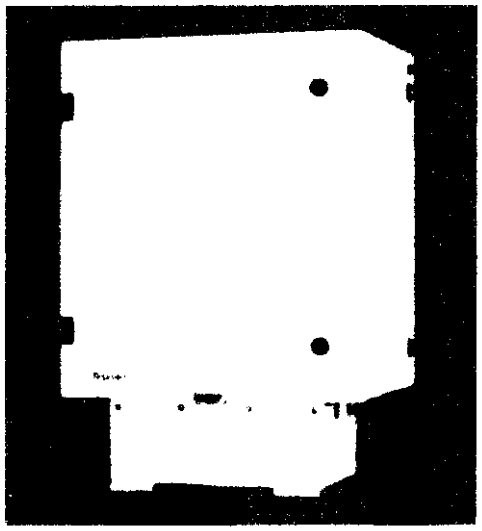
Appendix B

Instruction Book

OA1900C NR

Operations Manual



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Revision B

August 1998

Repeater Technologies

Perfecting Wireless Coverage Worldwide

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August 1998, Revision B

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Chapter 1. Overview

About This Book

This manual is divided into the following chapters.

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

Chapter 2. Installation Instructions (page 11)
Provides overview information about the installation process and equipment, as well as instructions for receipt and inspection of the OA1900C NR.

Chapter 3. Mounting the OA1900C NR (page 15)
Provides the information you need to mount the OA1900C NR.

Chapter 4. Powering the OA1900C NR (page 25)
Provides information about AC power, DC power, modem, and alarm and control wiring.

Chapter 5. Orienting and Isolating Antennas (page 33)
Provides information about antenna mounting, orientation, and isolation.

Chapter 6. Completing Installation (page 37)
Provides information about activating system power, assigning frequency, configuring initial gain, verifying and optimizing coverage area, and configuring for alarm reporting and system operation.

Chapter 7. Maintenance and Troubleshooting (page 41)
Includes information about the following topics: routine checks required to maintain performance and to address problems, return and repair of the OA1900C NR, and the product warranty.

General Repeater Information

The ***Repeater Technologies Over-the-Air 1900C 1-Channel 6.3 Watt Network Repeater™*** (hereafter referred to as the OA1900C NR or the repeater) is a bi-directional, on-frequency, over-the-air RF channelized Repeater for CDMA.

The OA1900C NR extends the coverage of PCS base stations. It is available with an optional diversity receive feature, which improves base station receive performance in high-mobility applications.

The repeater receives signals from a Base Transceiver Station (BTS) and re-transmits them to a subscriber Personal Communications Service (PCS) telephone; likewise, the repeater receives signals from a subscriber telephone and re-transmits them to the BTS. Repeaters significantly improve coverage in areas with weak signal reception or transmission.

The OA1900C NR is designed for indoor or outdoor installation and can be either wall or pole mounted. The unit's compact cabinet simplifies installation, while its aesthetically acceptable design allows it to be zoned easily in many locations. The repeater only requires initialization. Also, as a field-replaceable unit, it requires no component-level repair.

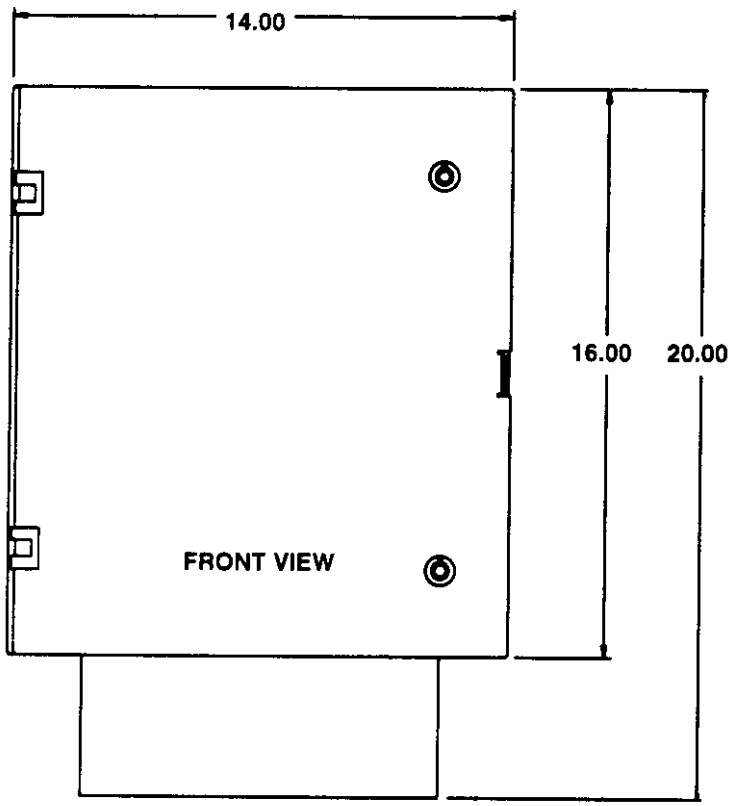

Figure 1. OA1900C NR Exterior Front View

The repeater consists of the following assemblies:

- ⇒ LNA (Low Noise Amplifier)
- ⇒ PA (Power Amplifier)
- ⇒ Channel Select Filters
- ⇒ Diplexers
- ⇒ Power Supplies
- ⇒ ACU (Alarm and Control Unit)

All assemblies are mounted on a heatsink and enclosed in a sealed, painted aluminum, weathertight cabinet. During normal operation, the cabinet housing remains closed. Access to power and to data transmission connections is provided through an Entry Box, which extends from the bottom of the cabinet.

Install repeaters and associated hardware in locations suitable for adequate reception of signals from the BTS and for effective retransmission of these signals to a subscriber.

The OA1900C NR may be equipped with an optional cellular telephone, which is mounted on the interior of the entry box front door, as shown in the following Entry Box figure. The cellular telephone feature can be used with RepeaterNet NMS for monitoring a network of repeaters. For more information, see *RepeaterNet Craft for the OA1900C NR.*

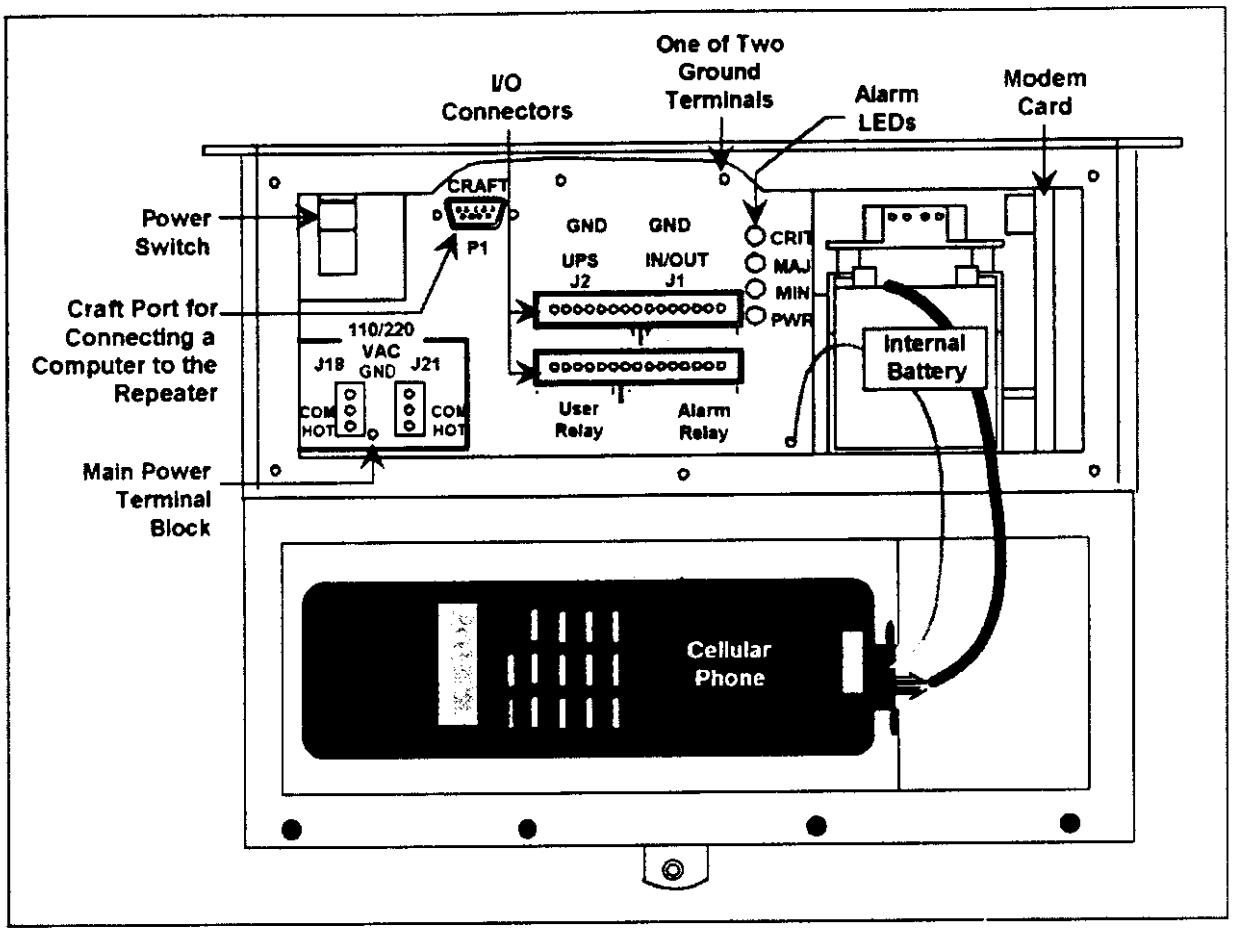

Figure 2. OA1900C NR Entry Box (AC)

Functional Description

The OA1900C NR uses a unique Intermediate Frequency (IF) filtering design to achieve a high degree of selectivity. It also uses a common local oscillator for up-and down-conversion to prevent frequency conversion error.

The RepeaterNet Craft software is the configuration management and alarm monitoring interface for the OA1900C NR. The repeater has two communication (COM) ports for RepeaterNet connections—a serial port for direct, laptop connections and a modem port for remote connections.

An Automatic Level Control (ALC) circuit protects the repeater's circuitry from potentially damaging high input levels and minimizes the generation of Intermodulation Distortion (IMD) in the transmit power amplifier. The following figure is a block diagram of the OA1900C NR.

The signal processing flow through the repeater in the forward direction (BTS to mobile) is similar to the flow in the reverse direction (mobile to BTS).

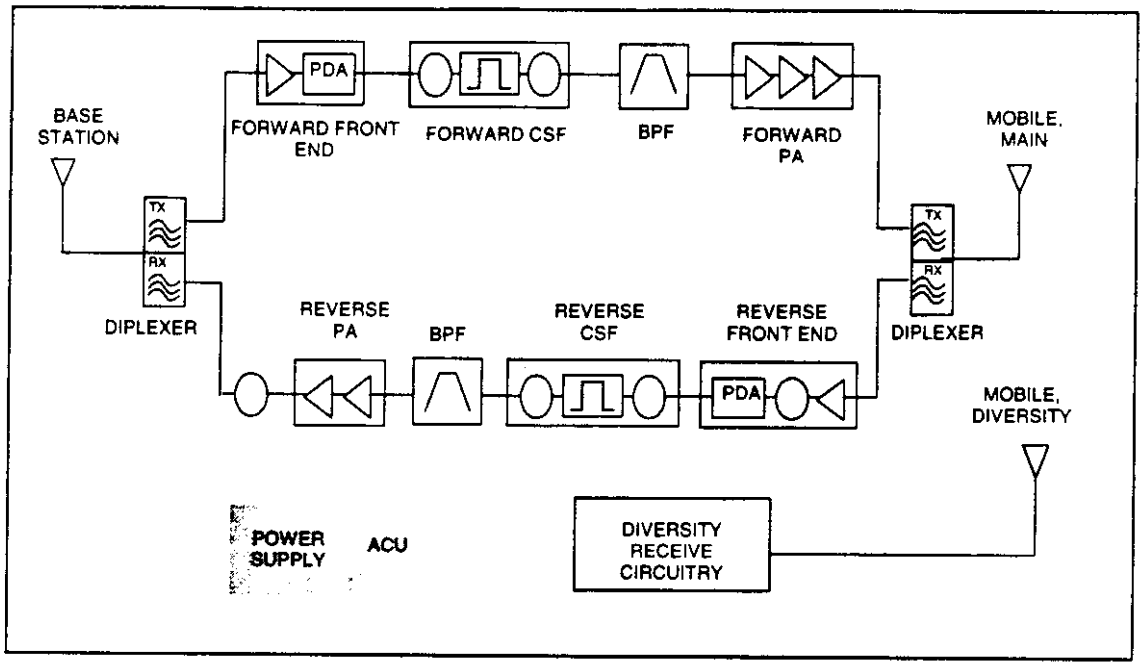

Figure 3. Simplified 1-Channel OA1900C NR Block Diagram—Signal Flow

Signal flow is as follows:

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

Licensing

All owners of the OA1900C NR should consult with the appropriate local and national agencies for information on licensing.

