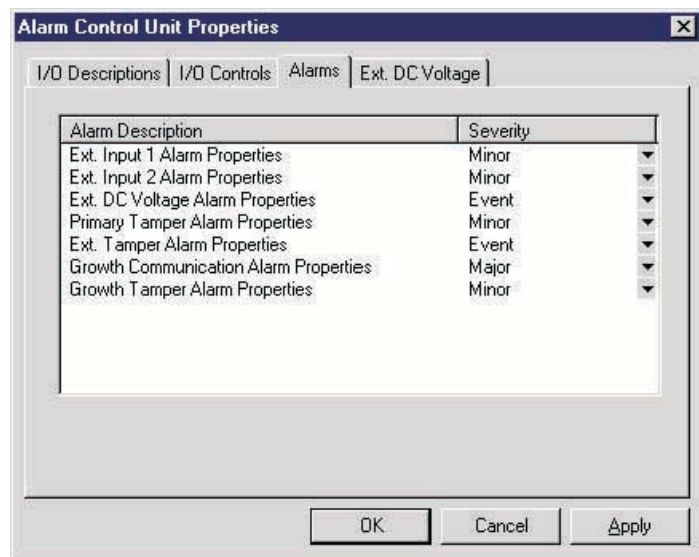
RT131118

9.12.4 ACU DC Voltage Alarm Threshold Tab

RepeaterNet can monitor an external DC voltage power source (a battery) in a range of 0 to 60 volts, in 250 mV 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 9-19).

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 9-19   ACU Properties Screen, External DC Voltage Tab
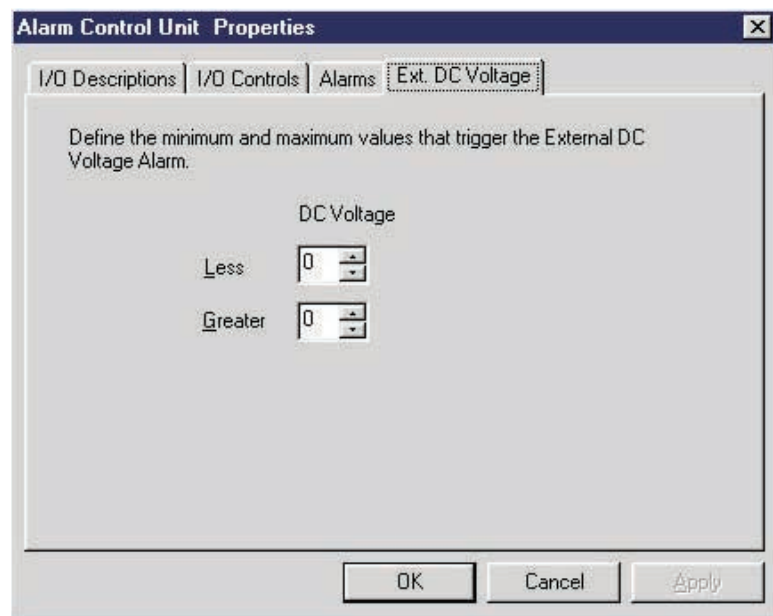
9.13 Modem Properties

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

The Modem Properties screen opens (see Figure 9-20). This screen has three tabs:

<u>Alarm Setting Tab</u> - Sets the alarm severity for the Modem alarm. This alarm indicates a failure of the internal modem.

<u>Modem Properties Tab</u> - Defines the port settings for the internal or external modem.

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

Figure 9-20   Modem Properties Screen
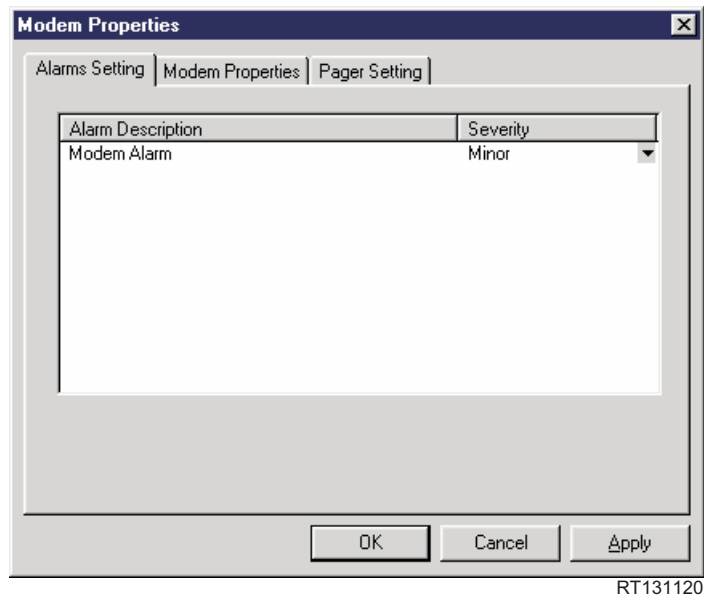
RT131120

9.13.1 Alarm Setting Tab

Use the Alarms tab to redefine alarm severity for the repeater's modem (see Figure 9-21). Internal modem component failure triggers a Modem alarm.

1. Click the down-arrow next to an Alarm field to select one of the following alarm severity settings:
    *   Disabled
    *   Event
    *   Minor
    *   Major
    *   Critical

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.

Figure 9-21   Modem Properties Screen, Alarms Tab
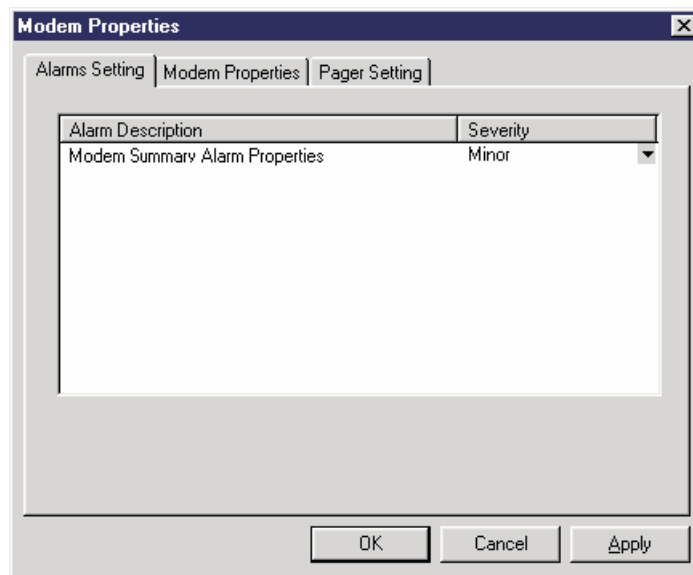
RT131121

9.13.2 Modem Properties Tab

To define modem settings for the repeater's modem, use the Modem Properties tab (see Figure 9-22).

NOTE: The RepeaterNet Craft software uses the values for Setup String, Phone Number, and Call Attempts, only if you are using the RepeaterNet Network Management System, or other network management software. If you do not have NMS, skip to Section 9.13.3, "Pager Setting Tab" on page 9-34.

To define modem properties, use the following procedure:

1. Select Modem from the Configuration menu in the Main Control Screen.

   The Modem Properties screen opens (see Figure 9-22).

2. Click the Modem Properties tab.

   If you are using RepeaterNet NMS, or another network management system, define the Setup String, Phone Number and Call Attempts.

   • Setup String configures a modem. The modem setup string is S37=6.

   • The Phone Number is the phone number of a remote computer that the repeater calls.

   • Call Attempts is the number of callouts to attempt before disconnecting; a value of zero(0) disables calling.

3. Set the Baud Rate for the modem.

   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. Set the Parity to None.

5. Set Data Bits to 8.

NOTE: Set the Parity and Data Bits the same on both the repeater's and computer's modem.

---

6. Set the Dial Type to Tone.

7. Click the Apply or OK button.

   • The Apply button sets the modem properties and keeps the Modem Properties screen open.

   • The OK button sets the modem properties and closes the Modem Properties screen.

Figure 9-22   Modem Properties Screen, Modem Properties Tab

RT131122
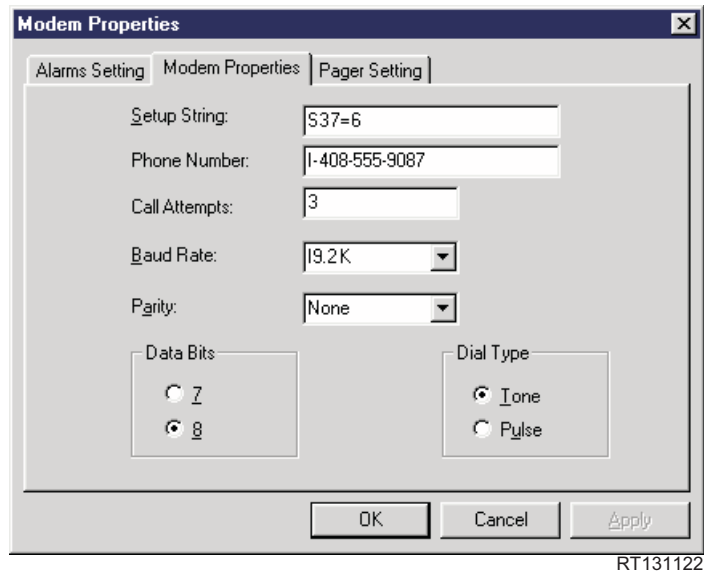
Setting Up a Modem for Over-the-Air Repeaters

If you connected an external wireless interface (such as the Telular) to an OA (Over-the-Air) repeater from Repeater Technologies, Inc. (RTI), then you must properly configure the repeater's modem. If you improperly set up the modem, calls to the OA repeater will not be successful.

Use the following procedure to set up the modem for all Repeater Technologies OA products.

1. Connect to the repeater through the local Craft port.
2. Start RepeaterNet software.
3. Establish a connection to the repeater.
4. Select Configuration from the menu bar located at the top of the screen.
5. From the Configuration menu, select Modem Properties.
6. Click on the Modem Properties tab.
7. Enter S37=6 in the Setup String field (the top field on the Modem tab).
8. Enter a Phone Number.

   For example, enter:

       9,222 123-4567

NOTE: Each comma creates a two-second delay in dialing. The RepeaterNet software ignores parentheses () and spaces.

9. Enter the number times that RepeaterNet should attempt to make the connection. For example, enter:

    3

NOTE: Entering zero(0) in this field disables calling.

---

10. Click Apply or OK button at the bottom of the window.
    - •The Apply button sets the modem properties and keeps the Modem Properties screen open.
    - •The OK button sets the modem properties and closes the Modem Properties screen.

Important Points About Modem Setup

- This procedure forces the repeater initialize the modem to 2400 baud, which improves the connection on analog wireless networks.
- If you configure a repeater to automatically call out and report alarm status, the repeater Com port settings must match the settings of the modem that the repeater calls.
- If you use a modem to login to the repeater, the port settings of the computer's modem (defined in the configuration file) must match the settings of the repeater modem.
- If the repeater is equipped with an internal modem, the repeater's hardware automatically controls the setup string. However, if the repeater is connected to an external modem, you must consult the modem's documentation for the setup string.
- Changes to the default settings on the Modem Properties screen, take effect when you exit the RepeaterNet software.

9.13.3 Pager Setting Tab

The Pager Setting tab sets the RepeaterNet software, so that it sends out a page when an alarm occurs. It also assigns a specified severity level to the alarm. Table 9-3 describes the Alarm Severity settings.

RepeaterNet generates a page if the summary alarm severity is greater than or equal to the selected Minimum Severity setting. When RepeaterNet detects a page request, the repeater terminates any current modem connection, and generates a page. The page format consists of the repeater number, followed by the severity level. For example:

      123456-2

where 123456 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.

Table 9-3   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 Modem Properties screen.
2. Enter the Pager Number.

   The Pager Number is the phone number to call. This phone number must include the networking access number (9), 1 and the area code (if needed). Access the network dial number, and wait five seconds before sending the page sequence.

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.

Therefore, 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 call the pager number (Call Attempts).

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

---

4. Enter the number of the repeater (Repeater Number).

   This is a system identification number or description.
5. Select one of the following minimum alarm severity settings for paging:
   - Critical
   - Major
   - Minor
6. Click the Apply or OK button.
   - The Apply button sets the pager properties and keeps the Pager Properties screen open.
   - The OK button sets the pager properties and closes the Pager Properties screen.

9.14 Cell Phone Properties

1. From the Configuration menu in the Main Control screen, select Cellular Phone.

    The Cell Phone Properties screen opens (see Figure 9-23).

NOTE: If the repeater does not have a cell phone, the Cellular Phone Properties selection is disabled.

---

2. Use the Alarm Setting tab to set the alarm severity for the Cellular Alarm.

    The Cell Phone alarm indicated a failure of a cellular phone.

3. Click the down-arrow next to an Alarm field to select one of the following alarm severity settings:

    • Disabled

    • Event

    • Minor

    • Major

    • Critical

NOTE: The cellular phone alarm severity should normally be set to minor. The Cell Phone alarm generates if the cell phone fails to report an alarm, after all retry attempts by either the modem or the pager. This alarm clears when the cell phone succeeds in reporting an alarm.

---

4. Click the Apply or OK button.

    • The Apply button changes the alarm severity setting and keeps the Cellular Phone Properties screen open.

    • The OK button changes the alarm severity setting and closes the Cellular Phone Properties screen.

