



CDR500 Wall Mount Repeater
CDR700 Desktop Repeater

Service/Programming Manual

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Scope of Manual

This manual is intended for use by experienced technicians familiar with similar types of equipment. It contains all service information required for the equipment described and is current as of the printing date. Changes which occur after the printing date are incorporated by service manual revisions. These revisions are added to the manuals as the engineering changes are incorporated into the equipment.

How to Use This Manual

This manual contains introductory material such as model charts and accessories, as well as sections that deal with specific service aspects of the CDR500 Wall Mount Repeater and CDR700 Desktop Repeater. Refer to the Table of Contents for a general overview of the manual, or to the "Overview" paragraph in each section for a specific overview of the information in that section.

Other Documentation

Table 1 lists other documentation you may need to setup and configure for the CDR500 Wall Mount Repeater and CDR700 Desktop Repeater.

Table 1. Other Documentations

Information	Location
CDM-Series Operation (North America)	CDM750 User Guide (6881091C54) CDM1250 User Guide (6881091C55) CDM1550 User Guide (6881091C56)
PRO-Series Operation (Latin America)	PRO3100 User Guide (6881091C57) PRO5100 User Guide (6881091C58) PRO7100 User Guide (6881091C59)
CDM-Series Programming (North America)	CDM-Series CPS HVN9025
PRO-Series Programming (Latin America)	PRO-Series CPS HVN9027
CDM-Series Service (North America)	Basic Service Manual (6881091C62) Detailed Service Manual (6881091C63)
PRO-Series Service (Latin America)	Basic Service Manual (Eng) (6881092C71) Basic Service Manual (Span) (6881092C72) Basic Service Manual (Port) (6881092C73) Detailed Service Manual (Eng) (6881091C63) Detailed Service Manual (Span) (6881092C75) (Detailed Service Manual (Port) (6881092C76)
i20R Operation Maintenance	i20R Service Manual (6880904Z40)
i20R General Programming	i20R RSS Manual (6880904Z55)

Table 1. Other Documentations (Cont'd.)

Information	Location
ZR310 Operation/Maintenance/Programming	ZR310 Service Manual (6880904Z64)
ZR340 Operation/Maintenance/Programming	ZR340 Service Manual (6880905Z90)
Zetron Model 42 Operation	Zetron Model 42 User Manual (6880309G56)
Zetron Model 49 Operation	Zetron Model 49 User Manual (6880309G57)
Multibase Programming	Zetron Multibase Programming Manual (6880309G58)
ST-853M SmarTrunk II Operation/Programming	ST-853M SmarTrunk II Service Manual (6880905Z59)
Trident RAIDER Installation	Trident RAIDER Installation Manual (6880309G46)
Trident MARAUDER Installation	Trident MARAUDER Installation Manual (6880309G47)

Technical Support

To obtain technical support, you may call Motorola Product Services. When you call, we ask that you have ready the model and serial numbers of the respective radio or its parts.

Service Policy

If malfunctions occur within 30 days that cannot be resolved over the phone with Motorola Product Services, a defective "major" component (such as a repeater controller or the power supply) should be returned. You must obtain authorization from Motorola Product Services before returning the component. After 30 days, you must return any defective component to the location shown in Table 2. Make sure that the component is shipped in its original packaging or use careful packing procedures, to eliminate the possibility of damage while en route. During the warranty period, the components will either be repaired or replaced as required. If the component is out of warranty, you must pay a service fee.

Table 2. Service After 30 Days

Major Component*	Repair Location
HPN9005_ & HKPN4001_ (Power Supply)	StarWerks
HPN9033_ & HKPN4000_ (Power Supply)	DuraComm
HLN3948 (Basic)	Motorola, Inc.
HLN8388_ (ZR310)	Zetron
HLN9119_ (ZR340)	Zetron
RLN4744_ (Model 42)	Zetron
RLN4746_ (Model 49 w/2-wire interconnect)	Zetron
RLN4747_ (Model 49 w/4-wire interconnect)	Zetron
HLN9447_ (i20R)	GAI-Tronics
HLN3104_ (ST-853M)	SmarTrunk

Ordering Replacement Parts

Table 2. Service After 30 Days (Cont'd.)

Major Component*	Repair Location
RLN4684 (RAIDER)	Trident
RLN4685 (MARAUDER)	Trident

* Obtain authorization from the applicable repair location before returning the component

We do not generally recommend that you make repairs to the piece part level on the CDR500 and CDR700 repeater components. However, we recommend that you keep spare station components (or a complete station) available at all times, so that once you have identified a defective component you can immediately replace it, getting the repeater back in service within a few minutes. If the transceiver should fail in the transmit or receive role, you can use a transceiver from your normal inventory.

Ordering Replacement Parts

You can order additional components and some piece parts directly through your Motorola price pages. When ordering replacement parts, include the complete identification number for all chassis, kits, and components. If you do not know a part number, include with your order the number of the chassis or kit which contains the part, and a detailed description of the desired component. If a Motorola part number is identified on a parts list, you should be able to order the part through Motorola Accessory and Aftermarket Division. If only a generic part is listed, the part is not normally available through Motorola. If no parts list is shown, generally, no user serviceable parts are available for the kit.

Customer Resources Technical Support & 30-Day Warranty

8000 W. Sunrise Blvd.
Plantation, FL 33322 USA
1-800-927-2744 (U.S. & Canada)

Motorola Radio Support Center

If your country does not have a depot, please contact your Business Development Manager, Distributor, or contact Motorola Technical support at:

LATECH1@email.mot.com

United States & Canada:

Attention: Warranty Return
3760 South Central Avenue
Rockford, IL 61102 USA
1-800-227-6772 (U.S. & Canada)

Motorola Do Brasil:

Service Center, Doca 26
Rodovia SP 340 Km 128,7 s/n
Bairro Tanquinho
Jaguariúna - São Paulo
13820-000 - Brazil
55-19-1847-8333
55-19-3847-8144 or 55-19-3847-6050 (FAX)

Motorola De Puerto Rico:

Ave. Chardon

Edificio Telemundo 2
Hato Rey, P.R. 00917
787-641-4100
787-641-4085 (FAX)

Motorola De México, S.A.:

Bldv. Manuel Avila Camacho #32 Primer Piso
Col. Lomas de Chapultepec CP 11000
México D.F., México
5-387-0500
5-387-0558 (FAX)

Motorola De Columbia:

Diagonal 127 A N° 17-64
Santa Fe de Bogotá
D.C. - Colombia
571-520-0510
571-216-2429

Major Component Repair

Motorola Radio Support Center
3760 South Central Avenue
Rockford, IL 61102 USA

Instrument Associates Major Component Repair (for i20R)

GAI-Tronics
400 E. Wyomissing Ave.
Mohnton, PA 19540
1-800-442-4782

Zetron Major Component Repair

(for ZR310, ZR340, Model 42, and Model 49)
Zetron Inc.
12034 134th Court N.E.
Redmond, WA 98052 USA
1-425-820-6363

SmarTrunk Component Repair (for ST-853M)

SmarTrunk Systems, Inc.
28301 Industrial Blvd., Suite K&L
Hayward, CA 94545 USA
1-510-887-1950

Trident Component Repair (for RAIDER and MARAUDER)

Trident Micro Systems
Two Trident Drive
Arden, NC 28704 USA
1-800-798-7881

Star Werks Component Repair

(for HPN9005 and HKPN4001 power supply)
Star Werks Inc.
1237 Capitol Drive
Addison, IL 60101 USA
1-630-628-0880

DuraComm Major Component Repair

(for HPN9033 and HKPN4000 power supply)
DuraComm Corporation
2119 Atlantic Ave.
North Kansas City, MO 64116
1-816-472-5544

Motorola Accessory and Aftermarket Division

1-800-422-4210

1-847-538-8198 (FAX)

Parts Identification

1-847-538-8023

1-847-576-3023 (FAX)

Regulatory Requirements

In the United States, the FCC regulates licensing of RF frequencies. The terms of the FCC radio license for a particular operation will determine the frequencies, output power, and antenna height(s) for a given situation. The applicable "Part" of the FCC Rules and Regulations must be consulted before a CDR500 or CDR700 repeater is activated. In countries other than the United States, contact the local government for licensing rules.

NOTE

In the United States of America, the CDM-Series radios may not legally be used as the transmit radio in a UHF (450 to 512 MHz) repeater or base station application with 12.5 kHz channel spacing. The ± 2.5 -ppm frequency stability capability of the radio does not meet the requirements of part 90 of the Rules and Regulations of the Federal Communications Commission (FCC). In other countries, check local frequency stability requirements before placing a CDM- or PRO-Series radio based repeater or base station in operation.

Any telephone interconnect equipment sold in the U.S. must comply with Part 68 of the FCC rules. On the repeater controller housing there is a label that lists the FCC registration number and ringer equivalence number (REN) for this equipment. You must, on request, provide this information to your telephone company. In other countries additional compliance information or testing may be required. Contact Radius Product Services for further information.

The ringer equivalence number (REN) is useful in determining the quantity of devices you may connect to your telephone line and still have all of those devices ring when your telephone number is called. In most, but not all areas, the sum of the RENs of all devices connected to one line should not exceed five. Contact your local telephone company to determine the maximum REN for your calling area.

If your telephone equipment causes damage to the telephone, the telephone company may discontinue your service temporarily. If possible, they will notify you in advance, but, if advance notice is not practical, you will be notified as soon as possible. In such a case, you will be informed of your right to file a complaint with the FCC.

Your telephone company may make changes in facilities, equipment, operations, or procedures that could affect the proper functioning of your equipment. If it does, you

will be notified in advance to give you an opportunity to maintain uninterrupted telephone service.

If any interconnect equipment malfunctions, the telephone company may ask you to disconnect it from the network until the problem has been corrected or until you are sure that the equipment is no longer malfunctioning.

Interconnect equipment cannot be used on coin service provided by the telephone company. Connection to party lines is subject to tariffs.

CAUTION

This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manuals, can cause interference to radio communications. It has been tested and found to comply with the limits for a "Class A" computing device pursuant to Part 15 of FCC Rules which are designed to provide reasonable protection against such interference when the equipment is operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference in which case the user, at his own expense, will be required to take whatever measure is necessary to correct the interference.

Industry Canada Requirements

The Canadian Department of Communications label identifies certified equipment. The certificate means that the equipment meets certain protective, operational, and safety requirements of the telecommunications network. The Department does not guarantee the equipment will operate to a user's satisfaction.

Before installing this equipment, make sure you are permitted to connect it to the facilities of the local telecommunications company. You must also install the equipment using an acceptable method of connection. In some cases you may extend the company's inside wiring for a single line individual service by means of a certified connector assembly (telephone extension cord). You should be aware, however, that compliance with the above conditions may not prevent degradation of service in some situations.

Repairs to certified equipment should be made by an authorized Canadian maintenance facility designated by the supplier. Any repairs or alterations made by a user to this equipment, or any equipment malfunctions may give the telephone communications company cause to request the user to disconnect the equipment.

WARNING

For your own protection, make sure that the electrical ground connections of the power utility, telephone lines, and internal metallic water pipe system, if present,

⚠ WARNING (Cont'd.)

are connected together. This precaution may be particularly important in rural areas. Do not attempt to make electrical ground connections yourself. Contact an appropriate electrical inspection authority or electrician.

Industry Canada Load Number (refer to the FCC label)

The load number (LN) assigned to each terminal device denotes the percentage of the total load to be connected to the telephone loop used by the device to prevent overloading. The termination on a loop may consist of any combination of devices, subject to the requirement that the total of the load numbers of all devices cannot exceed 100.

Industry Canada Compliance Notice

This digital apparatus does not exceed the Class A limits for radio noise emissions for digital apparatus as set out in the Radio Interference Regulations of the Canadian Department of Communications.

Avis De Conformation avec le Ministère des Communications du Canada

Le présent appareil numérique n'émet pas de bruits radioélectriques dépassant les limites applicables aux appareils numériques de la classe A, précitées dans le règlement sur le brouillage radioélectrique édicté par le Ministère des Communications du Canada.

Safety and General Information

IMPORTANT INFORMATION ON SAFE AND EFFICIENT OPERATION. READ THIS INFORMATION BEFORE USING YOUR RADIO

The information provided in this document supersedes the general safety information contained in user guides published prior to October 2000. For information regarding radio use in a hazardous atmosphere please refer to the Factory Mutual (FM) Approval Manual Supplement or Instruction Card, which is included with radio models that offer this capability.

Radio Frequency (RF) Operational Characteristics

To transmit (talk) you must push the Push-To-Talk button; to receive (listen) you must release the Push-To-Talk button. When the radio is transmitting, it generates radio frequency (RF) energy; when it is receiving, or when it is off, it does not generate RF energy.

Radio Operation and EME Exposure

Your Motorola radio is designed to comply with the following national and international standards and

guidelines regarding exposure of human beings to radio frequency electromagnetic energy (EME):

- United States Federal Communications Commission, Code of Federal Regulations; 47 CFR part 2 sub-part J
- American National Standards Institute (ANSI) / Institute of Electrical and Electronic Engineers (IEEE) C95. 1- 1992
- Institute of Electrical and Electronic Engineers (IEEE) C95.1- 1999 Edition
- National Council on Radiation Protection and Measurements (NCRP) of the United States, Report 86, 1986
- International Commission on Non- Ionizing Radiation Protection (ICNIRP) 1998
- Ministry of Health (Canada) Safety Code 6. Limits of Human Exposure to Radiofrequency Electromagnetic Fields in the Frequency Range from 3 kHz to 300 GHz, 1999
- Australian Communications Authority Radio-communications (Electromagnetic Radiation - Human Exposure) Standard 1999 (applicable to wireless phones only)

Electromagnetic Interference/ Compatibility**NOTE**

Nearly every electronic device is susceptible to electromagnetic interference (EMI) if inadequately shielded, designed or otherwise configured for electromagnetic compatibility.

Antenna Installation**Fixed Site Antennas**

Mobile radio equipment is sometimes installed at a fixed location and operated as a repeater, a base station, or as a fixed unit. In such cases the antenna installation must comply with the following requirements in order to assure optimal performance and make sure human exposure to radio frequency electromagnetic energy is within the guidelines set forth in the above standards.

- The antenna must be mounted outside the building.
- Mount the antenna on a tower if at all possible.
- If the antenna is to be mounted on a building then it must be mounted on the roof.
- As with all fixed site antenna installations, it is the responsibility of the licensee to manage the site in accordance with applicable regulatory requirements and may require additional compliance actions such as site survey measurements, signage, and site access restrictions in order to insure that exposure limits are not exceeded.

Accessories

Motorola offers several accessories to increase communications efficiency. Many of the accessories available are listed below, but for a complete list, consult your Motorola dealer.

Repeater Housing & Control Panel

HKLN4056	CDR700 Desktop Repeater (North America)
HKLN4060	CDR500 Wall Mount Repeater Housing (North America)
HK1008	CDR 700 Desktop Repeater w/ Euro line cord
HK1009	CDR 700 Desktop Repeater w/ UK line cord
HK1010	CDR 700 Desktop Repeater w/ Argentina line cord
HK1011	CDR 700 Desktop Repeater w/ US line cord
HK1012	CDR 500 Wall Mount Repeater w/ Euro line cord
HK1013	CDR 500 Wall Mount Repeater w/ UK line cord
HK1014	CDR 500 Wall Mount Repeater w/ Argentina line cord
HK1015	CDR 500 Wall Mount Repeater w/ US line cord
RLN4801	Professional Series Remote Mount (Control Head A)
RLN4802	Professional Remote Mount (Control Heads B and C)

Controller Modules

HLN3948	Basic Interface Controller
HLN9447	i20R Controller
HLN3104	SmarTrunk II Controller
HLN9119	ZR340 Controller
HLN8388	ZR310 Community Tone Panel
RLN4744	Zetron Model 42
RLN4746	Zetron Model 49 w/2-wire interconnect
RLN4747	Zetron Model 49 w/4-wire interconnect
RLN4684	Trident RAIDER Dispatch LTR
RLN4685	Trident MARAUDER Dispatch

Duplexer Modules

HFD8464	136-144 MHz, VHF
HFD8188	144-155 MHz, VHF
HFD8457	150-160 MHz, VHF
HFD8189	155-162 MHz, VHF
HFD8190	162-174 MHz, VHF
HFE8400	406-450 MHz, UHF
TDE7780	450-470 MHz, UHF (Factory Tuned)
RFE4000	450-470 MHz, UHF
HFE8401	470-490 MHz, UHF
HFE8454	490-512 MHz, UHF

Preselector Modules

HFD8463	136-144 MHz, VHF
HFD8461	144-160 MHz, VHF
HFD8462	160-174 MHz, VHF
HFE8458	406-440 MHz, UHF
HFE8459	440-474 MHz, UHF
HFE8460	474-512 MHz, UHF

Power Supplies

HPN9005	CDR500 Power Supply (North America)
HPN9033	CDR700 Power Supply (North America)
HKPN4000	CDR700 Power Supply (Latin America)
HKPN4001	CDR500 Power Supply (Latin America)
3085801L01	Power Supply Line Cord (Argentina)
3082933N09	Power Supply Line Cord (Euro)
3082933N13	Power Supply Line Cord (UK)

Accessories

C200 Desksets

L3144	Basic Extended Local Control Desk Set
L3145	Basic DC Remote Control Desk Set
L3146	Basic Tone Remote Control Desk Set w/4-Freq., w/intercom
L3147	Advanced Extended Local Control Desk Set w/RapidCall
L3148	Advanced DC Remote Control Desk Set w/4-Freq., w/RapidCall
L3149	Advanced Tone Remote Control Desk Set w/16-Freq., w/RapidCall
L3150	DC Remote Adapter w/F1/F2 & Service Manual
L3151	Tone Remote Adapter w/16-Freq. & Service Manual

External Speakers

HSN8145	7.5 Watt Speaker (8 Ohm)
RSN4001	13 Watt Speaker (4 Ohm)

Microphones

AARMN4025	Compact Touch Code Microphone w/ 7 ft. cord
AARMN4038	Heavy Duty Microphone
AAREX4617	Telephone Style Handset
HMN3000	Desk Microphone, black
HLN9573_R	Shorting Plug Kit for Microphone Jack

16-Pin Accessory in Repeater

HLN9457	16-Pin Accessory Kit
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Antennas

RDD4527	150-158 MHz, VHF 3 dB Gain
RDE4556	450-470 MHz, UHF 3.8 dB Gain

Cables

HKKN4000	Power Sense Cable
HKKN4001	External Duplexer RF Cables
HKKN4002	Internal Duplexer RF Cables
HKN9028	SmarTrunk II Cable
3080384F66	Controller to Controller Cable 3 ft. (for Trident RAIDER and MARAUDER)
3080384F67	Controller to Controller Cable 7 ft. (for Trident RAIDER and MARAUDER)

General Accessories

HLN9455	Battery Revert Kit (used with CDR700)
RRX4025	Type "N" Connector Coaxial In-line Arrestor
RRX4032	Tower Mount Hardware w/In-line Arrestor
ST788	1/2" Jacketed Heliac Coaxial Ground Clamps
ST853	7/8" Jacketed Heliac Coaxial Ground Clamps
RLN4264	120 V AC, 15 Amp Duplex Surge Protector
HLN9169	GR500 Wall and Rack Mounting Plate (used with CDR500)
HKLN4121	CDR700 Filler Plate

Manuals/Software

6881091C54	CDM750 Mobile Radio User Guide
6881091C55	CDM1250 Mobile Radio User Guide
6881091C56	CDM1550 Mobile Radio User Guide
6881091C57	PRO3100 Mobile Radio User Guide
6881091C58	PRO5100 Mobile Radio User Guide
6881091C59	PRO7100 Mobile Radio User Guide
6881091C62	CDM-Series Mobile Radio Basic Service Manual
6881091C63	CDM-Series Mobile Radio Detailed Service Manual
6881092C71	PRO-Series Mobile Radio Basic Service Manual (Eng)
6881092C72	PRO-Series Mobile Radio Basic Service Manual (Span)
6881092C73	PRO-Series Mobile Radio Basic Service Manual (Port)
6881091C63	PRO-Series Mobile Radio Detailed Service Manual (Eng)
6881092C75	PRO-Series Mobile Radio Detailed Service Manual (Span)
6881092C76	PRO-Series Mobile Radio Detailed Service Manual (Port)

HVN9025	CDM-Series CPS Programming
HVN9027	PRO-Series CPS Programming
6880904Z40	i20R Controller Service Manual
6880904Z55	i20R Controller RSS Manual
6880904Z64	ZR310 Controller Service and Programming Manual
6880905Z90	ZR340 Controller Service and Programming Manual
6880309G56	Zetron Model 42 User Manual
6880309G57	Zetron Model 49 User Manual
6880309G58	Zetron Multibase Programming Manual
6880309G46	Trident RAIDER Installation Manual
6880309G47	Trident MARAUDER Installation Manual

Service Aids

The following table lists service aids recommended for working on the CDR500 Wall Mount Repeater and CDR700 Desktop Repeater.

Motorola Part No.	Description	Application
HLN9214	Radio Interface Box	Enables communication between the radio and the computer's serial communications adapter.
HSN9412	RIB Power supply	Used to supply power to the RIB.
HKN9216	Computer Interface cable	Connects the computer's serial communications adapter to the RIB.
HKN9217	Program Test Cable	RIB to Radio Cable
HVN9025	CDM-Series CPS	Software on 3-1/2 in. diskettes.
HVN9027	PRO-Series CPS	Software on 3-1/2 in. diskettes.

Test Equipment

The following table lists test equipment required to service the CDR500 Wall Mount Repeater and CDR700 Desktop Repeater.

Motorola Model No.	Description	Characteristics	Application
R2200, R2400, or R2001	Service Monitor	This monitor will substitute for items with an asterisk *	Frequency/deviation meter and signal generator for wide-range troubleshooting and alignment
*R1049	Digital Multimeter		Two meters recommended for ac/dc voltage and current measurements
*S1100	Audio Oscillator	67 to 200 Hz tones	Used with service monitor for injection of PL tones
*S1053, *SKN6009, *SKN6001	AC Voltmeter, Power Cable for meter, Test leads for meter	1mV to 300V, 10-Megohm input impedance	Audio voltage measurements
R1053	Dual-trace Oscilloscope	20 MHz bandwidth, 5mV/cm - 20V/cm	Waveform measurements
*S1350, *ST1215 (VHF) *ST1223 (UHF) *T1013	Wattmeter, Plug-in Elements (VHF & UHF), RF Dummy Load	50 Ohm, $\pm 5\%$ accuracy, 1-0 Watts, maximum 0-1000 MHz, 300 Watts	Transmitter power output measurements
S1339	RF Millivolt Meter	100uV to 3V RF, 10 kHz to 1.2 GHz	RF level measurements
*R1013	SINAD Meter		Receiver sensitivity
S1347 or S1348 (prog)	DC Power Supply	0-20 Vdc, 0-5 Amps	Bench supply for 12.5 Vdc

Section 1

Introduction to Repeaters and Components

Overview

This section introduces you to the CDR500 and CDR700 Repeater Stations; outlines the major components; physical appearance; accessories; general information about duplexers, cables, and antenna spacing; and basic assembly of the repeater station.

Repeater Stations

The CDR500 and CDR700 Repeater Stations are unique products which provide low cost communications systems. These repeaters are unique because they are designed to use off-the-shelf mobile radios for the transmitter and receiver. This design provides additional benefits of quick repair and minimizing inventory. In the CDR500 and CDR700 repeaters, all of the necessary components (interface options and mobile radios) are built into one cabinet. Both repeater housings allow space for two mobile radios, one or two (CDR500 only) repeater controllers, the power supply, a duplexer, and a preselector (CDR500 only).

A few features that distinguish the CDR500 Wall Mount Repeater:

- **Mounting**
The CDR500 repeater is a wall-mount unit.
- **Space for Repeater Interface Options**
The CDR500 repeater cabinet has space for **two** repeater interface options.
- **Fan**
The CDR500 repeater has a single speed (2800 rpm, 100 cfm) fan.
- **Power Supply**
The CDR500 has a 15 Ampere, 50% duty cycle (20 minutes ON/20 minutes Standby) linear power supply with battery revert operation.
- **Duplexer and Preselector**
The CDR500 provides spaces for mounting a duplexer and a preselector inside the repeater housing.

A few features that distinguish the CDR700 Desktop Repeater:

- **Portability**
The CDR700 repeater is a portable, desktop unit.
- **Fan**
The CDR700 repeater has a single speed (1900 rpm, 70 cfm), thermal switch controlled fan.
- **Power Supply**
The CDR700 has a 15 Ampere, continuous duty switch mode power supply.
- **Duplexer or Preselector**
The CDR700 provides a mounting location for either a duplexer or a preselector inside the repeater housing.

Repeater Controllers

The following repeater controllers are available for use with the CDR500 and CDR700 Repeater Stations:

- Basic Controller (identical to R*I*C*K)
- Multiple Tone Community Repeater Controller (ZR310)
- On-Site Repeater Controller (i20R)
- Advanced Interconnect Controller (ZR340)
- Digital Trunking Controller (SmarTrunk II ST-853M)
- LTR[®] Compatible Controller (Zetron Model 42)
- LTR Compatible Controller with Telephone Interconnect (Zetron Model 49)
- Multiple Tone and LTR Compatible Controller (Trident RAIDER)
- Multiple Tone and LTR Compatible Controller with Telephone Interconnect (Trident MARAUDER)

Mobile Radio Compatibility

Table 1-1 lists these components and the basic functions of the CDR500 and CDR700 repeaters when combined with each component.