Technical Specifications

Table 1. Frequency Range by Block (A–F)

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 2. RF Output Power Per Carrier at the Antenna Port

ELECTRICAL CHARACTERISTICS			
LINK	**RF OUTPUT POWER PER CARRIER AT THE ANTENNA PORT (dBm)**		**GAIN (dB)**
	1-CHANNEL	2-CHANNEL	
Forward	+38 dBm	+38 dBm	65 – 95
Main Reverse	+18 dBm	+18 dBm	65 – 95
Diversity Reverse	+18 dBm	+18 dBm	65 – 95

Table 3. Mechanical/Electrical

MECHANICAL / ELECTRICAL CHARACTERISTICS						
POWER CONSUMPTION		**SIZE**	**WEIGHT**	**INPUT VOLTAGE OPTIONS**	**TEMPERATURE**	**ANTENNA CONNECTORS**
1-channel	310 Watts	16H x 14W x 11.5D (inch) 406H x 356W x 292D (mm)	<50 lb. or 23 Kg.	110/230 VAC or +24 VDC	-40° to 55° C ambient	Type N (f)
2-channel	570 Watt (total)					

Table 4. Additional Characteristics

ADDITIONAL CHARCTERISTICS						
WAVEFORM QUALITY DEGRADATION FACTOR (rho)	**SPURIOUS RESPONSE**	**3 dB SAW FILTER BANDWIDTH**	**GROUP DELAY**	**MAXIMUM INPUT SIGNAL (without damage)**	**VSWR**	**NOISE FIGURE**
$\rho > 0.95$	per ANSI J-STD-008	<1.27 MHz	<6 µsec	+10 dBm	<1.5:1	<6 dB per path

Table 5. Alarm, Monitoring, and Control

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 6. Alternate Power Options

ALTERNATE POWER OPTIONS	
TYPE	**DESCRIPTION**
BUPS	2-8 hours of backup power without AC
Solar Power	PV(Photovoltaic) with regulated charging to batteries
Hybrid Solar and TEG	PV with thermal electric propane generation assistance
Hybrid Solar and MG	PV with propane or diesel generation assistance

Table 7. Inputs and Outputs

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 8. LED Indicators

LED INDICATORS
System Ready
Critical Alarm
Major Alarm
Minor Alarm

Table 9. Modem Options

MODEM OPTIONS
• Internal wireless modem
• Internal 14400 kbps modem card with an RJ-11 jack for a land-line connection through Oki 1430 800 MHz Cellular Handset
NOTE: You also can order a repeater without a modem option.

Ordering Information

Consider the following requirements when ordering the OA1900C NR.

Table 10. Ordering Considerations

Item	Requirement
Electrical Power	AC or DC, power cord, watertight conduit or connector.
Back-up Power	A power supply in case of interrupted electrical service; note that a Back-up Power System (BUPS) is available from Repeater Technologies.
Antennas, Donor or Subscriber	What types are required; what is the intended system coverage. Note that antennas are available from Repeater Technologies.
Coaxial Cabling	What type and length are required. Note that coaxial cable is available from Repeater Technologies.
Mounting	Special requirements for the repeater and antennas.
Antenna Interface Connectors	Type N to $^{7}/_{16}$ DIN Jumper Cables

OA1900C NR Configurations and Part Numbers

Table 11. Configuration and Part Numbers

Band	No. of Channels	Voltage	Diversity	Part Number
A	1	115/230 VAC	yes	090-3100-01
	1	115/230 VAC	no	090-3100-03
	1	+24 VDC	yes	090-3100-05
	1	+24 VDC	no	090-3100-07
	2	115/230 VAC	no	090-3100-04
	2	+24 VDC	yes	090-3100-06
B	1	115/230 VAC	yes	090-3110-01
	1	115/230 VAC	no	090-3110-03
	1	+24 VDC	yes	090-3110-05
	1	+24 VDC	no	090-3110-07
	2	115/230 VAC	no	090-3110-04
	2	+24 VDC	yes	090-3110-06
C	1	115/230 VAC	yes	090-3120-01
	1	115/230 VAC	no	090-3120-03
	1	+24 VDC	yes	090-3120-05
	1	+24 VDC	no	090-3120-07
	2	115/230 VAC	no	090-3120-04
	2	+24 VDC	yes	090-3120-06
D	1	115/230 VAC	yes	090-3130-01
	1	115/230 VAC	no	090-3130-03
	1	+24 VDC	yes	090-3130-05
	1	+24 VDC	no	090-3130-07
	2	115/230 VAC	no	090-3130-04
	2	+24 VDC	yes	090-3130-06

Band	No. of Channels	Voltage	Diversity	Part Number
E	1	115/230 VAC	yes	090-3140-01
	1	115/230 VAC	no	090-3140-03
	1	+24 VDC	yes	090-3140-05
	1	+24 VDC	no	090-3140-07
	2	115/230 VAC	no	090-3140-04
	2	+24 VDC	yes	090-3140-06
F	1	115/230 VAC	yes	090-3150-01
	1	115/230 VAC	no	090-3150-03
	1	+24 VDC	yes	090-3150-05
	1	+24 VDC	no	090-3150-07
	2	115/230 VAC	no	090-3150-04
	2	+24 VDC	yes	090-3150-06

Optional Equipment Available from Repeater Technologies

Table 12. Spare Parts and Accessory Items

Description	Part Number
Antennas*	Call for information.
Connectors	Call for information.
Coaxial Cable	Call for information.
Power Cord	103-0137-01
Solar Shields	To be announced.
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)*
Cabinet Door	024-0978-02
I/O Entry Box with Cover	024-1004-01
I/O Box Cover Gasket	022-0120-02
I/O Box Gasket	022-0121-01
Internal Lead Acid Back-up Battery	149-0852-01
PC Interface Cable DB9 9-Pin Female-to-Female	187-0713-01
Modem Module	087-1524-01
Wireless Interface Cable	187-0877-01
Wireless Antenna I/O - N(F) to SMA(F) Bulk head adapter connection	142-0521-01
800 MHz Mag Mount Antenna for Wireless I/O, 6' cable with N(M) connector	149-0934-01
Cellular Phone (Oki-1430)	149-0924-01
BUPS-25/40	250-1103-02
BUPS-25/80	250-1011-07
Surge Protector - N(M) to N(F) Lightening	149-0932-01
Operations Manual (Hard Copy)	550-3100-01

Description	Part Number
Operations Manual (CD-ROM)	To be announced.
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.*	

Back-up Power System

To select a BUPS (Back-up Power System) for your application, match the repeater you are using with the amount of back-up time required.

Table 13. Back-up Power System Selection Guide

Product Model Number	Power Consumption @ 24 Vdc	Calculated Current @ 24 Vdc	Back-up Hours	
			BUPS-25/40 25 A 40 A-H	BUPS-25/80 25 A 80 A-H
OA1900C, 6.3 Watt, 1-channel	310 W	12.92 A	3.1	6.2
OA1900C Growth Cabinet, 6.3 Watt, 2-channel*	570 W	23.75 A	1.7	3.4
**Growth cabinet power (2nd channel power) is the sum of the Repeater plus the growth cabinet: 310 W + 260 W = 570 W.*				

Accessory Kit Items

Table 14. Contents of AC and DC Accessory Kits

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 Powr and Alarm Cable Assembly	1 each
Wrench, Hex Key (Allen Wrench)	1 each	Wrench, Hex Key (Allen Wrench)	1 each
PC Interface Cable 9B-D-SUB/8P-SUB	1 each	PC Interface Cable 9B-D-SUB/8P-SUB	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	1 disk	RepeaterNet Craft Software	1 disk

Ordering Procedure

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

Technical Services

Repeater Technologies offers technical services to supplement the manpower resources of its customers. Quotations for the following services are available upon request.

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

Contacting Repeater Technologies

Contact the Repeater Technologies corporate headquarters for sales information or technical assistance for the OA1900C NR, or for any other of our communications or related products.

Corporate Headquarters

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(888) 747-1515 (USA and Canada)

Fax: (408) 747-0375

Web: www.repeaters.com

Customer Service

Tel: (408) 747-1946

(800) 928-1901 (USA and Canada)

Chapter 2. Installation Instructions

Installation Overview

The OA1900C NR is designed for indoor or outdoor installation and can be either wall-mounted or pole-mounted. The unit's compact cabinet simplifies installation, while its aesthetically acceptable design allows it to be easily zoned in many locations.

Because the RepeaterNet Craft software is used during the physical installation of the repeater, pre-load the Craft software on the laptop computer to be used at the installation site. See *RepeaterNet Craft for the OA1900C NR* for information about installing and using RepeaterNet. Bring a DB-9 cable to the installation site to connect your laptop with the repeater.

NOTE: *Only qualified service or technical personnel should install the OA1900C NR.*

See the following illustration of a typical repeater installation with installed components.

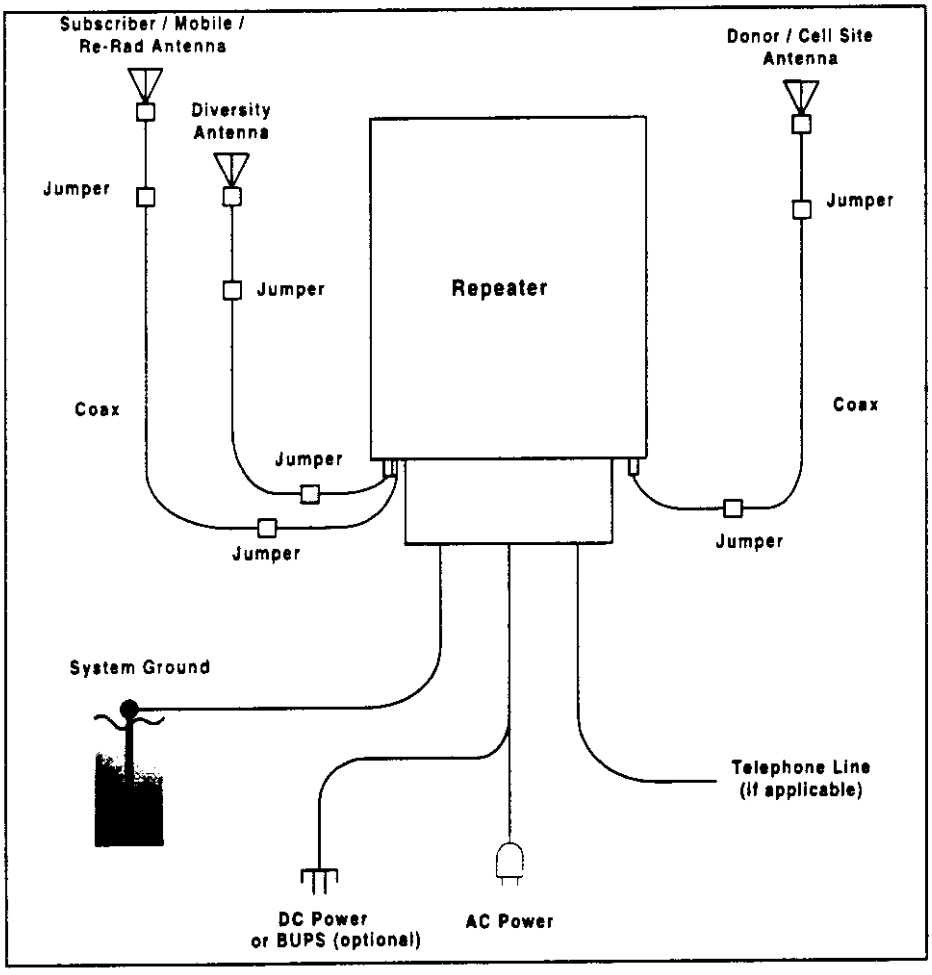


Figure 4. Typical Installation

Receipt and Inspection of the OA1900C NR

Inspect the OA1900C NR for damage immediately upon receipt; note any damage on the waybill. Be sure to request that the delivery agent sign the waybill for verification. Should damage be found:

⇒ Notify the transfer company as soon as possible
⇒ Submit a damage report to the carrier
⇒ Inform the Field Services Department of Repeater Technologies in writing

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

After unpacking the equipment, inventory the contents against the packing lists. Inspect the unit thoroughly for damage hidden by the packaging, paying particular attention to the following:

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

Also, inspect the contents of the accessory kit and any optional equipment ordered with the unit.