Figure 9-23   *Cellular Phone Properties Screen*
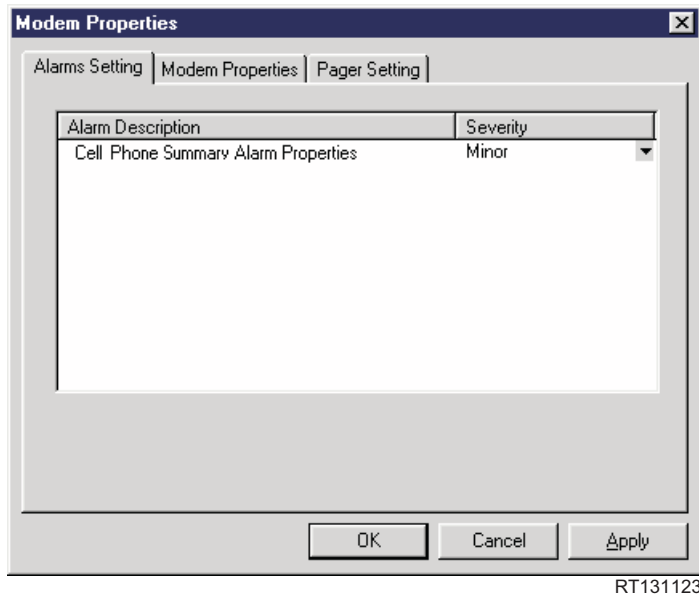
RT131123

9.15 Power System Properties

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

    The Power System Properties screen opens (see Figure 9-24). This screen provides access to initial configuration settings for the power subsystem.

2. 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:

<u>Input Power Alarm</u> - The input power to the repeater is out of the system tolerances.

<u>Power Supply Alarm</u> - The internal system power of the repeater is out of tolerances.

<u>PS Battery Alarm</u> - The voltage of the internal battery is below tolerances. This battery supplies power to the Alarm Control Unit (ACU), modem, and cell phone, in the event of a system power failure. This internal battery lets the repeater call out and report its status. It also supplied power to the memory that stores the Alarm and Event Log.

NOTE: The internal battery does not provide power for RF components. The repeater cannot provide RF coverage during a power failure.

<u>Growth Box Input Power Alarm</u> - The input power to the growth box is out of system tolerances.

<u>Growth Box Power Supply Alarm</u> - The internal system power of the growth box is out of tolerances.

3. Click the down-arrow next to an Alarm field to select one of the following alarm severity settings:
    - Disabled
    - Event
    - Minor
    - Major
    - Critical

4. 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.

Figure 9-24 Power System Properties Screen
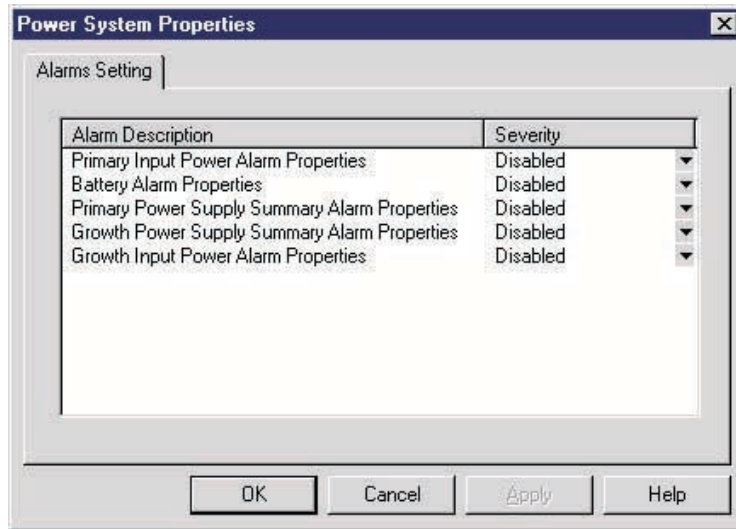
RT131124

9.16 Back-up Power System (UPS) Properties

The UPS Properties screen provides the initial configuration settings 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 -> UPS.

    The UPS Properties screen opens (see Figure 9-25).

2. Use the Alarm Setting tab to redefine alarm severity for the back-up power systems.

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

AC 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.

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

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

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

UPS Summary Alarm - Indicates that one or more of the BUPS alarms have triggered.

UPS Tamper Alarm - Indicates that the door of the BUPS is open.

3. Click the down-arrow next to an Alarm field to select one of the following alarm severity settings:
    - Disabled
    - Event
    - Minor
    - Major
    - Critical

4. Click the Apply or OK button.

    •The Apply button changes the alarm severity setting and keeps the UPS Properties
      screen open.

    •The OK button changes the alarm severity setting and closes the UPS Properties
      screen.

Figure 9-25   UPS Properties Screen
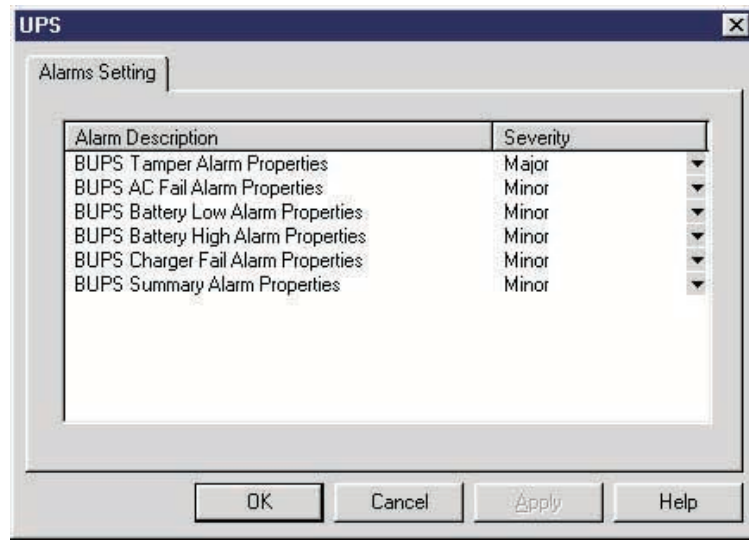
RT131125

9.17　Monitoring Repeater Status

The subsystem Status screens monitor and control various repeater system functions. By clicking the appropriate subsystem icons, you can check each subsystem in the repeater.

Each Status screen includes one or more of the following tabs:

Alarms Tab - Reports present subsystem alarm states, with date and time stamps.

Measurements Tab - Reports power and operational temperature measurements, including Low and High values. A Reset Low/High button resets the values.

Voltages Tab - Reports present voltages for a subsystem.

Control Tab - Includes On/Off switches for internal and external subsystem hardware.

Status screens for the repeater are:

- Front End Status
- Channel Status
- Filter Status (Forward and Reverse)
- PA Status (Forward and Reverse)
- Alarm Control Unit (ACU) Status
- Modem Status
- Cellular Phone Status
- Power System Status
- UPS Status

9.18 Front End Status

Click an FFE (Forward Front End) icon to display the Front End Status screen.

The Alarm tab in the Front End Status screen reports theses alarms:
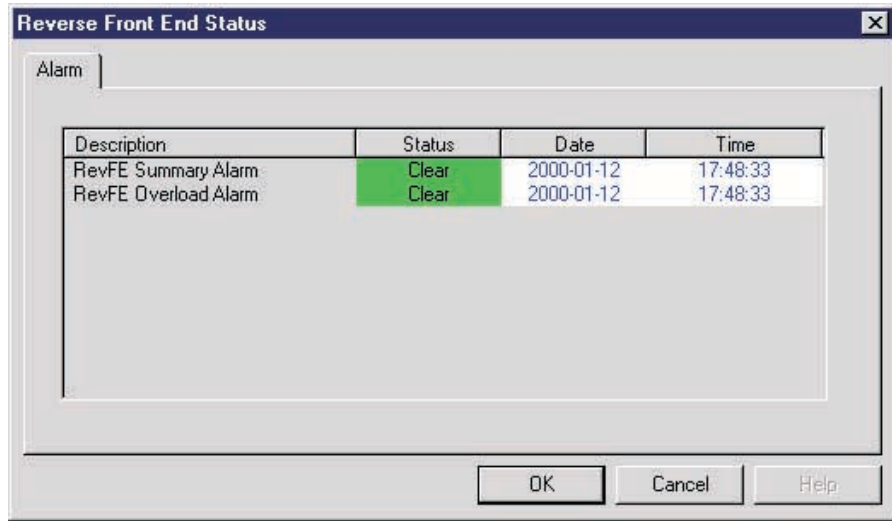
<u>Forward FE Alarm</u> - This alarm activates when the forward signal power level is too strong, and is being attenuated to protect the repeater from possible damage (see Figure 9-26).

Figure 9-26   Forward Front End Status Screen
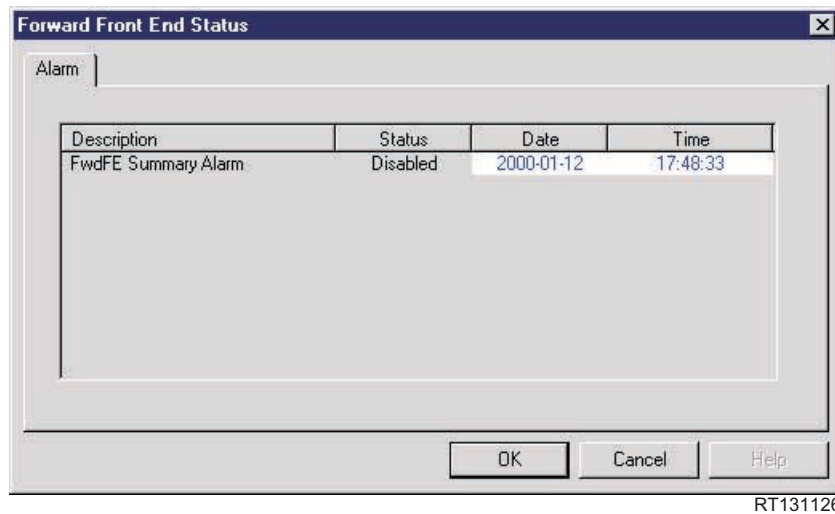
Reverse FE Alarm - This alarm activates when the reverse signal power level is too strong, and is being attenuated to protect the repeater from possible damages (see Figure 9-27).

Figure 9-27   Reverse Front End Status Screen

RT131127

<u>Diversity FE Alarm</u> - This alarm activates when the Diversity Receive signal power level is too strong, and is being attenuated to protect the repeater from possible damage (see Figure 9-28).

Figure 9-28   *Diversity Front End Status Screen*
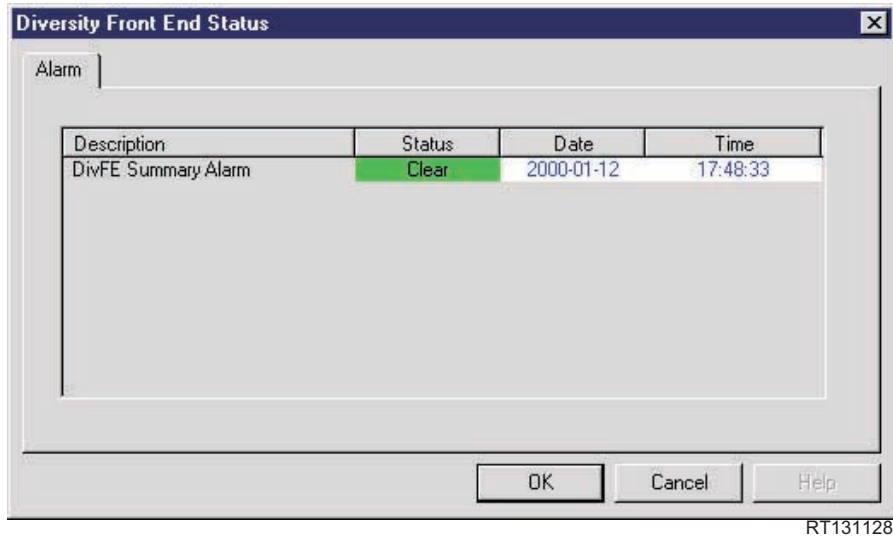
9.19 Channel Filter Status

Click a Channel 1 or Channel 2 filter icon (sine waves) to open a filter Status screen.

The Channel Filter Status screen (see Figure 9-29) reports a CSF1 Forward Alarm (Forward Filter), and a CSF1 Reverse Alarm (Reverse Filter), both including date and time stamps.

A failure in the Reverse or Forward filter assembly triggers an alarm.