Table 1-1. Repeater Function With Components

Component	Repeater Function
Basic	Single-User Repeater
ZR310	Community Repeater (for up to 70 groups)
i20R	Multiple-Tone Panel (up to 10 groups)
ZR340	Advanced Interconnect
SmarTrunk ST-853M	Digital Trunking
Zetron Model 42	LTR Trunking
Zetron Model 49	LTR Trunking w/Interconnect
Trident RAIDER	Multiple Tone & LTR Trunking
Trident MARAUDER	Multiple Tone & LTR Trunking w/Interconnect

Each repeater interface component has its own manual. The manuals are listed in Table 1-2.

Table 1-2. Documentation for Components

Component	Service Manual	Software Manual
Basic	6864110R66	
ZR310	6880904Z64	
i20R	6880904Z40	6880904Z55
ZR340	6880905Z90	
SmarTrunk	6880905Z59	
Zetron 42		6880309G58
Zetron 49		6880309G58
Trident RAIDER	6880309G46	
Trident MARAUDER	6880309G47	

Mobile Radio Compatibility

The CDM750, CDM1250, CDM1550, PRO3100, PRO5100, and PRO7100 mobile radios may be used with the controllers.

Physical Description

The following paragraphs describe the physical characteristics of the CDR500 and CDR700 Repeater Stations:

- CDR500 Repeater Housing
- CDR700 Repeater Housing
- CDR500 Repeater Fan Assembly
- CDR700 Repeater Fan Assembly
- CDR500 Repeater Power Supply
- CDR700 Repeater Power Supply
- Repeater Controllers
- Receive and Transmit Radios
- Duplexer
- Preselector

Table 1-9 and Table 1-10 show the physical dimensions and weight of these units. Figure 1-1 shows a completely assembled CDR500 repeater using a Basic repeater controller. Figure 1-2 shows a completely assembled CDR700 repeater using a Basic repeater controller.

CDR500 Repeater Housing

The CDR500 repeater housing provides mounting for the units that make up a customer's individually tailored wall-mounted repeater station. The CDR500 repeater is shipped from the factory with the fan assembly and the power supply already installed in the repeater housing. To ensure proper orientation when the CDR500 repeater is mounted on the wall, the repeater components (radios and controllers) should be assembled upside-down.

CDR700 Repeater Housing

The CDR700 repeater housing provides mounting for the units that make up a customer's individually tailored, free-standing repeater station. The CDR700 repeater is shipped from the factory with the fan assembly and the power supply already installed in the repeater housing. Before you can assemble the CDR700 repeater, the housing must be partially disassembled as described in Section 3 of this manual.

CDR500 Repeater Fan Assembly

A fixed-speed (2800 rpm), continuously operating 12 Vdc fan is provided for cooling the assembled CDR500 repeater. The fan operates at an air flow rate of approximately 100 cfm.

CDR700 Repeater Fan Assembly

The fixed-speed (1900 rpm) 12 Vdc fan assembly is mounted onto the rear wall of the CDR700 repeater housing chassis. It keeps the equipment from overheating and causing malfunctions. A thermal switch from the power supply is connected to the heatsink on the underside of the transmit radio and monitors the temperature of the radio. The fan turns on when necessary.

CDR500 Power Supply

The CDR500 repeater's power supply HPN9005 or HKPN4001 operates from a 115/230 V ac operates from a (switch selectable) power source. The power supply provides power to the fan assembly, both radios, and up to two repeater controllers. Battery backup/revert with trickle charging is a standard feature of the CDR500 repeater's power supply. The power supply has three connectors:

- one inside the CDR500 repeater, which connects power to the radios (the controllers obtain power from one or both of the radios), and the fan
- one outside the CDR500 repeater, which connects to an external battery
- one IEC ac receptacle for various line cords (US standard, 3-prong 115 V ac cord provided).

CDR700 Repeater Power Supply

The CDR700 repeater operates using voltages generated by the HPN9033 or HKPN4000 power supply. The power supply operates from a 115/230 Vac (switch selected) power source. The power supply provides power for the fan assembly and both radios. The power to the repeater interface component is obtained from one of the radios. To secure the power supply to the housing, mounting screw holes are located on each side of the power supply. The power supply has three connectors:

- one pigtail with a 2-prong “Ford” connector to mate with the Y-split power cable (30-85859M01) to power the radios.
- one pigtail with a 6-position connector to power the fan.
- one IEC ac receptacle for various line cords (U.S. standard, 3-prong, 115 Vac cord provided).

A slide switch on the power supply allows thermal control or continuous ON fan operation.

Repeater Controllers

Except for the Basic Controller, the other repeater controllers appear almost identical. They each have mounting screw holes on each side with which to secure them to the CDR500 or CDR700 repeater housings. The Basic Controller, because of its smaller size, cannot be directly installed into either repeater housing. Instead, it comes mounted on a tray which is placed into the repeater housing. The Basic Controller is supplied with a masking shroud for use in the CDR700 repeater. The shroud is not needed in the CDR500 repeater.

Connectors for cabling between the radios and the repeater controller(s) are located on the back of each component. Operating power for the interface components is obtained from one or both of the radios. LEDs, **Set-Up** controls, and a **Programming** modular jack (where applicable) are located on the front of the repeater controllers.

Receive and Transmit Radios

Any of the Professional Series radios may be used to assemble a mobile radio based repeater.

NOTE

In the United States of America, the Federal Communications Commission (FCC) requires a frequency stability of ± 1.5 -ppm for 12.5 kHz repeaters at UHF (450-512 MHz). Contact Motorola Customer Resources Technical Support for a possible solution.

The Professional Series radios have a mounting screw hole on each side in which to secure the radios to the CDR500 or CDR700 repeater housing. Connectors for interconnecting the radios between the duplexer and the corresponding repeater controller(s) are located at the back. Controls, indicators, and the microphone connector are located on the front panel. A top cover provides entrance into the radios for maintenance. You should not remove this cover except for maintenance purposes.

Duplexer (optional)

The duplexer allows the Professional Series radios to operate simultaneously in the same frequency band with a single antenna and transmission line. Without the duplexer installed in the CDR500 or CDR700 repeater, it would be necessary to use two antennas spaced apart, with one connected to the receive radio and the other to the transmit radio. The duplexer mounts inside the repeater housing. The position of the mounting holes can vary, depending upon the type of duplexer used. RF connectors are on the rear of the duplexer, and tuning adjustments are on the front.

Preselector (optional)

The preselector is a filter that allows a relatively narrow range of frequencies to pass through to the receiver while rejecting all other frequencies. In locations of high RF congestion, the preselector can reduce interference from intermodulation, desensitization, and spurious responses. The preselector is placed in Series with the input of the receive radio from the duplexer or a separate receive antenna. The preselector may be tuned before mounting into the CDR500 or CDR700 repeater housing.

NOTE

The internal space of the CDR700 repeater allows mounting of a duplexer OR a preselector, but not both.

Accessories

Many of the Professional Series radio accessories are compatible with the CDR500 and CDR700 repeaters. However, some of the accessories which plug into the radio style accessory connector are not compatible, because some of the functions needed are not available. Table 1-3 shows compatibility for the audio and DTMF

Table 1-3. Accessory Compatibility (Audio & DTMF)

Repeater Controller									Part No.	Accessory
SmaTrunk	Zetron 42	Zetron 49	Trident RAIDER	Trident Marauder	i20R	Basic	ZR310	ZR340		
					X	X	X	X	L3144, L3147	Local Desksets
					X	X	X	X	L3150	DC Remote Adapter
					X	X	X	X	L3151	Tone Remote Adapter
X	X	X	X	X	X	X	X	X	HMN3000_	Desk Microphone
X	X	X	X	X	X	X	X	X	AARMN4026, 4038	Enhanced Keypad and Heavy Duty Microphones
X	X	X	X	X	X	X	X	X	AAREX4617	Telephone Style Handset

Table 1-4. Accessory Compatibility (General)

CDR500 Repeater	CDR700 Repeater	Part No.	Accessory
X	X	HSN8145	7.5 Watt External Speaker
X	X	RSN4001	13 Watt External Speaker
X		HLN9169	CDR500 Wall & 19" Panel Mount
	X	HLN9455	CDR700 Battery Revert/Float Maintenance Charger

accessories with each repeater controller. Table 1-4 shows general compatibility for the other accessories available with the CDR500 and CDR700 repeaters. Additional accessories may be compatible if custom programming is done on the CPS and/or accessory cables are modified.

Duplexers, Cables, and Antenna Spacing

Duplexers

The duplexer “isolates” the receive radio from the transmit radio in the CDR500 or CDR700 repeater. Without this isolation, the ability of the receive radio to detect weak signals would be severely degraded by the output signal of the transmit radio. Isolation may also be obtained by using separate antennas with proper spacing (distance) between the antennas. Less vertical spacing is needed for a given isolation of land mobile antennas than may be obtained easily with horizontal spacing.

There are two basic types of duplexers:

- bandpass
- bandreject

The bandpass duplexer has two filters connected together such that each filter will “pass” or appear transparent to, a narrow segment of frequencies; the filters are tuned to different frequencies. Any signal within the segment is transferred from or to the

antenna while frequencies outside of the segment are “blocked.”

The bandreject duplexer has two filters connected together such that each filter rejects, or “blocks,” a narrow segment of frequencies. Again, the filters are tuned to different frequencies but any signal outside of the segment is transferred from or to the antenna while frequencies within the segment are “blocked.”

The choice of which duplexer configuration to purchase may be dictated by the particular application. If several repeaters and a CDR500 or CDR700 repeater are to operate at a given location, the bandpass duplexer might provide additional rejection to the signals from the other radios.

Basic Specifications

The basic specifications for a VHF or a UHF duplexer are:

- Impedance: 50 ohms
- Isolation: 70 dB minimum

Instead of the term “isolation,” the manufacturer of the duplexer may use the terms “Receiver (or Rx) Isolation at the Transmitter Frequency” and “Transmitter (or Tx) Noise Suppression at the Receiver Frequency.”

- Power handling: 50 Watts minimum

Power handling may be called “Continuous Power Input” by the manufacturer. If a Lowband repeater is being assembled with the low band Professional

Series radios, the power handling capability would have to be increased to 100 Watts.

- Insertion loss: 3 dB maximum

Less insertion loss of the duplexer means the receive radio will be able to discern weaker signals and the transmit radio will deliver more power output to the antenna. The 3 dB specification will result in coverage range being reduced approximately 30%. Typical insertion losses quoted in catalog sheets are 1.5 dB.

- Frequency spacing: Band dependent

Frequency spacing” is the frequency difference between the operating frequencies of the receiver and the transmitter. Frequency spacing less than 3 MHz can be achieved but the physical size of the duplexer increases dramatically. If a VHF repeater is being assembled, be aware of the minimum frequency spacing that a duplexer can provide when choosing the operating frequencies for the repeater. The VHF duplexers available from Motorola stock are specified at 4.5 MHz minimum spacing. In the United States, the spacing in the 450 MHz to 470 MHz UHF band is 5 MHz and the spacing in the 470 MHz to 512 MHz band is 3 MHz.

If the proper equipment necessary to tune a duplexer is not available, then the duplexer must be pretuned by the manufacturer. Be ready to provide the exact receiver and transmitter frequencies at the time of purchase. Also indicate that the duplexer will be used in a CDR500 or CDR700 repeater.

- Connector type-N

The type BNC connector may be used on the receiver and transmitter inputs but must be avoided for the antenna. The BNC is prone to mechanical movement which can generate noise when the transmitter is operating. Type UHF connectors will suffice for VHF but should be avoided for UHF. The mini-UHF connector, if available for the duplexer, is very good. Other connectors, such as the SMA and the TNC, are very good but may be more expensive, fragile and rather difficult to assemble in the field. The best general performance comes from the type-N.

The cables provided with the CDR500 and CDR700 repeaters mate with a type-N at the duplexer end. Any other type of connector will require you to assemble cables.

Cables

The coaxial cables that connect the radios to the duplexer are fabricated from RG58A/U (the cable that is used with most of the mobile antenna kits). Since RG58A/U does not have a perfect shield, the routing of

the cables should allow a physical separation of approximately 1 inch.

Do not use RG58A/U as the coaxial cable that connects the antenna connector of the repeater to the antenna. The rather small size of RG58A/U can introduce excessive losses in the system that will decrease the effective range of the repeater.

Substitute RG400/U for short lengths and RG214/U or 1/2-inch “hardline” for the longer lengths. If the “hardline” is used, connect the antenna connector of the repeater to the end of the “hardline” with a flexible jumper cable. This will avoid undue stress on the connectors of the cables and the repeater.

In planning a system, make sure that the various connectors found on the duplexer, feedlines, feedline jumpers and antenna are the correct mating pairs.

Table 1-5 can be used to determine which feedline to choose for a given frequency band and line length to maintain 1.5 dB (approximately 30%) or less power loss. Table 1-6 is a list of Motorola part numbers for the various connectors and cables.

Table 1-5. Maximum Feedline Length in Feet (Meters)

Band	RG400/U	RG214/U	Hardline
Low (50 MHz)	55 (17)	100 (30)	300 (90)
VHF (150 MHz)	25 (7.5)	50 (15)	150 (45)
UHF (450 MHz)	15 (4.5)	25 (7.5)	90 (27)
800 MHz	10 (3)	20 (6)	70 (21)

Table 1-6. Part Numbers for Connectors/Cables

Part	Motorola Part Number
mini-UHF male connector	2884606M01
UHF male connector	2884579F04
type-N male connector	2884476G01
type-N 1/2” hardline male	TDN6677
type-N 1/2” hardline female	TDN6678
RG58A/U coaxial cable	3000475378
RG400/U coaxial cable	3084173E01
RG214/U coaxial cable	3015068A17
1/2” hardline cable	3080329A22
8 ft. jumper cable	TDN8406A*
type-N f-f adapter	5882764A01*

*Use of the type-N f-f adapter may be required to connect the jumper cable to the main feedline.

Antenna Spacing

Isolation between the output from the transmitter and the input to the receiver may be obtained with physical distance. Instead of using a duplexer, two antennas may be spaced apart and connected to the receive radio and

Preventive Maintenance

the transmit radio with separate transmission lines. The separation necessary to yield the desired 70 dB of isolation is dependent upon the frequency band of operation. It is obvious from the following charts that, for all vertically polarized antennas in use for land mobile services, vertical spacing will get the 70 dB more easily than horizontal spacing. The horizontal spacing may be reduced if buildings, hills, or mountains are present between the antennas; the amount of reduction has to be determined by experiment. Table 1-7 shows the vertical spacing and Table 1-8 shows the horizontal spacing.

NOTE

The losses associated with long transmission lines have not been included in the calculations of the spacings. It is readily apparent that horizontal spacing of antennas is somewhat useless; the cost of the transmission lines to the two antennas would be greater than the cost of a duplexer.

NOTE

The two antennas will couple to a common metallic support; the position of one of the antennas may have to be varied to attain the desired isolation.

NOTE

The following tables contain spacing information for vertically polarized antennas used in land mobile services.

Table 1-7. Vertical Spacing

Frequency (MHz)	Spacing	
	feet	meters
30	295	90
40	220	68
50	177	54
150	59	18
170	52	16
400	22	7
470	20	6

Table 1-8. Horizontal Spacing

Frequency (MHz)	Spacing	
	feet	meters
30	12,800	3,900
150	2,600	780
400	960	293

Preventive Maintenance

Preventive maintenance of the CDR500 and CDR700 repeaters consist of:

- visual inspection
- periodic cleaning

Visual Inspection

Check that external surfaces of the equipment are clean, that connecting cables are not damaged, and that connections are firm. A detailed inspection of the interior electronic circuitry is not needed or desired.

Periodic Cleaning

Periodically clean smudges and grime from the exterior housing. Use a soft, non-abrasive cloth moistened in a mild soap and water solution. Rinse the surface using a second cloth moistened in clean water, and clean any dirt or debris from the fan grill.

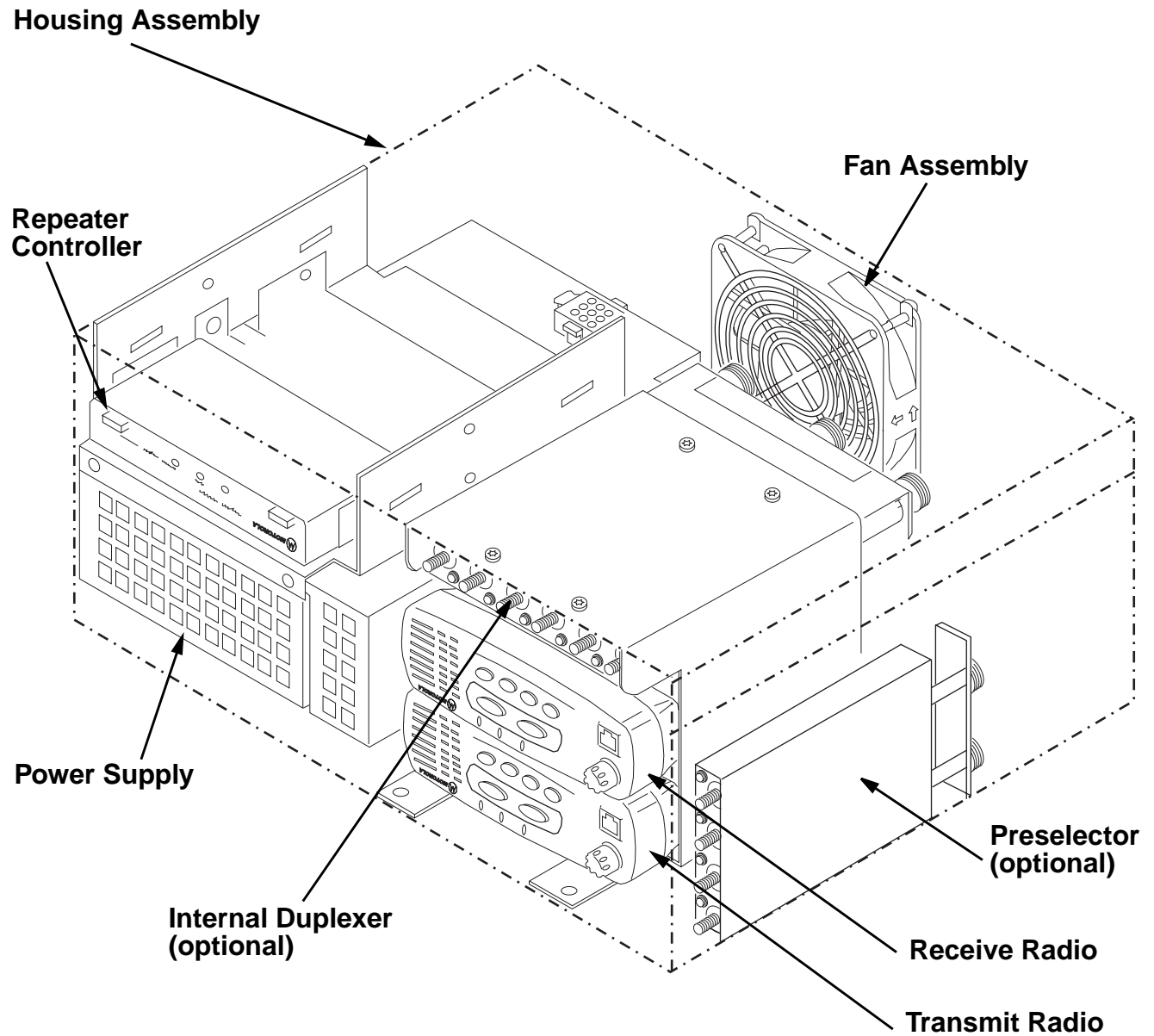


Figure 1-1. CDR500 Wall Mount Repeater Station (before mounting)

Table 1-9. CDR500 Repeater Equipment Physical Characteristics

Major Component/Assembly	Height	Width	Depth	Weight
CDR500 Repeater Station (includes the weights of all of the components)	7.4 in. (336 mm)	17.4 in. (790 mm)	13.5 in. (613 mm)	42.7 lbs. (19.37 kg)
Professional Series radios (each) (maximum dimensions)	2.83 in. (72 mm)	7.28 in. (185 mm)	7.87 in. (200 mm)	3.5 lbs. (1.59 kg)
Repeater Controllers (except Basic)	1.3 in. (34 mm)	7.1 in. (180 mm)	8.7 in. (221 mm)	1.7 lbs. (0.77 kg)
Basic Repeater Controller	1.3 in. (33 mm)	7.1 in. (180 mm)	6.7 in. (170 mm)	1.2 lbs. (0.54 kg)
Duplexer (maximum dimensions)	1.3 in. (33 mm)	6.3 in. (160 mm)	9.5 in. (241 mm)	3.5 lbs. (1.59 kg)
Power Supply	3.7 in. (168 mm)	4.3 in. (195 mm)	11.6 in. (527 mm)	12 lbs. (5.45 kg)
Fan Assembly	4.8 in. (218 mm)	4.8 in. (218 mm)	1.5 in. (68 mm)	1.3 lbs. (0.59 kg)

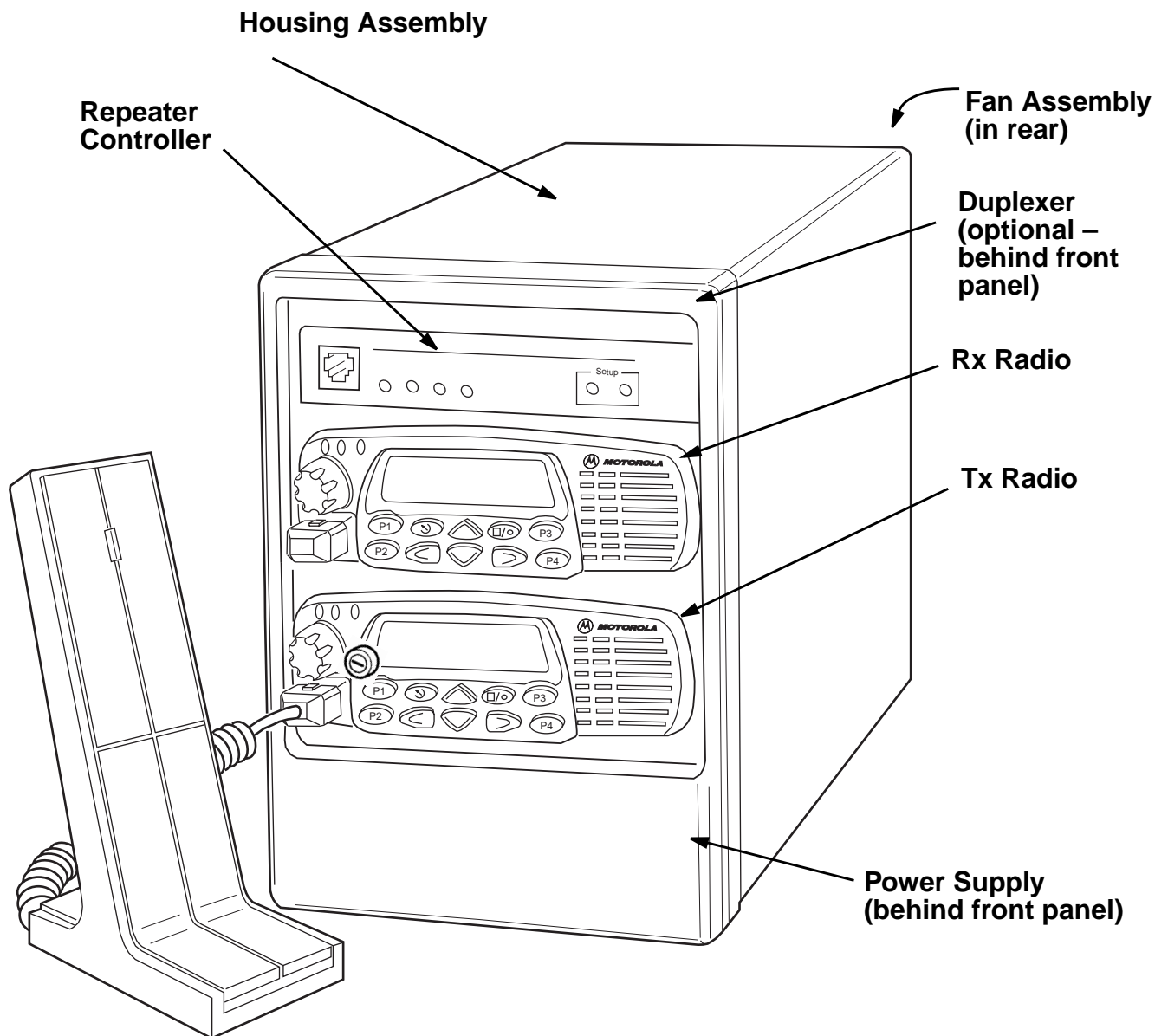


Figure 1-2. CDR700 Repeater Station

Table 1-10. CDR700 Repeater Equipment Physical Characteristics

Major Component/Assembly	Height	Width	Depth	Weight
CDR700 Repeater Station (includes the weights of all of the components)	12.2 in. (310 mm)	8.3 in. (211 mm)	12.5 in. (317 mm)	28 lbs. (12.84 kg)
Professional Series radios (each) (maximum dimensions)	2.83 in. (72 mm)	7.28 in. (185 mm)	7.87 in. (200 mm)	3.5 lbs. (1.59 kg)
Repeater Controllers (except Basic)	1.3 in. (33 mm)	7.1 in. (180 mm)	8.7 in. (221 mm)	1.7 lbs. (0.77 kg)
Basic Repeater Controller	1.3 in. (33 mm)	7.1 in. (180 mm)	6.7 in. (170 mm)	1.2 lbs. (0.54 kg)
Duplexer (maximum dimensions)	1.3 in. (33 mm)	6.3 in. (160 mm)	9.5 in. (241 mm)	3.5 lbs. (1.59 kg)
Power Supply	2.0 in. (51 mm)	7.0 in. (178 mm)	7.5 in. (191 mm)	3.1 lbs. (1.41 kg)
Fan Assembly	8.0 in. (142 mm)	7.4 in. (188 mm)	3.3 in. (84 mm)	2.1 lbs. (0.95 kg)

Section 2

CDR500 Wall Mount Repeater Station

Overview

This section contains information about the performance of the CDR500 Wall Mount Repeater Station, the basic assembly and disassembly. The steps for tuning the duplexer can be found in Section 5 of this manual.