Installation Equipment

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

NOTE: *The Path Data Sheet and site plan are needed during installation to define the intended parameters of the project, including coverage area, gain settings, and antenna location. If necessary, consult a network administrator for more information.*

Table 15. Required Installation Equipment

Use this equipment:	**To:**
Site Plan/Network Engineering documentation	Correctly configure the repeater to operate in the PCS network
Ratchet or Hex Screwdriver for $^{7}/_{32}$ Pin-in-Socket Driver	Detach security screws
Voltmeter, Fluke 75*	Test power connections and analog test points
Spectrum Analyzer HP 8591	Test power output
Cellular Service Monitor with Signal Generator, IFR-1500, HP-8594A*	Test antenna isolation and repeater power
Type N (m) 50-ohm Termination, 20 W, (2 ea.)	Terminate antenna ports during off-air test
Mounting Hardware	Mount repeater and antennas
Electrical Wiring Equipment (as needed)	Connect external systems to input and output connectors
Laptop Computer (with RepeaterNet installed)	Control and monitor the repeater
Accessory Kit	Mount and install the repeater
Pole Mounting Kit and Tightening/Crimping Tool (for pole mounting only)	Mount the repeater to a pole and secure pole mounting straps
**Equivalent substitute can be used.*	

Site Survey

Review the installation site thoroughly before mounting antennas or the OA1900C NR. Site review should include, but not necessarily be limited to:

Weather

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

Security

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

Optional Site Equipment

Determine whether additional site equipment, such as a pump, generator, or light is required. If so, where is the equipment to be located, and are special enclosures for any equipment required.

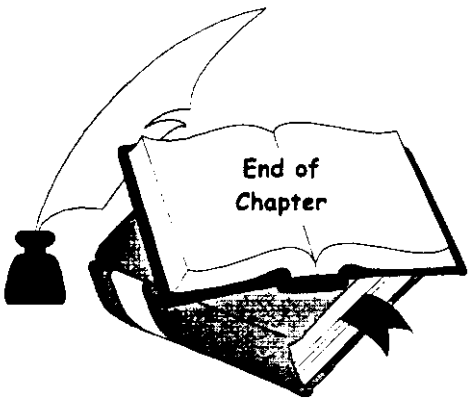
Wiring and Wiring Access

Determine any special wiring requirements.

Cabinet Access

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

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


End of
Chapter

Chapter 3. Mounting the Repeater

Mounting Associated Equipment

Mount the OA1900C NR assembly antennas, antenna coaxial cabling, and BUPS (if used) before mounting and wiring the repeater.

If you intend to add a second frequency channel, you will need to install a growth cabinet to house the second channel. Be sure to allow enough space either above or to the right of the repeater for mounting; examples are shown in the following figure.

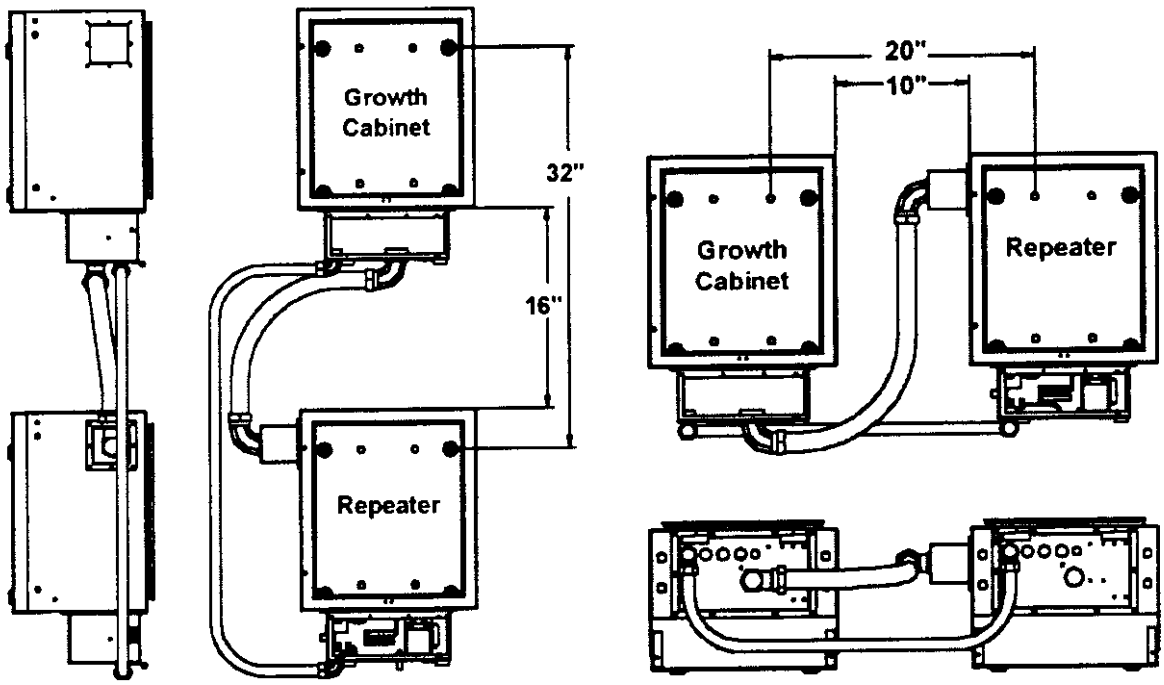


Figure 5. Mounted Growth Cabinet Examples

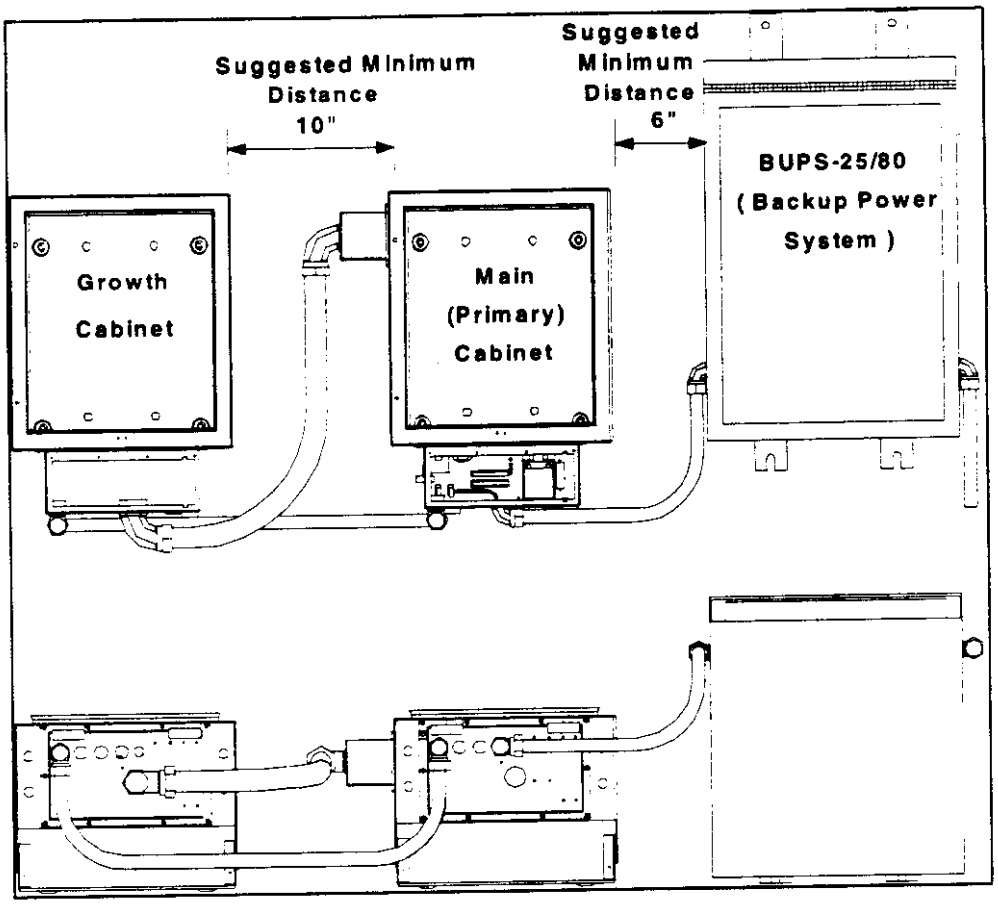


Figure 6. Growth Cabinet Example with BUPS-25/80

Mounting and Connecting Antennas

Antenna size is specified on the Path Data Sheet—do not install antennas of a different size. The size of antenna coaxial cabling for an application depends upon a number of system parameters including, but not limited to:

⇒ Required signal output
⇒ Antenna gain
⇒ Transmission line length

The allowable path loss for antenna cabling, and therefore the size of the cabling, is specified on the Path Data Sheet for the project. Do *not* install cabling of a different size than specified on the Path Data Sheet.

NOTES:

⇒ *As a signal passes through coaxial cable, the strength of that signal decreases. This loss of signal strength, known as path loss, decreases as the diameter of the cable increases.*

⇒ *Check the diameter of the coaxial cable before installing. If the cable is more than ½-inch (1.3 cm) in diameter, attach a coaxial jumper assembly (which you must supply) to the connector on the antenna cable. Make the jumper assembly of ½-inch (1.3 cm) coaxial cabling and use 7/16 DIN or a Type N connector, one male and one female.*

To install coaxial cabling to the Base and Mobile antennas:

1. Make sure the coaxial cable is long enough to reach the OA1900C NR installation site.
2. Install either a 7/16 DIN (m) or a Type N (m) connector on the coaxial cable.
3. Connect cables to the Base and Mobile antennas.

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

4. Having read the above caution, connect the other end of the antenna cables to the appropriate ports labeled on the bottom of the repeater.

You can mount the OA1900C NR on a pole or on the wall of a building. The OA1900C NR is shipped with the rear mounting bracket attached to the unit.

The following figure illustrates the bracket with dimensions.

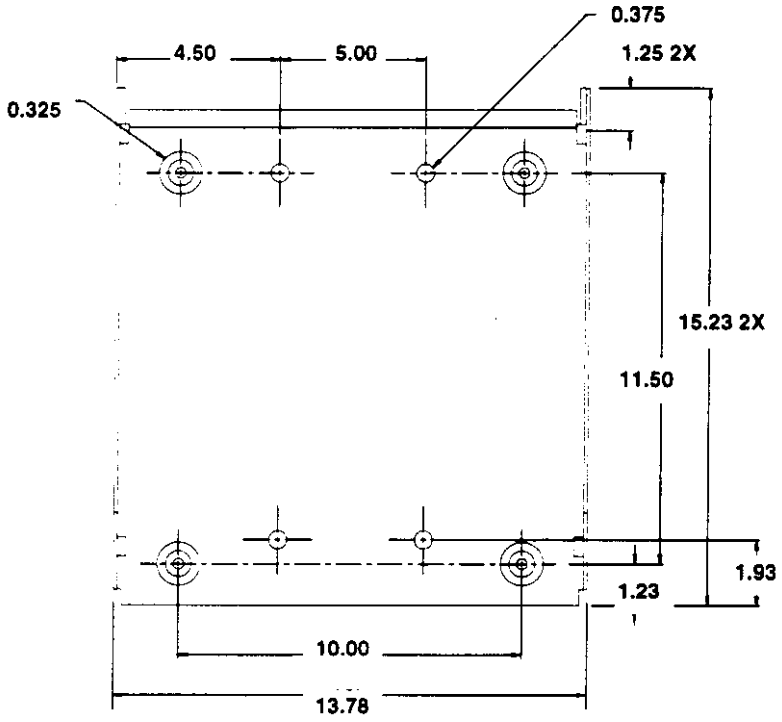


Figure 7. Rear Mounting Bracket

The following figure shows a side view of the OA1900C NR and the rear mounting bracket.