Figure 9-29   Channel Filter Status Screen
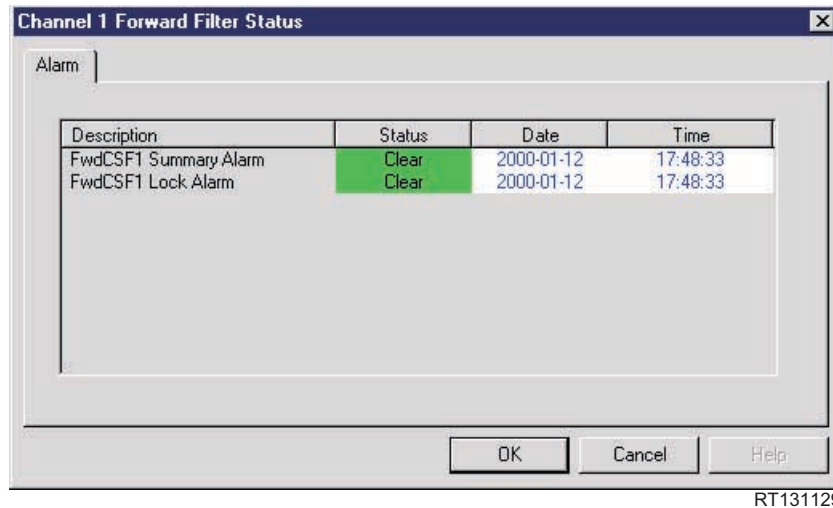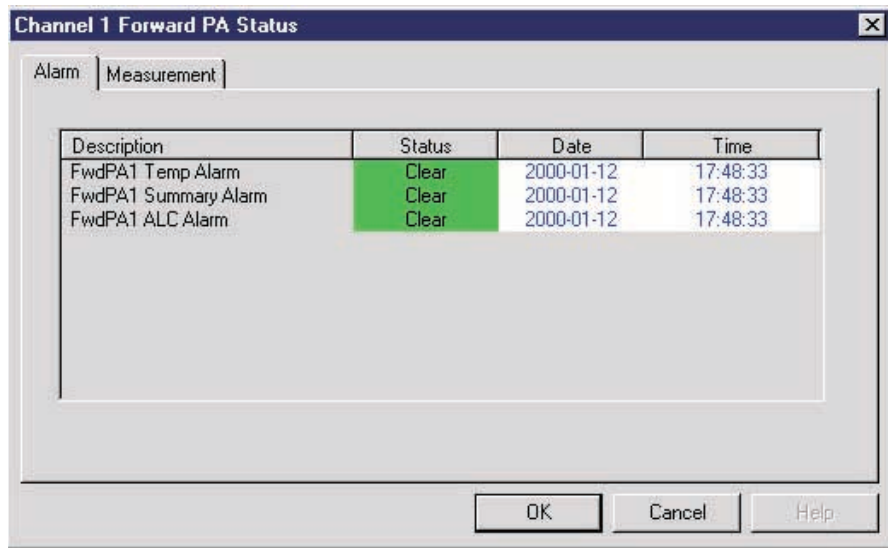
9.20 Channel PA Status

Click a Channel 1 or Channel 2 FPA (Forward Power Amplifier) or a RPA (Reverse Power Amplifier) icon, to open a PA Status screen.

9.20.1 PA Alarm Tab

The PA Alarm tab (see Figure 9-30) reports subsystem alarms, including date and time stamps. A failure in the Forward or Reverse PA assembly triggers an alarm.

Figure 9-30   Power Amplifier Status Screen, Alarms Tab

RT131130

9.20.2 PA Measurement Tab

The Channel 1 and Channel 2 PA Measurement tabs (see Figure 9-31) report the output power of the repeater, including low and high output values.

To reset low and high output values, click Reset Low/High.

Figure 9-31   Power Amplifier Status Screen, Measurement Tab
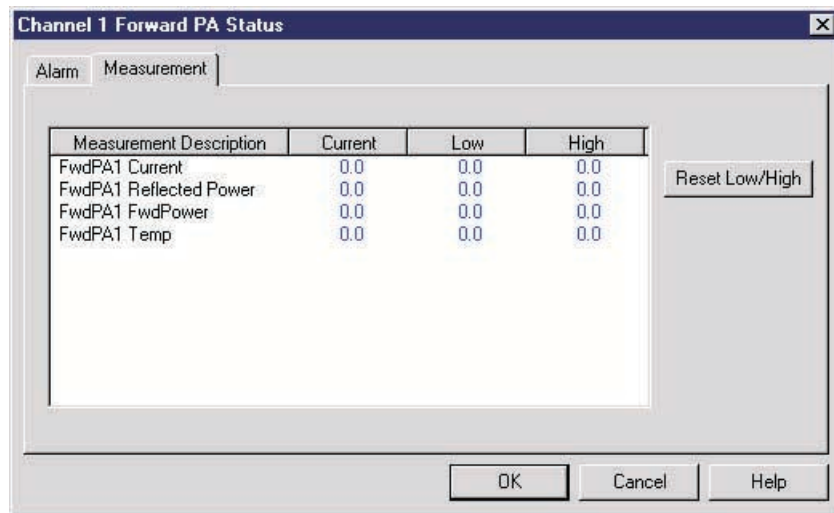
RT131131

9.21 ACU Status

Click the ACU icon to open the ACU Status screen.

This screen has two tabs:

- Alarm
- Measurement

ACU Alarm Tab

The Alarm tab (see Figure 9-32) reports subsystem alarms, including date and time stamps. A failure in the ACU assembly triggers an alarm. ACU alarms include:

External Input Alarms (1 and 2) - The alarm is from a piece of optional, external equipment.

Temperature Alarm - The system temperature threshold was exceeded.

Tamper Alarm - The repeater door is open.

Analog Input Alarm - The upper and lower voltage limit was exceeded, from the DC voltage source for the analog input.

External Growth Box Alarm Status - The growth box connection (to the primary repeater box) is detached, disconnected, or broken.

Figure 9-32   ACU Status Screen, Alarm Tab

RT131132

9.21.1 ACU Status Screen, Measurement Tab

The Measurement tab (see Figure 9-33) reports current, low, and high system temperature.

It also reports DC voltage source values.

Click on the Reset Low/High button to reset the low and high values.

Figure 9-33   ACU Status Screen, Measurement Tab
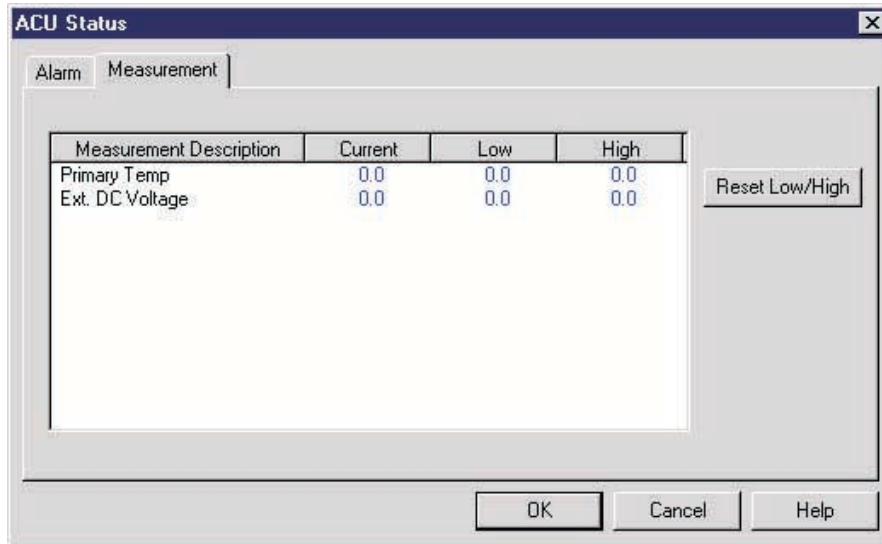
9.22 Modem Status

Click on the Modem icon.

The Modem Status screen opens (seeFigure 9-34). This screen reports a modem alarm, including a date and time stamp.

Failure of an internal modem component triggers a Modem alarm.

Figure 9-34   *Modem Status Screen*
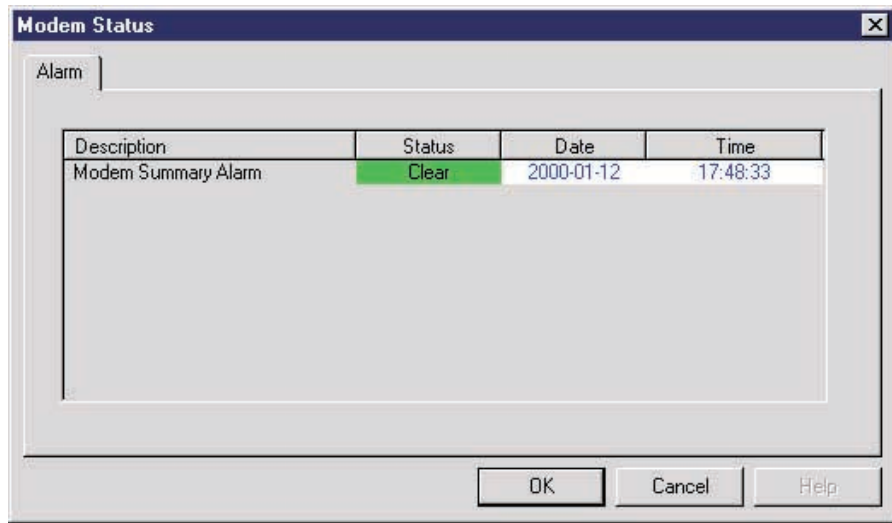
RT131134

9.23 Cell Phone Status

Click on the Cell Phone icon.

The Cell Phone Status screen (see Figure 9-35) opens. This screen reports any Cell Phone Alarm, including a date and time stamp.

Failure of an internal cellular phone component triggers a Cell Phone alarm.

Figure 9-35   Cell Phone Status Screen
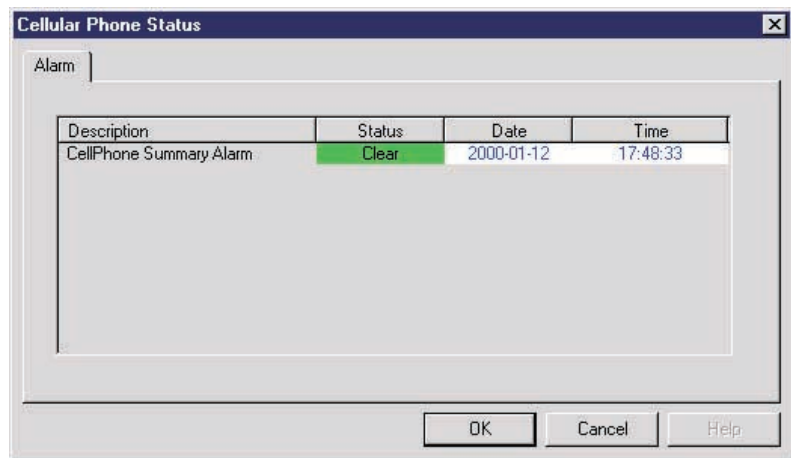
RT131135

9.24 Power System Status

Click the Power icon.

The Power System Status screen opens. This screen monitors and operates the repeater's power subsystem.

9.24.1 Alarm Tab

The Alarm tab (see Figure 9-36) reports the status of the following alarms, including severity, date and time information for each:

<u>Input Power Alarm</u> - The input power to the repeater is out of tolerance.

<u>Power Supply Alarm</u> - The system power for the repeater is out of tolerance.

<u>PS Battery Alarm</u> - Indicates that the voltage of the internal battery is out of tolerance. This battery supplies power to the ACU, modem, and cellular phone, in the event of a system power failure. The repeater uses this battery to call out and report its status. The battery also supplies power to the memory, which stores that Alarm and Event Log.

The internal battery does not provide power for RF components. The repeater cannot provide RF coverage during a power failure.

Figure 9-36   Power System Status Screen, Alarms Tab
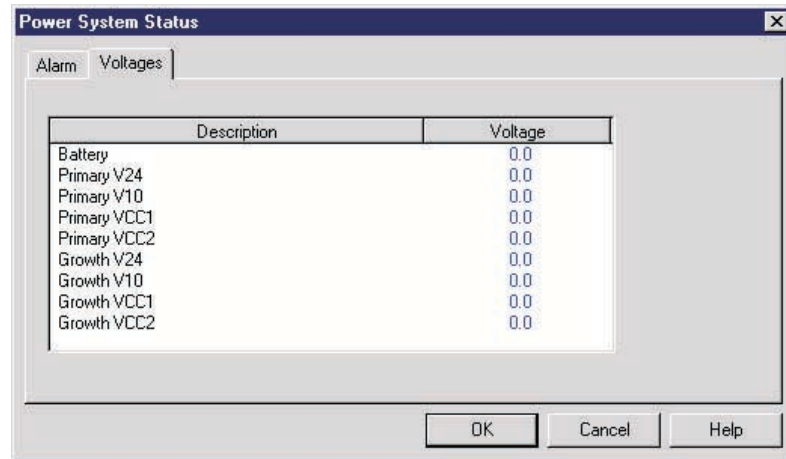
RT131136

9.24.2 Voltages Tab

The Voltages tab (see Figure 9-37) shows the current power values for:

- •Battery Volts
- •Channel 1 PA (Power Amplifier) Volts
- •Channel 2 PA Volts

Figure 9-37   Power System Status Screen, Voltages Tab

RT131137

9.25 UPS Status

The UPS Status (Uninterruptable Power Supply status) screen monitors the optional, external Back-up Power Supply (BUPS).

The Alarms tab in this screen (see Figure 9-38) displays the alarm status of the following alarms:

<u>AC Fail Alarm</u> - Input power to the BUPS failed. The BUPS provides 40 or 80 amp-hours of backup power (depending on the installed BUPS type) at the repeater site, before shut-down. The AC source powers the charger.

<u>Low Battery Alarm</u> - BUPS battery voltage is below operating tolerances, and cannot power any repeater functions.
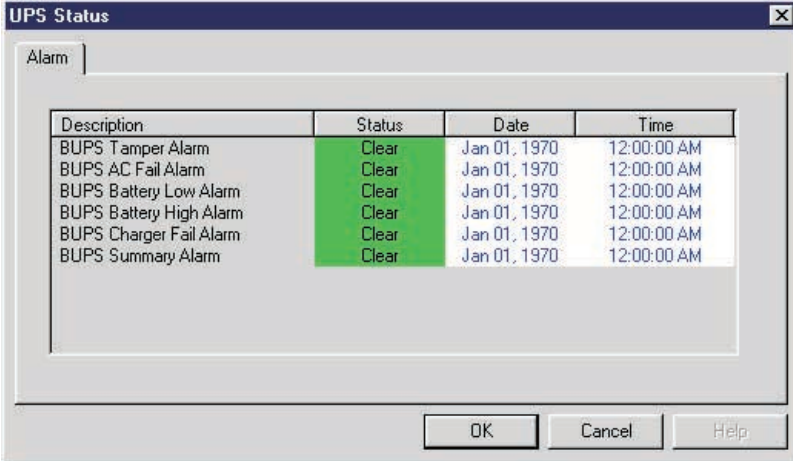
<u>High Battery Alarm</u> - BUPS battery voltage is above operating tolerances, and cannot power any repeater functions.