Performance

The CDR500 repeater is not a high performance repeater, but it is designed to withstand constant use. It was designed and tested with the Professional Series mobile radios. The CDR500 repeater package is designed for fixed locations where protection from the elements (snow, rain, etc.) can be provided. The repeater station is intended for permanent wall or rack mounting. (The rack mounting requires the optional HLN9169 mounting plate).

The fan is single speed to provide maximum cooling at elevated ambient temperatures and during heavy transmit duty cycles. The station is defined as intermittent transmit duty cycle, but it may have a surprisingly lower power slump when keyed for long periods in an office or shop environment.

Provision has been made for mounting a receiver pre-selector (optional) inside the CDR500 repeater housing. The preselector increases the interference rejection of the receive radio to strong signals several MHz away from the desired receive channel.

Contents of the Kit

The CDR500 repeater kit contains two bags of hardware (Bags 1 and 2) for assembling your repeater.

The following is a checklist of the contents of Bag 1 and Bag 2 (with quantities listed in brackets):

Bag 1

- [8] M5 Torx Machine Screw, 8mm long (Blk) (Motorola Part Number 0310907B08)
- [2] Cable, 16-Pin (Motorola Part Number 3080577D02)
- [2] Tie Wraps, Nylon, 6"

Bag 2

- [1] ac Line Cord
- [1] Line Cord Clamp
- [1] Cover for Battery Terminal Block
- [2] Nuts and Lockwashers for Ground Lugs

HKKN4001 (Optional External Duplexer Cables)

- [2] Mini-UHF Plug to N Bulkhead RF Cables
- [2] Vinyl Caps

HKKN4002 (Optional Internal Duplexer Cables)

- [4] Tinnerman Nut Clips
- [4] 6 x 32 x 1/2 Machine Screw, Pan Head
- [2] Mini-UHF Plug to N Plug RF Cables
- [1] N Plug to N Bulkhead RF cable
- [4] Tie Wraps, Nylon
- [1] Vinyl Cap
- [1] Plastic D-hole Filler Plug

Additional Kits You May Require

In addition to the CDR500 repeater housing kit (HKLN4060), you may need some of the following units or optional kits.

Professional Series Transceiver

Almost any of the Professional Series radios may be used in the receive radio and transmit radio functions. This applies to both uni-directional and bi-directional repeater configurations. Be aware of any local regulatory requirements when choosing the model(s).

If a lowband repeater is being configured, it may be necessary to reduce the output power to remain within the 15 Ampere current rating of the HPN9005 or HKPN4001 Power Supply.

HKKN4000 Power Sense Cable

Adding ignition sense to the receive and transmit radios with the HKKN4000 Power Sense Cable and programming the radios for ignition sensing operation will ensure that the repeater automatically powers up whenever power is applied. This is particularly important if the repeater is mounted in a relatively inaccessible location.

Disassembling the CDR500 Repeater Housing

HKKN4001 External Duplexer Cable Kit

The two (2) RF cables in this kit provide connection between the mini-UHF RF antenna connectors on the Professional Series transceivers and type-N bulkhead female connectors that mount on the back panel of the CDR500 repeater housing. Use this kit if the repeater has separate transmit and receive antennas, a transmit combiner/receiver multi-coupler system or a duplexer that is not capable of being mounted inside the CDR500 repeater housing.

HKKN4002 Internal Duplexer Cable Kit

Two (2) of the three (3) RF cables in this kit provide connection between the mini-UHF RF antenna connectors on the Professional Series transceivers and the type-N connectors on the receiver and transmitter ports of an internally mounted duplexer. The third cable provides the connections between the type-N antenna connector of the duplexer and a type-N bulkhead female on the back panel of the CDR500 repeater housing.

Duplexer (internally mounted)

There are several duplexers available from Motorola that can be mounted inside the CDR500 repeater housing. The radio/duplexer bracket has the mounting hole pattern to accommodate these duplexers. Please note that the minimum transmit to receive frequency spacing is 4.5 MHz for VHF models and either 5 MHz (444-470 MHz) or 3 MHz (above 470 MHz) for the UHF models of the duplexers.

Preselector (Optional)

The preselector is a filter that allows a relatively narrow range of frequencies to pass through to the receiver while rejecting all other frequencies. In locations of high RF congestion, the preselector can reduce interference from intermodulation, desensitization and spurious responses. The preselector is placed in series with the input of the receive radio from the duplexer or a separate receive antenna. The preselector should be tuned before mounting into the CDR500 repeater housing.

Disassembling the CDR500 Repeater Housing

(Refer to Figure 2-2 on page 2-3)

NOTE

Unless specifically instructed otherwise, DO NOT discard any hardware removed during disassembly.

1. Turn the quarter-turn front cover fasteners counterclockwise to open the front cover.
2. Remove the bag(s) of hardware and cables from the housing.

3. With appropriate socket tools perform the following:
 - 3A. Remove the 8-32 nuts that secure the front of the radio/duplexer bracket in the CDR500 repeater housing.
 - 3B. Loosen, but do not entirely remove, the 8-32 nuts that secure the back of the radio/duplexer bracket (this is the end of the bracket with notched mounting tabs).
 - 3C. Remove the radio/duplexer bracket.
 - 3D. Remove the two 8-32 screws that secure the repeater controller bracket to the front of the power supply module.
 - 3E. Loosen, but do not entirely remove, the two 8-32 screws that secure the back of the repeater controller bracket to the top of the power supply module (this is the end of the bracket with notched mounting tabs).
 - 3F. Remove the repeater controller bracket.

Assembling the CDR500 Repeater Housing**Installing the Optional Duplexer RF Cables**

1. If you are installing the optional external duplexer RF cable kit, locate kit HKKN4001. Remove the two RF cables from the bag.
2. The short (10"/25.4cm) cable (30-80517U05) connects to the transmit radio.
3. The long (15"/38.1cm) cable (30-80517U10) connects to the receive radio.
4. If you are installing the optional internal duplexer RF cable kit, locate kit HKKN4002. Remove the three RF cables from the bag.
5. The cable with the type-N male and type-N female bulkhead cable connectors is the antenna cable from the internal duplexer.
6. The long (14"/35.6cm) type-N male to mini-UHF connector cable (30-80517U11) connects to the transmit radio.
7. The short (12"/30.5cm) type-N male to mini-UHF connector cable (30-80517U07) connects to the receive radio.

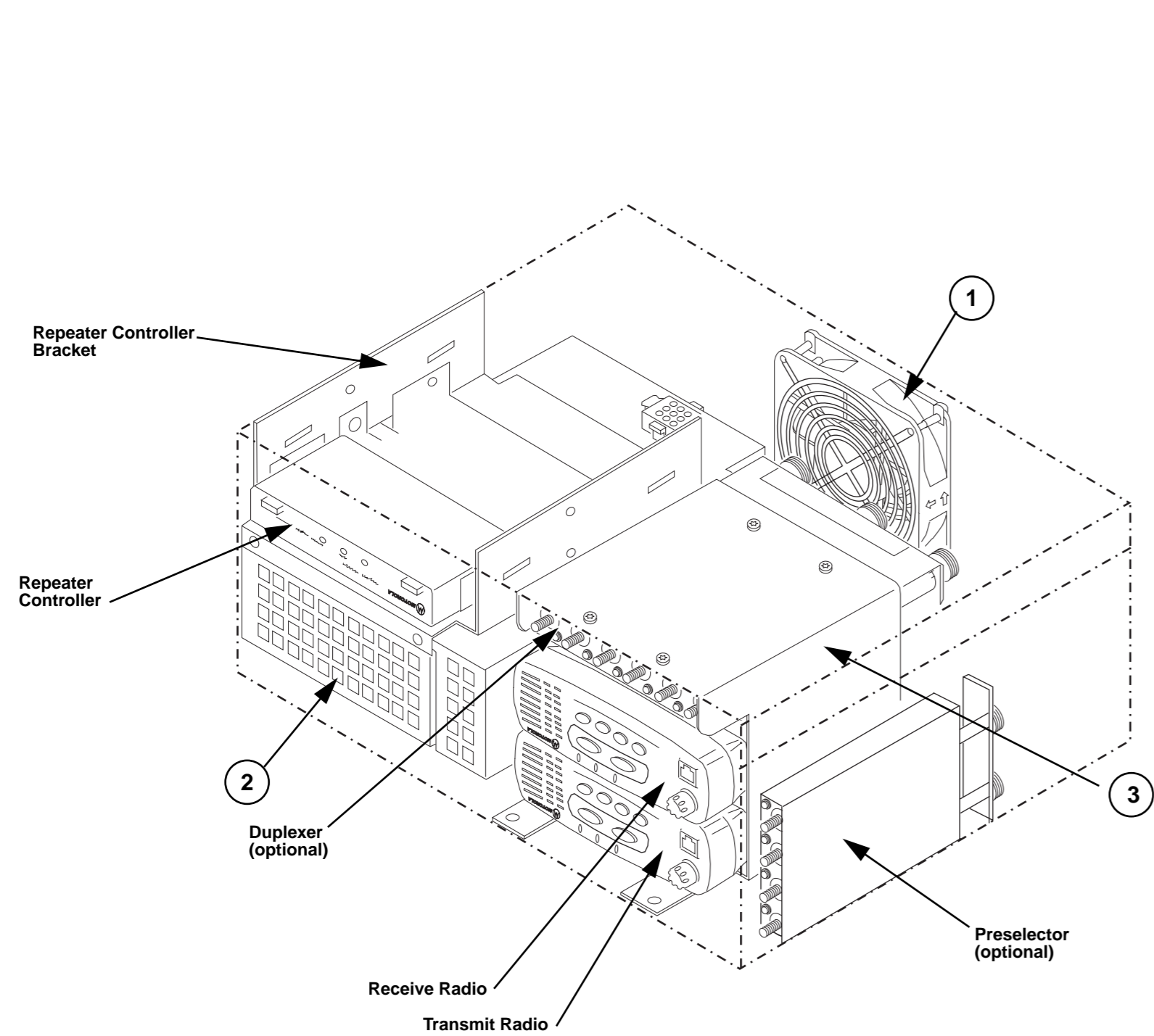


Figure 2-2. CDR500 Repeater Station (before wall mounting)
Front View Internal Parts

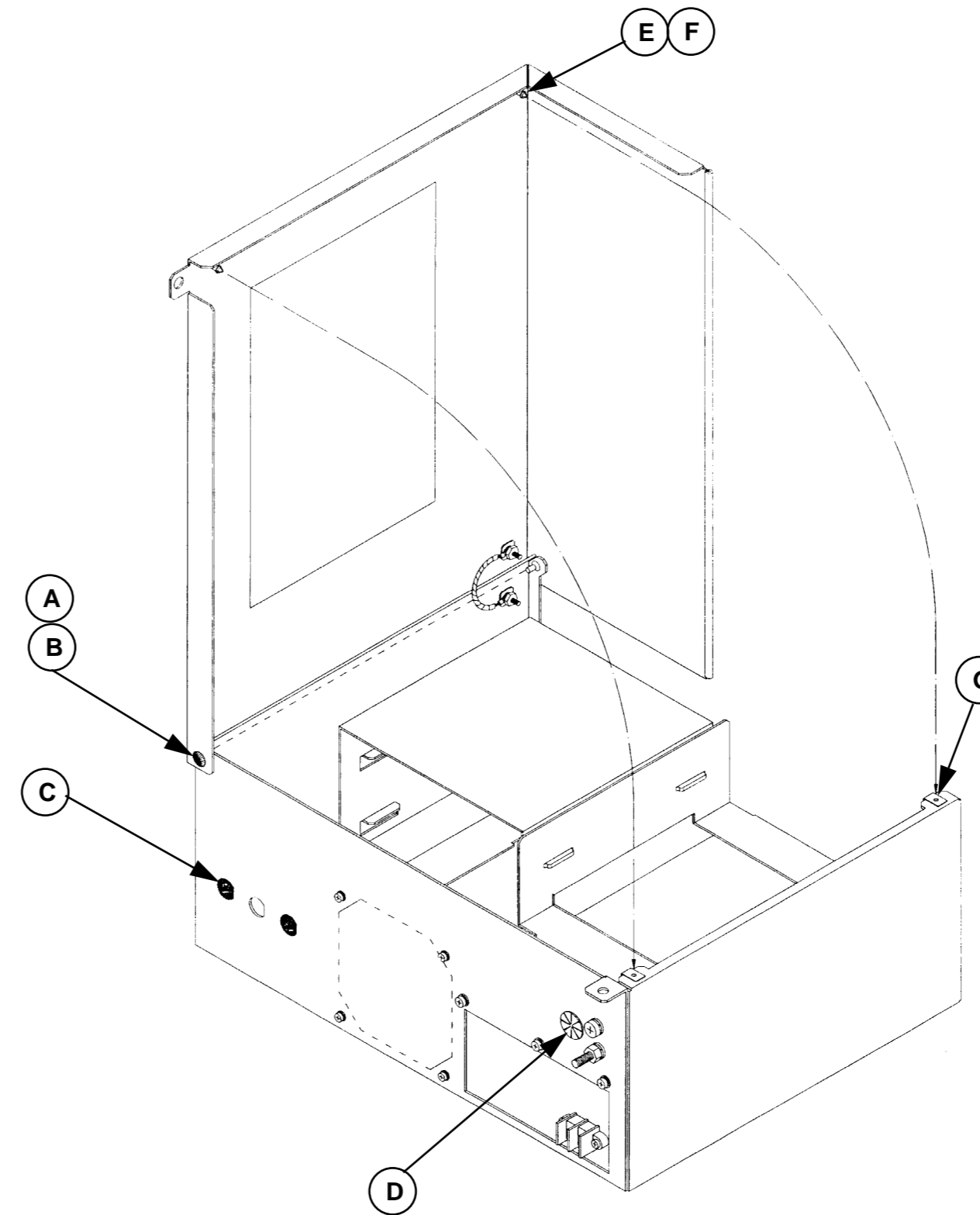


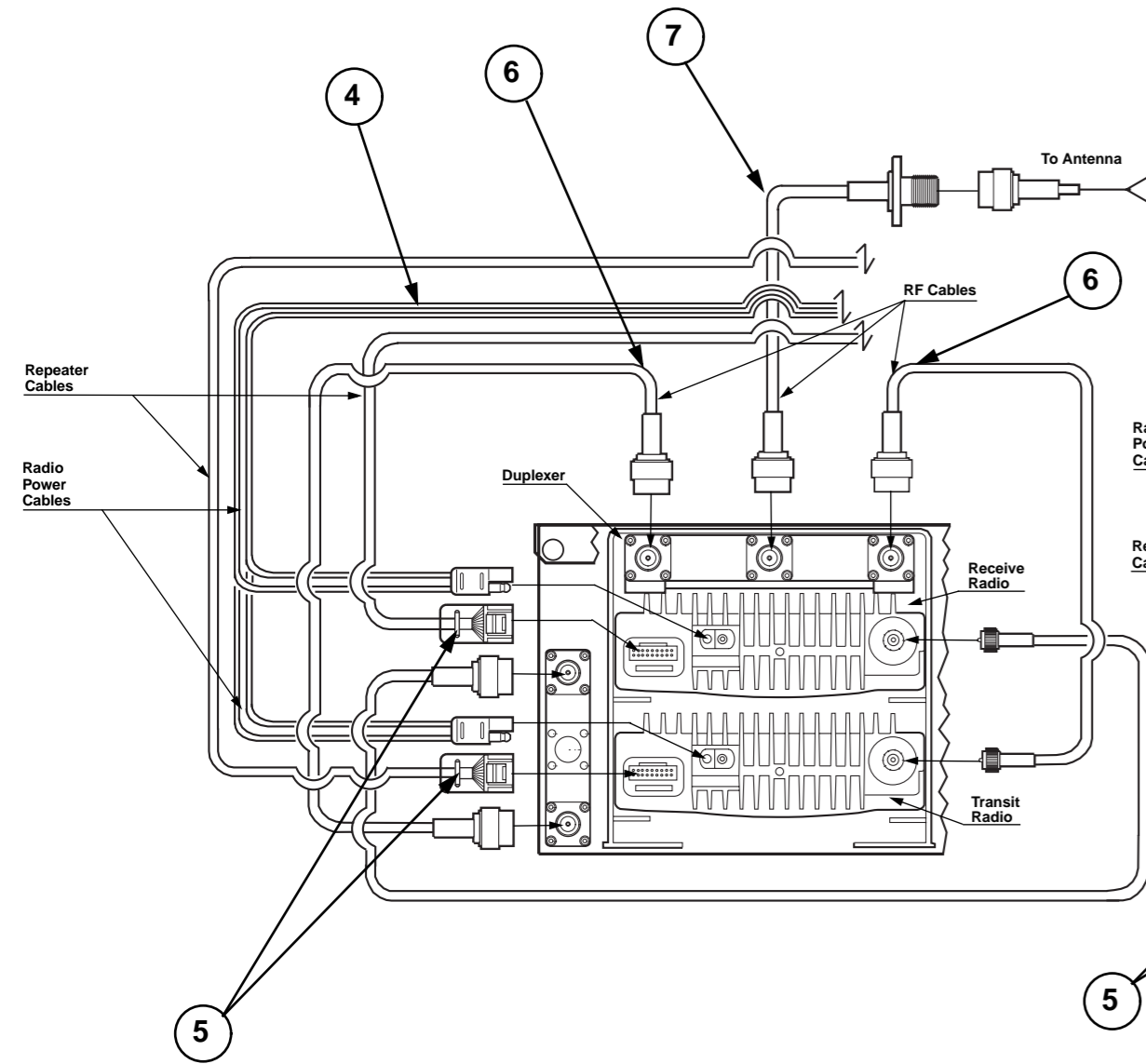
Figure 2-3. CDR500 Repeater Station, Rear Isometric View

Parts List

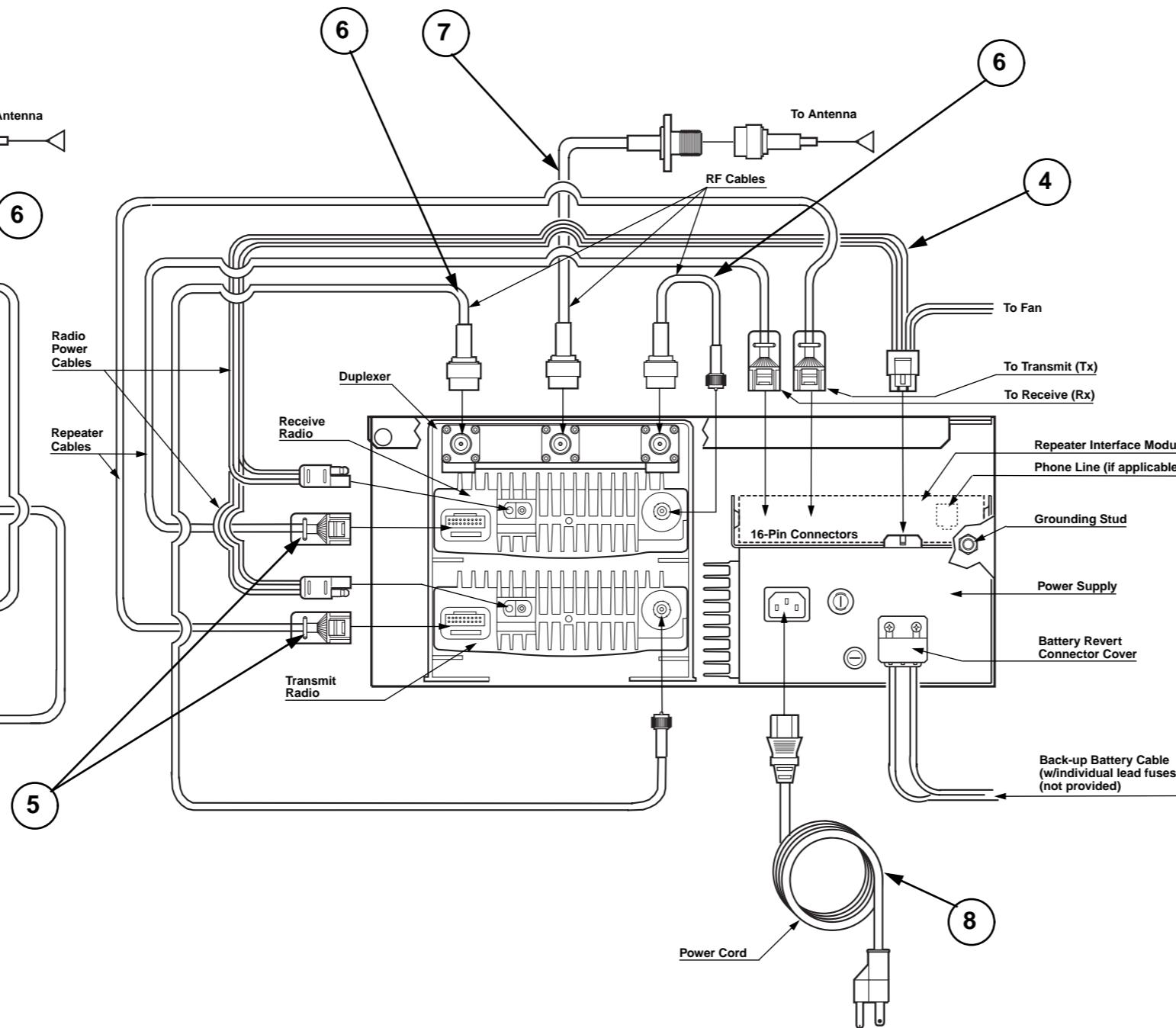
CDR500 Repeater Housing Kit HKLN4060/HKN1012/13/14/15
Replacement Parts List PL-201026-O

REFERENCE NO.	MOTOROLA PART NO.	DESCRIPTION
1	HLN9291	FAN w/mounting hardware
2	HPN9005	POWER SUPPLY w/mounting hardware and ac line cord (IEC to U.S. 115 V ac)
3	or HKPN4001 0785868M01	POWER SUPPLY w/mounting hardware wo ac line cord BRACKET, radio/duplexer; (also available in GR500 retrofit Kit HKLN4117)
4	3080577D01	POWER HARNESS, radios and fan to power supply
5	3080577D02	CABLE, 16-pin to 16-pin
6	---	CABLE, RF radio to duplexer (p/o HKKN4002)
7	---	CABLE, duplexer to antenna connector (p/o HKKN4002)
8	3082933N08	CORD, ac line (IEC to U.S. 115 V) (p/o HPN9005)
	or 3085801L01	CORD ac line (230 V) (p/o HKPN4001) Argentina
	or 3082933N09	CORD ac line (230 V) (p/o HKPN4001) Euro
	or 3082933N13	CORD ac line (230 V) (p/o HKPN4001) UK
	---	MISC. HARDWARE consists of:
A		RIVET, solid brazier head: 2 used
B		PUSH NUT for 3/16 stud; 2 used
C		PLUG, double "D" 0.625 dia.2 used
D		GROMMET, vane, snap universal 0.875 dia.; 1 used
E		FASTENER, 1/4 turn; 2 used
F		RETAINER, nylon 1/4 turn; 4 used
G		RECEPTACLE, 1/4 turn; 2 used
non-referenced items		
	0310907B08	SCREW, M5 x 0.8 x 8 Torx, panhead machine (black); 8 used
	HKKN4000	POWER SENSE CABLE KIT
	HKKN4001	EXTERNAL DUPLEXER CABLE KIT

Internal Duplexer w/Preselector Interconnect Cabling



Internal Duplexer Interconnect Cabling



Your configurations may vary from these shown above.

Parts List

CDR500 Repeater Housing Kit HKLN4060/HKN1012/13/14/15
Replacement Parts List

PL-201026-O

REFERENCE NO.	MOTOROLA PART NO.	DESCRIPTION
1	HLN9291	FAN w/mounting hardware
2	HPN9005	POWER SUPPLY w/mounting hardware and ac line cord (IEC to U.S. 115 V ac)
	or HKPN4001	POWER SUPPLY w/mounting hardware wo ac line cord
3	0785868M01	BRACKET, radio/duplexer; (also available in GR500 retrofit Kit HKLN4117)
4	3080577D01	POWER HARNESS, radios and fan to power supply
5	3080577D02	CABLE, 16-pin to 16-pin
6	---	CABLE, RF radio to duplexer (p/o HKKN4002)
7	---	CABLE, duplexer to antenna connector (p/o HKKN4002)
8	3082933N08	CORD, ac line (IEC to U.S. 115 V) (p/o HPN9005)
	or 3085801L01	CORD ac line (230 V) (p/o HKPN4001) Argentina
	or 3082933N09	CORD ac line (230 V) (p/o HKPN4001) Euro
	or 3082933N13	CORD ac line (230 V) (p/o HKPN4001) UK
	---	MISC. HARDWARE consists of:
A		RIVET, solid brazier head; 2 used
B		PUSH NUT for 3/16 stud; 2 used
C		PLUG, double "D" 0.625 dia.2 used
D		GROMMET, vane, snap universal 0.875 dia.; 1 used
E		FASTENER, 1/4 turn; 2 used
F		RETAINER, nylon 1/4 turn; 4 used
G		RECEPTACLE, 1/4 turn; 2 used
non-referenced items		
	0310907B08	SCREW, M5 x 0.8 x 8 Torx, panhead machine (black); 8 used
	HKKN4000	POWER SENSE CABLE KIT
	HKKN4001	EXTERNAL DUPLEXER CABLE KIT

Figure 2-4. CDR500 Interconnect Cabling Diagrams

Installing the Transmit Radio

IMPORTANT

Before installing the radios into the CDR500 Repeater Station connect the RF and repeater cables.