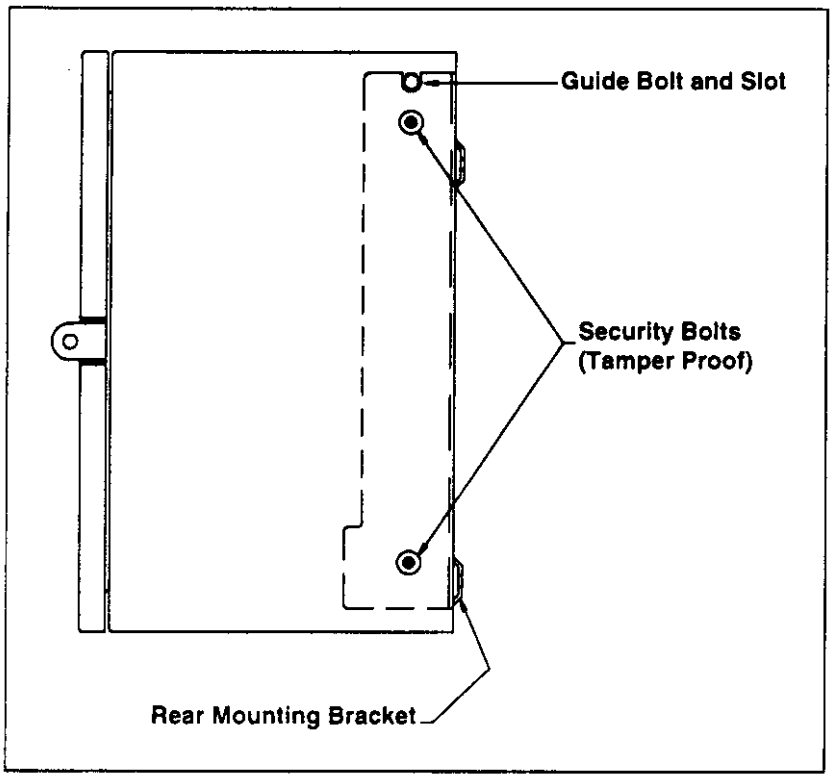


Figure 8. Rear Mounting Bracket with Unit—Side View

Wall Mounting

Wall mounting hardware, which can be ordered from Repeater Technologies, contains the following:

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

To mount the OA1900C NR on a wall:

1. Separate the rear mounting bracket from the Repeater by removing the attachment bolts and washers (using a ratchet or hex screwdriver and the $^{7}/_{32}$ pin-in-socket driver provided in the accessory kit).
2. Using the mounting hardware, secure the bracket to a wall—see the following figure.

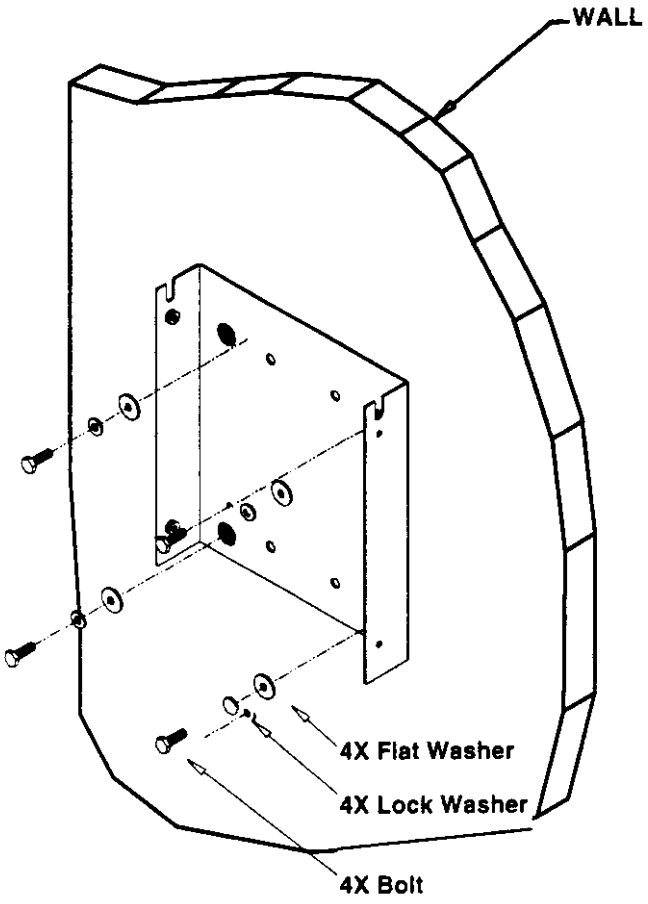


Figure 9. Installation of Rear Mounting Bracket on a Wall

Set the repeater into the bracket by sliding the guide bolt into the guide slot, then replace the attachment bolts and washers removed in Step 1—see the following two figures.

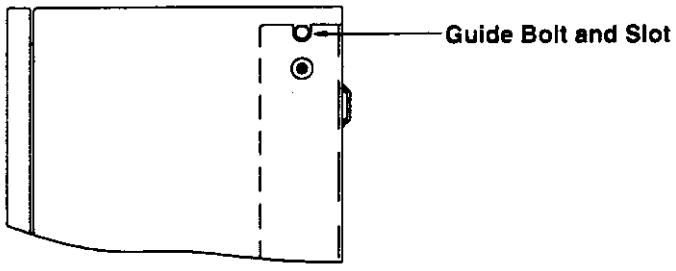


Figure 10. Guide Bolt and Slot

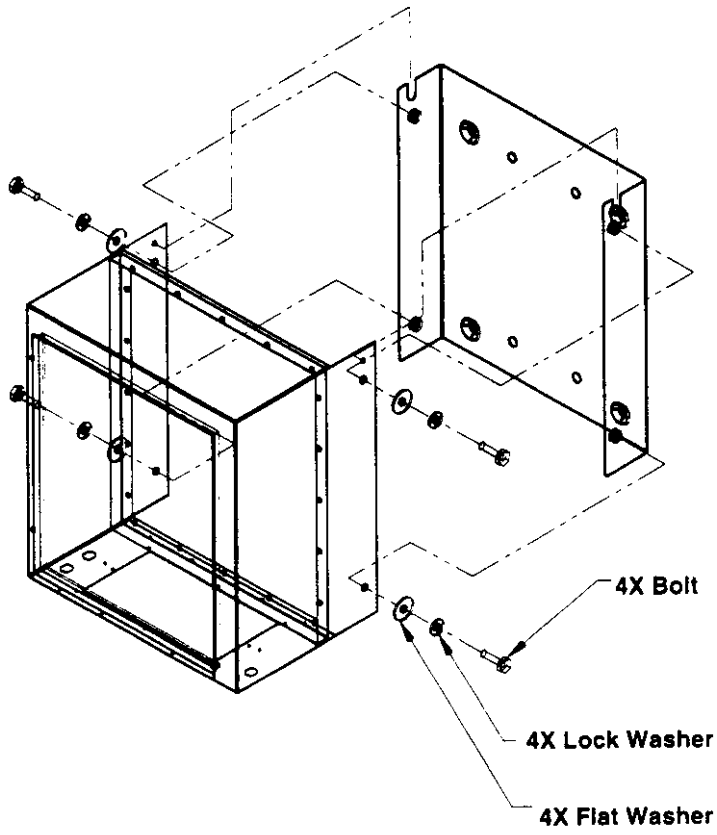


Figure 11. Repeater Mounting and Hardware Placement

Pole Mounting

Repeater Technologies offers optional pole mounting equipment for the OA1900C NR, available when ordering the OA1900C NR.

Pole installation requires the following materials:

⇒ Pole mounting kit (available from Repeater Technologies)

⇒ Banding kit (purchased separately; available from McMaster-Carr) if you are mounting the repeater on a concrete or metal pole

⇒ Class A - Pole Line Hardware if you are bolting the Pole Mounting Bracket to a wood pole

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

If a concrete pole is used as the mounting structure, typically it is not prudent to try and drill a hole through its center. Similarly, because metal poles may have cable run up the center, drilling is not recommended. Banding is preferred over drilling. However, wood telephone-type poles are *forgiving* and the pole-mounting channel can be easily fastened to the pole with lag screws or through-pole bolts.

(Class A Pole - Line Hardware is a telephone term that specifies bolts and screws that have a heavy electro-galvanized plating so they do not rust.) This type of ruggedized hardware typically is available from distributors such as Garybar Electric, ALLTEL Supply, Spring-North Supply, PowerTel Supply, and so on. This hardware is also available from antenna suppliers and tower erector companies.)

The following table describes the Pole Mounting and Banding Kits. Because the Banding Kit comes with 100 feet of band, you need not purchase a kit with every repeater.

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
¾-Inch Banding Kit (Part No. 5653K12) (McMaster-Carr Supply Co., Los Angeles, CA, USA, Tel. # (562) 692-5911)	
1	Tightening-Crimping Tool
100 ft.	¾-inch, Type 201 Stainless Steel Band
100	Stainless Steel Buckles
25	Stainless Steel Scru-Lockt Buckles
1	Carrying Case

NOTE: Two people are required for pole mounting.

To mount the OA1900C NR to a pole:

1. Remove the attachment bolts and washers, then separate the rear mounting bracket from the repeater.
2. Using the hardware provided with the accessory kit, secure the rear mounting bracket to the two (2) pole brackets—see Figure 12 on page 22.
3. Insert the 4 plugs provided into the 4 outer holes in the rear mounting bracket.
4. Position the rear mounting bracket (with the attached pole 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. Set the repeater into the bracket by sliding the guide bolt into the guide slot.
7. Secure the repeater to the bracket with the security screws and washers removed in Step 1.

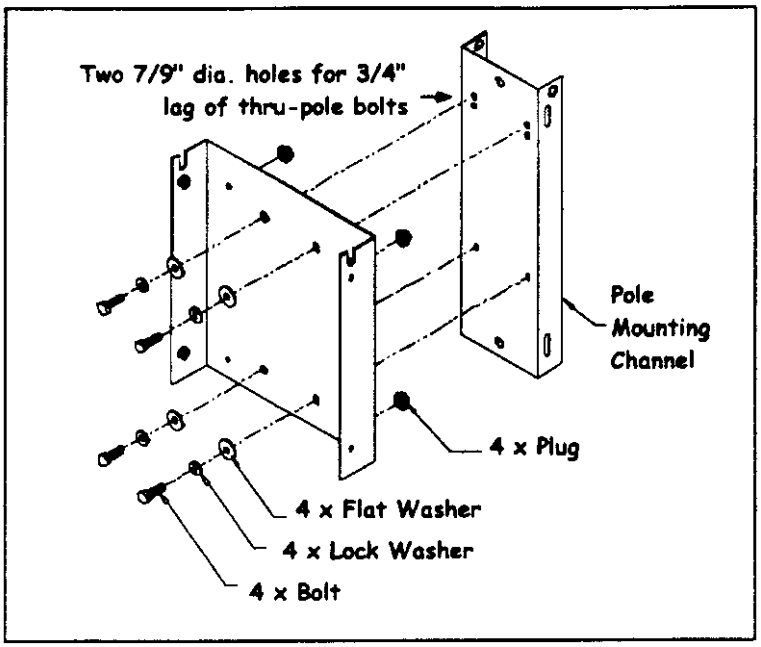


Figure 12. Pole Mounting Hardware

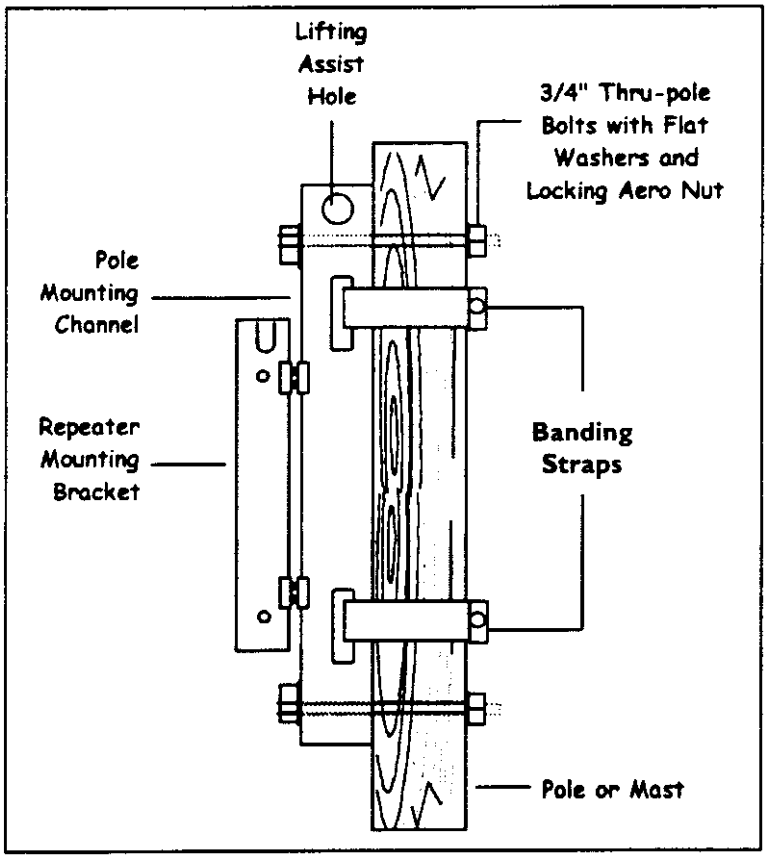


Figure 13. Pole Mount—Side View

Grounding the Repeater

If detailed grounding information is required, refer to the Repeater Technologies application note, *Installation Standards for Grounding Requirements*. Contact Repeater Technologies to receive a copy of this application note.

Connect the screw-compression ground lug (located on the left *exterior* of the Entry Box) to a suitable earth ground (copper ground rod, copper pipe, grounded steel building frame, or similar ground point) using 2 to 7 mm, No. 6 to 2 AWG, copper wire—see the following figure.