<u>Charger Fail Alarm</u> - The internal charger for the BUPS has failed. The BUPS cannot recharge its batteries.

<u>UPS Summary Alarm</u> - One or more of the BUPS alarms has triggered.

<u>UPS Tamper Alarm</u> - The door of the BUPS is open.

Figure 9-38   UPS Status Screen, Alarms Tab

RT131138

9.26 RepeaterNet Menu Commands

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

9.26.1 File Menu - RepeaterNet Craft

From the Main Control screen, open the File menu. Figure 9-39 shows the RepeaterNet commands in this menu.

Figure 9-39   RepeaterNet Craft, File Menu
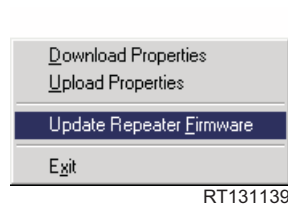
Download Properties

Use the Download Properties command to download all settings that are already uploaded to a repeater, including:

- Download the default configuration file, which is distributed with the Craft software. Downloading avoids manually configuring each setting.
- 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.

Figure 9-40 shows the preset configuration files that distributed with RepeaterNet Craft installation software. To find these files, follow the Windows Explorer path shown. Table 9-4 describes each of these files.

NOTE: Examples shown are for the OA850C repeater.

Figure 9-40   Preset Configuration Files in RepeaterNet Craft
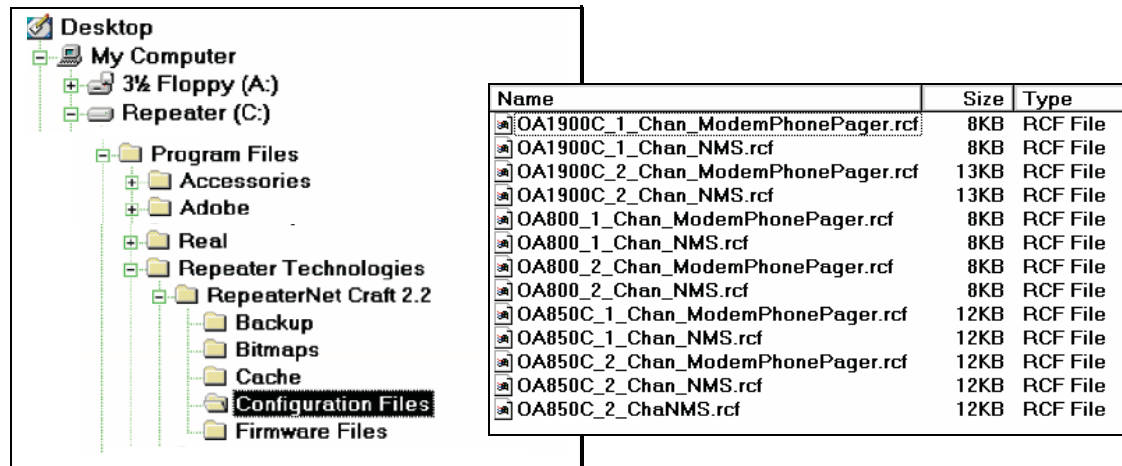
RT131140

Table 9-4   Descriptions of Configuration Files

Configuration File	Configuration
OA850C_2_Chan_NMS.rcf	2-channel OC850C repeater without modem or phone
OA850C_2_Chan_ModemPhonePager.rcf	2-channel OA850C repeater with modem or phone
OA850C_1_Chan_ModemPhonePager.rcf	1-channel OA850C repeater with modem or phone
OA850C_1_Chan_NMS.rcf	1-channel OA850C repeater without modem or phone

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

1. From the Craft Main Control File menu, select Download Properties.

    A confirmation box lets you either confirm, or cancel, the downloading.

2. Click on the OK button to proceed.

    A Select File to Restore box displays (see Figure 9-41).

3. Select the repeater configuration file whose properties will be download.

4. Click on the Open button to proceed with the download.

    When the download is complete, a confirmation message box displays.

Figure 9-41   Downloading Repeater Configuration Files
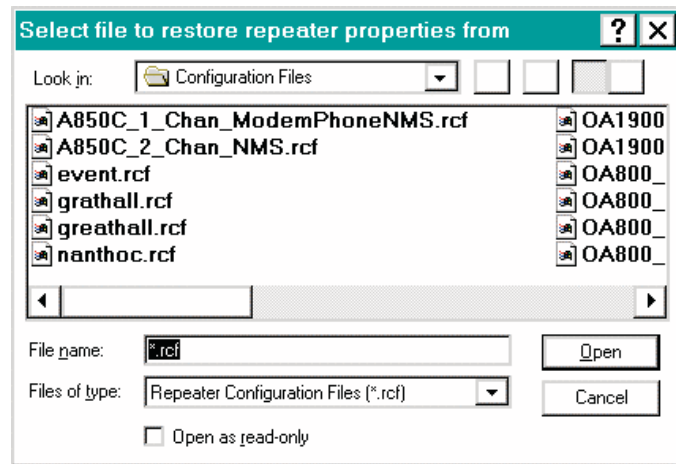
RT131141

Upload Properties

RepeaterNet stores system settings 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 a repeater.
2. Open the Craft software.
3. Select File -> Upload Properties.
4. A Select File to Save Repeater Properties To dialog box opens (see Figure 9-42).
5. Enter a name for the file, without a file extension.

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

    > Filename.rcf

6. Click Save to initiate the upload.

    When the upload is complete, a message box displays.

7. Click the OK button.
8. Save a copy of the repeater configuration file onto a floppy disk, for safe keeping.

NOTE: When creating a backup file, be aware that if you used a Network Monitor login to create Repeater Configuration (.rcf) files, then the files include Ids and passwords. The Craft software saves the Repeater Configuration (.rcf) in the RepeaterNet program directory.

Figure 9-42   Saving Repeater Properties to a File
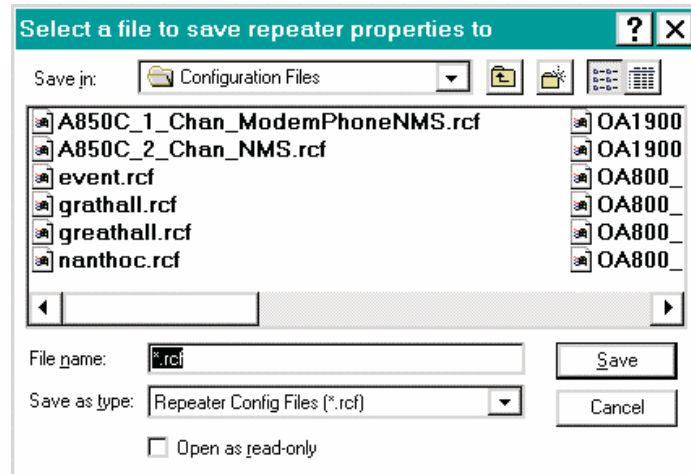
RT131142

Update Repeater Firmware

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

NOTE: Repeater Technologies, Inc. (RTI) automatically sends firmware updates to the designated point of contact, for every affected owner of a specific type of repeater. RTI uses overnight delivery to send update packages.

Firmware updates include:

- A detailed description of the update
- A floppy disk 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. Login to a communications session, using the repeater to be upgraded.
3. Insert the upgrade disk into the computer's floppy drive.
4. From the menu bar in the Main Control screen, select File -> Update Repeater Firmware.

   A message box displays (see Figure 9-43).
5. Click on the OK button.

   A file selection screen displays (see Figure 9-44).

Figure 9-43   Firmware Update Message Box
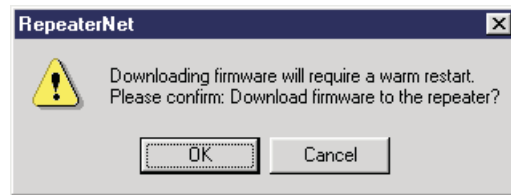
RT131143

Figure 9-44   Selecting File Names for Saving Firmware Updates
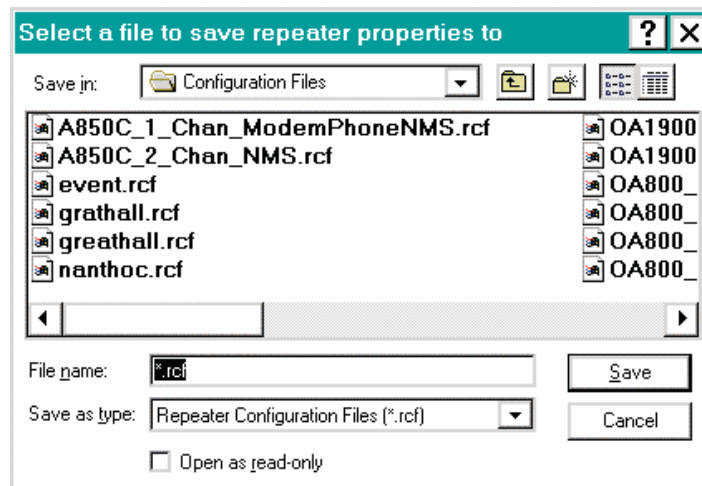
RT131144

6. Select whether to save the repeater's configuration.

- To save the configuration and continue updating firmware, select an .rcf file, and click the Save button.

- To cancel saving the repeater configuration to a file, click the Cancel button.

Either way, the upload operation proceeds. An Uploading Repeater window displays the progress of the upload.

When the upload completes, the Select a Firmware File to Download to the Repeater box displays (see Figure 9-45).

7. In the Look In field, select the disk drive that contains the upload disk.

8. Double-click the upgrade file.

The upgrade file is labeled with an .s09 extension - for example:

    Filename.s09

Installation overwrites the previous firmware version.

When the upgrade is complete, the Craft software automatically restores the repeater's configuration, from the file selected in the Open dialog box.

Figure 9-45   File Selection Box for Downloading Firmware

RT131145
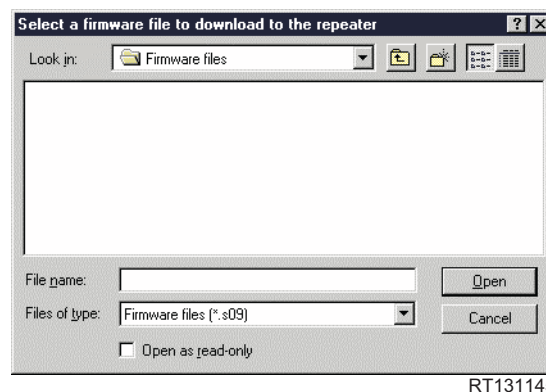
Exit

The Exit command ends an active session in the RepeaterNet software, and returns to the Welcome screen.

9.26.2 Configuration Menu - RepeaterNet Craft

To initially configure the repeater, use the Configuration menu commands, shown in Figure 9-46.

See Section 9.8, "Configuring Repeater Properties" on page 9-11, for detailed information.

Figure 9-46   RepeaterNet Craft, Configuration Menu
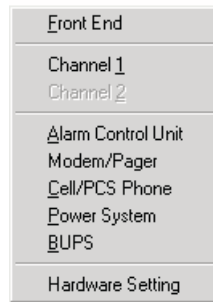
RT131146

9.26.3 System Menu - RepeaterNet Craft

This section describes commands in the System menu, as shown in Figure 9-47.

Figure 9-47   RepeaterNet Craft, System Menu

```
┌─────────────────────────────────────┐
│  Properties...                        │
├─────────────────────────────────────┤
│  Alarm and Event Log            ▶    │
├─────────────────────────────────────┤
│  Refresh Alarms                       │
├─────────────────────────────────────┤
│  Test Alarm Dial Out Setup            │
└─────────────────────────────────────┘
                              RT131147
```

Properties

Select Properties from the System menu.

The System Properties screen opens.

NOTE: When the repeater is on a network, you must enter the system name, as used at the Network Management Station. This ensures that RepeaterNet Craft recognizes unsolicited alarms.

<u>System Tab</u>

The System tab includes data fields for storing site-specific information (see Figure 9-48):

- 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

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 (required)
   - 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)
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 9-48   System Properties Screen, System Tab

RT131148

<u>System Inventory Tab</u>

The System Inventory tab (see Figure 9-49) 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 9-5 summarizes the data displayed in the information-only fields of this tab.

Figure 9-49   System Properties Screen, System Inventory Tab
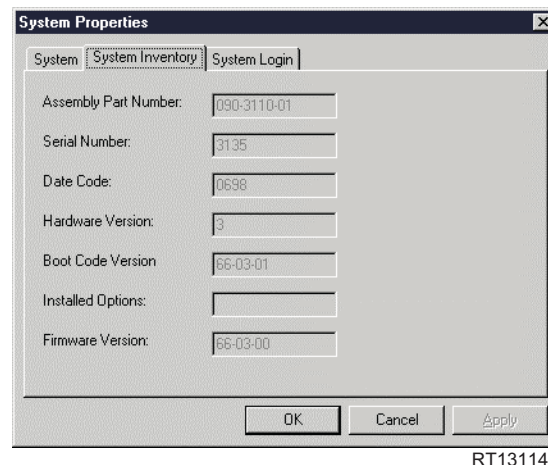
RT131149

Table 9-5   Description of System Inventory Fields

Field Name	Description
Assembly Part Number	The part number of the repeater (for example: 090-1200-09)
Serial Number	The 9-digit serial number of the repeater
Date Code	The date when the repeater was built
Hardware Revision	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

<u>System Login Tab</u>

The System Login tab (see Figure 9-50) includes fields to do the following:

- Type in login IDs
- Type in 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 9-50   System Properties Screen, System Login Tab

RT131150

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 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, this information also must reside in the NMS Database.