1. Place the radio/duplexer bracket on a flat surface with the open end down.
2. Remove the cover gasket from the accessory connector of the transmit radio.
3. Locate either the 30-80517U05 or 30-80517U11 cable (depending upon the duplexer option).
4. Connect the mini-UHF end of the cable to the antenna connector of the transmit radio. Refer to Figure 2-4 on page 2-4.
5. Connect one end of the first repeater cable to the accessory connector of the transmit radio.
6. Place the transmit radio, upside-down, at the bottom (open end) of the bracket. (The rear of the radio must be on the same end of the bracket that contains the slotted tabs for mounting the bracket into the CDR500 repeater housing.) Position the radio to align the holes of the radio with the M5 holes of the housing.
7. Attach the transmit radio to the bracket with two M5 x 0.8 x 8 T25 Torx, pan head, machine screws.

NOTE

DO NOT yet tighten the screws.

Installing the Receive Radio

1. Remove the cover gasket from the accessory connector of the receive radio.
2. Locate either the 30-80517U10 or 30-80517U07 cable (depending upon the duplexing option).
3. Connect the mini-UHF end of the cable to the antenna connector of the receive radio. Refer to Figure 2-4 on page 2-4.
4. Connect one end of the second repeater cable to the accessory connector of the receive radio.
5. Place the receive radio, upside-down, in the middle position of the bracket (directly above the transmit radio). Position the radio to align the mounting holes of the radio with the M5 holes of the bracket.
6. Attach the receive radio to the bracket with two M5 x 0.8 x 8 T25 Torx, pan head, machine screws.

NOTE

DO NOT yet tighten the screws.

Installing the Duplexer

NOTE

If an external duplexer is being used with the CDR500 repeater station, skip to the next section "Installing the Antenna Cable(s)".

1. Examine the duplexer that was ordered for the CDR500 repeater model being assembled. If four of the mounting holes contain Pennnuts (threaded inserts), proceed to Step 3. If no Pennnuts are present, continue with Step 2.
2. Using a pair of needle nose pliers, place Tinnerman clips from kit HKKN4002 over four of the mounting holes of the duplexer (refer to Figure 2-5).

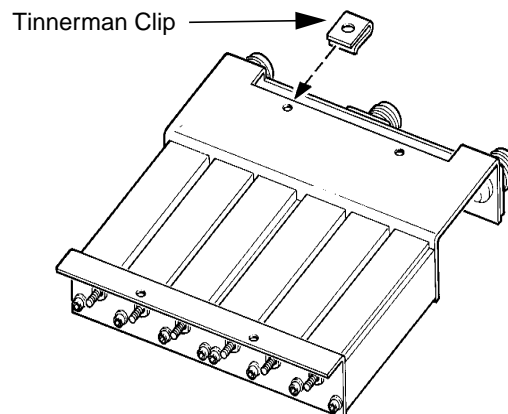


Figure 2-5. Duplexer, Bottom View

NOTE

The threaded side of each clip should be on the connector/tuning screw side of the duplexer.

3. Place the duplexer in the radio/duplexer bracket with the six tuning screws facing in the same direction as the front of the radios. The mounting holes of the duplexer must face upward.
4. Secure the duplexer to the bracket with the four 6-32 x 1/2" T15 Torx, pan head machine screws from kit HKKN4002.
5. Locate the type-N male and type-N female bulkhead cable in kit HKKN4002.

Assembling the CDR500 Repeater Housing

6. Connect the type-N male connector of the cable to the antenna connector of the internal duplexer. Refer to Figure 2-4 on page 2-4.
7. Connect the type-N end of the RF cable from the transmit radio to the appropriate port of the duplexer.
8. Connect the type-N end of the RF cable from the receive radio to the appropriate port of the duplexer.
9. Tighten all of the M5 machine screws to 1.58 N-m (14 in.-lbs.) torque. Tighten all of the 6-32 machine screws to 0.68 N-m (6 in.-lbs.) torque for the Tinnerman clips or 1.35 to 1.58 N-m (12 to 14 in.-lbs.) for Pennnuts.

Installing the Antenna Cable(s) and Radio Power Cables

1. Place the assembled radio/duplexer bracket module into the CDR500 repeater housing close enough to the back wall to allow connecting the duplexer antenna bulkhead connector(s) to the wall.
2. Remove the nut and lockwasher from the type-N female bulkhead connector of the antenna cable from the internal duplexer or from the transmit radio.
3. Align the flat side of the bulkhead connector with the straight side of the D-shaped hole in the back of the CDR500 repeater housing.
4. Push the connector, from the inside to the outside, through the CDR500 repeater housing.
5. Secure the bulkhead connector to the CDR500 repeater housing using the nut and lockwasher removed in Step 2, and torque to 2.25 N-m (20 in.-lbs.).
6. If the external duplexer cable kit, HKKN4001 is used, remove the hole plug from the outer of the two remaining D-shaped holes in the back wall. The hole plug may be discarded.
7. Repeat steps 2 through 5 to install the receive radio external duplexer antenna cable.
8. Locate the longer dc power cable, with the 2-prong "Ford" connector, from the power supply.
9. Plug the cable into the dc power connector of the (lower) transmit radio.
10. Plug the remaining dc power cable into the dc power connector of the (upper) receive radio.

Installing the Radio/Duplexer Bracket

1. Tilt the radio/duplexer bracket slightly upward at the front end and slide the rear notched mounting tabs on the radio/duplexer bracket under the 8-32 nuts of the threaded studs toward the back of the CDR500 repeater housing.
2. Press the radio/duplexer toward the back of the housing.

NOTE

Do not yet tighten the back mounting nuts to attach the radio/duplexer module to the CDR500 repeater housing.

3. Slide the front mounting tabs of the radio/duplexer bracket over the 8-32 studs. Reinstall the 8-32 nuts, removed in Step 3A under "Disassembling the CDR500 Repeater Housing" on page 2-2, on the studs and tighten to 1.80 to 2.00 N-m (16 to 18 in.-oz.) torque.
4. Tighten the back mounting 8-32 nuts to 1.80 to 2.00 N-m (16 to 18 in.-oz.) torque.

Installing the Repeater Controller

1. Place the repeater controller bracket on a flat surface with the open end up.

NOTE

If you are using the Basic Repeater Controller, before continuing:

- Remove it from its mounting tray and replace it, upside-down, in the tray for proper viewing when the CDR500 repeater is mounted.
 - Slide the tray up through the open area of the bracket and into position.
-

2. Slide the repeater controller module, upside-down, into the lower mounting position (nearest the power supply).
3. Attach the repeater controller to the bracket with two M5 x 0.8 x 8 T25 Torx, pan head, machine screws, and torque to 1.58 N-m (14 in.-lbs.).

Installing the Mounting Bracket for the Repeater Controller

1. Place the assembled repeater controller bracket into the CDR500 repeater housing on top of the power supply. Tilt the module slightly upward at the front end and slide the rear notched mounting tabs of the bracket

under the 8-32 screws toward the back of the power supply.

2. Press the bracket toward the back of the housing until the front of the bracket is against the front of the power supply.

NOTE

Do not yet tighten the back mounting screws to attach the repeater controller to the CDR500 repeater housing.

3. Using the two 8-32 screws removed in Step 3D under “Disassembling the CDR500 Repeater Housing” on page 2-2, secure the repeater controller bracket to the front of the power supply.
4. Tighten all four 8-32 screws to 1.58 to 1.80 N-m (14 to 16 in.-lbs.) torque.
5. Connect the repeater cable from the transmit radio to the transmit connector of the repeater controller.
6. Connect the repeater cable from the receive radio to the receive connector of the repeater controller.
7. Install the shorting plugs in the microphone jacks of both radios (or plug a microphone into the jack of the transmit radio, if desired).

Mounting the CDR500 Repeater

To mount the CDR500 repeater to a wall or other mounting surface, we recommend using the accessory mounting plate (HLN9169). If you use the accessory mounting plate to mount the CDR500 repeater, follow the directions included with it. If you do not use the mounting plate, refer to Figure 2-7 (not to scale) for the locations of the wall mounting holes for the CDR500 repeater.

CAUTION

The CDR500 repeater weighs approximately 50 pounds (22.7 kg) when assembled. Lifting improperly can cause injury.

Get help from a second person and use care when lifting the CDR500 repeater.

CAUTION

The CDR500 repeater weighs approximately 50 pounds (22.7 kg) when fully assembled, and can fall if not properly mounted.

Use proper hardware and mount the CDR500 repeater only to a structurally sound wall or mounting surface.

CAUTION

If the CDR500 repeater is mounted in an area of high vibration, incorrect mounting hardware can loosen.

To prevent loosening of the mounting hardware, use high strength fasteners and lockwashers to mount the CDR500 repeater.

CAUTION

A dirty or plugged fan grill (on the bottom of the mounted unit) can cause overheating or improper operation.

Clean dust and debris periodically from the grill, and allow sufficient air flow to the fan.

IMPORTANT

The CDR500 repeater is designed for indoor use.

Install in a location that is protected from the weather and outdoor environment.

IMPORTANT

To operate the CDR500 repeater, the antenna feed line, ac line cord, ground cable, (optional) phone lines, and (optional) battery cables must be connected to the bottom of the unit.

When mounting the CDR500 repeater, plan for cable access to the bottom of the unit.

Final Assembly

To operate the CDR500 repeater, you must connect all of the necessary cables and accessories to the bottom of the CDR500 repeater (refer to Figure 2-4 on page 2-4):

1. Attach a ground wire from an absolute earth ground to the 1/4" threaded grounding stud on the far right of the CDR500 repeater, using one of the lockwashers and nuts provided in Bag 2. Tighten to 2.25 to 3.38 N-m (20 to 30 in.-lbs.) torque.
2. Connect lightning arrestors.

CAUTION

Lightning can damage the CDR500 repeater and its components if the unit is not grounded properly.

For lightning protection, ground the CDR500 repeater to an absolute earth ground using at least #6 gauge copper wire, and use adequate lightning arrestors.

3. Connect the antenna lead(s) to the antenna connector(s) on the far left of the CDR500 repeater.

Repackaging

4. If necessary, feed phone line(s) through the vane grommet on the right side of the CDR500 repeater and connect to the repeater controller(s).
5. If you are using a repeater controller with a grounding wire, use the remaining lockwasher and nut provided in Bag 2 to connect the wire to the 1/4" threaded grounding stud on the **inside** of the CDR500 repeater housing. If no grounding wires are present, place the lockwasher and nut on the threaded stud. Tighten to 2.25 to 3.38 N-m (20 to 30 in.-lbs.) torque.

IMPORTANT

Before connecting the AC line cord into an AC mains outlet, ensure that the "115/230" V ac switch on the power supply is in the appropriate position. The switch is located on the power supply housing near the fan.

6. Connect the ac line cord to the CDR500 repeater, attach the retaining cable clamp and plug the other end of the cord into the AC main outlet.

CAUTION

A retaining cable clamp for the AC power cord is provided with your CDR500 repeater to keep the power cord plug in the connector.

To prevent accidental disconnection of the power cord, plug it into the CDR500 repeater and attach the retaining cable clamp to the CDR500 repeater housing with the center top mounting screw of the power supply before connecting the cord to an AC power source (refer to Figure 2-6).

7. If you are using a battery backup, refer to section Section 7 for further information. Otherwise install the battery connector shroud. Refer to Figure 2-6.

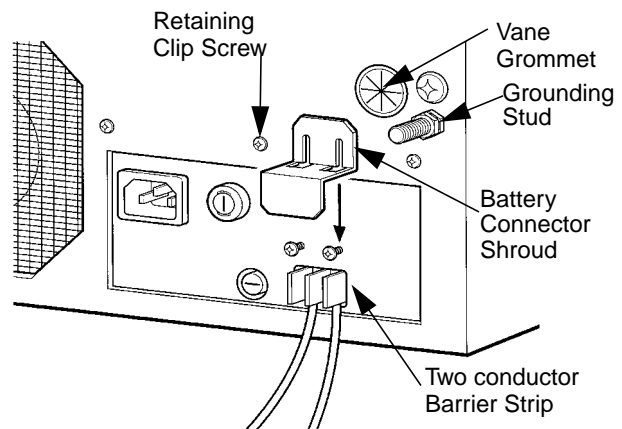


Figure 2-6. Placement of Battery Connector Shroud

Repackaging

The CDR500 Repeater Station's shipping box is recommended for reshipping. If it is necessary to repack the repeater as a built-up unit, follow these suggested steps to repack the unit in its original box.

CAUTION

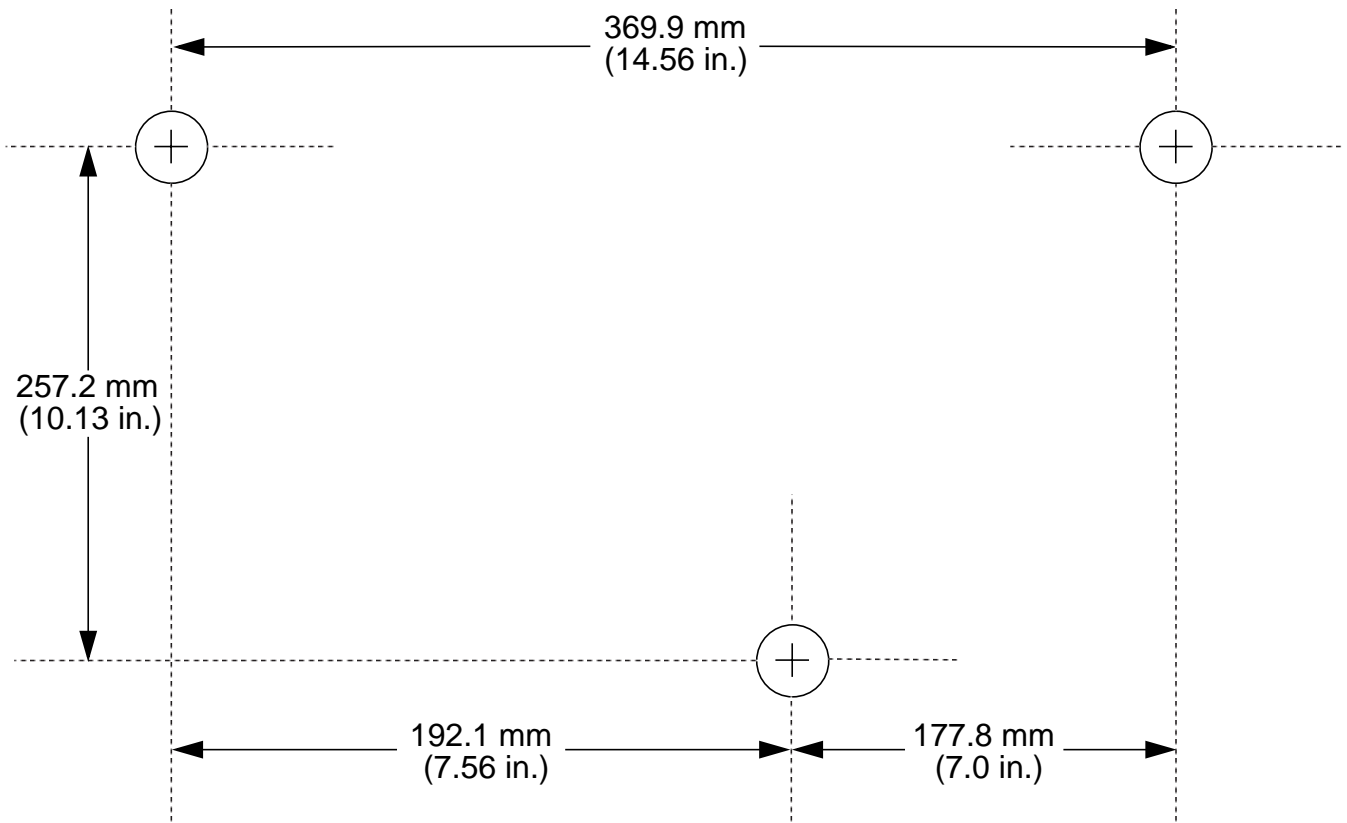
The CDR500 repeater shipping box may be used for reshipping a built-up unit. Please ship with extreme care.

CAUTION

Motorola, Inc. takes no responsibility for reshipping a built-up CDR500 repeater.

CAUTION

Extreme caution should be taken when reshipping an CDR500 repeater in its original box. A built-up CDR500 repeater could weigh approximately a maximum of 60 pounds (27.2 kg) when fully assembled and in its original box. Lifting improperly can cause injury. Get help from a second person and use care when lifting the repeater.

**NOTE:**

This drawing is **not** actual size and **not** to scale. You must make your own template from the measurements indicated.

Figure 2-7. Locations of Wall Mounting Holes for CDR500 (without Mounting Plate)

Repackaging

Section 3

CDR700 Desktop Repeater Station

Overview

This section contains information about the performance, basic disassembly and assembly of the CDR700 Desktop Repeater Station.

Performance

The CDR700 repeater is not a high performance repeater, but it is designed to withstand constant use. It was designed and tested with Professional Series mobile radios. The CDR700 repeater package is designed for fixed locations where protection from the elements (snow, rain, etc.) can be provided. The station is relatively light and portable.

The fan is controlled by a thermal switch connected to the power supply. This switching minimizes noise in office environments while providing maximum cooling at elevated ambient temperatures or during heavy transmit duty cycles. The station is defined as intermittent transmit duty cycle, but it may have a surprisingly lower power slump when keyed for long periods in an office or shop environment.

The Professional Series mobile radios may be programmed as “transmit only” as well as “receive only” mode of operation.

Contents of the CDR700 Desktop Repeater Kits

The following is a checklist of the contents of the kits used in assembling the CDR700 repeater. Some of these kits are optional for connecting an internal duplexer, or an external duplexer to the CDR700 repeater. The quantities are listed in [] brackets.

HKN4059 (Cable and Hardware)

- [6] M5 Torx® Machine Screw, 8mm long (Blk)
- [5] Tie Wraps, Nylon, 3-5/8”
- [2] 1/4-20 Nut
- [2] 1/4-20 External Lockwashers
- [1] 1/4-20 x 1-1/2” Screw, Phillips Head
- [1] Thermal Switch Clip
- [1] Open Bushing Insulator
- [2] Repeater Cables (30-80137S02)
- [1] Y-split Power Cable (30-85859M01)
- [1] AC Line Cord

HKKN4001 (Optional External Duplexer Cables)

- [2] Mini-UHF Plug to N Bulkhead RF Cables
- [2] Vinyl Caps

HKKN4002 (Optional Internal Duplexer Cables)

- [4] Tinnerman Nut Clips
- [4] 6 x 32 x 1/2 Machine Screw, Pan Head
- [2] Mini-UHF Plug to N Plug RF Cables
- [1] N Plug to N Bulkhead RF cable
- [4] Tie Wraps, Nylon
- [1] Vinyl Cap
- [1] Plastic D-hole Filler Plug

Additional Kits You May Require

In addition to the CDR700 repeater housing kit (HKLN4056), you may need some of the following units or optional kits.

Professional Series Transceiver

Almost any of the Professional Series radio may be used in the receive radio and transmit radio functions. This applies to both uni-directional and bi-directional repeater configurations. Be aware of any local regulatory requirements when choosing the model(s).

If a lowband repeater is being configured, it may be necessary to reduce the output power to remain within the 15 Ampere current rating of the HPN9033 Power Supply.

HKKN4000 Power Sense Cable

Adding ignition sense to the receive and transmit radios with the HKKN4000 Power Sense Cable and programming the radios for ignition sensing operation will ensure that the repeater automatically powers up whenever power is applied. This is particularly important if the repeater is mounted in a relatively inaccessible location.

HKKN4001 External Duplexer Cable Kit

The two (2) RF cables in this kit provide connection between the mini-UHF RF antenna connectors on the Professional Series transceivers and type-N bulkhead female connectors that mount on the back panel of the CDR700 repeater housing. Use this kit if the repeater

has separate transmit and receive antennas, a transmit combiner/receiver multi-coupler system or a duplexer that is not capable of being mounted inside the CDR700 repeater housing.

HKKN4002 Internal Duplexer Cable Kit

Two (2) of the three (3) RF cables in this kit provide connection between the mini-UHF RF antenna connectors on the Professional Series transceivers and the type-N connectors on the receiver and transmitter ports of an internally mounted duplexer. The third cable provides the connections between the type-N antenna connector of the duplexer and a type-N bulkhead female on the back panel of the CDR700 repeater housing.

Duplexer (internally mounted)

There are several duplexers available from Motorola that can be mounted inside the CDR700 repeater housing. The internal equipment bracket has the mounting hole pattern to accommodate these duplexers. Please note that the minimum transmit to receive frequency spacing is 4.5 MHz for VHF models and either 5 MHz (444-470 MHz) or 3 MHz (above 470 MHz) for the UHF models of the duplexer.

Preselector (internally mounted)

There are several preselectors available from Motorola that can be mounted inside the CDR700 repeater housing. The internal equipment bracket has the mounting hole pattern to accommodate these preselectors. Please note that the internal equipment bracket allows mounting either a duplexer or a preselector, but not both simultaneously.

HLN9455 Battery Revert Module

The HLN9455 battery revert module may be mounted in the CDR700 repeater housing. It is placed on the rear panel of the housing. Holes are provided in the rear panel for affixing the module to the CDR700 repeater housing.

HKLN4121 CDR Filler Plate

The blank panel in this kit is used to fill the opening in the front panel of the CDR700 repeater housing if an external repeater controller is desired. These controllers would include typical "off-the-shelf" conventional and trunking controllers. The kit should be used to ensure proper flow of cooling air within the CDR700 repeater housing when an internally mounted repeater controller is not used.

Basic Disassembly/Assembly

NOTE

Unless specifically instructed otherwise, DO NOT discard any hardware removed during disassembly.

In order to conserve space in the packing box, the CDR700 repeater housing is shipped completely assembled with the fan assembly, top cover, front panel, and power supply installed. To gain access to its mounting holes and equipment shelves, **the CDR700 repeater housing may have to be completely disassembled.** With the CDR700 repeater housing disassembled, you can begin to install the radios and other components before reassembling the housing.

Before beginning installation, remove all items from the packing container and check them against the items referenced in one of the parts lists on pages 3-1 and 3-5. This ensures that you have received all items necessary to assemble the CDR700 Repeater Station. Immediately report any missing or damaged items to Motorola Product Services.

The following steps explain how to disassemble the CDR700 repeater housing and how to reassemble it while installing the components (duplexer, transmit and receive radios, repeater controller, front panel, and top cover).

Disassembling the CDR700 Repeater Housing

The following steps cover disassembly of the repeater housing. Refer to Figure 3-3, on page 3-5 for identification of each part and its corresponding reference number.

1. Place the CDR700 repeater housing on a flat surface.

NOTE

Use one of the small cardboard pieces from the packing material as a "lazy susan" to facilitate disassembly and reassembly.

Removing the Housing Cover

1. Remove the four TT3.5, pan head Taptite screws, located at the sides of the housing, using a Torx T15 driver.
2. Slide the top cover back to clear the front panel.
3. Lift the cover straight up and remove it from the housing chassis.

Removing the Front Panel

1. Remove the four TT3.5, pan head Taptite screws, that secure the front panel to the internal equipment bracket, using a T15 Torx driver.
2. Pull the front panel off from the internal equipment bracket.

Removing the Internal Equipment Bracket

NOTE

It is NOT necessary to remove the power supply from the internal equipment bracket.

1. Loosen the left side TT4.0 pan head Taptite screws on the internal equipment bracket using a T20 Torx driver. One or two turns are sufficient.
2. Remove the right side TT4.0 pan head Taptite screws on the internal equipment bracket using a T20 Torx driver.
3. Slide the internal equipment bracket slightly toward the right to clear the left side screws and remove the bracket from the repeater housing.

Assembling the CDR700 Repeater Housing

The following steps enable you to reassemble the CDR700 Repeater Station. Refer to Figure 3-3, on page 3-5 for identification of each part and corresponding reference number.

Assembling the CDR700 Repeater with an Internal Duplexer (optional)

1. Examine the duplexer that was ordered for the CDR700 repeater model being assembled. If four of the mounting holes contain threaded inserts, proceed to "Installing the Internal Duplexer into the CDR700 Internal Equipment Bracket" on page 3-3. If threaded inserts are not present, continue with Step 2.
2. Open the optional internal duplexer RF cable kit bag (HKKN4002) and remove the four Tinnerman clips.
3. Using a pair of needle nose pliers, place the Tinnerman clips over the four mounting holes of the duplexer (refer to Figure 3-1).

NOTE

The threaded side of each clip should be on the connector/tuning screw side of the duplexer mounting flange.