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

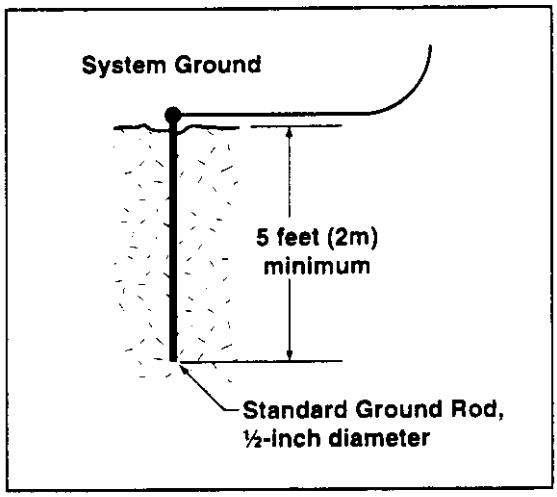
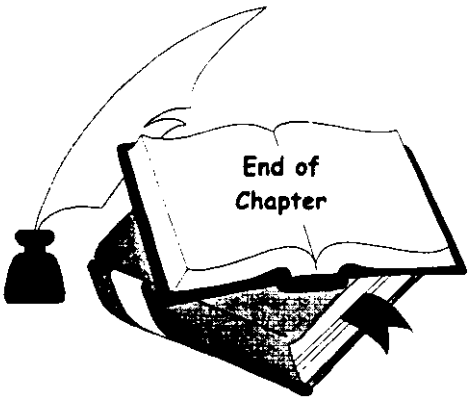


Figure 14. Typical System Ground


End of
Chapter

Chapter 4. Powering the OA1900C NR

The OA1900C NR is factory-configured with one of the following AC or DC (future) power supplies:

⇒ 115 VAC/230 VAC ±10% (available)

⇒ 24 VDC/48 VDC ±10% (24 VDC available; 48 VDC future)

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

AC Power Wiring

See the following figure for the location of power features. Note that the AC power cord enters the Entry Box through the left-most conduit and that the free end of the cord is equipped with a 3-prong plug. Also, the AC plug used for wiring is shipped connected to the J18 receptacle.

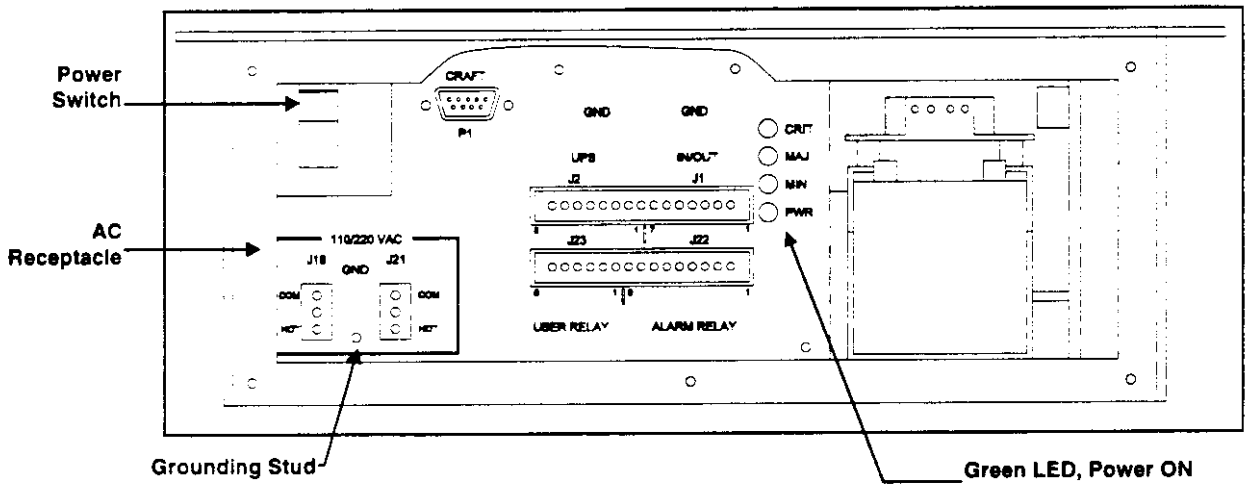


Figure 15. Power Features

To wire the AC power leads to the repeater:

1. Using a medium Phillips head screwdriver, remove the Entry Box access plate located at the front/bottom of the unit.
2. Feed the open end of the power cord through the left-most conduit and into the Entry Box. Note that the color coding of the wires is as follows:

   White = Neutral
   Black = Live / Hot
   Yellow/Green = Ground

   NOTE: Check polarity with a voltometer before wiring.

3. Remove the nut from the grounding stud.
4. Attach the ring lug terminal of the grounding wire to the grounding stud and replace the nut. Tighten the nut until the terminal is secure.
5. Locate the AC plug connected to the J18 receptacle, and note the labels next to the plug: COM (common) designates the location of the neutral wire and HOT designates the location of the live wire.

6. Unplug the AC plug from the J18 receptacle and loosen the two end terminal screws. The middle terminal screw is not used.
7. Insert the Live and Common wires into the proper wire guard receptacles, then tighten the terminal screws to clamp wires. (If necessary, reinsert the AC into the J18 receptacle to determine proper wire locations.)
8. Re-insert the wire AC plug into the J18 receptacle.

To connect power:

1. Turn OFF the external power source (the circuit breaker). The power supply should be a fuse or circuit breaker rated at 10 amps for 115 VAC or 7.5 amps for 230 VAC mains.
2. Plug the cord from the conduit into the circuit breaker box (if there is an appropriate outlet).
3. If there is no outlet, cut off the plug from the power cord and expose the 3 colored leads. Strip about ¼ inch (⅓ cm) from the end of each wire.
4. If the leads do not reach to the circuit breaker box, measure and cut wiring to make up the difference. Use #14 AWG wire for live and neutral lines, and #10 AWG for the ground line.
5. Connect the ends of the leads to the appropriate terminals in the circuit breaker box. ***Match live, neutral, and ground lines to the correct connections***. The color coding of the wires is as follows:

   White = Neutral
   Black = Live / Hot
   Yellow/Green = Ground

   NOTE: Check polarity with a voltometer before wiring.

6. Wrap any exposed connections with electrical tape to avoid shorts.
7. Neatly arrange or secure and, if necessary, environmentally protect power wiring.

CAUTION: *Do not activate AC power at this time.*

DC Power Wiring

The BUPS-25/80 provides backup DC power to your repeater.

The following is a diagram of the OA1900C Network Repeater to BUPS-25/80 Wiring Kit. This diagram, as well as **Figure 6. Growth Cabinet Example with BUPS-25/80** on page 16, are provided for planning purposes.

For more information, refer to your BUPS documentation.

OA1900C Network Repeater to BUPS-25/80 Wiring Kit

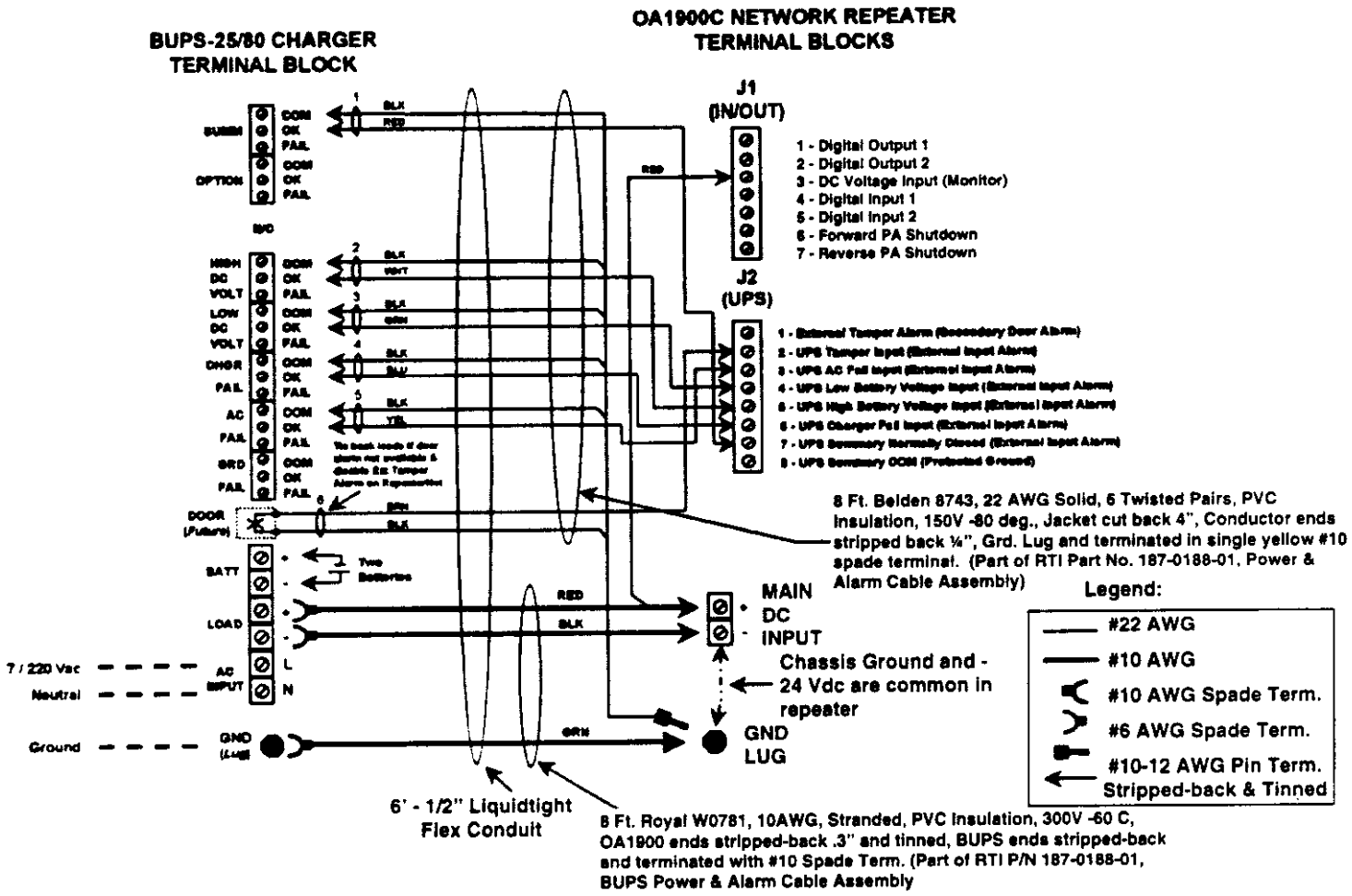


Figure 16. OA1900C NR to BUPS-25/80 Wiring Kit

Alarm and Control Wiring

Repeater installation continues with alarm and control wiring. The following figure shows I/O terminal block designations.

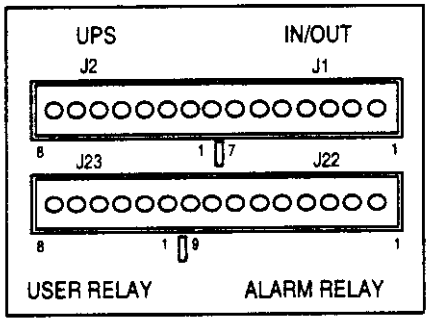


Figure 17. Customer UPS, I/O Alarm and Monitoring Terminal Blocks

The next table shows I/O lead descriptions.

Table 16. Wiring Harness Input/Output Lead Descriptions

Block	Pin No.	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	0–75 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	UPS Summary COM	Protected Ground
J22 Alarm Relay	1	Critical Relay NO	Normally Open Output
	2	Critical Relay COM	Common Input
	3	Critical Relay NC	Normally Closed Output
	4	Major Relay NO	Normally Open Output
	5	Major Relay COM	Common Input
	6	Major Relay NC	Normally Closed Output
	7	Minor Relay NO	Normally Open Output
	8	Minor Relay COM	Common Input
	9	Minor Relay NC	Normally Closed Output
J23 User Relay		User 1 NO	Normally Open Output
		User 1 COM	Common Input
		User 1 NC	Normally Closed Output
		User 2 NO	Normally Open Output
		User 2 COM	Common Input
		User 2 NC	Normally Closed Output

WARNING: *When connecting wiring, be sure the wiring assembly is not plugged into the repeater.*

Digital Control Outputs

The OA1900C NR has two digital outputs, each with one open collector transistor lead. When the output switch is ON, current flows through a circuit that includes the open collector transistor output—see the following figure. The reference ground is any of the panel-mounted screw lugs (repeater cabinet ground).