Alarm and Event Log

Open the Alarm and Event Log from the System menu, to view the alarm and event history. This log dynamically updates during viewing.

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.

9.26.4 Options Menu - RepeaterNet Craft

Figure 9-51 shows the RepeaterNet commands in the Options menu.

Figure 9-51   RepeaterNet Craft, Options Menu

RT131151

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 9-6 describes each of the color-independent icons.

Table 9-6   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	\

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.

9.26.5 Help Menu - RepeaterNet Craft

RepeaterNet on-line help provides quick access to information related to the operation of the repeater. Figure 9-52 shows the Help menu.

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

Figure 9-53 shows a typical window that opens when you select Help -> Help Topics.

Figure 9-52   RepeaterNet Craft, Help Menu

RT131152

Figure 9-53   Help Topics Window

RT131153
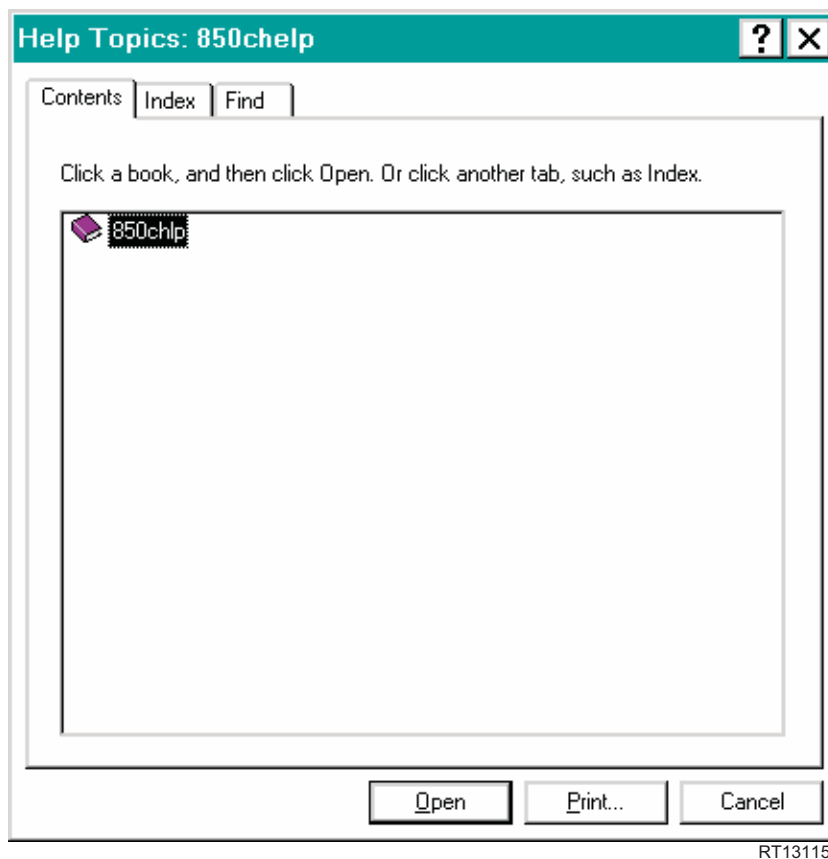
Contents Tab

1. From the Contents tab (see Figure 9-54) of the Help Topics window, double-click a book icon.

    Online Help opens the book's contents.

2. Double-click a topic icon.

    This opens the topic's Help page.

A help page provides detailed topic information. Help pages can contain links to related topics (green, underlined text identifies a link).

Figure 9-54   Help Topics Window, Contents Tab
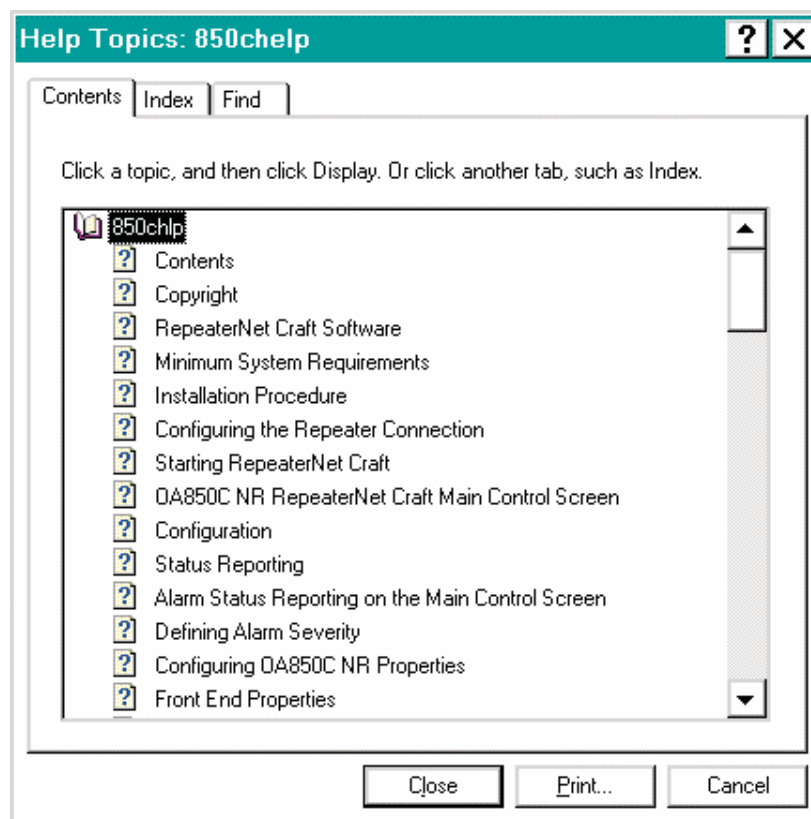
RT131154

Index Tab

1. From the Index tab (see Figure 9-55) of the Help Topics window, do either of the following:

    • Type a topic name in the data field.

    • Online help automatically jumps to the index entry for the selected topic.

    • Use the scroll bar to locate a topic entry.

2. Double-click an index entry.

    The appropriate Help page opens.

Figure 9-55   Help Topics Window, Index Tab
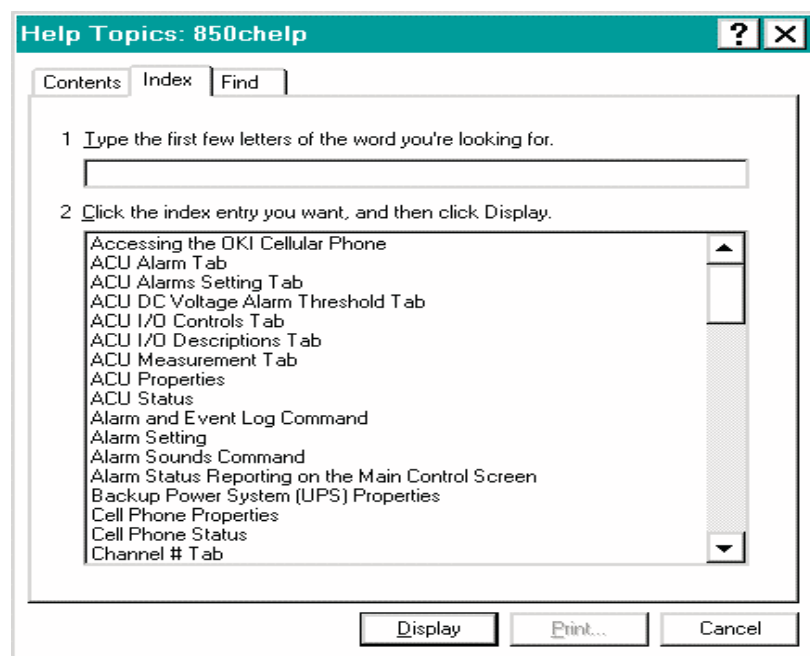
RT131155

Find Tab

1. In the Help Topics Window, click on the Find tab.

   The Find Setup Wizard utility opens (see Figure 9-56).

   Use this wizard to search for specific words and phrases in Online Help, instead of searching by category.

2. Follow the prompts in the Find Setup Wizard utility.

   When the Find Setup Wizard finishes, a window such as Figure 9-57 displays.

Figure 9-56   Find Setup Wizard (Two Screens)
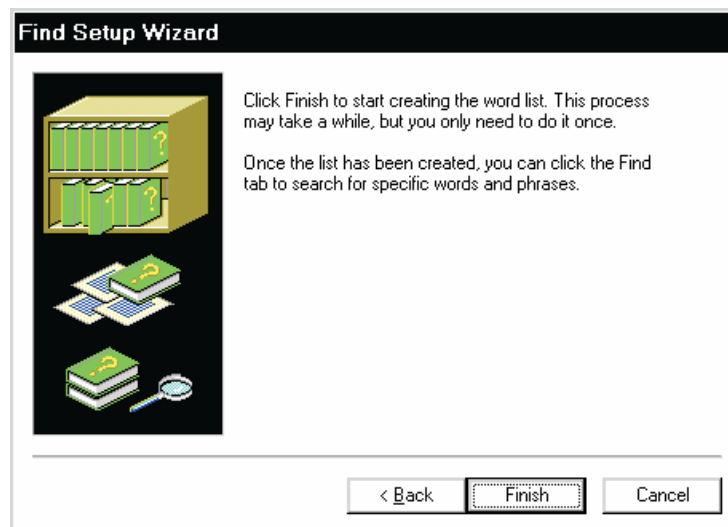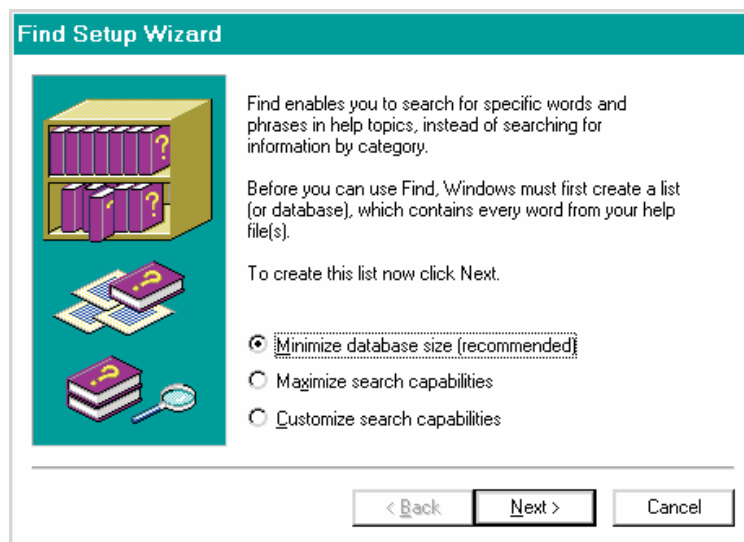
RT131156

Figure 9-57 Result of Find in Help Topics Window
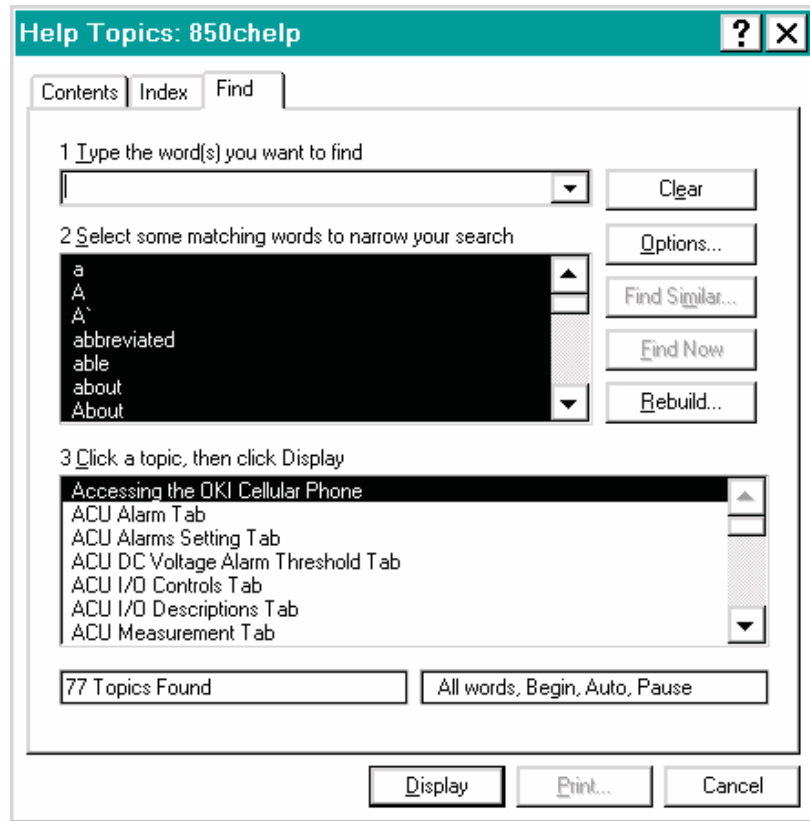
RT131157

9.26.6 Exiting RepeaterNet

To exit RepeaterNet, return to the File menu in the Main Control screen, and select Exit.

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Final Testing and Optimization

<div style="text-align: right; font-size: 3em;">10</div>

10.0 Link Engineering Considerations

10.0.1 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.