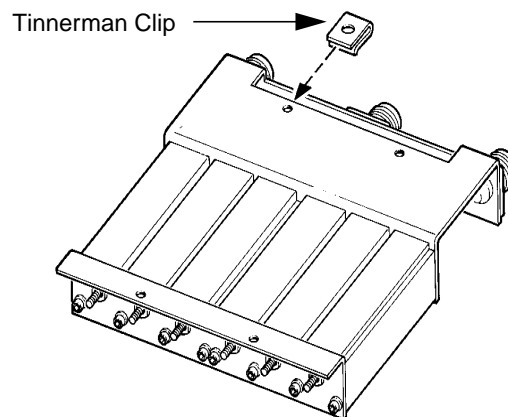


Figure 3-1. Duplexer, Bottom View

Installing the Internal Duplexer into the CDR700 Internal Equipment Bracket

1. At the front of the internal equipment bracket, hold the duplexer at the top of the bracket with the six tuning screws facing toward the front panel end of the CDR700 internal equipment bracket (stamped "FRONT"). The mounting holes of the duplexer must face the top of the CDR700 bracket.
2. Secure the duplexer to the internal equipment bracket with the four 6-32 x 1/2", pan head machine screws (supplied in cable kit bag HKKN4002) using a T15 Torx driver. Tighten the screws to 0.68 N-m (6 in.-lbs.) torque for the Tinnerman clips or 1.35 to 1.58 N-m (12 to 14 in.-lbs.) for the threaded inserts.

NOTE

The front of all duplexers face toward the front panel.

Installing the Radios

NOTE

The internal equipment bracket of the CDR700 has tabs kicked out of the metal to secure the radios to the bracket. The tabs have numbered holes to properly locate each model of the Professional Series radios.

1. If the radio model being installed uses the remote mount kit, secure the radio to the internal equipment bracket with the number "1" holes (the set nearest the front panel of the CDR700 repeater).
2. If the radio model being installed uses the "A" control head with the LED display, secure the radio to the internal equipment bracket with the number "2" holes (the middle set).

Assembling the CDR700 Repeater Housing

- If the radio model being installed uses either the "B" or the "C" control head with the LCD panel, secure the radio to the internal equipment bracket with the number "3" holes (the set farthest from the front panel of the CDR700 repeater).

NOTE

During assembly, to facilitate mounting the radios and an internal repeater controller, loosen the screws that secure the power supply to the internal equipment bracket.

Installing the Receive Radio**IMPORTANT**

Before installing the receive radio into the CDR700 Repeater Station, be sure to connect the RF and repeater cables to the radio.

- If you are installing the optional external duplexer RF cable kit, locate kit HKKN4001. Remove the two RF cables from the bag.
- The short (10"/25.4cm) cable (30-80517U05) connects to the transmit radio.
- The long (15"/38.1cm) cable (30-80517U10) connects to the receive radio.
- If you are installing the optional internal duplexer RF cable kit, locate kit HKKN4002. Remove the three RF cables from the bag.
- The cable with the type-N male and type-N female bulkhead cable connectors is the antenna cable from the internal duplexer.
- The long (14"/35.6cm) type-N male to mini-UHF connector cable (30-80517U11) connects to the transmit radio.
- The short (12"/30.5cm) type-N male to mini-UHF connector cable (30-80517U07) connects to the receive radio.
- Locate either the 30-80517U10 or 30-80517U07 cable (depending upon the duplexing option).
- Connect the mini-UHF connector of the cable to the antenna connector of the receive radio. Refer to Figure 3-2.
- Remove the accessory connector dust cover from the receive radio.
- Connect one end of the first repeater cable to the accessory connector of the receive radio (refer to Figure 3-2).
- Place the receive radio on the middle mounting tabs for the upper radio position (directly below the repeater controller mounting loca-

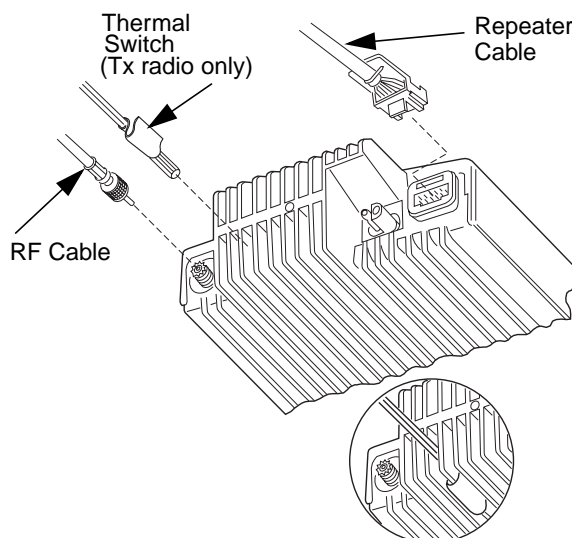


Figure 3-2. Professional Series Transmit Radio, Rear View

tion) of the CDR700 internal equipment bracket. The front panel of the receive radio faces in the direction of "FRONT" stamped on the top of the internal equipment bracket. Refer to Figure 3-3.

- Align the mounting holes of the receive radio with the M5 holes of the bracket.
- Attach the receive radio to the bracket with two M5 x 0.8 x 8, T25 Torx, pan head, machine screws from kit HKN4059.

NOTE

DO NOT tighten the screws at this time.

Installing the Transmit Radio**IMPORTANT**

Before installing the transmit radio into the CDR700 repeater housing, be sure to connect the RF and repeater cables to the radio.

- Locate either the 30-80517U05 or 30-80517U11 cable (depending upon the duplexing option).
- Connect the mini-UHF connector of the cable to the antenna connector of the transmit radio. Refer to Figure 3-2.
- Remove the accessory connector dust cover from the transmit radio.
- Connect one end of the second repeater cable to the accessory connector of the transmit radio (refer to Figure 3-2).
- Place the transmit radio on the lower mounting tabs for the lower radio position. The front panel of the transmit radio faces the same direction as the front panel of the receive radio. Refer to Figure 3-3.

Parts List

CDR700 Housing Kit HKLN4056/HK1008/09/10/11
Replacement Parts List

PL-201027-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION	QUANTITY
1	1585860M01	COVER	1
2	0310943M59	SCREW, TT3.5 x 0.6 x 6mm, star, black, Taptite	8
3	0180557U01	FAN, w/connector	1
4	1383852R01	GRILLE, fan	1
5	0185863M01	CHASSIS, assembly	1
6	HPN9033 or HKPN4000	POWER SUPPLY (with AC Line Cord) POWER SUPPLY (w/o AC Line Cord)	1
7	1585857M01	PANEL, front	1
8	0383498N04	SCREW, M4 x 0,7 x 7mm	4
9	0310907B08	SCREW, M5 x 0.8 x 8mm, pan, black, machine	8
10	HKLN4122	BRACKET, internal equipment	1
11	4285866M01	CLIP, thermal switch	1
12	3085859M01	CABLE, y-split radio power	1
13	3080137S02	CABLE, repeater	2
14	3082933N08 or 3085801L01 or 3082933N09 or 3082933N13	CORD, ac line (IEC to U.S. 115 V) (p/o HPN9033) CORD ac line (230 V) (p/o HKPN4000) Argentina CORD ac line (230 V) (p/o HKPN4000) Euro CORD ac line (230 V) (p/o HKPN4000) UK	1
non-referenced items			
--		TIE WRAP, APPROX. 4" LG. (Not Shown)	1
HKKN4000		POWER SENSE CABLE	
HKKN4001		EXTERNAL DUPLEXER CABLES	
HKKN4002		INTERNAL DUPLEXER CABLES	

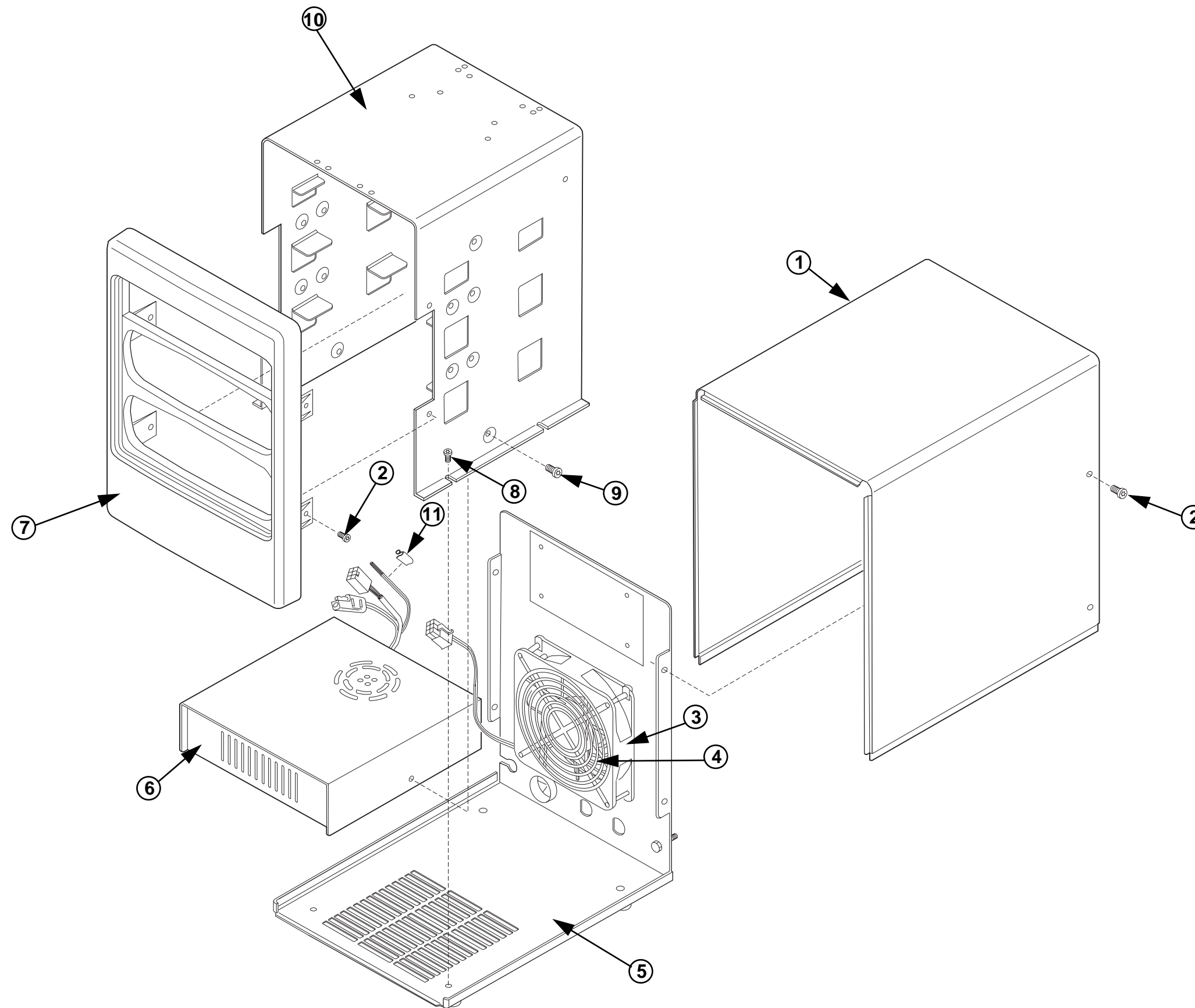


Figure 3-3. CDR700 Repeater Housing

Parts List

CDR700 Housing Kit HKLN4056/HK1008/09/10/11
Replacement Parts List

PL-201027-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION	QUANTITY
1	1585860M01	COVER	1
2	0310943M59	SCREW, TT3.5 x 0.6 x 6mm, star, black, Taptite	8
3	0180557U01	FAN, w/connector	1
4	1383852R01	GRILLE, fan	1
5	0185863M01	CHASSIS, assembly	1
6	HPN9033 or HKPN4000	POWER SUPPLY (with AC Line Cord) POWER SUPPLY (w/o AC Line Cord)	1
7	1585857M01	PANEL, front	1
8	0383498N04	SCREW, M4 x 0.7 x 7mm	4
9	0310907B08	SCREW, M5 x 0.8 x 8mm, pan, black, machine	8
10	HKLN4122	BRACKET, internal equipment	1
11	4285866M01	CLIP, thermal switch	1
12	3085859M01	CABLE, y-split radio power	1
13	3080137S02	CABLE, repeater	2
14	3082933N08 or 3085801L01 or 3082933N09 or 3082933N13	CORD, ac line (IEC to U.S. 115 V) (p/o HPN9033) CORD ac line (230 V) (p/o HKPN4000) Argentina CORD ac line (230 V) (p/o HKPN4000) Euro CORD ac line (230 V) (p/o HKPN4000) UK	1
non-referenced items			
--		TIE WRAP, APPROX. 4" LG. (Not Shown)	1
	HKKN4000	POWER SENSE CABLE	
	HKKN4001	EXTERNAL DUPLEXER CABLES	
	HKKN4002	INTERNAL DUPLEXER CABLES	

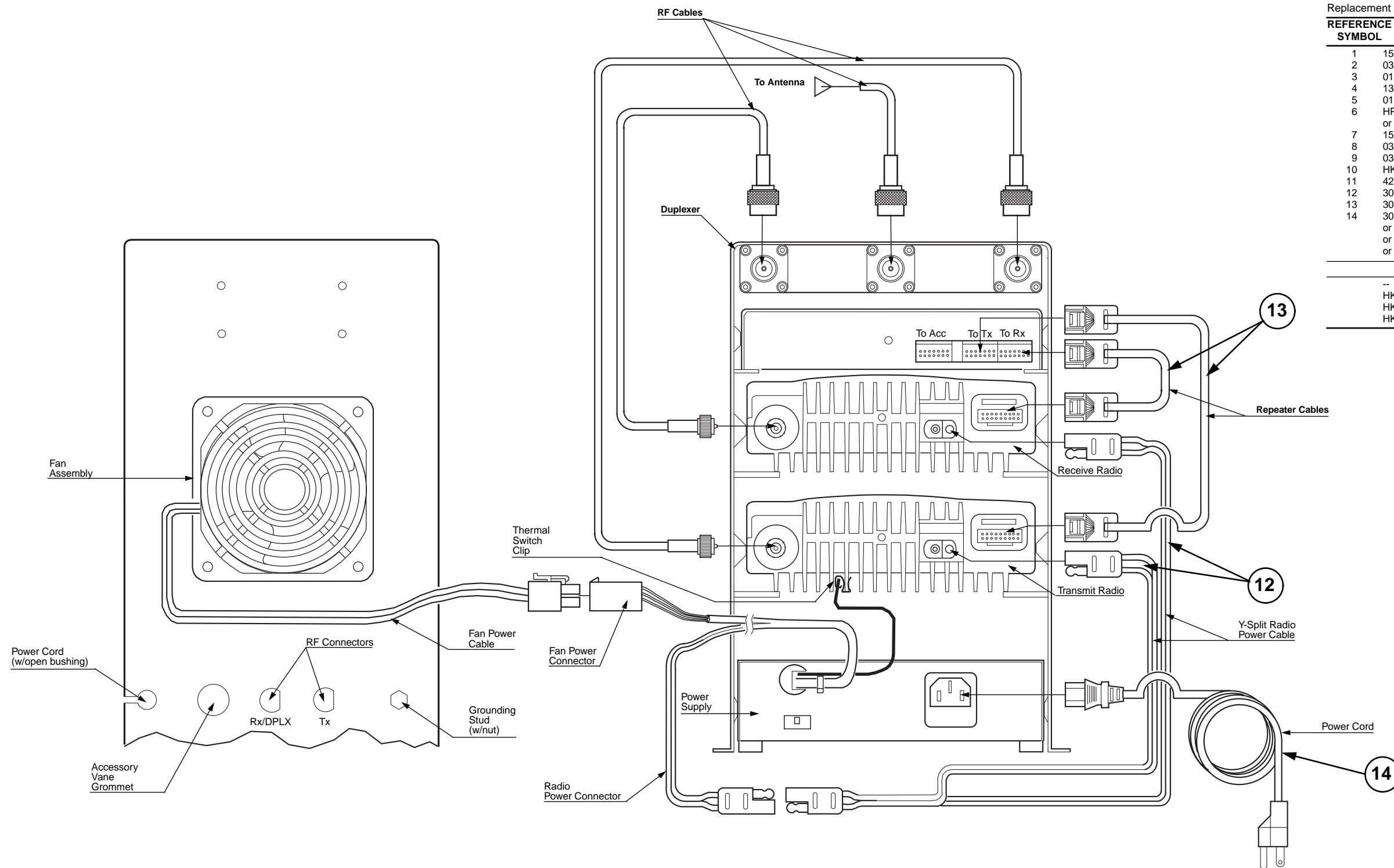


Figure 3-4. CDR700 Interconnect Cabling Diagram

- Align the holes of the transmit radio with the M5 holes of the bracket.
- Attach the transmit radio to the bracket with two M5 x 0.8 x 8, T25 Torx, pan head, machine screws from kit HKN4059.

NOTE

DO NOT tighten the screws at this time.

Installing the Repeater Controller

- Place the repeater controller on the top mounting tabs (below the internal duplexer) of the CDR700 internal equipment bracket, allowing the rear panel to be partially exposed. The front panel of the controller faces in the same direction as those of the radios.
- Connect the receive radio repeater cable to the **Receive** connector of the controller (Figure 3-4 on page 3-6).
- Connect the transmit radio repeater cable to the **Transmit** connector of the controller (Figure 3-4 on page 3-6).

CAUTION

To avoid damage to cable tabs and radio components, install cables with locking tabs up (Figure 3-5).

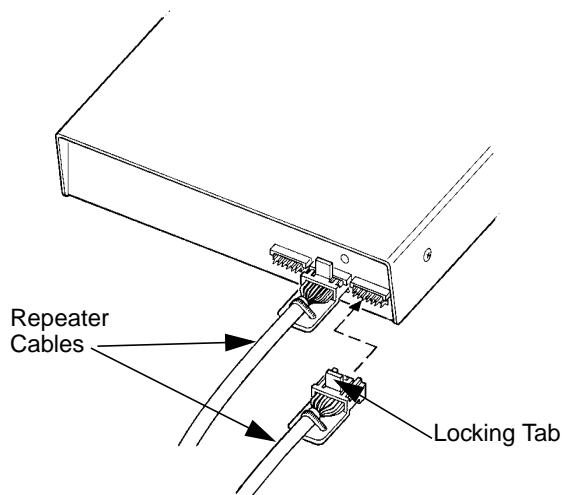


Figure 3-5. Repeater Controller, Rear View

- Align the mounting holes of the controller with the M5 holes of the bracket.
- Using a T25 Torx screwdriver, secure the controller to the chassis using two M5 x 0.8 x 8 machine screws from kit HKN4059.

NOTE

DO NOT tighten the screws at this time.

Connecting to the Power Supply

- Locate the Y-split power cable, 30-85859M01, in the HKN4059 cable and hardware kit.
- If the HLN9455 Battery Revert Module will be used, skip to Step 3. Connect the 2-prong “Ford” connector of the power supply output connector to the single 2-prong “Ford” connector end of the cable.
- Connect one of the 2-prong “Ford” connectors at the double end of the Y-split cable to the dc power connector of the transmit radio.
- Connect the remaining 2-prong “Ford” connector at the double end of the Y-split cable to the dc power connector of the receive radio.
- Locate the thermal switch mounting clip supplied with kit HKN4059. Slip the mounting clip onto the thermal switch, from the power supply. Refer to Figure 3-6.

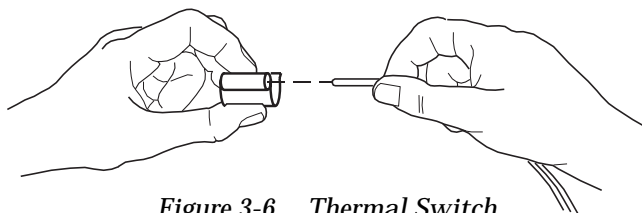


Figure 3-6. Thermal Switch

- Place the thermal switch and mounting clip, in-between the long fins (5 and 6 on the antenna connector side) of the transmit radio's heatsink. Refer to Figure 3-2
- Carefully push the thermal switch mounting clip securely onto fin 6.

NOTE

The fully assembled equipment bracket is called the “Internal Equipment Bracket Module”.

If the (optional) HLN9455 Battery Revert Module is not being installed, skip to “Installing the Internal Equipment Bracket Module” on page 3-8.

Installing the HLN9455 Battery Revert Module

If the optional HLN9455 Battery Revert Module will be used, follow these instructions to install the module into the CDR700 housing. Orientation for the following steps is with respect to viewing the front panel from the outside of the CDR700 housing.

Mounting the Module in the CDR700 Housing

1. If necessary, unplug the ac line cord of the HPN9033 power supply unit from the ac mains.
2. If necessary, unplug the dc power cable from the HPN9033 power supply unit to the Y-split power cable.
3. If necessary, unplug the fan power cable to the fan.
4. The module mounts near the top center of the back wall of the inside, above the fan assembly of the CDR700 chassis. Observe the hole pattern shown in Figure 3-7.

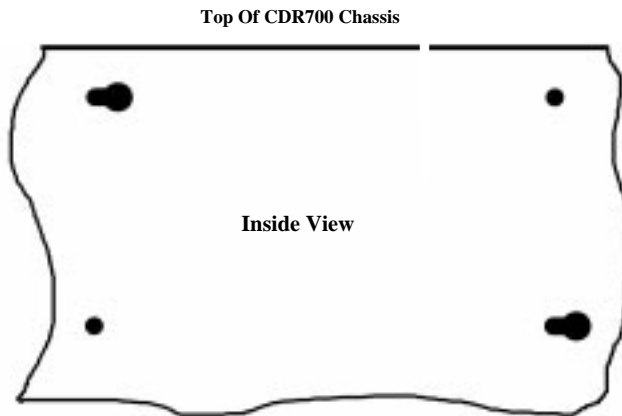


Figure 3-7. CDR700 Battery Revert Mounting Hole Pattern (Inside View)

5. Locate the Battery Revert module in the HLN9455 Battery Revert kit.
6. Locate two (2) of the M3.0 x 0.5 x 10 mm black, panhead, machine screws supplied in kit HLN9455.
7. Position the module with the plastic cover down and the cables exiting to the right.
8. Start the two (2) M3.0 screws into the upper lefthand and lower righthand corner threaded holes in the bottom of the chassis of the module. Two to three turns are sufficient.
9. Place the Battery Revert module into the inside of the CDR700 housing. Ensure that the cables of the module extend downward (toward the fan). The heads of the two (2) screws threaded into the module in Step 8 pass through the keyholes in the CDR700 chassis back panel.

NOTE

The two cables from the left side of the battery revert module pass to the left side of the fan assembly. The three cables from the right side of the module pass to the right side of the assembly.

10. Slide the module to the left until it is snug against the narrow slots of the keyholes.
11. Locate the remaining two (2) of the M3.0 x 0.5 x 10 mm black, panhead, machine screws supplied in the HLN9455 Battery Revert kit.
12. Pass the screws through the two empty mounting holes in the CDR700 chassis back panel. Turn the screws into the threaded holes of the chassis of the Battery Revert module.
13. Secure the module to the CDR700 housing by tightening all four (4) M3.0 screws to 0.68-0.90 N-m (6-8 in.-lbs).

Installing the Internal Equipment Bracket Module

1. Place the assembled internal equipment bracket module on the chassis of the CDR700 repeater housing.
2. Tilt the bracket slightly upward at the right side and slide the left side notched mounting tabs on the module under the TT4.0 screws.
3. Replace the two (2) TT4.0 screws removed from the right side in Step 2 under "Removing the Internal Equipment Bracket" on page 3-3. Tighten all four (4) TT4.0 screws to 1.58 N-m (14 in.-lbs.) torque.
4. Tighten all six (6) M5 x 0.8 x 8, T25 Torx, pan head, machine screws that secure the receive and transmit radios and the repeater controller to the bracket to 3.16 N-m (28 in.-lbs.) torque. If you loosened the screws that secure the power supply to the bracket, tighten them to 3.16 N-m (28 in.-lbs.) torque.
5. If the HLN9455 Battery Revert Module has been installed, skip to "Connecting the Battery Revert Cables".
6. If the HLN9455 Battery Revert Module has not been installed, connect the 6-position fan cable connector to the fan supply connector of the pigtail from the power supply. Skip to "Attaching the External Duplexer RF Cables" or "Attaching the Internal Duplexer RF Cables".

Connecting the Battery Revert Cables

The HLN9455 Battery Revert Module has three (3) cables with 2-prong “Ford” connectors. One of the prongs of each connector is covered with insulation and the other is bare. Please note that the two (2) longest cables have opposite “polarities”. Refer to Figure 3-8.

1. Locate the shortest 2-prong “Ford” cable from the module (“power supply input cable”).
2. Connect the power supply input cable to the dc power cable from the HPN9033 power supply.
3. Locate the 6-position connector with the blue and black wires from the module (“charger supply cable”).
4. Connect the charger supply cable to the 6-position fan cable connector from the HPN9033 power supply.
5. Locate the 6-position connector with the red and black wires from the module (“fan supply cable”).
6. Connect the fan supply cable to the 6-position fan cable connector from the CDR700 fan.
7. Examine the module and locate the longest 2-prong “Ford” cable with the red wire leading to the insulated prong (“transceiver power cable”).
8. Connect the transceiver power cable to the Y-split power cable for the receive and transmit radios.

9. Examine the module and locate the longest 2-prong “Ford” cable with the black wire leading to the insulated prong (“battery cable”).
10. Pass the battery cable through the vane grommet on the back panel of the CDR700 housing.

Refer to the instructions in Section 7 of this manual for properly connecting and fusing the cable to the battery and adjusting the float maintenance charger.

Attaching the External Duplexer RF Cables

1. Remove the nut and lockwasher from the long cable from the receive radio.
2. Insert the type-N female bulkhead connector into the “RX/DPLX” D-hole located on the chassis back panel. The threaded portion of the connector will stick out the back of the chassis.
3. Replace the lockwasher and nut onto the connector. Tighten to 2.26 N-m (20 in.-lbs.) torque.
4. Remove the nut and lockwasher from the short cable from the transmit radio.
5. Insert the type-N female bulkhead connector into the “TX” D-hole located on the chassis back panel. The threaded portion of the connector will stick out the back of the chassis.
6. Replace the lockwasher and nut onto the connector. Tighten to 2.26 N-m (20 in.-lbs.) torque.