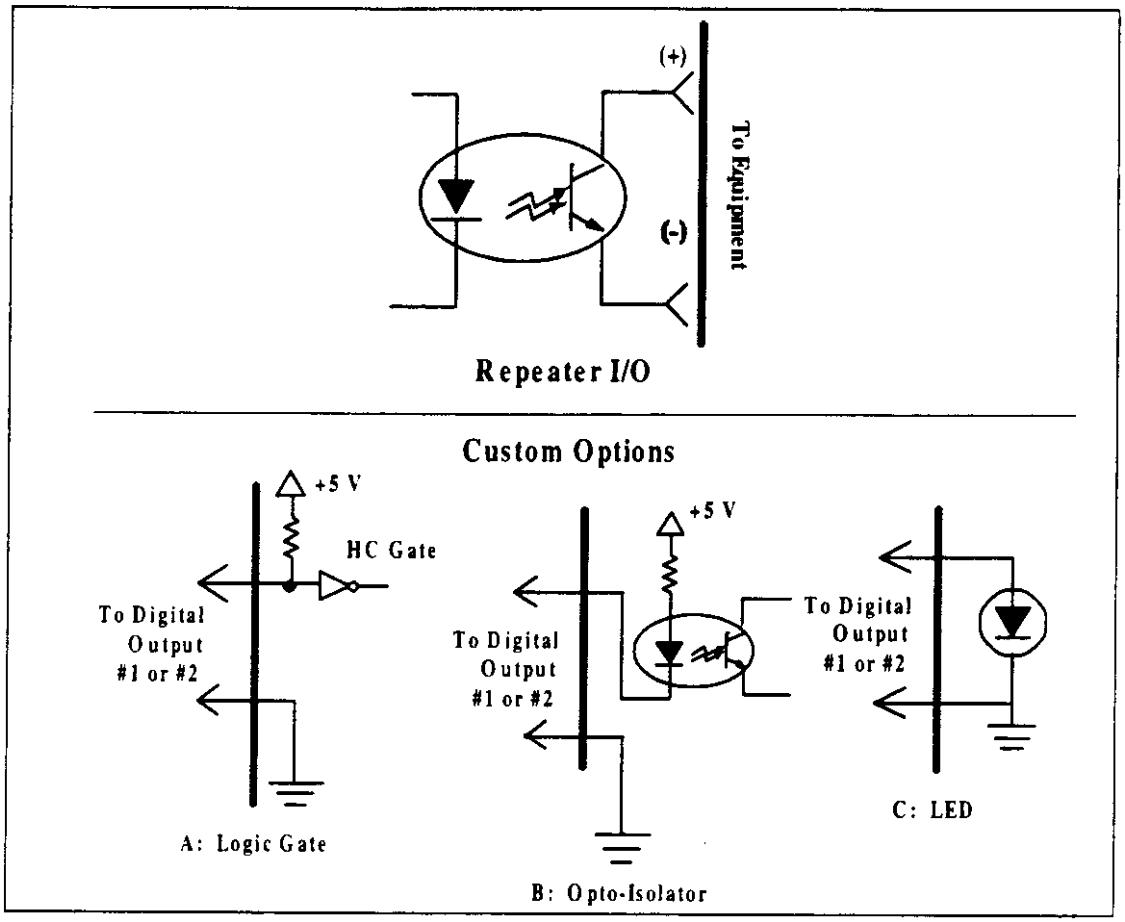


Figure 18. Typical Digital Output Applications

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

Forward Current–Continuous ---------- 300 mA

Maximum Positive to Negative Lead Voltage ---------- 50 Volts

Maximum Negative to Positive Lead Voltage ---------- 0 Volts

Leakage Current in OFF State ---------- 1 µA

See the "ACU Status Screen" in *RepeaterNet Craft for the OA1900C NR* for instructions about activating digital outputs. ***See Table 17*** for lead descriptions.

Alarm and Control Relay Outputs

The OA1900C NR has both alarm and control relay outputs (Form C) with common, normally open, and normally closed connections. When attached to the normally open and common leads, an alarm relay *closes* a circuit when a critical alarm activates and *opens* the circuit when the condition clears.

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

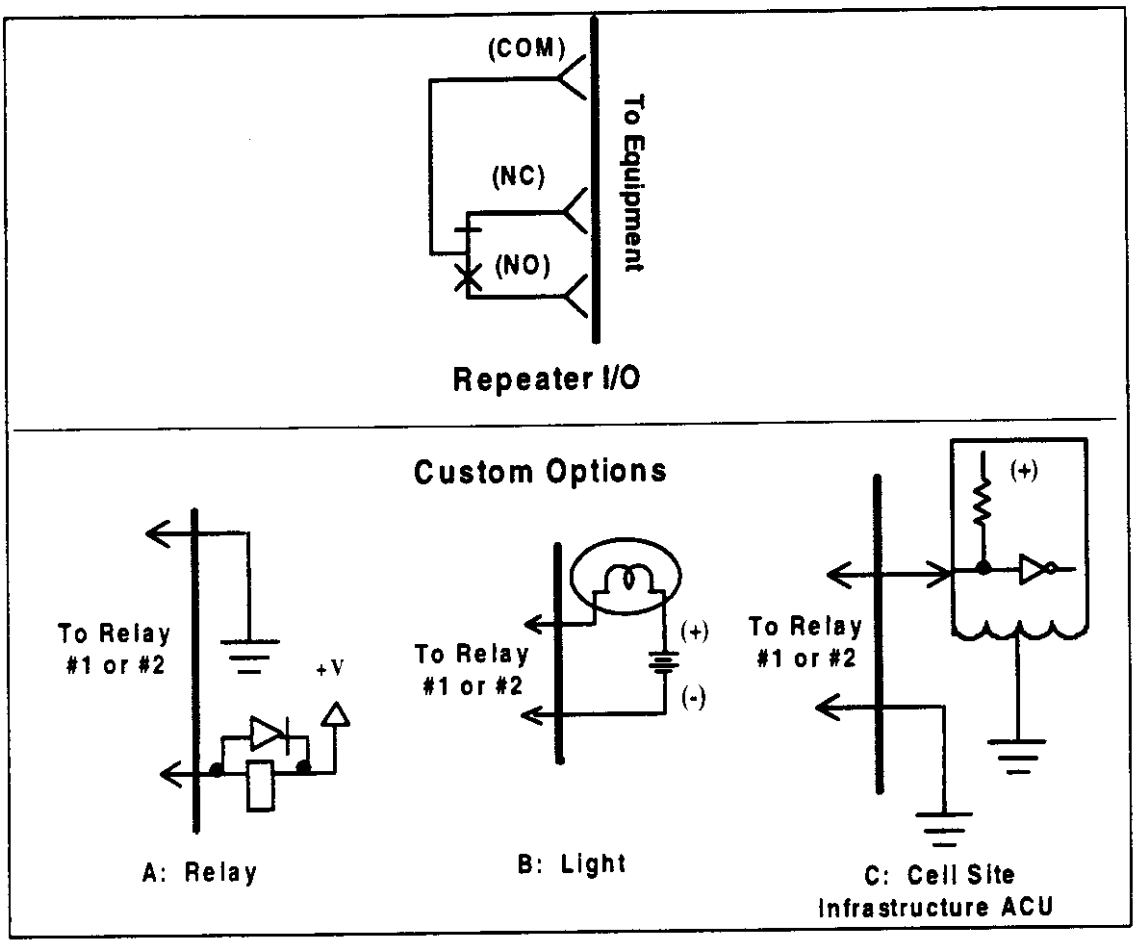


Figure 19. Typical Relay Applications

Do not exceed the following specifications with relay connections:

Maximum Switching Voltage and Current: 30 VDC/2 Amps, 200 VDC/200 mA

See the "ACU Status Screen" in RepeaterNet Craft for the OA1900C NR for instructions about activating digital outputs. **Table 16** on page 28 shows I/O lead descriptions.

Digital Inputs

The OA1900 NR has digital inputs for external alarm monitoring and for disabling the Forward and Reverse PAs. Each input triggers an alarm (or disables the PA) if the leads form a high impedance circuit (an open contact) and clears an alarm if the leads form a low impedance circuit (a contact closing).

NOTE: *If a PA is disabled using the digital inputs, the PA Alarm is triggered. To avoid triggering a PA Alarm in this manner, set the PA Alarm severity to disabled—see "Redefining Alarm Severity" in RepeaterNet Craft for the OA1900C NR.*

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

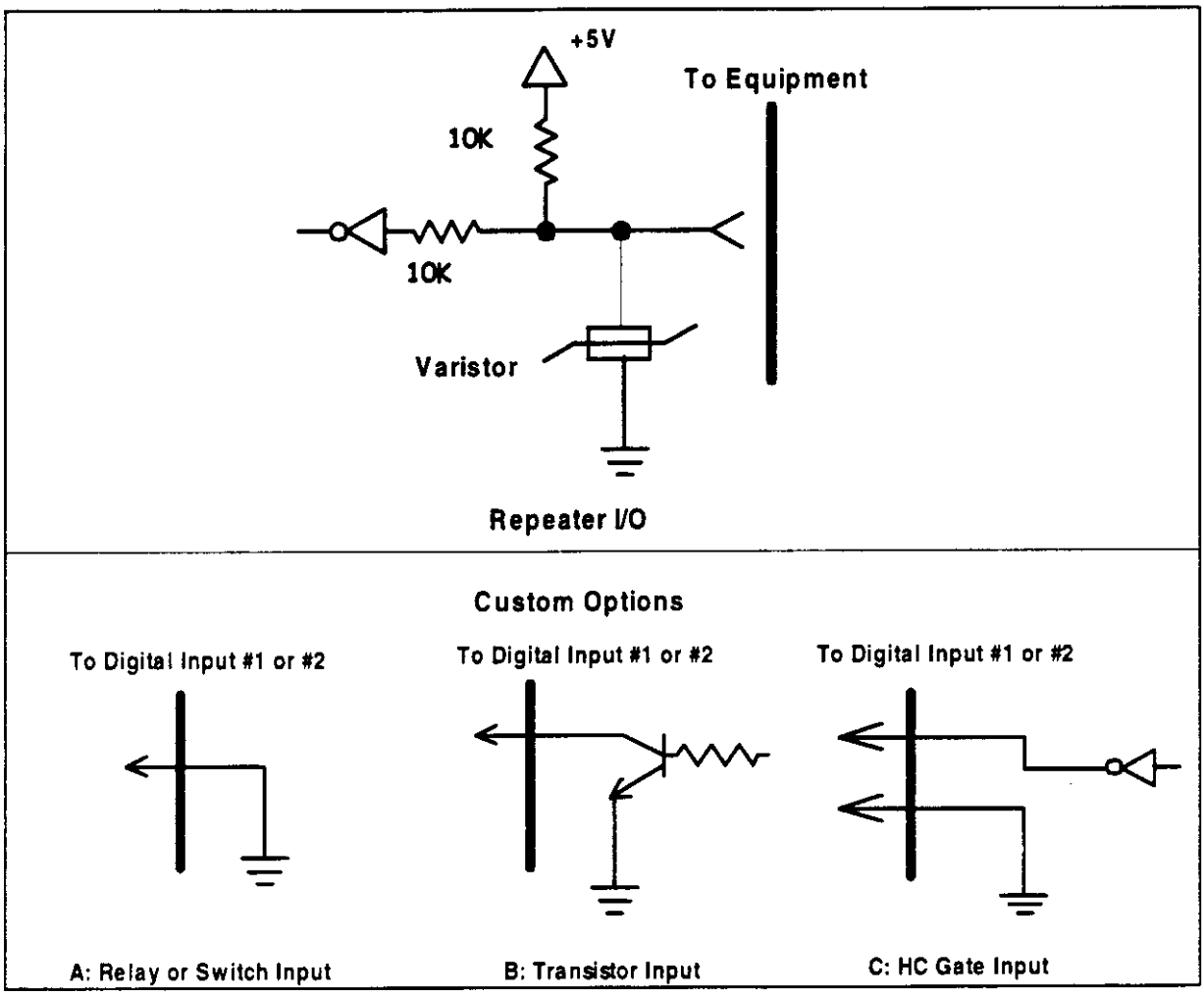


Figure 20. Typical Digital Input Applications

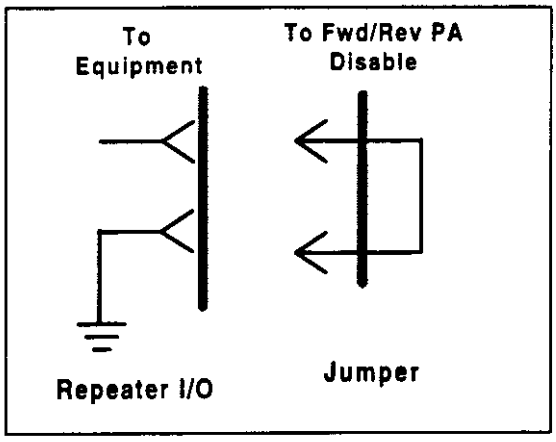


Figure 21. Typical PA Disable Input

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

External DC Input Voltage

The OA1900C NR 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.