10.1 System Timing Issues

10.1.1 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 a detailed description of this issue see Appendix E, *System Timing Issues, Cell Radius, Search Window Widths, and Pilot Inc*, in the Repeater Engineering Handbook.

10.1.2 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:

Δ(Chips)   =   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. For a detailed description of this issue, see Appendix E, System Timing Issues, Cell Radius, Search Window Width, and Pilot Inc, in the Repeater Engineering Handbook.

10.1.3 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 form 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 Link Engineering Spread Sheet (LESS) 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, refer to the Reverse Search Window Overview document. The Repeater Technologies Application Engineering Group can also address issues such as this.

10.1.4 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 ten-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 the equation calculates the worst-case TOA, you can set the search window width accordingly.

10.1.5 Updating 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.

10.2 Drive Testing Requirements

10.2.1 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 to identify areas of high RFER and/or high Mobile_TX parameters.

10.2.2 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.
- Safco.
- 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.

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Reviewing Technical Specifications 11

11.0 RC1920C Specifications

Table 11-1   Table Inputs and Outputs

Local I/O	Output Type	Local I/O	Output Type	Local I/O	Output Type
Critical Alarm	Form C Relay	Remote Control Relays (2)	Form C Relay	External Battery Monitor	Analog (DC Volts)
Major Alarm	Form C Relay	Digital Outputs (2)	Opto-Isolated TTL	BUPS Monitor	6 Alarms
Minor Alarm	Form C Relay	Digital Inputs (2)	Opto-Isolated TTL		

Table 11-2   Additional Characteristics

Waveform Quality Factor Degradation (rho)	Spurious Response	3 dB SAW Filter Bandwidth	Delay	Maximum Input Signal (without damage)	VSWR	Noise Figure
p>0.95	per IS-95/IS-97	<1.27 MHz	<6 msec	+10 dBm	<1.5:1	<6 dB per path

Table 11-3   RepeaterNet Alarm, Monitoring, and Control

Access Options	GUI	Functions	
• RS-232 (local) • POTS (dial-up) • Wireless Modem	• Windows 95/NT (craft) • Windows NT (NMS) • 32-bit • Point-and-click • Wireless Modem	• Summary Alarm • Interrupt Reporting • Definable Threshold • Remote Control: Gain, Channel, PA On/Off	•

Table 11-4   Alternate Power Options

Type	Description
BUPS	2-8 hours of backup power, without AC
Solar Power	PV (Photovoltaic), 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

11.1 RC1900C Specifications

Table 11-5   Frequency Range Options (MHz)

Block	Bandwidth	Reverse	Forward
A	15	1850-1865	1930-1945
B	15	1870-1885	1950-1965
C	15	1895-1910	1975-1990
D	5	1865-1870	1945-1950
E	5	1885-1890	1965-1970
F	5	1890-1895	1970-1975

Table 11-6   Electrical Characteristics

	RF Output Per Carrier at the Antenna Port		
Link	1-Channel	2-Channel	Gain (dB
Forward	+38 dBm	+38 dBm	65-95
Main Reverse	+18 dBm	+18 dBm	65-95
Diversity Reverse	+18 dBm	+18 dBm	65-95

Table 11-7   Mechanical/Electrical Characteristics

Power Consumption		Size	Weight	Input Voltage Options	Temperature	Antenna Connectors
1-channel	310 Watts	16Hx14Wx 11.5D (inches) 406Hx356Wx 292D (Mm)	<501~or 23 Kg.	110/230 VAC or +24/28 VDC	-40° to 55° ambient	Type N (f) 7/16 DIN (f) optional
2-channel	570 Watts (total)					

Table 11-8   AC and DC Electrical Power Characteristics

Power Type	Voltage	Current (typical) 1-channel	Current (typical) 2-channels
AC	100 to 264 Colts (auto-ranging)	1.75 Amps @ 177 VAC 0.95 Amps @ 230 VAC	3.0 Amps @ 117 VAC 1.6 Amps @ 230 VAC
DC	22 to 32 Volts	7.5 Amps @ 24 VDC	12.8 Amps @ 24 VDC

NOTE: For solar-power applications, if the repeater is not handling CDMA traffic (only paging, pilot, and sync channels), it enters Power-Save Mode, reducing power consumption by 20%.

Table 11-9   Additional Characteristics

Waveform Quality Factor Degradation (rho)	Spurious Response	3 dB SAW Filter Bandwidth	Group Delay	Maximum Input Signal (without damage)	VSWR	Noise Figure
Þ>0.95	Per ANSI J-STD-008	<1.27 MHz	<6msec	+10dBm	<1.5:1	<6dB per path

Table 11-10   RepeaterNet Alarm, Monitoring, and Control

Access Options	GUI	Functions
• RS-232 (local) • POTS (dial-up) • Wireless Modem	• Windows 95 Craft • Windows NT (NMS) • 32-bit Point-and-click • Wireless Modem	• Summary Alarm • Interrupt Reporting • Definable Threshold • Remote Control: Gain, Channel and PA On/Off

Table 11-11   Alternate Power Options

Type	Description
BUPS	2-8 hours of backup power, without AC
Solar Power	PV (Photovoltaic), 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 11-12   Inputs and Outputs

Local I/O	Output Type	Local I/O	Output Type	Local I/O	Output Type
Critical Alarm	Form C Relay	Remote Control Relays (2)	Form C Relay	External Battery Monitor	Analog: DC Volts
Major Alarm	Form C Relay	Digital Outputs (2)	Opto-isolate TTL	BUPS Monitor	6 Alarms
Minor Alarm	Form C Relay	Digital Inputs(2)	Opto-isolate TTL		

Table 11-13   Table LED Indicators

System Ready
Critical Alarm
Minor Alarm
Major Alarm

11.2 Ordering Information

The tables that follow provide information about ordering from Repeater Technologies, Inc.; 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 destinations 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 11-14   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	137-0438-01
McMaster-Carr ¾-inch Banding Kit	Part No. 5653K12, McMaster-Carr Supply Co., Los Angeles, CA, USA, Tel.# (562) 692-5911
I/O Entry Box Door (OA850C Only)	024-1008-01
I/O Entry Box (OA850C Only)	024-1007-01
I/O Box Door Gasket (OA850C Only)	022-0122-01
I/O Entry Box and Door (OA1900C Only)	024-1004-01
I/O Box Door Gasket (OA1900C Only)	022-0127-01
I/O Box Gasket (OA850C Only)	022-0124-01
Internal Lead Acid Back-up Battery	149-0852-01
PC Interface Cable DB9, 9-pin, Female-to-Female	187-0713-01
Modem Module (OA850C Only)	087-1524-05
Modem Module (OA1900C Only)	087-1524-01
Wireless Interface Cable	To be announced.
BUPS-25/80	250-1011-07

Table 11-14   Spare parts and Accessory Items (Continued)

Description	Part Number
Surge Protector - N(M) to N(F) Lightning	Call RTI
Operations Manual (Hard Copy)	550-5100-01
Operations Manual (CD ROM)	550-5100-02
Alarm, Power, and Growth Cabinet Button Plugs	137-0446-01
Conduit Fitting	137-0447-01
Back Mounting Plate	020-1229-03
Stainless Steel 3/8" Locking Washer	125-0059-07
Stainless Steel 3/8" x 1" Flat Washer	125-0068-07
Stainless Steel Pin-in-Head Security Bolts	125-0212-13
Stainless Steel Hex Head Bit Pin-in-Head, 7/32	"129-0007-08
Door Hinge Set	137-0428-01
Allen Wrench	129-0007-02
RepeaterNet NMS 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 BUPS (Back-up Power System) for the repeater application, match the repeater with the amount of back-up time required.

Table 11-15   Back-up Power System Selection Guide

Product Model Number	Power Consumption @24 Vdc	Calculated Current @24 Vdc	Back-up Hours
			BUPS-25/80 25 A 80 A-H
Oaxxx, 1-channel	260 W	10.8 A	7.4
Oaxxx,, 2-channel	500 W	20.8 A	3.8

Table 11-16   Contents of AC and DC Accessory Kits, for RC1920C

AC Accessory Kit (P/N 091-0105-01)		DC Accessory Kit (P/N 091-0105-02	
Items	**Quantity**	**Items**	**Quantity**
Power Cord	1 each	BUPS Power and Alarm Cable Assembly	1 each
Wrench, Hex Key (Allen Wrench)	1 each	Wrench, Hex Key (Allen Wrench)	1 each
PC Interface Cable DB9, Female to Female	1 each	PC Interface Cable	1 each
Hex bit, Pin-in-Socket, 7/32	"1 each	Hex bit, Pin-in-Socket, 7/32	"1 each
Alarm, Power, and Growth Cabinet Button Plugs	4 each	Alarm, Power and Growth Cabinet Button Plugs	4 each
Conduit Fitting	4 each	Conduit Fitting	4 each
Operations Manual (Hard Copy)	1 each	Operations Manual (Hard Copy)	1 each
RepeaterNet Craft Software	4 disks	RepeaterNet Craft Software	4 disks

Table 11-17   Contents of AC and DC Accessory Kits, for RC1920C

AC Accessory Kit (P/N 091-0105-01)		DC Accessory Kit (P/N 091-0105-02)	
Items	**Quantity**	**Items**	**Quantity**
Power Cord	1 each	BUPS Power and Alarm Cable Assembly	1 each
Wrench, Hex Key (Allen Wrench)	1 each	Wrench, Hex Key (Allen Wrench)	1 each
PC Interface Cable DB9, Female to Female	1 each	PC Interface Cable	1 each
Hex Bit, Pin-in-Socket, 7/32	"1 each	Hex Bit, Pin-in-Socket, 7/32	"1 each
Alarm, Power, and Growth Cabinet Button Plugs	4 each	Alarm, Power, and Growth Cabinet Button Plugs	4 each
Conduit Fitting	4 each	Conduit Fitting	4 each
Operations Manual (Hard Copy)	1 each	Operations Manual (Hard Copy)	1 each
RepeaterNet Craft Software	4 disks	RepeaterNet Craft Software	4 disks

11.3 Technical Services

Repeater Technologies offers technical services to supplements the manpower resources of it customers. RTI will provide3 quotations for the following services, upon request:

- Site and construction surveys
- Network Design
- Design Verification
- Training
- Installation
- Accessories (antenna, coaxial cabling, and so on)

Programming the Cellular Phone 12

12.0 Introduction

This cheaper describes how to program the Motorola Micro T.A.C. Elite II cellular phone. This phone is installed in the Entry Box of the repeater (the Entry Box is the separate housing attached to the bottom of the main repeater box). The cellular phone includes a battery, but the repeater provides normal operating power to the phone.

12.1 Removing the Cellular Phone for Programming

The cellular phone is located inside the lid of the repeater's Entry Box.

To remove the cell phone unit for programming, use the following procedure.

1. Open the lid of the repeater's Entry Box.
2. Disconnect the power plug, located at the base of the phone.
3. Carefully pull the phone away from its cradle.

12.2 Programming the Cellular Phone

1. To program the cellular phone properly, install an AC charger, and a cell phone antenna.

2. Press the phone PWR (Power) button to turn On power to the cellular phone.

3. Press the FCN (Function) button followed by zero(0).

NOTE: The factory Default Security Code is 000000.

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4. Enter the six-digit security code, twice.

5. Press the RCL (Recall) button on the cellular phone.

6. Press the star (*) button.

   The program advances to the first data field for Entry 01 (System ID).

7. Use the keypad to enter the new data for this field.

8. Repeat Steps 5 and 6 to advance to, and to set, each subsequent data field in the programming sequence.

Refer to Table 12-1 for the programming sequence.

9. Exit the programming mode.

   • To exit the programming mode without saving changes, press the Pound (#) button.

   • To save the newly-entered data, press the SND (Send) button, while on any entry number. After the cellular phone sends all entries, the sequence wraps around to Entry 01.

10. Press the PWR (Power) button to turn Off power to the cellular phone.

12.3 Reinstalling the Cellular Phone, After Programming

After programming the cellular phone, use the following procedure to reinstall the unit in the Entry Box lid.

1. Remove the cellular battery and antenna from the phone.
2. Reconnect the plug at the base of the phone.
3. Press the cell phone back into its cradle.
4. Secure the lid of the repeater's Entry Box.

Table 12-1   Data Sequence Programming

Entry Number	Standard Default	Description
01	00000	System ID (SID) - The five-digit number that the FCC assigns, for system identification. "A" side is odd; "B" side is even.
02	111	Cellular Area Code - Assigned by the System Operator.
03	1110111	Cellular Telephone Number - Assigned by the System Operator.
04	XX	Station Class mark
05	00	Access Overload Class
06	00	Group ID Mark
07	000000	User Security Code
08	123	Unlock Code
09	0334	Initial Paging Channel - Enter 0333 for "A" side System Ids (SIDs), and 0334 for "B" side SIDs.
10	011100	Options Programming. Binary bits (1 or 0), read from left to right.
	0	Internal Speaker Disable
	1	Local Use. assigned by the System Operator.
	1,0,?	MIN Mark.
	1	Auto Recall 1=enabled.
	0	Second Telephone Number Enabled.
	0	Diversity 1=enabled.