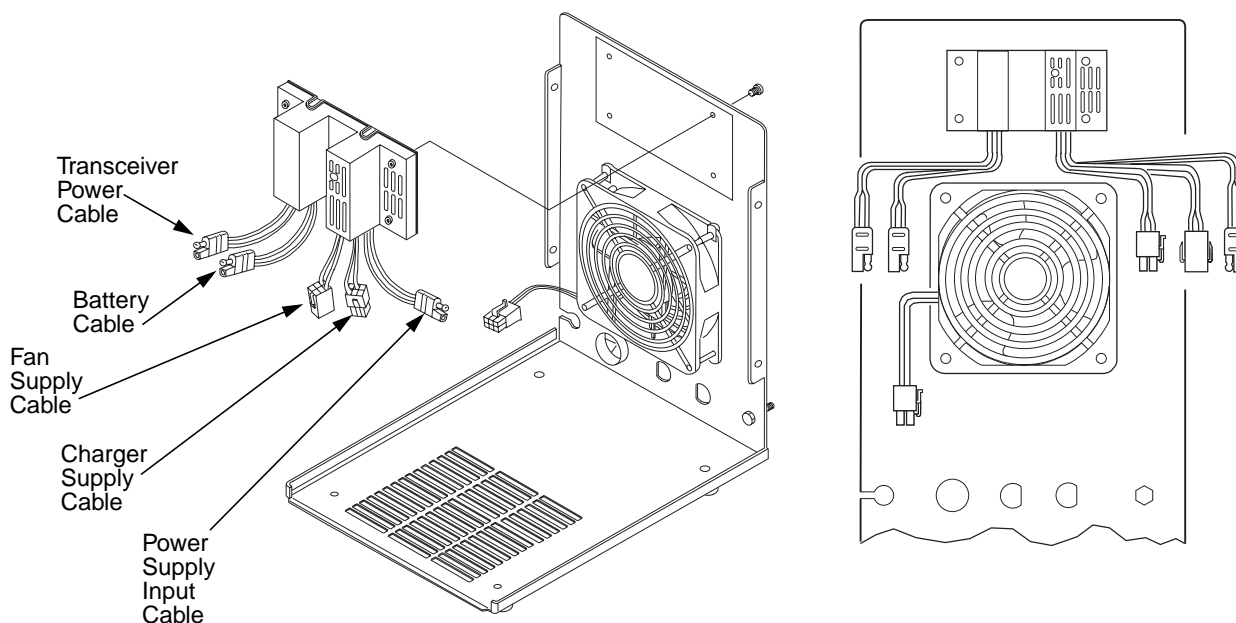


Figure 3-8. Battery Revert

Assembling the CDR700 Repeater Housing

Attaching the Internal Duplexer RF Cables

1. Remove the nut and lockwasher from the antenna cable from the internal duplexer.
2. Insert the type-N female bulkhead connector into the "RX/DPLX" D-hole located on the chassis back panel. The threaded portion of the connector will stick out the back of the chassis.
3. Replace the lockwasher and nut onto the connector. Tighten to 2.26 N-m (20 in.-lbs.) torque.
4. Locate the D-hole filler plug in cable kit HKKN4002.
5. Insert the D-hole filler plug into the D-hole "TX" located on the chassis back panel.

Attaching the Repeater Controller Phone Line and Ground Wire

1. If the repeater controller requires a phone line, pass the line through the "Acc" vaned grommet on the back panel of the chassis and connect the line to the jack at the back of the repeater controller.

NOTE

Pass the phone line from the outside to the inside of the repeater housing.

2. If you are using a repeater controller with a grounding wire, connect the wire to the 1/4" threaded ground stud (stamped "Gnd" or "⊥") at the left side of the repeater housing (as viewed from the rear).
3. Pass the wire from the inside to the outside through the vane grommet.
4. Remove the outer 1/4"-20 nut and lockwasher.
5. Connect the controller ground wire to the ground stud.
6. Replace the 1/4"-20 nut and lockwasher removed in Step 4 and tighten.

Attaching the AC Power Cord

1. Locate the AC power cord, the open bushing insulator and one of the plastic tie wraps contained in kit HKN4059.
2. Slip the open bushing insulator onto the AC power cord, making sure that the thicker "shoulder" portion of the insulator is facing toward the ac mains plug end of the cord.

3. Plug the female connector of the AC power cord into the IEC receptacle located on the back of the power supply.
4. Slide the cord of the ac power cord through the opening at the right side of the back panel of the chassis.
5. Insert the open bushing insulator into the slotted hole on the chassis back panel. Allow an excess "service loop" of the power cord between the power supply and the slotted hole as shown in Figure 3-9.

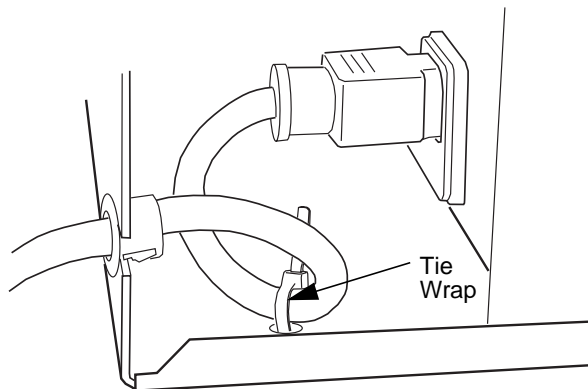


Figure 3-9. Service Loop

6. Use a tie wrap from kit HKN4059 to anchor the "service loop" to the chassis through the two holes in the bottom of the chassis as shown in Figure 3-9. Trim off the excess tie wrap.

CAUTION

To avoid interference with the housing cover, the AC power cord "service loop" must be on the inside of the cabinet.

Replacing the Front Panel to the CDR700 Chassis**NOTE**

If a repeater controller is used that requires mounting external to the CDR700 housing, use kit HKLN4121 to fill the opening left by the internal controller and provide proper airflow in the repeater housing.

1. If the repeater does NOT use a Basic controller or an externally mounted repeater controller, skip to Step 6.
2. For the Basic controller, locate the Repeater Interface Shroud (15-85891M01) and the two P3x8, Plastite tapping screws, included with the controller kit.

3. For an externally mounted repeater controller, locate the blank filler plate and the two P3x8, Plastite tapping screws, included in kit HKLN4121.
4. Place the shroud or the blank filler plate in the upper (controller) opening of the front panel.
5. Use a T10 Torx driver to secure the shroud or the plate to the front panel with the two P3x8 screws. Tighten to 0.8 N-m (7 in.-lbs.) of torque.
6. Attach the front panel to the chassis and align the mounting holes. Ensure that the openings of the front panel clear the front panels of the receive and transmit radios and the repeater controller (if applicable).
7. Using a T15 Torx driver, secure the panel to the chassis with the four TT 3.5, pan head Tap-tite screws removed in Step 1, "Removing the Front Panel" on page 3-3. Tighten to 1.24 N-m (11 in.-lbs.) torque.

Replacing the Housing Cover to the CDR700 Chassis

1. Slide the housing cover down onto the chassis making sure to clear all of the wires from inside the housing to avoid pinching.

NOTE

The cover only needs a small clearance from the front panel.

2. Slide the housing cover forward until the lips engage the front panel.
3. Using a T15 Torx driver, replace the four TT3.5, pan head Tap-tite screws removed in Step 1, "Removing the Housing Cover" on page 3-2. Tighten to 1.24 N-m (11 in.-lbs.) torque.

Final Installation

IMPORTANT

To operate the CDR700 repeater, the AC line cord, antenna feed line, ground cable, phone lines (not supplied); and (optional) battery cables must exit from the rear of the unit.

To operate the CDR700 repeater, you must connect all of the necessary cables and accessories as follows:

1. Attach a ground wire from an absolute earth ground to the 1/4" threaded ground stud on the left of the repeater housing.
2. Connect lightning arrestors.

CAUTION

Lightning can damage the CDR700 repeater and its components if the unit is not grounded properly. For lightning protection, ground the repeater to an absolute earth ground using at least #6 gauge copper wire, and use adequate lightning arrestors.

3. Connect the antenna lead(s) to the antenna connector(s) on the back panel of the CDR700 repeater housing.

IMPORTANT

Before connecting the AC line cord into an AC mains outlet, ensure that the "115/230" V ac switch on the power supply is in the appropriate position. The switch is accessible from the bottom of the repeater housing.

4. Plug the AC line cord into an AC mains outlet.

Repackaging

The CDR700 Repeater Station's shipping box is recommended for reshipping. If it is necessary to repack the repeater as a built-up unit, follow these suggested steps to repack the unit in its original box.

CAUTION

The CDR700 repeater shipping box may be used for reshipping a built-up unit. Please ship with extreme care.

CAUTION

Motorola, Inc. takes no responsibility for reshipping a built-up CDR700 repeater.

CAUTION

Extreme caution should be taken when reshipping an CDR700 repeater in its original box. A built-up CDR700 repeater could weigh approximately a maximum of 34 pounds (15.4 kg) when fully assembled and in its original box. Lifting improperly can cause injury. Get help from a second person and use care when lifting the repeater.

Repackaging

Section 4

Converting a GR500 Repeater Into a CDR500 Repeater

A retrofit kit, HKLN4117, is available to convert an existing GR500 repeater into an CDR500 repeater. This allows replacing the older GM300-series radios with the new Professional Series radios.

Disassembling the Repeater

NOTE

Unless specifically instructed otherwise, DO NOT discard any hardware or cables removed during disassembly.

Disconnecting the Controller Cables

1. Disconnect the controller cables from the repeater controller.

Disassembling the Radio/Duplexer Bracket

1. Disconnect the Type-N male connector of the bulkhead cable from the antenna connector of the duplexer
2. Remove the two (2) 8-32 nuts that secure the front of the radio/duplexer bracket.
3. Loosen, but do not entirely remove, the two (2) 8-32 nuts that secure the back of the radio/duplexer bracket (this is the end of the bracket with notched mounting tabs).
4. Lift the front of the bracket and slide forward. Do not remove the bracket from the GR500 housing at this time.

Disconnecting the Power Cables

1. Disconnect the dc power cable plugged into the receive radio.
2. Disconnect the dc power cable plugged into the transmit radio.

3. Remove the radio/duplexer bracket from the GR500 housing.

Removing the Duplexer

1. Disconnect the RF cable from the receive radio antenna connector.
2. Disconnect the RF cable from the transmit radio antenna connector.
3. Remove the four (4) 6-32 x 1/2", pan head screws that secure the duplexer to the bracket.
4. Remove the duplexer, with the two RF cables attached, from the bracket.

Removing the Receive and Transmit Radios

1. Disconnect the controller cables from both radios.
2. Remove the two (2) M5 x 8, pan head screws that secure the receive radio to the bracket.
3. Remove the receive radio from the bracket.
4. Remove the two (2) M5 x 8, pan head screws that secure the transmit radio to the bracket.
5. Remove the transmit radio from the bracket.

Assembling the Repeater

Refer to "Section 2, CDR500 Wall Mount Repeater Station" of this manual for instructions on completing the conversion of the GR500 repeater to a CDR500 repeater.

Section 5

Tuning the Duplexer and Repeater Operational Tests

Overview

Before using your repeater, you must tune the duplexer, using one of the following three methods for ensuring that the duplexer is tuned to the correct frequencies of operation:

- **Pre-Tuned Method (preferred method)**
Order the duplexer from the manufacturer or supplier pre-tuned to the desired frequencies. This is not a “method” of tuning the duplexer but does not require any test equipment.

- **Visual Method**
Use a tracking (sweep) generator and spectrum analyzer to adjust the tuning of the passbands and reject bands of the duplexer.

- **“In a Pinch” Method**
The following paragraphs address a simple method of tuning a “notch” (reject) duplexer such as the TDN7407 UHF duplexer. This is not as accurate a method of tuning as the visual method afforded by the tracking generator/spectrum analyzer sweep setup but it is much less costly. It may be sufficiently good for all but the most exacting applications. Use this method only when the operating frequencies of the receiver and transmitter satisfy the requirements of the duplexer. For example, the TDN7407 is designed for a transmitter/receiver frequency spacing of 5 MHz. If the operating frequencies for the repeater are appreciably different than that 5 MHz specification, degraded performance of the repeater will result.

The following procedure assumes that the CDR500 or CDR700 repeater is fully assembled and the radios and duplexer are mounted in the housing. The radios should be connected to the proper ports of the duplexer with the RF coaxial cables provided in the HKKN4002 optional internal duplexer cable. The front panel of the CDR700 must be removed to gain access to the tuning screws of the duplexer.

Programming the Radios

1. Program the receive radio with an additional “receive only” mode at the frequency of the transmit radio.
2. Program the transmit radio with an additional “receive only” mode at the frequency of the receive radio.

NOTE

Instead of programming additional modes, you can connect the coaxial cables from the radios to the “opposite” ports of the duplexer.

3. Connect a Communications System Analyzer (CSA), such as the Motorola R2000 series, or an RF signal generator to the antenna port of the duplexer. The CSA should be operating in the “Generate” mode. Modulate the RF source with a 1 kHz tone at 60% system deviation to facilitate “hearing” the signal during the tune-up procedure.

NOTE

Before proceeding, ensure that the repeater is disabled.

Tuning the Receive Radio Section

NOTE

Tuning the receive radio section of the duplexer begins with the tuning screw closest to the antenna port of the duplexer.

1. Adjust the frequency of the CSA or generator to that of the transmit radio.
2. Place the receive radio on the transmit radio frequency mode defined in Step 1 under “Programming the Radios.”
3. Adjust the level of the CSA or generator until a weak signal is heard from the receive radio.
4. Increase the level of the CSA or the generator by approximately 20 dB.
5. Adjust the tuning screw of the duplexer for the greatest rejection of the signal. This will appear as a noisier signal. **If necessary:**

Operational Tests

- 5A. Slightly loosen the locking nuts of the tuning screws to allow the tuning screws to turn more freely (but not “sloppy”) **and**
- 5B. Increase the level of the CSA or the generator to maintain an audible 1 kHz tone.
6. Repeat Steps 4 through 5B for each of the tuning screws on the duplexer. Begin with the tuning screw closest to the antenna port and work in order toward the tuning screw closest to the receive radio port.
7. Tighten the locking nuts of the tuning screws.

CAUTION

To avoid damage to the tuning screws and to allow fine tuning of the duplexer, do not overtighten the locking nuts.

8. Readjust the tuning screws of the duplexer for the greatest rejection of the signal. This will fine-tune the receive radio section of the duplexer.

Tuning the Transmit Radio Section**NOTE**

Tuning the transmit radio section of the duplexer begins with the tuning screw closest to the antenna port of the duplexer.

1. Adjust the frequency of the CSA or generator to that of the receive radio.
2. Place the transmit radio on the receive radio frequency mode defined in Step 2 under "Programming the Radios."
3. Adjust the level of the CSA or generator until a weak signal is heard from the transmit radio.
4. Increase the level of the CSA or the generator by approximately 20 dB.
5. Adjust the tuning screw of the duplexer for the greatest rejection of the signal. This will appear as a noisier signal. **If necessary:**
 - 5A. Slightly loosen the locking nuts of the tuning screws to allow the tuning screws to turn more freely (but not “sloppy”) **and**
 - 5B. Increase the level of the CSA or the generator to maintain an audible 1 kHz tone.
6. Repeat Steps 4 through 5B for each of the tuning screws on the duplexer. Begin with the tuning screw closest to the antenna port and move in order toward the tuning screw closest to the transmit radio port.
7. Tighten the locking nuts of the tuning screws.

CAUTION

To avoid damage to the tuning screws and to allow fine tuning of the duplexer, do not overtighten the locking nuts.

8. Readjust the tuning screws of the duplexer for the greatest rejection of the signal. This will fine-tune the transmit radio section of the duplexer.

CAUTION

If you connected the coaxial cables from the radios to the ‘opposite’ ports of the duplexer, do not forget to reconnect them to the ‘proper’ ports before placing the repeater into operation.

Operational Tests

Before closing the cover for a CDR500 repeater or reassembling the housing cover to the chassis for a CDR700 repeater, three operational tests should be performed.

A Communications System Analyzer (CSA) with a duplex generator capable of operating at an offset equal to the difference between the transmitter and receiver frequencies (T/R spacing) is the preferred piece of test equipment. Typical models are the Motorola R2000, R2550, and R2600 Series. Some means is required to reduce the output of the duplex generator to the usable sensitivity level. This may be designed into the CSA or accomplished with an external Step Attenuator.

CAUTION

These tests assume a properly tuned duplexer, either internal or external, is being used. An improperly tuned duplexer may result in serious damage to one or both radios, the duplexer and/or the test equipment.

Test Equipment Interconnection to the Repeater

1. If required, connect the output of the duplex generator of the CSA to the input of the Step Attenuator.
2. If required, connect the output of the Step Attenuator to a coupling tee in line with the “RF In/Out” of the CSA.
3. Connect the output of the coupling tee, if required, or the “RF In/Out” of the CSA to the antenna port of an external duplexer or the “RX/DPLX” connector for an internal duplexer.
4. If an external duplexer is being used, connect the “RX/DPLX” and the “TX” connectors at

the chassis back panel of the repeater to the appropriate ports of the duplexer.

5. Connect the handset output of the receive radio (available through the front panel microphone connector on pin #8 and ground on pin #4) to the SINAD input of the CSA.

Initial Settings for the Test Equipment

1. Refer to your operating manual for the CSA to determine the correct control and switch settings.
2. Select the DUPLEX MONITOR mode (or equivalent) of the CSA and set the duplex generator for the appropriate T/R spacing (“DPLX OFFSET”).
3. Adjust the modulation of a 1 kHz tone on the duplex generator for 60% of rated system deviation.

Channel Spacing	60% Deviation
12.5/15 kHz	1.5 kHz
20/25/30 kHz	3.0 kHz

Measure the Repeater Desensitization

1. Select the “DVM/DIST” (or equivalent) mode of operation to allow measuring SINAD.
2. Select the “MONITOR” (or equivalent) mode of operation.
3. Disable the repeater (method depends upon which repeater controller is used). Adjust the level of the duplex generator until 12 dBs sensitivity is reached.

NOTE

If the receive radio mutes at or before attaining 12 dBs, place the radio in the “Volume Set” mode. This may require reprogramming one of the buttons of the radio.

4. Increase the RF output of the duplex generator by 1 dB (this increases the SINAD).
5. Enable the repeater (method depends upon which repeater controller is used). The transmit radio keys.
6. Read the SINAD level. It should not drop below 12 dB. If the SINAD is less than 12 dB,

check the tightness of connectors and the tuning of the duplexer.

Repeater Deviation

1. Select the “MONITOR” (or equivalent) mode of operation.
2. Disable the repeater (method depends upon which repeater controller is used). Adjust the duplex generator level for a strong (full “quieting”) signal into the receive radio.
3. Enable the repeater (method depends upon which repeater controller is used). The transmit radio keys.
4. Read the transmitter deviation. It should be within ±10% of the deviation of the duplex generator.

Channel Spacing	Minimum	Maximum
12.5/15 kHz	1.35 kHz	1.65 kHz
20/25/30 kHz	2.70 kHz	3.30 kHz

NOTE

If the transmit radio or the repeater controller has been programmed to generate TPL/DPL, the deviation of the TPL/DPL will add to the 1 kHz tone deviation.

Measure Repeater Transmitter Output Power

1. Follow steps 1 and 2 under “Repeater Deviation”.
2. Enable the repeater (“RPT EN” LED ON). The transmitter keys “TX” LED ON).
3. Read the transmitter RF power output from the duplexer. Determine the maximum rated insertion loss for your duplexer and the loss of all cables. Use the following table as a guide.

Rated Power	1 dB Loss	2 dB Loss	3 dB Loss
45 W	36 W	28 W	22 W
40 W	32 W	25 W	20 W
25 W	20 W	16 W	13 W
10 W	8 W	6 W	5 W

Overview

This section describes the system configurations, basic operation, theory of operation, jumper configurations, and adjustments for the Basic Repeater Controller.

System Configurations

The Basic Repeater Controller (identical to the R*I*C*K) connects between two Professional Series mobile radios to construct an intermittent duty radio repeater.

Possible configurations for a repeater with the Basic Repeater Controller are:

- Single Band RT (unidirectional) Repeater
- Crossband RT (unidirectional) Repeater
- Single Band, Bi-directional Repeater
- Crossband, Bi-directional Repeater

Basic Operation

Some of the possible uses for a repeater with the Basic Repeater Controller include:

- Mobile Repeater
- Mobile “Pac-RT Like” Repeater
- “Suitcase” Repeater
- Portable Site Repeater
- “Mountain Top” (Lookout) Repeater
- Fixed (Rural) Site Repeater
- Fixed (Base) Repeater
- Short Term, Substitute RT Repeater
- Link (RA) Repeater

Theory of Operation

Setup/Knockdown (U1A, Q1, Q2, Q3, Q4, Q11 and Q12):

U1A is one half of an IC dual type-D flip flop, an MC14013B. U1A is configured as a data latch. The CLEAR input, pin 4, is wired low. At power-up, the PRESET input of U1A, pin 6, is momentarily taken high via C2 and R9 and causes the “Q” output, pin 1, to go high and the “not-Q” output, pin 2, to go low. The “Q” output is connected to pin 1 of J6 and the “not-Q” output is connected to pin 3 of J6. If JU1 is across pins

1 and 2 of J6, then the repeater will be in the “Set-up” condition at power-up. If JU1 is across pins 2 and 3 of J6, then the repeater will be in the “Knockdown” condition at power-up.

The electronic switch, Q2/Q3, causes the Set-up/Knockdown action by applying or removing voltage at the ignition control, pin 10, of J3-TX. After power-up, the Setup or Knockdown state may be changed remotely with a signal from pin 4 of J5-RX or locally with front panel switch S3. S3 is a momentary contact switch that is debounced by the Q11/ Q12 latch circuit. The yellow SET-UP LED, CR3, illuminates to indicate the Set-up state.

As the Setup/Knockdown circuit goes from the Knockdown to the Set-up state, Q1 is momentarily turned on by Q3 via the C1/R2 timing circuit. The push to talk (PTT) input of the receive radio, pin 3 of J5-RX is pulled low by Q1 and keys the transmitter. The COR LED, CR2, will briefly flash during the moment that Q1 is conducting.

The external alarm input of the receive radio, pin 4 of J5- RX, is held low by Q4 during the Set-up state. As the Setup/Knockdown circuit changes from Set-up to Knockdown, Q4 turns off. The transmitter of the receive radio will key and send an Emergency Alarm if that feature has been enabled.

VOX (Q9)

Any audio signal present at pin 1 of J1-RX or pin 11 of J5-RX causes Q9 to conduct. This in turn will activate the drop-out delay and push to talk circuitry.

COR Buffer (Q15)

Q15 is a dc amplifier (buffer) for the COR signal from pin 8, through S2-3, or from pin 14, through S2-2, of J5-RX. The output of Q15 is switched from a low state during inactivity of the repeater to a high state with an active low state for the COR signal.

Audio Gate (Q6 and Q8):

The audio gate, Q8, enables and disables the audio from the receive radio. The audio input to Q8 is from pin 1 of J1-RX or pin 11 of J5-RX. The output of Q8 is applied to pin 11 of J4-ACC and potentiometer, R23. The output of R23 is applied to S2-5 and S2-6. S2-5 will route the audio to the flat transmitter audio, pin 5 of J3-

Theory of Operation

TX and **J4-ACC**. S2-6 will route the audio to the microphone transmitter audio, pin 3 of **J2-TX** and pins 2 of **J3-TX** and **J4-ACC**.

R23 is used to adjust the receive radio audio output to the proper level for the transmit radio audio input. The audio gate is enabled with an active dc level low at either pin 8 or pin 14 of **J5-RX**. The gate can also be hard enabled if S2-7 is closed.

Dropout Delay and PTT (Q5, Q10, U1B and Q7):

The dropout delay circuit uses the second half of U1, the MC14013B dual D flip flop, to generate a PTT signal for the transmit radio. The Q output, pin 13, of U1B is low if the repeater is inactive. When an input signal is present at the receive radio, either pin 8 or pin 14 of **J5-RX** will be pulled low and turn off Q15. Q5 will turn on and discharge C3. Q10 will turn on when the voltage across C3 is less than 4.5 Vdc. The output from Q10 pulls the PRE-SET input of U1B high. The Q output of U1B switches to a high state and turns on Q7. Pin 4 of **J2-TX** and pin 3 of **J3-TX** are pulled low and key the transmit radio PTT. The red **COR** LED, CR2, illuminates.

The dropout delay is generated when Q5 ceases to conduct. Q10 will remain on until the voltage across C3 reaches 4.5 Vdc or greater. S2-10 and S2-11 are used to switch in the appropriate resistance to generate the desired time constant.

S1 on the front panel is used to enable the repeater function and will not allow Q7 to conduct unless it is in the enable (in) position. S1 also interrupts the **COR** signal from pin 8 or pin 14 of **J5-RX** and the output of the **VOX** circuit to disable the repeater.

Reverse Key-up

Whenever pin 8 of **J3-TX** goes low, it will pull pin 3 of **J5-RX** low. When the reverse key-up function is being used, as in the bi-directional repeater configuration, S2-3 must be open and no functions can be programmed which will use pin 8 of **J5-RX**. A **NULL** with active **LOW** state on pin 8 will prevent any unwanted reverse key-up.

Reverse Audio Path

Audio present on pin 11 of **J3-TX** is routed to either pin 2 or pin 5 of **J5-RX**. S2-8 and S2-9 determine to which pin the audio is routed. As with the forward direction, a potentiometer, R24, is used to adjust the audio level.