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

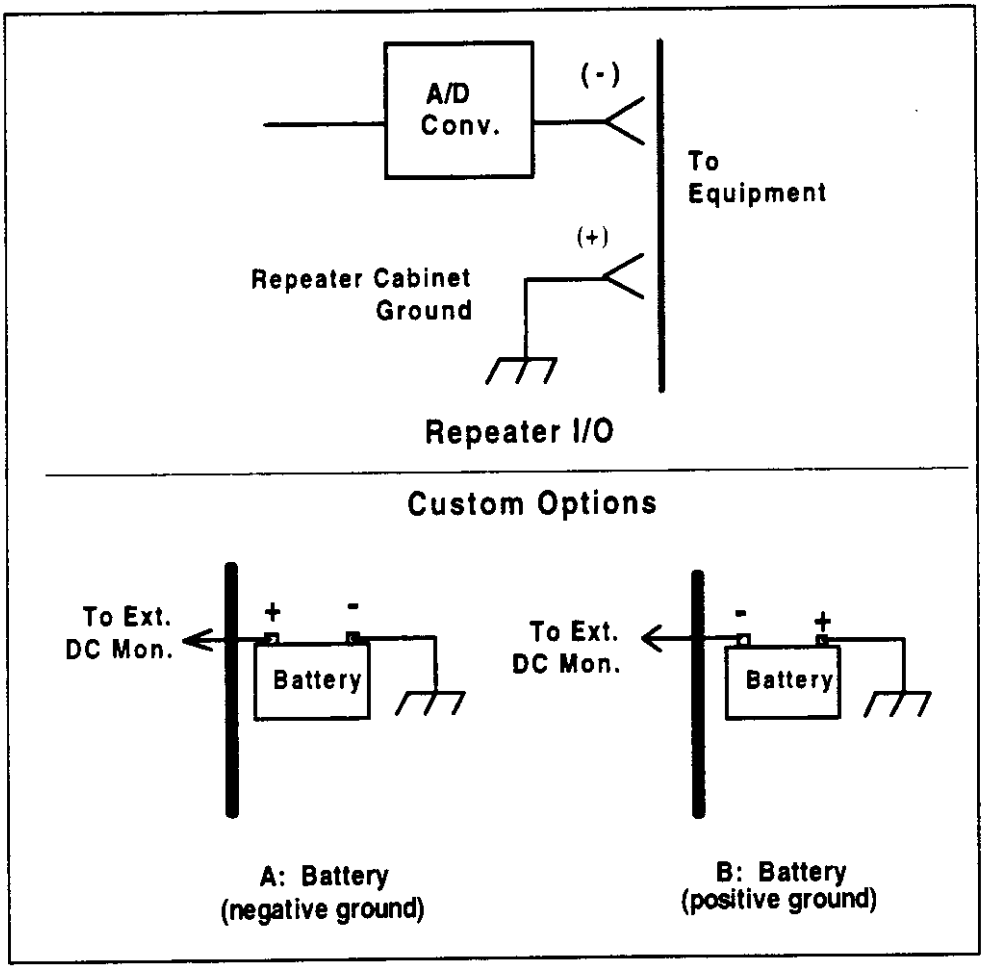


Figure 22. Typical DC Monitoring Applications

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

Chapter 5. Orienting and Isolating Antennas

Preliminary Antenna Orientation

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

BTS Antenna

To orient the BTS antenna:

1. Disconnect the coaxial cable from the donor BTS antenna at the antenna port on the repeater.
2. Connect the service monitor to the cable from the BTS receiving antenna.
3. While monitoring the control channel assigned to the donor BTS, position the BTS antenna to maximize the RSL (Received Signal Level).
4. Analyze the signal to ensure it is correct.

NOTE: *Record the level of the control channel and other active carriers from the donor BTS for later reference.*

If the RSL is less than Maximum RF Output Power Level minus Maximum Gain, full repeater output power may not be reached when installed. See **Table 4** on page 5 for RF output and maximum gain levels. To correct the problem, reposition the antenna, change the mounting height of the antenna, or use an antenna with greater gain to reach the required RSL.

Mobile Antenna

The Mobile service antenna can only be *bore-sighted* (aimed by eye) at this time. Aim the antenna as closely as possible to its final position. Accuracy is important because the antenna position affects antenna isolation.

Antenna Fundamentals

An ***antenna*** is a transducer between electromagnetic waves in space and voltages or currents in a transmission line. When transmitting, the antenna converts electrical signals into radio waves; a receiving antenna reverses the process and transforms radio waves back into electrical signals.

All antennas are directional, transmitting more power in some directions than others. The direction of maximum transmission or reception is called the ***boresight direction***. The directional properties of an antenna are described by its radiation pattern, a pictorial representation of relative radiated power versus direction. Radiation patterns exhibit a lobe structure in which the largest lobe in three-dimensional space constitutes the beam through which the antenna radiates or receives most of its power.

The tendency of the antenna to concentrate its radiated power is called ***gain***. The angular width of the main beam measured between the half-power points is called the ***beamwidth*** of the antenna. Beamwidth and gain vary inversely with each other; a high-gain antenna has a narrow beamwidth and vice versa. Gain is proportional to the physical area of an antenna expressed in square wavelengths.

Radiation pattern lobes other than the main beam are called ***sidelobes***. The higher the sidelobe level, the more likely an antenna is to interfere with or be interfered with by a receiver in the direction of the largest sidelobe.

An antenna has an ***operating frequency***—the frequency at which the antenna exhibits optimum performance—and a ***bandwidth***—the frequency range over which the antenna impedance and radiation pattern remain within some required tolerance.

Antenna Isolation

To prevent oscillation or severe passband distortion, **the antennas must have a port-to-port isolation equal to 15 dB plus the OA1900C NR active gain.** For example, an OA1900C NR set for a maximum available gain of 95 dB requires a minimum antenna isolation of 110 dB (95 dB + 15 dB) for proper operation.

Be aware that the motion of objects near the antennas can change the isolation significantly. If possible, perform tests with expected objects present to ensure the isolation does not drop below minimum required levels.

To measure the isolation:

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

NOTE: *Because antennas are not yet connected to the repeater, isolation is obtained through the air.*

---

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

The following method can be used to *estimate* antenna isolation (referenced to dBd). During installation, always rely upon actual measurements, not estimated data.

$$Isol = Ls + Lf + Lo - Gd + ADd - Gr + ADr + XPD$$

US Standard

$Ls = -42.2 + 20\log_{10}(F \times D)$, F in MHz, D in feet, Ls in dBd

Metric

$Ls = -31.8 + 20\log_{10}(F \times D)$, F in MHz, D in meters, Ls in dBd.

Where

The following are all in dB:

Isol	Antenna isolation
Ls	Antenna separation loss
Lf	Total Feedline Loss
Lo	Obstruction loss from structure or shield
Gd	Gain of antenna toward donor BTS
ADd	Angular discrimination of donor BTS antenna toward re-radiation antenna
Gr	Gain of re-radiation antenna toward Mobile
ADr	Angular discrimination of re-radiation antenna toward donor BTS antenna
XPD	Cross polarization discrimination between antennas (if applicable)

Antenna Orientation and Output Measurement

To orient antennas:

1. Turn OFF system power. The power switch is located in the upper left corner of the Entry Box.
2. Remove the 50-ohm terminators from the antenna ports.
3. Connect the Donor and Mobile antenna feeders to the proper antenna ports.
4. Turn ON system power.
5. Open a session with the repeater by selecting the repeater on the dialog box displayed after the Welcome screen.
6. Turn ON Forward PA and Reverse PA power:

   A) Select **Forward PA** from the **Configuration** menu.
   B) Click the **Control** tab.
   C) Click the **PA Power** switch to turn it ON.
   D) Click **Apply** or **OK**.

   Repeat for **Reverse PA**.

7. Check Forward PA and Reverse PA RF output power:

   A) Select **Forward PA** from the **Configuration** menu.
   B) Click the **Measurements** tab.
   C) Compare displayed output power levels to the intended RF output power levels for the system (defined in the site plan or network engineering documentation) and the maximum output power of the repeater.

8. Repeat for **Reverse PA.**

NOTE: *Forward transmit power increases as the orientation of the Donor antenna is optimized. Make any required adjustments to the Donor antenna facing the Cell Site to maximize Forward power output.*

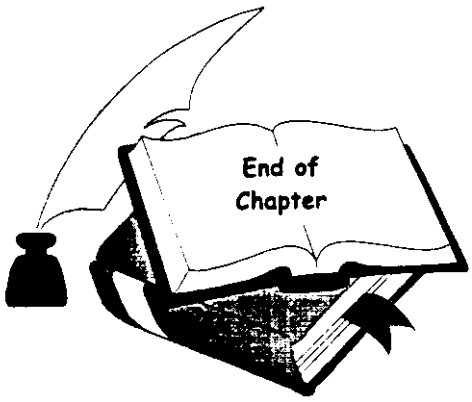
Adjusting for Hot Input Levels

The OA1900C NR has an adjustable gain range of 30 dB with upper and lower limits defined by the PA level of the repeater. In some applications, however, hot input levels require that antenna gain be set below the lower limit of this range.

To set antenna gain below the lower limit of the operating range:

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

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

Chapter 6. Completing Installation

Turning On System Power

RepeaterNet Craft is used for the first time during the installation procedure in this section. RepeaterNet Craft is the software program that confirms, controls, and monitors the OA1900C NR. Make sure RepeaterNet has been loaded on the laptop computer being used (at the installation site) to perform the initial configuration of the repeater. If necessary, see *RepeaterNet Craft for the OA1900C NR.*

To turn ON system power:

1. Terminate the OA1900C NR antenna ports with 7/16 DIN or Type N 50 OHM Power Loads.
2. Using a medium Phillips head screwdriver, remove the Entry Box access plate located at the front bottom of the unit and locate the internal backup battery. (See Internal Backup Battery on page 42 for information on the operation of this unit.)

Problem	Cause	Solution
Low RF Output or No RF Output	Alarm Conditions	⇒ Check for alarm conditions and resolve, if necessary.
	Strong, Out-of-Band Inputs	⇒ Check antenna orientation.
	Improper gain setting	⇒ Check gain and reset, if necessary.

3. Activate the power source to the repeater, then turn ON the repeater's power switch (located in the upper left corner of the Entry Box).

NOTE: *The power switch is also a magnetic sensing circuit breaker.*

4. Connect the red lead (quick disconnect type) of the internal backup battery.

Confirming Proper System Voltage

You now must check the repeater, using RepeaterNet, to confirm proper system voltage.

To connect to the repeater and to confirm proper system voltage:

1. Plug the female end of the DB-9 serial cable into the serial port of the computer.
2. Plug the male end of the cable into the serial port located in the Entry Box.
3. Start RepeaterNet.

   `Start->Programs->RepeaterNet->RepeaterNet`

4. If there is more than one repeater, select the appropriate from the list displayed to display the Main Control screen.
5. On the Login dialog box, enter a **Login ID** and **Password**.
6. Click **OK** to open the RepeaterNet Main Control screen.
7. Check the operation (color) of the Power subsystem (2-prong plug icon at the bottom of the screen):

   ⇒ **Green**—Normal Operation. Proceed to step 8.

⇒ **Red and flashing**—Alarm Condition.

Select **Power System** from the **Configuration** menu to open the Power System Properties screen. Identify the subsystem that triggered the alarm, and see Table 19 on page 42 for information about resolving the alarm.

NOTE: *Clear any active alarms before proceeding with the installation.*

8. If there are no alarms, or after clearing active alarms, continue with the procedure in the following section.

Checking that Power Amplifiers are OFF

All units are shipped with PAs turned OFF as indicated by the PA OFF indicator (a circle with a slash through it) displaying over each PA subsystem icon (FPA or RPA) on the Main Control screen. PAs should remain OFF until you adjust the gain. If any PA subsystem icon is not displaying the OFF indicator, do the following:

1. Select Forward PA or Reverse PA from the Configuration menu to open the **Properties** window.
2. Click the **Control** tab.
3. Click the PA Power button to turn it OFF.
4. Click **Apply** or **OK**.

Determining the Correct Frequency

Consult the site plan or network engineering documentation for the proper channel or band settings for this application. In CDMA applications, primary and secondary assignments depend upon the Donor BTS with which the repeater is coordinated. See the following table for a listing of CDMA channel assignments. Note that Korea and Japan use different CDMA channel assignments.