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Default Alarm Settings

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A.1 Introduction

Table A-1   Default Alarm Settings

Subsystem	Option	Alarm	Default Setting
Front End	Forward	Fwd FE Alarm	Critical
	Reverse	Rev FE Alarm	Critical
		Rev FE Protect Alarm	Critical
	Diversity	Diversity FE Alarm	Critical
Channel 1	Reverse PA	Rev PA Alarm	Critical
		Rev PA VSWR Alarm	Disabled
		Rev PA Thermal Alarm	Major
		Rev PA Ext Shutdown Alarm	Disabled
	Forward PA	Fwd PA Alarm	Critical
		Fwd PA VSWR Alarm	Disabled
		Fwd PA Thermal Alarm	Major
		Fwd PA Ext Shutdown Alarm	Disabled
	PA Control	Reverse PA	Off
		Forward PA	Off
	Reverse Filter	CSF Rev Alarm	Event
	Forward Filter	CSF Fwd Alarm	Event
	Gain	Forward and Reverse	65 dB

Table A-1   Default Alarm Settings (Continued)

Subsystem	Option	Alarm	Default Setting
Channel 2	Reverse PA	Rev PA Alarm	Critical
		Rev PA VSWR Alarm	Disabled
		Rev PA Thermal Alarm	Major
		Rev PA Ext Shutdown Alarm	Disabled
	Forward PA	Fwd PA Alarm	Critical
		Fwd PA VSWR Alarm	Disabled
		Fwd PA Thermal Alarm	Major
		Fwd PA Ext Shutdown Alarm	Disabled
	PA Control	Reverse PA	Off
		Forward PA	Off
	Reverse Filter	CSF Rev Alarm	Event
	Forward Filter	CSF Fwd Alarm	Event
ACU (Alarm Control Unit)	(*If the repeater uses external inputs or external equipment, set alarm severity as appropriate.)	External Input 1* Alarm	Disabled
		External Input 2* Alarm	Disabled
		Temperature Alarm	Minor
		Tamper Alarm	Major
		Analog Input Alarm	Disabled
		Ext. Growth Box Alarm	Disabled
Power Supply		Channel PS Input Power	Critical
		Power Supply Alarm	Critical
		Battery Alarm	Minor
Backup Power Supply (BUPS)		AC Fail Alarm	Disabled
		Low Battery Alarm	Disabled
		High Battery Alarm	Disabled
		Charger Fail Alarm	Disabled
		UPS Summary Alarm	Disabled
		Tamper Alarm	Disabled
Modem		Modem Alarm	Minor
Cellular Phone		Cell Phone Alarm	Minor

Troubleshooting
B

B.1   Verifying Correct Installation

This section summarizes how to verify that the repeater is correctly installed.

Isolating the Primary Cabinet

1.   Disconnect EVERYTHING from the RC1920C, except the Back-up Power Supply (BUPS).
2.   Power the repeater on.
3.   Start the RepeaterNet software, pull down the Configuration menu, and select Hardware.
4.   Uncheck growth box, if it is checked.
5.   Exit RepeaterNet.
6.   Restart RepeaterNet.
7.   Turn on the Power Amplifier (PA) gains, and make sure that everything is functioning.
8.   Turn off the PAs.
9.   Exit RepeaterNet.

This test verifies that the primary cabinet is working properly.

Testing the Primary Cabinet, with Antennas

1.   Connect the antennas to the repeater, one at a time.
2.   Start the RepeaterNet software, and make sure that no alarms are currently reported.
3.   Turn on the PAs, and adjust gains.
4.   Turn off the PAs.
5.   Exit RepeaterNet.
6.   Disconnect the antennas

This test verifies that the primary cabinet and antennas are working properly.

Isolate the Primary and Growth Cabinet

Follow these steps when isolating the primary cabinet from growth cabinet.

1. Connect the Growth Cabinet to the Primary Cabinet.
2. Power on ONLY the Primary Cabinet, and ensure that the connector is at +24 Volts DC.
3. With the multimeter still monitoring +24VDC, turn on the Growth (secondary channel) Cabinet.
4. If all is well, place the meter on the BUPS amps test port, and monitor the current.
5. Set the multimeter for "mV" range. On the BUPS, 1mV = 1 AMP.
6. Start the RepeaterNet software, pull down the Configuration menu, and select Hardware.
7. Check the growth box selection.
8. Exit RepeaterNet.
9. Restart RepeaterNet, and check for secondary-channel function.

    If there is no growth box function, check +24 VDC, at the input to the second channel, then check the ribbon cable for reverse-polarity. Finally, repeat Step 6.
10. Turn on the PAs (without antennas), and monitor the multimeter to ensure that the current is still within normal limits.

Note: The BUPS is designed for 25 AMPS.

11. Turn off the PAs.

This test verifies that the primary and growth cabinets are working properly.

Loaded Test

1. Connect the antennas.
2. Turn on all Power Amplifiers (PAs).
3. Monitor the BUPS current.

NOTE: The following error conditions might occur during these tests:

1. One or both channels are oscillating, drawing more current than the BUPS can provide. If this occurs, turn PAs off, and check whether DC power returns to both repeater units.
2. The antenna cables might be shorted, causing the PA to draw more current than the BUPS can provide. If this occurs, disconnect antennas, and ohm out the connectors.
3. The BUPS has failed. It cannot handle the load of both the Primary and Growth cabinets.

B.2   Verifying Correct Operation

This section describes some of the problems that you might encounter while operating the RepeaterNet system. The steps listed (to resolve the problem) might not include all of the possible reasons for non-operability, but this information is provided to assist you in identifying the actual difficulty. The problem attributes in the following paragraphs are in descending order, starting with the most likely problem listed first.

If the repeater continues to have problems, call Repeater Technologies Customer Support for assistance. See the front cover of this manual for current telephone numbers.

Problem 1   *RepeaterNet reports that it cannot open the database.*

Either the Data Source Name (DSN) is configured improperly, the DSN does not point to the proper location, or the system did not find the DSN itself. Call Customer Support for assistance.

- The correct DSN or User ID is not identified.
- The Windows Open DataBase Connectivity (ODBC) drivers are not installed.
- The database file, to which the DSN points, is corrupted, or needs repair.

Problem 2   *RepeaterNet reports that it cannot read the database Ports table*

You have not configured the ports, in the system database.

The Ports table in the database might be corrupted. Repair the database and retry.

Problem 3   *The System starts up without error, but when you launch a repeater graphical user interface, no detailed data appears.*

Wait for up to 4 minutes (the maximum time required to complete a cell modem connection), to determine whether the program can connect to the repeater. If the program cannot connect, a warning pops-up after 4 minutes, indicating that RepeaterNet could not establish communications.

Problem 4   *A specific port does not seem to be in use, and an Alert exists. Or the database log reports the error "Unable to initialize port COMn", where n designates the non-functioning port.*

You configured the port number incorrectly, or the port does not exist.

The port is assigned to another program, operating in the same PC. Windows does not permit two active programs to share a communications port. Shut down the other program.

Problem 5 *The system reports "Unable to connect to repeater…"*

This error message can indicate any of the following:

- The cellular carrier is not handling the call.
- The phone number that you provided is incorrect, or is out of service.
- The modem or phone line has a problem.
- The repeater itself has a problem.

Problem 6 *The system reports the message "An unsupported operation was attempted."*

This message appears if the installation failed to register the Object Linking and Embedding (OLE) controls, for alarm bitmaps.

Problem 7 *RepeaterNet conflicts with Microsoft Fax.*

To disable the Microsoft Fax auto answer mode:

1. Open the mail icon from the Microsoft Control Panel.
2. Select Microsoft Fax from the Services tab.
3. Click on the Properties button.
4. Select either the Manual or the Don't answer radio button.
5. Click the OK button, to save this change.

B.3 Verifying Primary and Secondary Channel

B.3.1 Test Equipment

Table B-1 lists the test equipment and tools required for verifying both traffic channels. You can use equivalent substitutes for the tools listed here.

Table B-1   Test Equipment for Channel Verification Tests

Item	Tests
Voltmeter, Fluke 75	Power System, Analog Test Points
Power Meter, HP 435B with 8481 Sensor	Power Output
Spectrum Analyzer, HP 8560 series, capable of up to 2 GHz	Power Output
Type N (male) 50-Ohm Termination, 20W, (2 ea.)	Power Output
Signal Generator, capable of generating CW signal of +10 dBm or greater, at 800 MHz or greater frequencies	Power Output
Laptop computer	RepeaterNet configurations
Type N (m) 30 dB pad, or bi-directional 30 dB coupler	Power Output
Open End Wrench or Spanner, 5/16 inch (1 ea.)*	Power Monitor, Maintenance
Screwdriver, 1/4 inch, 6 mm blade*	Wiring, Maintenance
Screwdriver, #1 Phillips	Wiring
* Not supplied with Growth Box.	

B.3.2 Applying Power

1. Terminate the antenna ports on the Repeaters, using Type N (male) 50-ohm Terminations.

2. Connect the laptop to the repeater.

3. Apply power to the Primary Cabinet, either AC or DC, as required.

4. Check that both the Critical LED and the Minor LED (on the entry panel of the Main Repeater) are ON.

NOTE: When Repeater Technologies ships the repeater from the factory, the Forward PA (Power Amplifier) and Reverse PA are both in the OFF position. The standby battery (located inside the Entry Panel) is disconnected.

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5. Connect the red battery lead to the standby Lead Acid battery.

B.3.3   Measuring Voltage

Measure the AC or DC voltage, at the J3 connector in the Entry Panel, to verify the proper voltage.

B.3.4   Measuring the Output

This section covers the testing required, to determine proper operation of the Repeater and the Growth Box.

1.   Start the RepeaterNet software.

NOTE: You must use RepeaterNet Craft Admin program to configure the connection to the Repeater and Growth Box before accessing the RepeaterNet Craft software.

2.   Select Configuration/ Hardware Setting from the RepeaterNet menus, to ensure that the Growth-Box configuration is enabled (see Figure B-1).

Figure B-1   Hardware Setting Screen
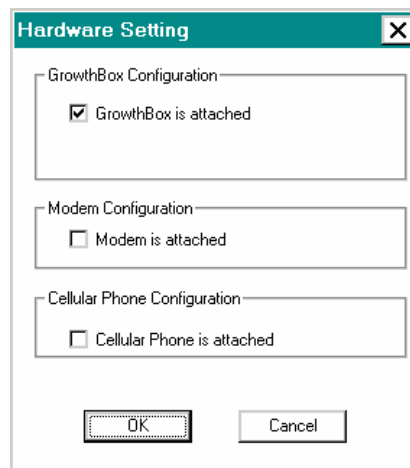
3.   Check the "Growth-Box is attached" box, and click the OK button
4.   Select Configuration/Channel 1 from the RepeaterNet menu, and select the Channel # tab to display and set the operating channel.

Figure B-2   Channel Properties Screen, Channel # Tab

RT130169
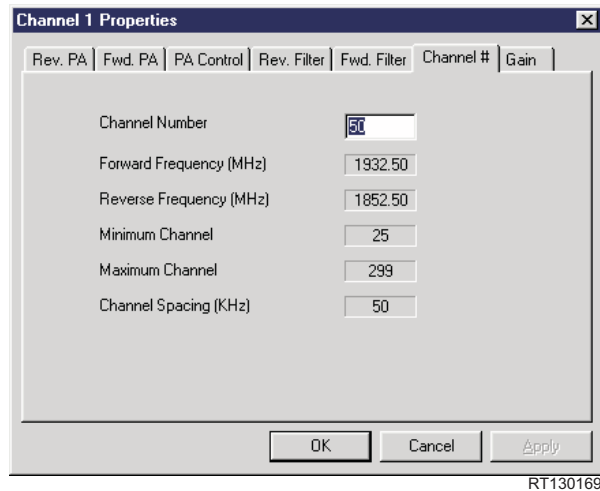
5. After selecting a channel #, click the Apply button.

    RepeaterNet displays the corresponding frequencies. Record these frequencies; you will use them when you set up the Signal Generator.

6. Select Configuration/Channel 2 from the RepeaterNet menu, and select the Channel # tab to display and set the operating channel.

7. After selecting a channel #, click the Apply button.

    RepeaterNet displays the corresponding frequencies. Record these frequencies; you will use them when you set up the Signal Generator.

8. Verify that the Reverse Power Amplifier is OFF, using the Rev PA tab in the Channel Properties window for both channel 1 and channel 2 (as shown in Figure B-3).

Figure B-3 Channel Properties Screen, Reverse PA Tab
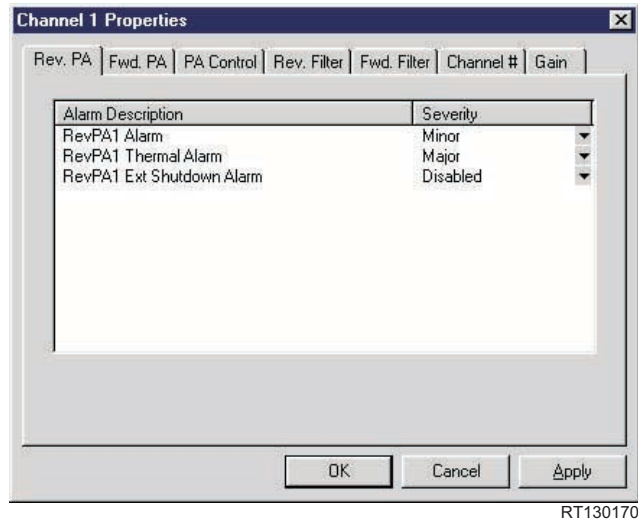
RT130170

9. Verify that the Forward Power Amplifier is OFF, using the Fwd PA tab in the Channel Properties window for both channel 1 and channel 2 (as shown in Figure B-4).