Accessory Jack (J4-ACC)

The accessory jack, **J4-ACC**, is connected to **J3-TX** and **J5-RX** such that all of the Radius standard accessories will still be compatible. Furthermore, the standard connections are retained (no new cables need to be made). The only input which causes the Basic Repeater Con-

troller to respond is pin 3 of **J4-ACC** (PTT). A low on the pin will cause a low on pin 3 of **J3-TX** and keying of the transmit radio.

DIP Switch (S2) Functions

DIP Switch positions for the Basic Repeater Controller (* = typical setup):

S2-1

S2-1 routes the PL/DPL & CSQ I/O signal (active low) from J3 pin 8 of the transmit radio to J3 pin 3 (the PTT) of the receive radio in the bidirectional repeater configurations. For unidirectional repeaters, S2-1 should be OFF.

S2-1 should be set:

- **OFF*** for unidirectional repeaters
- **ON** for bidirectional repeaters.

S2-2 and S2-3

S2-2 selects pin 14 of **J5-RX** as the **COR** input from the receive radio; S2-3 selects pin 8 of **J5-RX** for the same function. Either S2-2 or S2-3 should be ON with the other switch in the OFF position. However, no harm to the Basic Repeater Controller or the receive radio occurs if both of the switches are accidentally ON. In the bidirectional repeater configuration, continuous keying of the transmitter of the receive radio occurs if S2-3 is ON, therefore S2-2 (pin 14 I/O) must be used.

S2-2 should be set:

- **OFF*** for pin 8 I/O (CSQ or TPL/DPL)
- **ON** for pin 14 I/O (CSQ or TPL/DPL).

S2-3 should be set:

- **OFF** for pin 14 I/O (CSQ or TPL/DPL)
- **ON*** for pin 8 I/O (CSQ or TPL/DPL).

S2-4

S2-4 enables the remote Setup/Knockdown feature which requires the MDC-1200 RapidCall signalling format with a CDM1250, CDM1550, PRO5100, or PRO7100 mobile radio for the receive radio. The Basic Repeater Controller supplies operating voltage to J3 pin 10 (the ignition control input) of the transmit radio.

S2-4 should be set:

- **OFF*** for local only repeater Setup/Knockdown
- **ON** to enable remote Setup/Knockdown (MDC-1200).

S2-5 and S2-6

S2-5 and S2-6 are used to select the routing of the audio from the receiver of the receive radio to the proper audio

input of the transmit radio. If a normal EIA de-emphasized audio response is selected from the receive radio, pre-emphasized audio is required in the transmit radio and S2-6 should be ON (S2-5 should be OFF). If a flat audio response is selected from the receive radio, a flat audio response is required in the transmit radio and S2-5 should be ON (S2-6 should be OFF).

S2-5 should be set:

- **OFF*** for EIA de-emphasized /pre-emphasized audio
- **ON** for flat audio.

S2-6 should be set:

- **OFF** for flat audio
- **ON*** for EIA de-emphasized/pre-emphasized audio.

S2-7

S2-7 enables the audio path through the audio gate (Q8). S2-7 is ON when VOX is used (EIA de-emphasized/muted audio must be provided by the receive radio).

S2-7 should be set:

- **OFF*** for COR applications
- **ON** for VOX operation.

S2-8 and S2-9

S2-8 and S2-9 duplicate the functions of S2-6 and S2-5 for the audio input to the transmitter of the receive radio in a bidirectional repeater (note the reverse order for the corresponding functions). The typical bidirectional repeater uses de-emphasized receiver audio from the transmit radio and S2-8 should be ON (S2-9 should be OFF).

S2-8 should be set:

- **OFF** for flat audio
- **ON*** for EIA de-emphasized/pre-emphasized audio.

S2-9 should be set:

- **OFF*** for EIA de-emphasized/pre-emphasized audio
- **ON** for flat audio.

S2-10 and S2-11

S2-10 and S2-11 select the desired drop-out delay (hang time). With both switches OFF, the transmit radio unkeys approximately 3 seconds after the receive radio loses the COR indication (J3 pin 8 or pin 14 goes high). The dropout delay is decreased to approximately 1.5 seconds if S2-10 is ON. The shortest dropout delay, essentially “zero” seconds, is enabled by placing S2-11 in the ON position. For a bidirectional repeater, the “0” seconds dropout delay (S2-11 ON and S2-10 OFF or ON) should be used.

S2-10 should be set:

- **OFF*** for 3-second dropout delay
- **ON** for 1.5-second dropout delay

S2-11 should be set:

- **OFF*** for 1.5/3-second dropout delay
- **ON** for 0-second dropout delay.

S2-12

S2-12 allows the output of the VOX circuit to key the transmit radio. Note that the “zero” dropout delay should not be used with the VOX keying. A delay of 1.5 or 3 seconds should be used to “smooth” the output of the VOX. The audio gate must be enabled by placing S2-7 in the ON position. The VOX circuit operates only in a unidirectional mode (i.e. from the handset audio of the receive radio). The VOX also responds to the noise burst, or “squelch tail,” at the end of a transmission and the dropout delay increases by that amount. Use of coded squelch (TPL or DPL) is recommended.

S2012 should be set:

- **OFF*** for VOX disable
- **ON** for VOX enable.

Jumper Configurations

Table 6-1 lists the jumper settings for JU1 on the Basic repeater controller.

Table 6-1. Basic Repeater Controller Jumper Setting

Jumper	Default	Notes
JU1	Setup	Setup = Both radios turn on at power-up (repeater functional). Knockdown = Only receive radio turns on at power up.

Overview

An optional battery revert accessory is available for the CDR700 repeater station. The battery revert is an integral part of the power supply in the CDR500 repeater housing. This accessory allows you to cable your unit to a back-up battery which will engage in case of a power outage.

Trickle Charger Voltage Adjustments

1. Connect a digital multimeter to the two-conductor barrier strip of the CDR500 repeater or the 2-prong "Ford" connector of the battery cable from the HLN9455 battery revert module of the CDR700 repeater.
2. The charger float maintenance voltage is adjustable. For the CDR500 repeater, adjust the "BAT CHG ADJ" potentiometer, accessible through the round hole in the housing near the barrier strip. For the CDR700 repeater, adjust the potentiometer of the HLN9455 module that is accessible through a round hole in the plastic cover for the module.
3. For both revert modules, adjust the output voltage for 13.6 V dc ± 0.1 V dc. This is the recommended value for a sealed, lead acid, gel cell battery. Other batteries may require a different float voltage. Consult the manufacturer's recommendation for other battery types.

NOTE

The battery revert is adjustable between 12 and 15 V dc.

NOTE

A more accurate setting of the change voltage will be obtained by loading the output with a resistance sufficient to draw a current equal to 0.001C where C is the amp-hour rating of the battery.

4. Disconnect the digital multimeter from the battery cable.

Battery Attachment

Refer to "Installing the HLN9455 Battery Revert Module" on page 3-7, in Section 3 of this manual to install the battery revert module into an CDR700 repeater housing.

WARNING

Batteries used to power the repeater stations contain great amounts of stored energy. Use caution when working with these units. Use insulate battery terminal covers at all times. Wear protective clothing and eye goggles. For safety, it is strongly recommended that BOTH the positive and negative leads of the battery cable are fused as close as possible to the terminals of the battery.

CAUTION

Batteries may give off harmful or noxious fumes during charging. Provide adequate ventilation for the area in which the battery is stored.

CAUTION

If the wires leading to the battery are exposed, they can cause shorts or severe damage. To prevent damage, use a properly fused battery cable.

NOTE

Make sure the battery is fully charged before connecting to the battery revert for either the CDR500 or CDR700 repeater stations. DO NOT connect a battery if the terminal voltage of the battery is less than approximately 12.0 V dc.

CDR500 Repeater

1. The battery cable may be either a high power mobile dc cable kit (such as the HKN9402) or made from 14-gauge (or larger) stranded copper, insulation coated wire. If a mobile cable kit is used, cutoff the 2-prong "Ford" connector.
2. Per the "Warning" on this page, it is strongly recommended that *both* leads of the battery

Battery Type

cable as fused as close as possible to the connection points to the battery. The fuse holders must be insulated and have no exposed contacts or wiring.

3. Connect the battery cable to the battery. Observe proper polarity for the cable with respect to the polarity of the terminals of the battery. Above all else, work cautiously and very carefully around a battery.
4. Plug the power cord from the CDR500 repeater into a suitable ac mains outlet. Failure to apply ac power before connecting the battery cable will put the station on battery operation and possibly result in totally discharging the battery.
5. Attach the positive [+] wire from the battery to the positive [+] pole on the two-conductor barrier strip.

CAUTION

If you connect the negative [-] battery wire before connecting the positive [+] wire, shorts or severe damage can occur if the positive wire comes into contact with the CDR500 repeater housing or any uninsulated metal connected to the CDR500 repeater.

To prevent damage, connect the positive [+] wire **before** connecting the negative [-] wire.

6. Attach the negative [-] wire from the battery to the negative [-] pole on the two-conductor barrier strip.
7. Install the battery connector shroud.

CDR700 Repeater

1. The battery cable may be either a high power mobile dc cable kit (such as the HKN9402) or made by splicing 14-gauge (or larger) stranded copper, insulation coated wire cable to a 2-prong "Ford" connector. The positive (+) lead from the battery must go to the insulation coated contact of the "Ford" connector. The splice joints must be covered with insulating shrink tubing or electrical tape.
2. Per the "Warning" on page 7-1, it is strongly recommended that *both* leads of the battery cable as fused as close as possible to the connection points to the battery. The fuse holders must be insulated and have no exposed contacts or wiring.
3. Connect the battery cable to the battery. Observe proper polarity for the cable with respect to the polarity of the terminals of the battery (the positive (+) lead from the battery

must go to the insulation coated contact of the "Ford" connector).

4. Plug the power cord from the CDR700 repeater into a suitable ac mains outlet. Failure to apply ac power before connecting the battery cable will put the station on battery operation and possibly result in totally discharging the battery.
5. Plug the battery cable into the charger cable from the CDR700 battery revert module

CAUTION

Contacts on the battery connector are live at all times while either the CDR500 or the CR700 repeater is attached to an ac power source.

Keep the connector shroud for CDR500 repeater installed at all times.

Use electrical tape over the live (bare) contacts of the HLN9455 battery revert in the CDR700 repeater.

Battery Type

The back-up battery "bank" for the repeater consists of one or more rechargeable batteries. The most readily available batteries are the maintenance free solid gel electrolyte lead-acid and nickle-cadmium (NiCd). Whichever type you choose, the battery must be designed for a service of operation that is typically sporadic and short term and may experience deep discharging before recharging. In between discharging periods, the battery must be capable of sustaining continuous, "float maintenance" charging at less than 1% of the rated capacity. Batteries in this category are called "stationary", "general purpose float and cyclic", "deep cycle", or a similar term. Automotive batteries are not designed for this service and should be avoided.

Battery Capacity

To determine the capacity for the battery or battery bank, you must know, or at least, estimate the longest period of time that the repeater is expected to operate on this back-up power source. Also, the percentages of time the repeater is expected to transmit and receive/standby must be factored in. Personal experience or that of others may give you a close approximation. If all else fails, assume a standard eight (8) hour shift operating solely on the battery with an extra hour before and another one after the shift. Ten (10) hours makes the calculation easy. The transmit and receive/standby times can be set equal (50% usage).

The capacity of the battery is rated in Ampere-hours (Ah) and is called "C" or "1C". This is not to be construed as the amount of current that may be drawn from the battery in an hour of time. Typically, battery

manufacturers rate battery capacity based on the current drawn over a five (5), ten (10) or twenty (20) hour period. In terms of capacity, these are referred to as 0.2C, 0.1C and 0.05C rates, respectively. They are not linearly related; doubling the current drain will most likely reduce the time available by more than half.

Ambient temperature has a profound effect on the battery capacity. At -20°C (only 4 degrees below zero Fahrenheit!), approximately half of the capacity of room temperature is available.

Example:

What “size” battery do you need? Let’s assume that you customer’s repeater is in a location that experiences power outages that require battery backup for no more than 5 hours. The repeater operates at a 66% transmit duty cycle. The transmitter is on the air an average of 2 minutes and the repeater is then in standby/receive for 1 minute. The total cycle time is 3 minutes. The repeater transceiver draws 14A of current during transmit and 1.5A during receive. The repeater is using an external controller. The controller and the fan of the repeater add 0.5A to the current drains of transmit and receive. Therefore, for 2 minutes the battery must supply 14.5A and for the next 1 minute the battery must supply 2A. Then, the cycle repeats for a total of 5 hours.

Let the battery operating “capacity” be represented by C_{op} . This is based on the current drains during transmit and receive, the percentage of times of each and the total time required for battery operation. C_{op} may be represented by the following equation:

$$C_{op} = T_{total} \times \left[I_{tx} \times \left(\sqrt{\frac{T_{tx}}{T_{cycle}}} \right) + I_{rx} \times \left(\sqrt{\frac{T_{rx}}{T_{cycle}}} \right) \right]$$

where:

C_{op} = Operating capacity in Ampere-hours (A-h)

T_{total} = Total time the station is on battery power (in hours) = 5 hours

I_{tx} = Total current drain during transmit (in Amperes) = 14.5A

I_{rx} = Total current drain during receive/standby (in Amperes) = 2A

T_{tx} = Transmit time during a single cycle (in minutes) = 2 minutes

T_{rx} = Receive time during a single cycle (in minutes) = 1 minute

T_{cycle} = Cycle time (in minutes) = 3 minutes

Therefore:

$$C_{op} = 5 \times \left[14.5 \times \left(\sqrt{\frac{2}{3}} \right) + 2 \times \left(\sqrt{\frac{1}{3}} \right) \right]$$

$$C_{op} = 65$$

Now, how big is it? Let’s consider the rated battery capacity, C , as a function of the C_{op} calculated above. An approximation to the rated battery capacity can be calculated with the following equation:

$$C \approx C_{op} \times \left[\left(\frac{T_{cr}}{T_{op}} \right)^{0.1} \right]$$

where:

C = Rated battery capacity in Ampere hours (A-h)

T_{cr} = Rated battery discharge time in hours (usually 5, 10, or 20 hours)

T_{op} = Time, in hours, that the repeater will be operating on the battery

0.1 = Raise the term T_{cr} / T_{op} to the 0.1 power

A scientific calculator or the functions in a spreadsheet program can be used to solve the equation.

For our example, let’s consider the 65 A-h operating capacity, over 5 hours of operating on battery, and rated battery discharge times of 5 hours, 10 hours, and 20 hours.

1. $T_{cr} = 5$ hours

$$C \approx 65 \times \left[\left(\frac{5}{5} \right)^{0.1} \right]$$

$$C \approx 65$$

A 65 A-h (0.2C) battery would provide the required energy at room temperature environment.

2. $T_{cr} = 10$ hours

$$C \approx 65 \times \left[\left(\frac{10}{5} \right)^{0.1} \right]$$

$$C \approx 69.7$$

 Where to Buy the Battery?

A 70 A-h (0.1C) battery would provide the required energy at room temperature environment.

3. $T_{cr} = 20$ hours

$$C \approx 65 \times \left[\left(\frac{20}{5} \right)^{0.1} \right]$$

$$C \approx 74.7$$

A 75 A-h (0.05C) battery would provide the required energy at room temperature environment.

Remember that the above calculations are approximate. Different discharge rates yield different “end of discharge” cell voltages which were not taken into account. The battery revert module is designed to disconnect the station from the battery if the input voltage to the module drops below 11 V dc. When in doubt, you can consult the manufacturer of the battery you intend to use to obtain “project planning data” charts. Or, you can “err” to the high side and add 10% to 25% to the calculated number. If the battery is going to experience extremes in temperature, the capacity will

be affected. For cold climates, the capacity may need to be doubled or tripled.

Where to Buy the Battery?

Most of the larger electronic supply houses will carry or can obtain the type and capacity of battery required for your application. You may be able to deal directly with some of the battery manufacturers especially if you need large quantities of the same model.

NOTE

This trickle charger is intended to maintain the battery for long periods of time between power failures and is not intended for charging a fully discharged battery. If the battery is completely discharged, it must be removed and charged via a battery charger with higher current capability.

Section 8

Programming Professional Series Radios for use with a Basic Repeater Controller

Overview

This section describes the programming and setup of the Professional Series radios and the Basic (R*I*C*K) repeater controller for use in both unidirectional and bi-directional repeater configurations. Two Professional Series radios are required. In the unidirectional repeater configuration, one radio operates as the receiver of the repeater and the other radio operates as the transmitter of the repeater. In the bi-directional repeater configuration, each radio can receive or transmit. However, the radio that is connected to J3-TX will be referred to as the “transmit radio” and the radio that is connected to J5-RX will be referred to as the “receive radio”. Refer to the (R*I*C*K) manual, 6880901Z79, for additional information.

Programming

Programming Tools

The Professional Series Customer Programming Software (CPS) is used to program the receive radio and the transmit radio (or use archived CPS files for the radios) for the desired repeater configuration.

The Basic repeater controller is programmed with internal DIP switch settings.

Unidirectional Repeater

Professional Series Radios

Receive Radio Programming

1. Read the Professional Series receive radio.
2. After the radio is read, select “Radio Configuration” from the opening CPS “Tree View” window.
3. Click the “Basic” tab.
4. If necessary, uncheck the “Hook (HUB) Defeats PL” selection box. Your screen should appear similar to Figure 8-1.
5. Click the “Accessory Configuration” tab.
6. Click the “Rx Audio Type:” dropdown arrow button. Select “Filtered Audio”.
7. Click the “Ignition Sense Type:” dropdown arrow button. Select “On/Off & Ignition”. Your screen should appear similar to Figure 8-2.

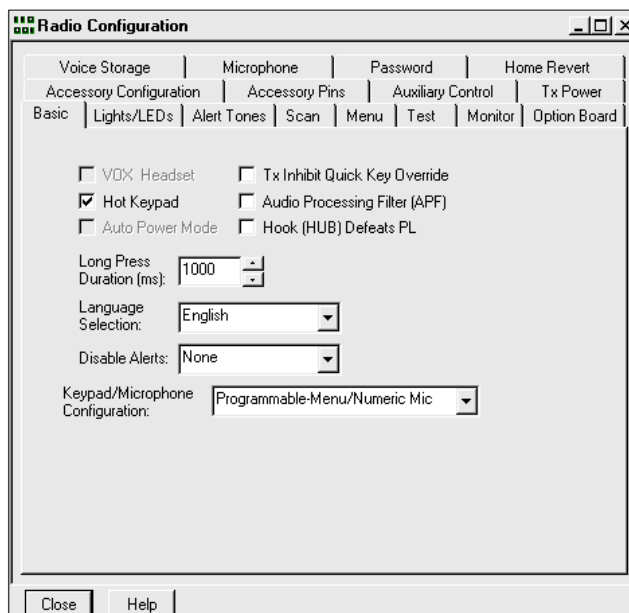


Figure 8-1. Basic (R*I*C*K) Unidirectional Repeater, Basic Configuration, Receive Radio

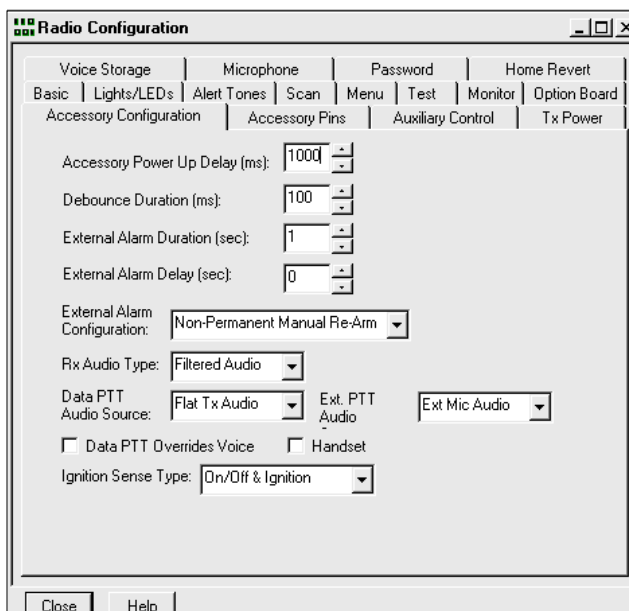


Figure 8-2. Basic (R*I*C*K) Unidirectional Repeater, Accessory Configuration, Receive Radio

Unidirectional Repeater

8. Click the “Accessory Pins” tab.
9. Click the “Accessory Package” dropdown arrow button. Select “RICK or I20R Rx”. Verify that pin 8 is “PL and CSQ Detect/Talkgroup Detect (Output)”, Active Level “Low”. Your screen should appear similar to Figure 8-3.

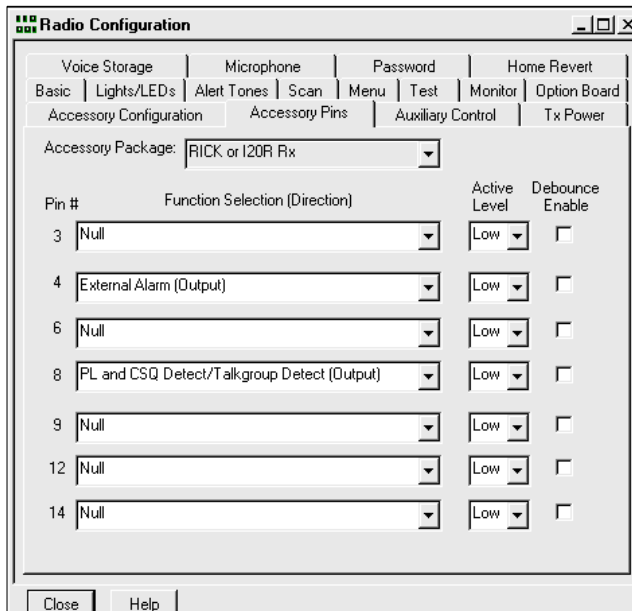


Figure 8-3. Basic (R*I*C*K) Unidirectional Repeater, Accessory Pins, Receive Radio

10. “Close” the Radio Configuration screen.
11. Click on the + indicator next to “Conventional Personality” selection from the opening CPS “Tree View” window.
12. Double click on the “Conventional Personality - 1” selection.
13. Select the “Basic” tab.
14. If the radio is a display model (LCD front panel), you may enter an “Alias” that will be displayed, such as “Repeater RX”.
15. Select a “Channel Bandwidth (kHz):” as defined by the radio licensing authority. You have the choice of 12.5, 20 or 25 kHz. (Typical bandwidths in the United States are 12.5 and 25 kHz for VHF Highband and 450 – 512 MHz UHF, and 20 kHz for Lowband.)
16. Enter the receive frequency for the repeater in the “Rx” area at “Frequency (MHz)”.
17. Select the “Squelch Type:” based upon the squelch type that the repeater will use. The

selections are: “CSQ” (Carrier Squelch), TPL (Tone Private Line or CTCSS) and DPL (Digital Private Line or CDCSS).

18. Check the “Rx Only Personality” box. Your screen should appear similar to Figure 8-4.

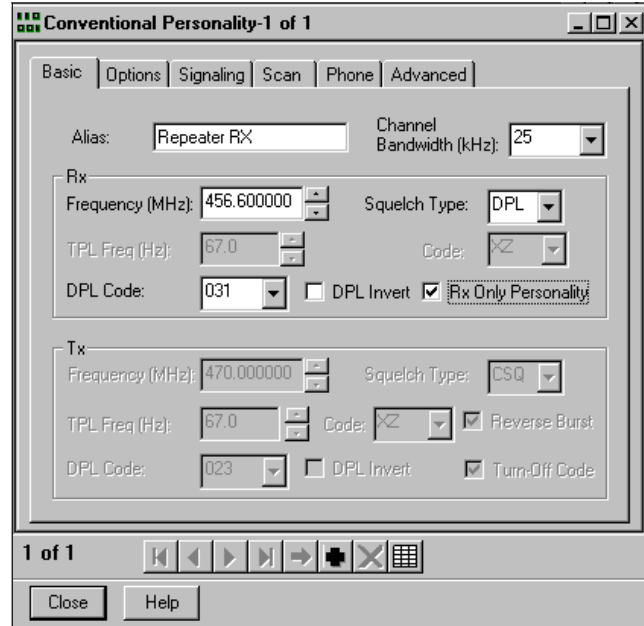


Figure 8-4. Conventional Personality, Basic, Receive Radio

19. Enter any other special programming requirements in the appropriate window.
20. Assign the personality to a zone in the “Personality Assignment to Zone” selection window.
21. Program the receive radio.

Transmit Radio Programming

1. Read the Professional Series transmit radio.
2. After the radio is read, select “Radio Configuration” from the opening CPS “Tree View” window.
3. Click the “Basic” tab.
4. If necessary, un-check the “Hook (HUB) Defeats PL” selection box. Your screen should appear similar to Figure 8-1 on page page 8-1 for the receive radio.
5. Click the “Accessory Configuration” tab.
6. Click the “Ext. PTT Audio” dropdown arrow button. Select “Ext Mic Audio”.

- Click the “Ignition Sense Type:” dropdown arrow button. Select “On/Off & Ignition”. Your screen should appear similar to Figure 8-5.