Table 17. Valid CDMA Channel No. to Frequency Cross Reference Chart

Frequency Block	Quasi Channel Number	Official Channel No.	Base to Mobile Forward (MHz)	Base to Mobile Forward (MHz)
A	1	25	1851.250	1931.250
	2	50	1852.500	1932.500
	3	75	1853.750	1933.750
	4	100	1855.000	1935.000
	5	125	1856.250	1936.250
	6	150	1857.500	1937.500
	7	175	1858.750	1938.70
	8	200	1860.000	1940.000
	9	225	1861.250	1941.250
	10	250	1862.500	1942.500
	11	275	1863.750	1943.750

Frequency Block	Quasi Channel Number	Official Channel No.	Base to Mobile Forward (MHz)	Base to Mobile Forward (MHz)
B	1	425	1871.250	1951.250
	2	450	1872.500	1952.500
	3	475	1873.750	1953.750
	4	500	1875.000	1955.000
	5	525	1876.250	1956.250
	6	550	1877.500	1957.500
	7	575	1878.750	1958.750
	8	600	1880.000	1960.000
	9	625	1881.250	1961.250
	10	650	1882.500	1962.500
	11	675	1883.750	1963.750
C	1	925	1896.250	1976.250
	2	950	1897.500	1977.500
	3	975	1898.750	1978.750
	4	1000	1900.000	1980.000
	5	1025	1901.250	1981.250
	6	1050	1902.500	1982.500
	7	1075	1903.750	1983.750
	8	1100	1905.000	1985.000
	9	1125	1906.250	1986.250
	10	1150	1907.500	1987.500
	11	1175	1908.750	1988.750
D	1	325	1866.250	1946.250
	2	350	1867.500	1947.500
	3	375	1868.750	1948.750
E	1	725	1886.250	1966.250
	2	750	1887.500	1967.500
	3	775	1888.750	1968.750
F	1	825	1891.250	1971.250
	2	850	1892.500	1972.500
	3	875	1893.750	1973.750

Setting the Channel or Band

To set the operational channel or band:

1. Confirm that the repeater is ON and a direct connection has been established.
2. From the Craft Main Control screen menu bar, select **Channel 1** from the **Configuration** menu to open the Channel 1 Properties screen.
3. On the Channel 1 Properties screen, click the **Channel #** tab.
4. Type the channel number in the **Channel** field to define a channel.
5. Click **Apply** or **OK** to set the channel.

Configuring Gain Initially

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

To initially set gain:

1. Confirm that the repeater is ON and a direct connection has been established.
2. From the Craft Main Control screen, select **Channel 1** from the **Configuration** menu to open the Channel 1 Properties screen.
3. Click the **Gain** tab.
4. Click-drag each horizontal slider to define Forward and Reverse gain, noting that gain adjusts in 2 dB increments. The gain value box (centered under each slider) displays selected gain.
5. Click **Apply** or **OK** to set the gain and return to the Main Control Screen.

NOTE: *For 2-channel units, select Channel 2 and repeat steps 3 and 4 for the Channel 2 Forward and Reverse PAs.*

Verifying and Optimizing the Coverage Area

For detailed information about repeater installation and link engineering, request the engineering handbook, *Installation, Operation, and Optimization of Over-the-Air Cellular and PCS Repeaters*, directly from Repeater Technologies.

Chapter 7. Maintenance and Troubleshooting

The OA1900C NR is a field-replaceable unit that requires no component-level repair. The use of highly reliable components virtually eliminates maintenance. Routine checks of the OA1900C NR and its supporting equipment are recommended to ensure reliable operation and early detection of problems.

Routine Maintenance

Repeater Technologies recommends a semi-annual maintenance schedule for the repeater. A procedure for routine maintenance follows:

1. Inspect the installation site and correct any problems.
2. Verify that the OA1900C NR and all associated hardware, including antennas, is securely mounted and properly in place.
3. Check input electrical wiring and BUPS for damage and ensure that connections are tight.
4. Check any battery terminals for corrosion; clean terminals, if necessary.
5. Clean solar panels and remove obstructions, if applicable.

CAUTION: *Follow manufacturers instructions when cleaning solar panels. Abrasive or acetone-based solutions can cause damage to some types of panels.*

6. Check antennas and coaxial cabling for damage and ensure that connections are tight.
7. Check the fins of the heatsink and clear any debris.

LEDs

The OA1900C NR Entry Box displays four LED indicators—see the following table.

Table 18. Descriptions of LED Indicators

LED Indicator	Description	LED Color	Normal	Trouble
System Ready	Power ON	Green	On	Off
Critical Alarm	Critical Alarm triggered	Red	Off	On steady
Major Alarm	Major Alarm triggered	Red	Off	On steady
Minor Alarm	Minor Alarm triggered	Yellow	Off	On steady

Troubleshooting

Perform all troubleshooting of the OA1900C NR with RepeaterNet. See the following table for a listing of common problems and possible solutions.

NOTE: *Contact the Repair Department of Repeater Technologies whenever problems with the unit can not be resolved—see "Repair and Return Procedure."*

Table 19. System Troubleshooting

Problem	Cause	Solution
Unable to Start RepeaterNet	Corrupted Program Data	⇒ Run the Scan Disk and Defragmenter utilities included with Windows 95.
	Improper Installation of RepeaterNet	⇒ Reinstall RepeaterNet.
	Damaged Hard Drive	⇒ Repair or replace hard drive.
No Connection	Improper COM Settings	⇒ Check telephone number, COM port, stop bits, parity settings, and baud rate. Correct settings, if necessary. ⇒ Check advanced settings from the COM Properties screen. Reduce buffer sizes or disable buffer and retry connection.
	Serial Cable Failure	⇒ Check the cable for a tight connection. ⇒ Check the cable and connection ports for damage. Replace cable, if necessary. Contact Repeater Technologies if the connection port is damaged.
	Modem Failure	⇒ Check telephone line connections at the computer and the Repeater. Re-connect, if loose. ⇒ Check telephone line for damage. Replace, if necessary. ⇒ Log in to a direct session with the Repeater and check the modem and cell phone alarms. If either alarm is active and does not clear, contact Repeater Technologies. ⇒ Check the computer's modem. Replace or repair computer modem, if necessary.
Overheating *(Temp. Alarm)*	Insufficient Cooling	⇒ Check the heatsink. Clear any airflow obstructions. ⇒ Shade the unit if it is in an extremely hot environment.
Low Voltage or No Voltage *(Input Power Alarm)*	Improper Solar Charging	⇒ Clean solar panels or remove obstructions. Do *not* use an acetone-based solution for cleaning.
	Power Supply Failure	⇒ Check the condition of the power source. ⇒ Check all wiring and power leads to the power source. ⇒ Check any fuses or circuit breakers in power supply equipment. ⇒ Check AC power service for outages or other service problems.
	Internal Power Converter Failure	⇒ Contact Repeater Technologies to replace unit.
ALC Power Limit Alarm	Gain Incorrectly Set PA Failure	⇒ Adjust gain. ⇒ Contact Repeater Technologies.
Low RF Output or No RF Output	Controls Not Turned ON	⇒ Check to ensure Repeater power is ON and both PAs are turned ON.
	Mobile or Base Antennas Oriented Incorrectly	⇒ Check antenna orientation and re-align, if necessary.

Problem	Cause	Solution
Low RF Output or No RF Output	Alarm Conditions	⇒ Check for alarm conditions and resolve, if necessary.
	Strong, Out-of-Band Inputs	⇒ Check antenna orientation.
	Improper gain setting	⇒ Check gain and reset, if necessary.
Oscillation	Active Alarm	⇒ Resolve alarm.
	Foreground reflections	⇒ Remove object causing reflection; adjust antenna orientation; move antenna mounting.
	Improper Antenna Isolation	⇒ Clear area around antennas of excessive plant growth.
	Improper Gain Settings	⇒ Adjust gain.

Internal Backup Battery

The OA1900C NR includes an internal backup battery to provide limited back-up power for the ACU and, if applicable, the cell phone and internal modem. In the event of a loss of system power, the internal battery provides power for the repeater to call out and report the failure, and to save the Alarm and Event Log. The length of time that the internal battery provides power depends upon Repeater configuration and environmental conditions (such as temperature).

Table 20. Internal Battery Backup Operation Estimates

Configuration	Operating Time*
Repeater with no internal modem	5 hours
Repeater with internal modem and no cell phone	2 hours
Repeater with internal modem and cell phone, with modem and phone continuously transmitting	20 minutes
**Values are estimates only: actual battery life may vary. Estimates assume a fully charged battery, adverse environmental conditions, and a 600 mW AMPS cell phone.*	

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

If a power outage lasts longer than the operational limit of the internal battery, the modem cannot send or receive calls, and Alarm and Event Log data is lost. Save the Alarm and Event Log when the repeater calls out to report a system power failure—see "The System Menu" in *RepeaterNet Craft for the OA1900C NR* for more information about the Alarm and Event Log.

NOTES:

⇒ *The internal battery does not provide power for RF transmission during a primary power outage. Service is interrupted during a loss of primary system power.*

⇒ *The battery should be replaced on a 3-year cycle to allow for normal aging, wear, and environmental deterioration.*

Sparing Recommendation

Because repeaters are often used to provide critical coverage, customers are advised to follow a sparing policy. While most carriers have internal policies related to equipment sparing, in the event that one does not exist, Repeater Technologies recommends that a carrier maintain a minimum of one (1) spare unit for every increment of 10 units or fraction thereof. This assumes that all spares are immediately available to the technician for installation. It is advised that each carrier develop a company-specific, equipment-specific policy, one that accounts for geographic and environmental factors and the total number of repeaters deployed in a given network.

Repair and Return Procedure

If a repair or return of the OA1900C is necessary, contact the Repeater Technologies Customer Service Department for instructions. Note that Customer Service needs the following information from you when you call:

⇒ A detailed explanation of the problem
⇒ The model name
⇒ The serial number of the unit

For equipment returns, a Repeater Technologies representative issues an RMA (Return Material Authorization) and shipping and packaging instructions. When returning the OA1900C NR, always use the original shipping carton and packaging materials. If the original shipping materials are unavailable, Repeater Technologies can send replacement materials at the cost of the purchaser.

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

Customer Service phones are staffed or monitored 24 hours a day, 7 days a week. Phone numbers for the Customer Service Department are as follows:

(408) 747-1946

(800) 938-1901 (USA and Canada only)

Product Warranty

A one-year product warranty is provided with the OA1900 NR. A copy of the product warranty is included with the Standard Terms and Conditions in every sales agreement. For more information, contact the Repeater Technologies Customer Service Department.

Glossary

This glossary defines communications industry acronyms, symbols, and terms. Hardware- and software-related acronyms have also been included. As this glossary supplements all operations manuals of 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.

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.

DAMPS Digital Advanced Mobile Phone System (equivalent of TDMA).

dB Decibel or decibels.

dBc Decibels referenced to the carrier level.

dBi Decibels referenced to the isotropic antenna.

dBm Decibels referenced to one milliwatt.

DF, DFB Distributed Feedback (Laser).

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 transmissions.

FRU Field Replaceable Unit

FSK Frequency-Shift Keying.

GSM Global System for Mobile Communications or Groupe Speciale Mobile.

GUI Graphical User Interface.

HAND-OFF The act of transferring the service of a call in progress on a cellular system from one cell or sector to another, typically also involving a change in the voice channel used.

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. Systems designed to control reverse attenuation will moderate the potentially damaging effect of hot tones.

IF Intermediate Frequency.

IM Intermodulation.

IMD Intermodulation Distortion.

LED Light-emitting diode.

LNA Low Noise Amplifier.

LO Local Oscillator, high-level input into mixer.

MICROCELL Any small, low-power cell site.

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 is a compound of multiple rays that have undergone one or more reflections and/or refractions. Cellular coverage is most often provided in a multipath environment, especially in high-density city areas.

NR Network Repeater.

OTU Optical Transceiver Unit.

PA Power Amplifier.

PCS Personal Communications Service.

PSTN Public Switched Telephone Network.

PEP Peak Envelope Power.

PLL Phase Locked Loop.

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 onto the RBS. Uplink transmission.

REVERSE GAIN Gain setting for Reverse transmissions.

RF Radio Frequency.

RFI Radio Frequency Interference.

RSL Receive Signal Level.

RSA Rural Service Area.

RSSI Receive Signal-Strength Indicator.

RX Receive.

SIMULCAST The process of transmitting the same signal from two or more sites simultaneously.

SMA A type of connector.

SMB A type of connector.

TDMA Time Division Multiple Access (equivalent to DAMPS).

TSA Traffic Service Area.

TX Transmit.

UHF Ultra High Frequency.

UPS Uninterruptable Power Supply.

V Volt or Volts.

VAC Voltage, Alternating Current.

VDC Voltage, Direct Current.

VSWR Voltage to Standing Wave Ratio.

W Watt or Watts.

XPD Cross Polarization.