Figure B-4 Channel Properties Screen, Forward PA Tab
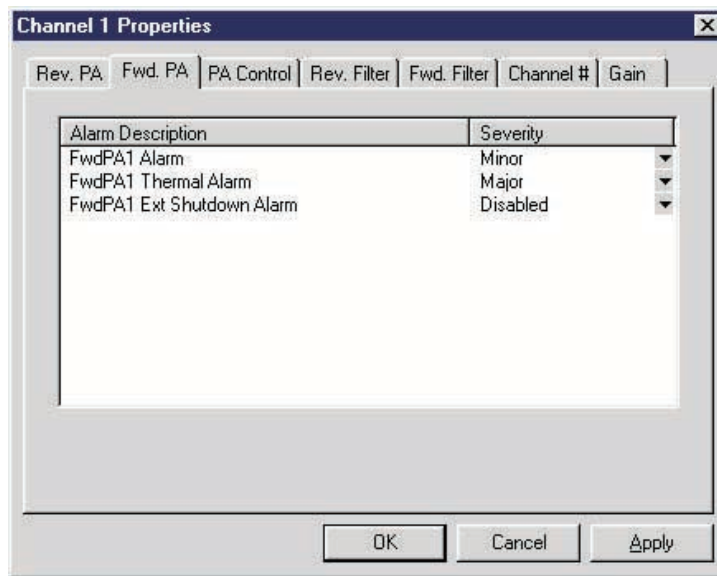
RT130171

10. Using the Gain tab in the Channel Properties screens for both Channels 1 and 2, set the channel gains to the minimum setting of 65 dB.

Figure B-5   Channel Properties Screen, Channel Gain Tab

RT130172
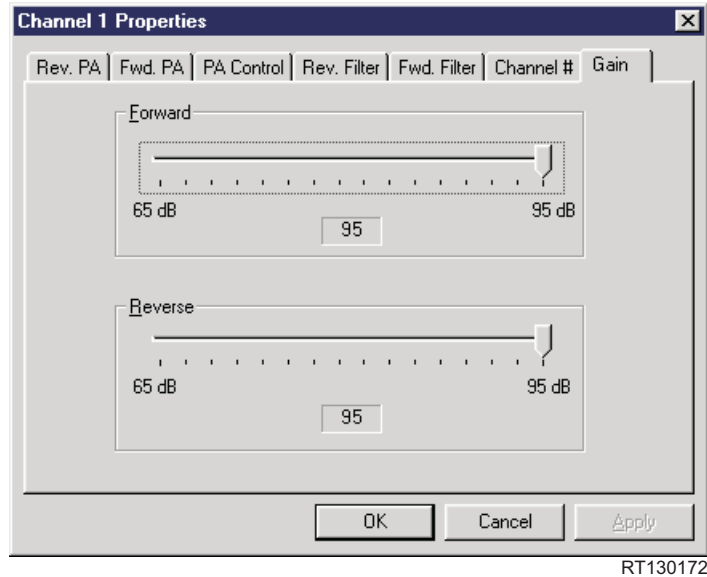
B.3.5 Verifying Forward Power Out, Channels 1 and 2

Configure the test equipment as shown in Figure B-6.

Figure B-6   Configuration for Measuring Forward Path Power
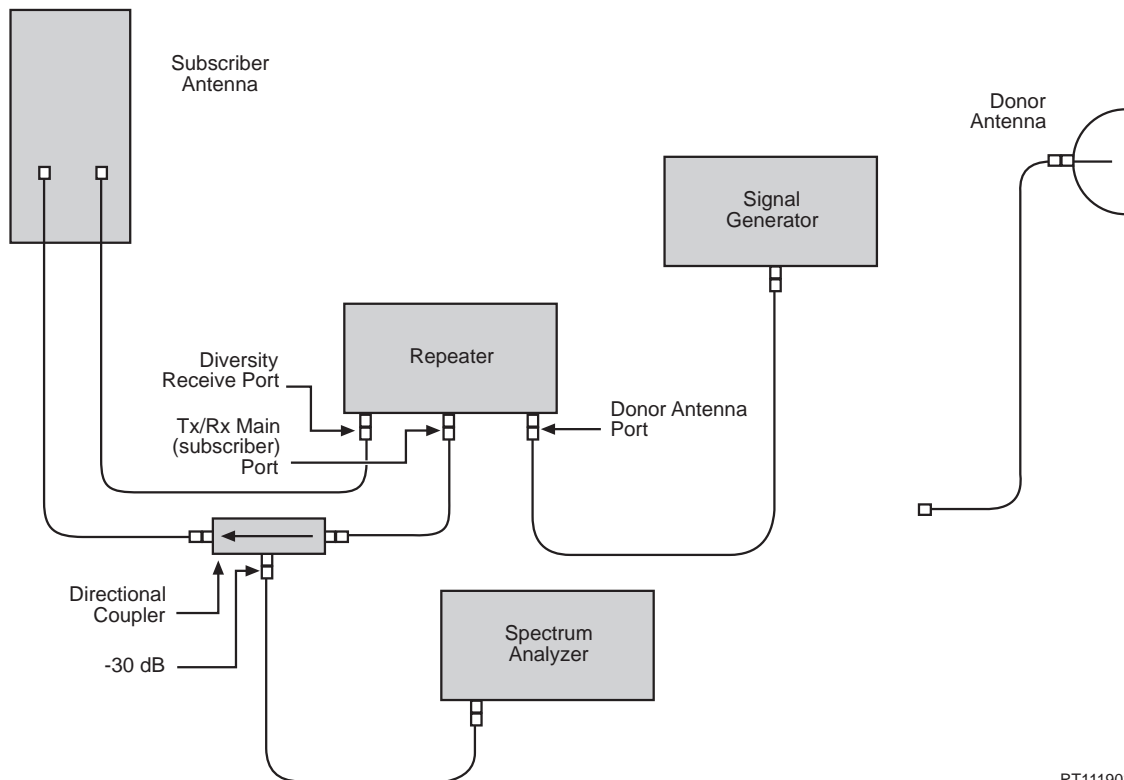
RT111903

1. Ensure that the Forward PA (Power Amplifier) is turned OFF for both the repeater and the Growth Cabinet.
2. Set the Signal Generator to the channel 2 forward frequency, to verify that the second (growth cabinet) channel works.
3. Set the Signal Generator output level to -56 dBm.
4. Configure the Spectrum Analyzer so that the measurement includes the 30 dB attenuation of the coupler.
5. Using the RepeaterNet software, ensure that the repeater channel frequency corresponds to the Signal Generator frequency.

Setting the Channel Gain to 95 dB

Perform the following procedure for both Channels 1 and 2.

1. In RepeaterNet, select Configuration, Channel 1 and 2.

    The Channel Properties window opens.

2. Click the Gain tab

3. Click and drag the Forward horizontal sliders, until they are set to 95 dB

    The gain value box (centered under the slider) displays the selected gain.

4. Click the Apply button.

    The Apply button sets the gain.

5. Click the OK button.

    The OK button closes the window.

Turning On the Forward Power Amplifiers

1. In RepeaterNet, select Configuration, Channel 1 and 2.

    The Channel Properties window opens

2. Click the PA Control tab.

    The PA Control tab provides a switch to turn Power Amplifier (PA) power either ON or OFF

3. Click on the value in the Forward PA box, to change the value to ON.

4. Click the Apply button.

    The Apply button turns on Forward PA power

5. Click the OK button.

    The OK button closes the window.

Measuring Forward PA Power

1. Observe the Spectrum Analyzer display. The amplitude of the signal should be +38.5 dBm, to within +0.5 dB.

2. Turn off the Forward PAs.

3. Set the Forward Channel Gain to 65 dB.

B.3.6 Verifying Reverse Power Out, Channels 1 and 2

Configure the test equipment as shown in Figure B-7.

Figure B-7   *Configuration for Measuring Reverse Path Power.*
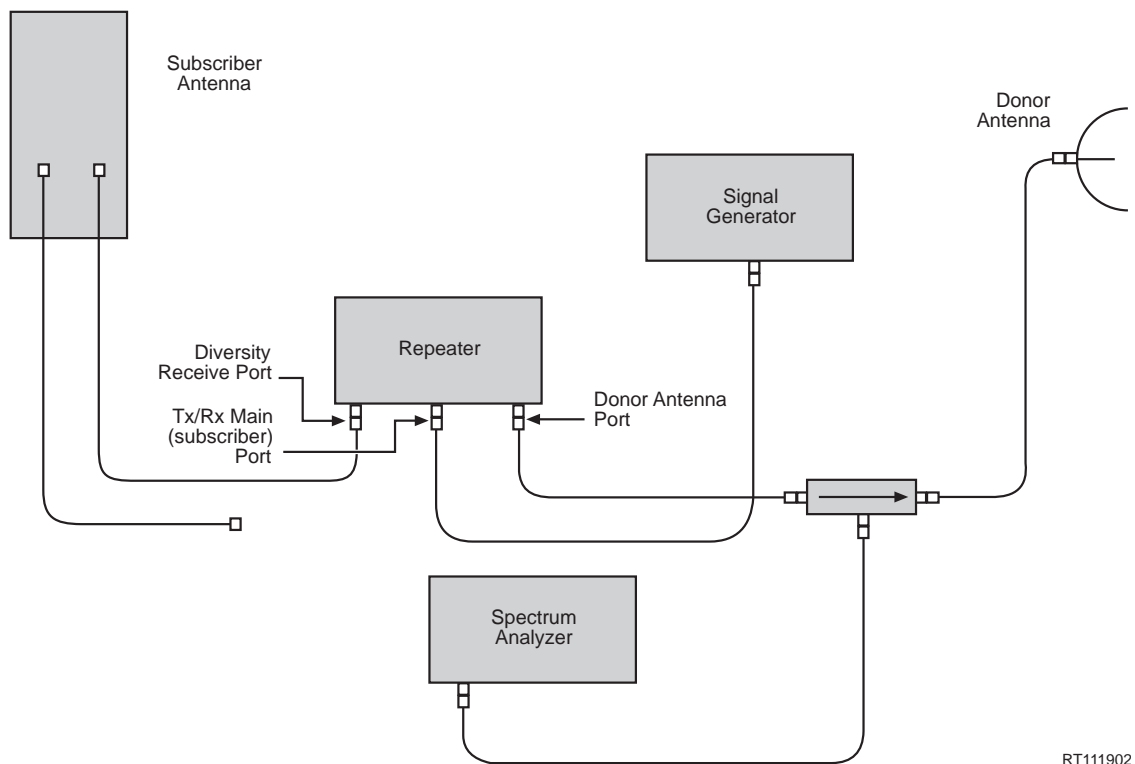
RT111902

1. Ensure that the Reverse PA (Power Amplifier) is turned OFF, for both the repeater and the Growth Box.

2. Set the Signal Generator to the channel (1 or 2) forward frequency.

3. Set the Signal Generator output level to -77 dBm.

4. Configure the Spectrum Analyzer, so that the measurement includes the 30 dB attenuation of the coupler.

5. Using the RepeaterNet software, ensure that the repeater channel frequency corresponds to the Signal Generator frequency.

Setting the Channel Gain to 95 dB

Perform the following procedures for both Channel 1 and 2.

1. In RepeaterNet, select Configuration, Channel 1 and 2.

   The Channel Properties window opens.

2. Click the Gain tab.

3. Click and drag the Reverse horizontal sliders, until they are set to 95 dB.

   The gain value box (centered under the slider) displays the selected gain

4. Click the Apply button.

   The Apply button sets the gain.

5. Click the OK button.

   The OK button closes the window.

Turning On the Reverse Power Amplifiers

1. In RepeaterNet, select Configuration, Channel 1 and 2.

   The Channel Properties window opens.

2. Click the PA Control tab.

   The PA Control tab provides a switch to turn Power Amplifier (PA) power either ON or OFF.

3. Click on the value in the Reverse PA box, to change the value to ON.

4. Click the Apply button.

   The Apply button turns on Reverse PA power.

5. Click the OK button.

   The OK button closes the window.

Measuring Reverse PA Power

1. Observe the Spectrum Analyzer display. The amplitude of the signal should be +18 dBm, to within +0.5 dB.

2. Turn off the Reverse PAs, and set the Reverse Channel Gain to 65 dB.

B.3.7   Concluding the Test

1. Exit the RepeaterNet software.

2. Turn off power to the repeater.

3. Disconnect the Spectrum Analyzer, the pad or coupler, and the Signal Generator.

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Glossary

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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	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.

D$_B$ Decibel or decibels.

D$_{BC}$ Decibels, referenced to the carrier level.

D$_{Bi}$ Decibels, referenced to the isotropic antenna.

D$_{Bm}$ 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   Number of decibels by which a repeater amplifies an audio (speech) signal, when transmitting it to (reverse gain) or from (forward gain) a base station (BTS).

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	If a Mobile transmits at full power in close proximity to a receive antenna, a hot tone—for example, a receive signal above -40 dBm—is produced. Too hot a tone can over-modulate a system, and force it to drop all calls. If a system is designed to control reverse attenuation, it can moderate the potentially-damaging effect of hot tones.
Hpp	Half Power Point of an antenna.
If	Intermediate Frequency.
Im	Intermodulation.
Imd	Intermodulation Distortion.
Led	Light-Emitting Diode.
Less	Link Engineering Spread Sheet. Controls signal noise and gain between the base transceiver station (BTS) and the repeater.
Lna	Low Noise Amplifier.
Lo	Local Oscillator, high-level input into mixer.
Los	Line-Of-Sight.
Microcell	Any small, low-power cell site.
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 RBS. 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	A type of connector.
Smb	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. To receive and retransmit speech signals between base stations (BTS), an RTI repeater needs to know the transmission rate and frequency that the vocoder uses on the specific cellular network. Use the *Link Engineering Spreadsheet* (LESS) to report this information to the repeater.

Vswr   Voltage Standing Wave Ratio.

W   Watt or Watts.

Xpd   Cross Polarization.

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