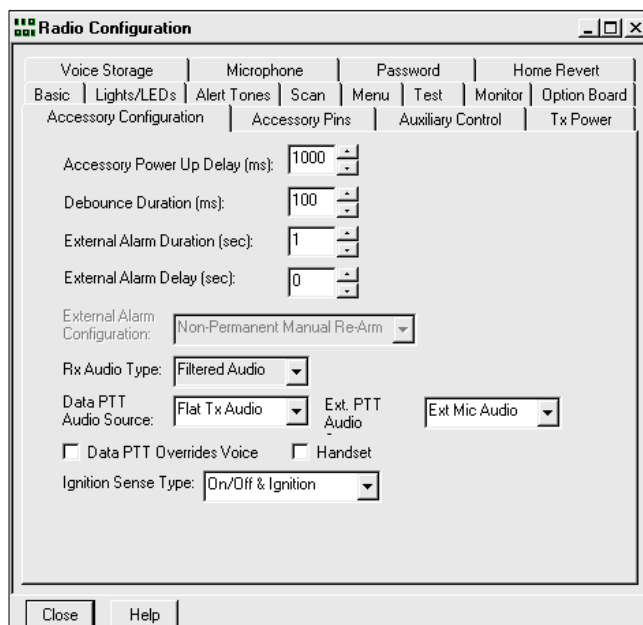


Figure 8-5. Basic (R*I*C*K) Unidirectional Repeater, Accessory Configuration, Transmit Radio

- Click the “Accessory Pins” tab.
- Click the “Accessory Package” dropdown arrow button. Select “RICK or I20R Tx”. Verify that pin 3 is “External Mic PTT (Input)”, Active Level “Low”. Your screen should appear similar to Figure 8-6.

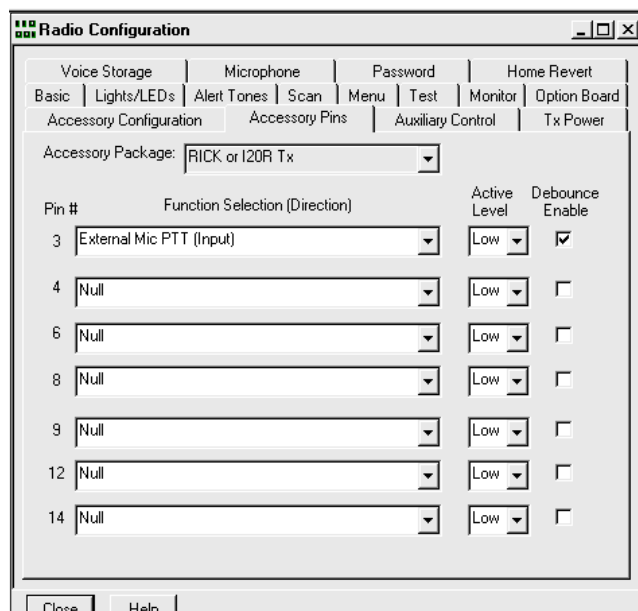


Figure 8-6. Basic (R*I*C*K) Unidirectional Repeater, Accessory Pins, Transmit Radio

In order to realize a “transparent” operation (60% peak system deviation from the transmit radio for 60% peak system deviation on the received signal), the accessory microphone gain for the transmit radio may be increased.

- Click the “Microphone” tab.
- Click the up-arrow button next to the “Accessory Mic Gain (dB)” display. Each click will change the gain by 1.5 dB. For use with the R*I*C*K, increase the gain to 31.5 dB or 33.0 dB. Your screen should appear similar to Figure 8-7.

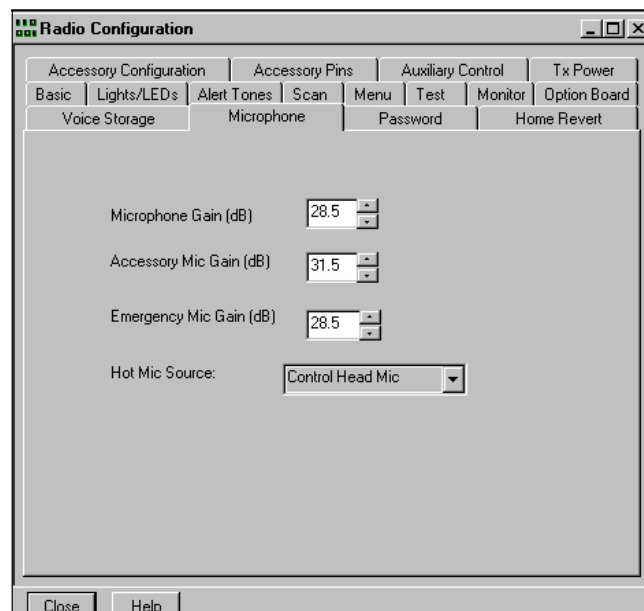


Figure 8-7. Radio Configuration, Microphone, Transmit Radio

- Close the “Radio Configuration” window.
- Click the + indicator next to “Conventional Personality” selection from the opening CPS “Tree View” window.
- Double click the “Conventional Personality - 1” selection.
- Select the “Basic” tab.
- If the radio is a display model (LCD front panel), you may enter an “Alias” such as “Repeater TX”.
- Select a “Channel Bandwidth (kHz):” as defined by the radio licensing authority.

Bi-directional Repeater

NOTE

In the United States of America, the Professional Series radios may not be used legally as the transmit radio in a UHF (450 to 512 MHz) repeater or base station application with 12.5 kHz channel spacing. The ± 2.5 -ppm frequency stability capability of the radio does not meet the requirements of Part 90 of the Rules and Regulations of the Federal Communications Commission (FCC). In other countries, check local frequency stability requirements before placing a Professional radio based repeater or base station in operation.

18. Enter the **transmit** frequency for the repeater in the “Rx” area at “Frequency (MHz)”.
19. Select the receiver “Squelch Type:” as “CSQ” (Carrier Squelch).
20. Enter the transmit frequency for the repeater in the “Tx” area at “Frequency (MHz)”.
21. Select the transmitter “Squelch Type:” based upon the type of operation that is required (CSQ, TPL or DPL). Your screen should appear similar to Figure 8-8.

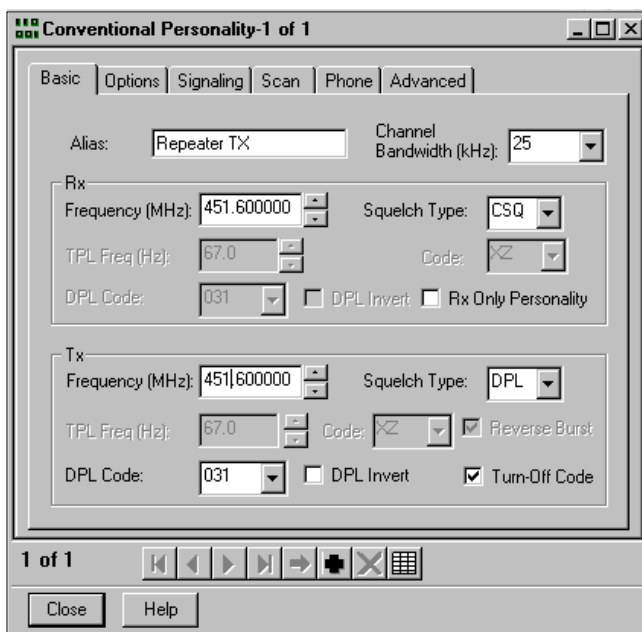


Figure 8-8. Conventional Personality, Basic, Transmit Radio

22. Enter any other special programming requirements in the appropriate windows.

23. Assign the personality to a zone in the “Personality Assignment to Zone” selection window.
24. Program the transmit radio.

Basic (R*I*C*K) Unidirectional Repeater - S2 DIP Switch Settings

Set the 12 positions of DIP switch S2 according to the following information:

1. The repeater is unidirectional: S2-1 “OFF”.
2. The pin 8 COR signal of the receive radio will key the transmit radio: S2-2 “OFF” and S2-3 “ON”.
3. There isn't any remote control to be used with the repeater: S2-4 “OFF”.
4. We will use normal receiver and transmitter audios from the radios; S2-5 “OFF”, S2-6 “ON”, S2-8 “OFF” and S2-9 “OFF”.
5. The audio gate in the Basic controller will be used: S2-7 “OFF”.
6. The unidirectional repeater will use dropout delay: S2-10 “OFF” for 3-second delay or “ON” for 1.5-second delay. S2-11 “OFF” in both cases.
7. The configuration is standard: S2-12 “OFF”.

The DIP switch should look similar to Figure 8-9.

Basic Adjustments

See "Basic Adjustments" at the end of this section for further instructions.

Bi-directional Repeater

Professional Series Radios

Receive Radio Programming

1. Read the Professional Series receive radio.
2. After the radio is read, select “Radio Configuration” from the opening CPS “Tree View” window.
3. Click the “Basic” tab.
4. If necessary, uncheck the “Hook (HUB) Defeats PL” selection box. Your screen should appear similar to Figure 8-1 on page 8-1.
5. Click the “Accessory Configuration” tab.
6. Click the “Rx Audio Type:” dropdown arrow button. Select “Filtered Audio”.

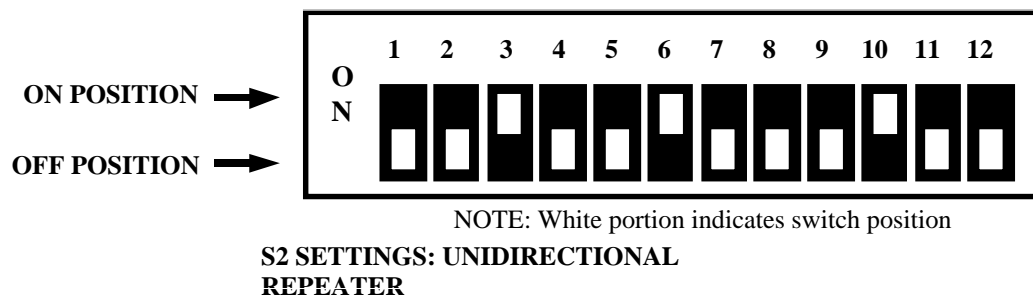


Figure 8-9. Basic (R*I*C*K) Unidirectional Repeater, DIP Switch S2 Settings

7. Click the “Ext. PTT Audio” dropdown arrow button. Select “Ext Mic Audio”.
8. Click the “Ignition Sense Type:” dropdown arrow button. Select “On/Off & Ignition”. Your screen should appear similar to Figure 8-2 on page 8-1.
9. Click the “Accessory Pins” tab.
10. Click the “Accessory Package” dropdown arrow button. Select “RICK or I20R Tx” (yes, “Tx” and not “Rx”). Verify that pin 3 is “External Mic PTT (Input)”, Active Level “Low”.
11. Click the “Pin # 14” down arrow button. Select “PL and CSQ Detect/Talkgroup Detect (Output)”, Active Level “Low”. Your screen should appear similar to Figure 8-10.

In order to realize a “transparent” operation (60% peak system deviation from the transmit radio for 60% peak system deviation on the received signal), the accessory microphone gain for the receive radio may be increased.

12. Click on the “Microphone” tab.
13. Click the up-arrow button next to the “Accessory Mic Gain (dB)” display. Each click will change the gain by 1.5 dB. For use with the R*I*C*K, increase the gain to 31.5 dB or 33.0 dB. Your screen should appear similar to Figure 8-7 on page 8-3.
14. “Close” the Radio Configuration window.
15. Click on the + indicator next to “Conventional Personality” selection from the opening CPS “Tree View” window.
16. Double click on the “Conventional Personality - 1” selection.
17. Select the “Basic” tab.
18. If the radio is a display model (LCD front panel), you may enter an “Alias” that will be displayed, such as “Repeater RX”.
19. Select a “Channel Bandwidth (kHz):” as defined by the radio licensing authority. You have the choice of 12.5, 20 or 25 kHz. (Typical bandwidths in the United States are 12.5 and 25 kHz for VHF Highband and 450 – 512 MHz UHF, and 20 kHz for Lowband.)
20. Enter the receive frequency for the receive radio of the bi-directional repeater in the “Rx” area at “Frequency (MHz)”.
21. Select the “Squelch Type:” based upon the squelch type that the repeater will use. The selections are: “CSQ” (Carrier Squelch), TPL (Tone Private Line or CTCSS) and DPL (Digital Private Line or CDCSS).

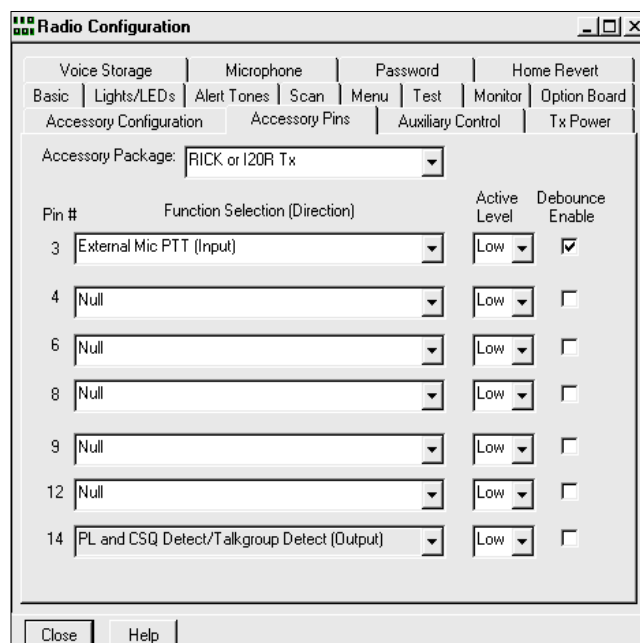


Figure 8-10. Basic (R*I*C*K) Bi-directional Repeater, Accessory Pins, Receive Radio

Bi-directional Repeater

NOTE

Programming for Carrier Squelch operation will allow proper monitoring of the operating frequency if required by local communications regulations.

22. Enter the transmit frequency for the receive radio of the bi-directional repeater in the “Tx” area at “Frequency (MHz)”.
23. Select the transmitter “Squelch Type:” based upon the type of operation that is required (CSQ, TPL or DPL). Your screen should appear similar to Figure 8-11.

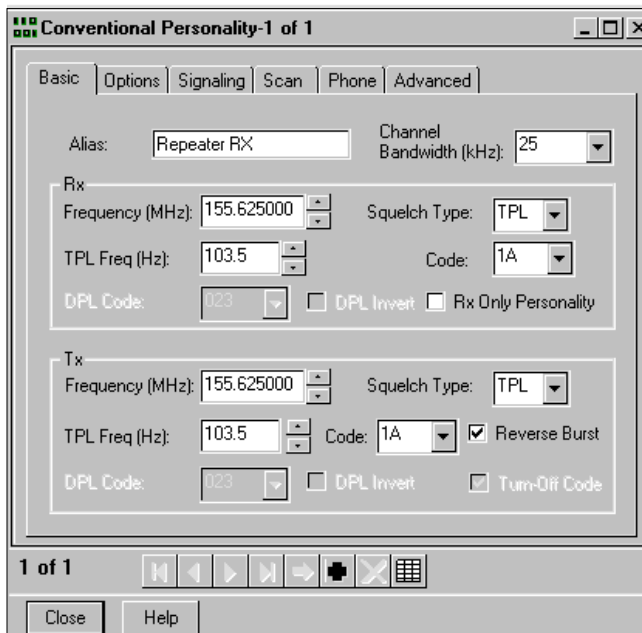


Figure 8-11. Conventional Personality, Basic, Receive Radio

24. Enter any other special programming requirements in the appropriate windows.
25. Assign the personality to a zone in the “Personality Assignment to Zone” selection windows.
26. Program the receive radio.

Transmit Radio Programming

1. Read the Professional Series transmit radio.
2. After the radio is read, select “Radio Configuration” from the opening CPS “Tree View” window.
3. Click the “Basic” tab.
4. If necessary, un-check the “Hook (HUB) Defeats PL” selection box. Your screen should

appear similar to Figure 8-1 on page 8-1 for the receive radio.

5. Click the “Accessory Configuration” tab.
6. Click the “Rx Audio Type:” dropdown arrow button. Select “Filtered Audio”.
7. Click the “Ext. PTT Audio” dropdown arrow button. Select “Ext Mic Audio”.
8. Click the “Ignition Sense Type:” dropdown arrow button. Select “On/Off & Ignition”. Your screen should appear similar to Figure 8-5 on page 8-3.
9. Click the “Accessory Pins” tab.
10. Click the “Accessory Package” dropdown arrow button. Select “RICK or I20R Tx”. Verify that pin 3 is “External Mic PTT (Input)”, Active Level “Low”.
11. Click on the “Pin #8” down button. Select “PL and CSQ Detect/Talkgroup Detect (Output)”, Active Level “Low”. Your screen should appear similar to Figure 8-12.

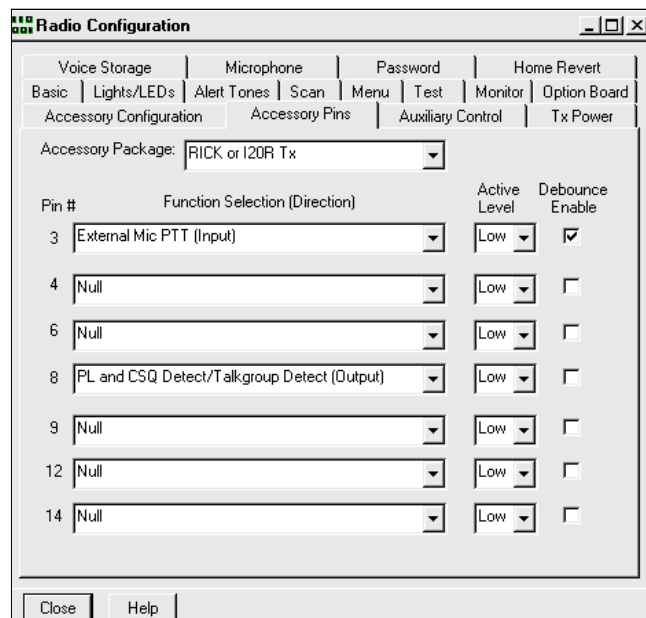


Figure 8-12. Basic (R*I*C*K) Bi-directional Repeater, Accessory Pins, Transmit Radio

In order to realize a “transparent” operation (60% peak system deviation from the transmit radio for 60% peak system deviation on the received signal), the accessory microphone gain for the transmit radio may be increased.

12. Click on the “Microphone” tab.

13. Click the up-arrow button next to the “Accessory Mic Gain (dB)” display. Each click will change the gain by 1.5 dB. For use with the Basic (R*I*C*K), increase the gain to 31.5 dB or 33.0 dB. Your screen should appear similar to Figure 8-7 on page 8-3.
14. “Close” the Radio Configuration window.
15. Click the + indicator next to “Conventional Personality” selection from the opening CPS “Tree View” window.
16. Double click the “Conventional Personality - 1” selection.
17. Select the “Basic” tab.
18. If the radio is a display model (LCD front panel), you may enter an “Alias” such as “Repeater TX”.
19. Select a “Channel Bandwidth (kHz):” as defined by the radio licensing authority.

NOTE

In the United States of America, the Professional Series radios may not be used legally as the transmit radio in a UHF (450 to 512 MHz) repeater or base station application with 12.5 kHz channel spacing. The ± 2.5 -ppm frequency stability capability of the radio does not meet the requirements of Part 90 of the Rules and Regulations of the Federal Communications Commission (FCC). In other countries, check local frequency stability requirements before placing a Professional radio based repeater or base station in operation.

20. Enter the receive frequency for the transmit radio of the bi-directional repeater in the “Rx” area at “Frequency (MHz)”.
21. Select the receiver “Squelch Type:” based upon the type of operation that is required (CSQ, TPL or DPL).
22. Enter the transmit frequency for the transmit radio of the bi-directional repeater in the “Tx” area at “Frequency (MHz)”.
23. Select the transmitter “Squelch Type:” based upon the type of operation that is required (CSQ, TPL or DPL). Your screen should appear similar to Figure 8-13.
24. Enter any special programming requirements in the appropriate windows.

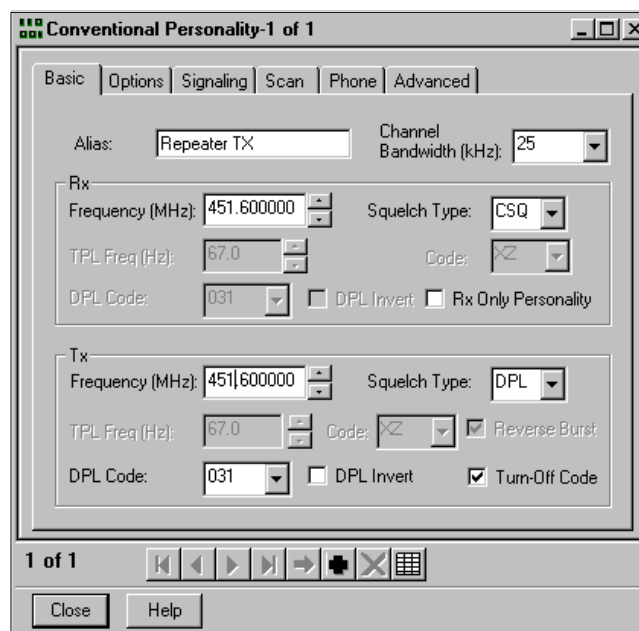


Figure 8-13. Conventional Personality, Basic, Transmit Radio

25. Assign the personality to a zone in the “Personality Assignment to Zone” selection windows.
26. Program the transmit radio.

Basic (R*I*C*K) Bi-directional Repeater – S2 DIP Switch Settings

Set the 12 positions of DIP switch S2 according to the following information:

1. The repeater is bi-directional: S2-1 “ON”.
2. The pin 14 COR signal of the receive radio will key the transmit radio: S2-2 “ON” and S2-3 “OFF”.
3. There isn't any remote control to be used with the repeater: S2-4 “OFF”.
4. We will use normal receiver and transmitter audios from the radios; S2-5 “OFF”, S2-6 “ON”, S2-8 “ON” and S2-9 “OFF”.
5. The audio gate in the Basic controller will be used: S2-7 “OFF”.
6. The bi-directional repeater will use the shortest dropout delay: S2-10 and S2-11 “ON”.
7. The configuration is standard: S2-12 “OFF”.

The DIP switch should look similar to Figure 8-14.

Basic Adjustments

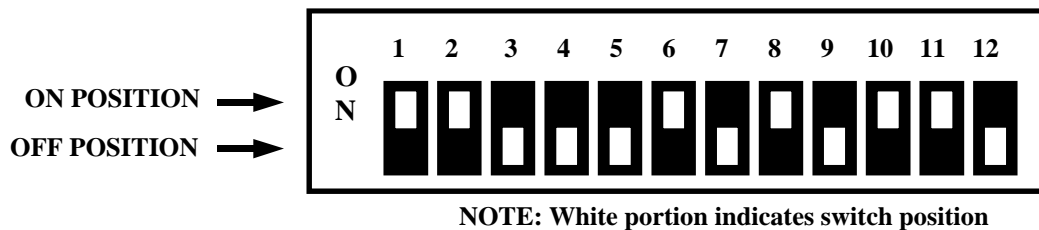
**S2 SETTINGS: BIDIRECTIONAL REPEATER**

Figure 8-14. Basic (R*I*C*K) Bi-directional Repeater, DIP Switch S2 Settings

Basic Adjustments

Jumper Configurations

Table 8-1 lists the programmable audio selections for the Professional Series transmit and receive radios when used with the Basic repeater controller. Table 8-2 lists the jumper settings for JU1 on the Basic repeater controller.

Adjustments

The following steps should be performed with a service monitor, such as the Motorola R2000 series, connected to the antenna jack of the duplexer (or the transmit radio, if applicable). The service monitor must be operating in the duplex mode. Set the service monitor to monitor the frequency of the transmit radio while generating the duplex signal at the frequency of the receive radio. Refer to the operating instructions of your service monitor.

1. Remove the Basic repeater controller in its tray from the repeater. Remove the controller from its tray, then remove the controller board from the housing by unscrewing the two long T15 machine screws at the rear of the housing. It will be necessary to unplug the cables from the board.
2. Reattach the cables to the Basic repeater controller board after the board is out of the housing.
3. Before energizing the power supply or the radios, ensure that the **REPEATER ENABLE** switch of the Basic repeater controller is in the released (out) position. Failure to “disable” the repeater will result in keying of the transmit radio.
4. Connect the line cord from the power supply of the repeater to a suitable 50/60 Hz ac source.
5. If necessary, turn on the two radios by pushing in the volume controls.
6. If the yellow LED is not illuminated, press the **SET-UP** momentary pushbutton switch.
7. Press the **REPEATER ENABLE** switch to the engaged (in) position; the green LED should illuminate.
8. Modulate the duplex generator of the service monitor with a 1 kHz tone at 60 percent of full rated system deviation.
9. Adjust potentiometer R23 in the Basic repeater controller for 60 percent of full rated system deviation of the transmit radio. If you cannot achieve at least 50 percent full rated system deviation with R23 at the maximum setting, increase the “Accessory Mic Gain (dB)”, under Radio Configurations in the CPS, for the transmit radio and readjust R23.
10. For a bi-directional repeater, apply a signal at the frequency of the receiver of the transmit radio. Modulate the duplex generator of the service monitor with a 1 kHz tone at 60 percent of full rated system deviation.
11. Set the service monitor to monitor the frequency of the transmitter of the receive radio.
12. Adjust potentiometer R24 in the Basic repeater controller for 60 percent of full rated system deviation of the receive radio. If you cannot achieve at least 50 percent full rated system deviation with R24 at the maximum setting, increase the “Accessory Mic Gain (dB)”, under Radio Configurations in the CPS, for the receive radio and readjust R24.
13. Check the settings of the 12 positions of DIP switch S2 for correctness.
14. Unplug the cables attached to the Basic repeater controller board.
15. Place the Basic repeater controller board into the housing. Attach the front panel with the two long T15 machine screws that were removed in Step 1.
16. Attach the cables to the Basic repeater controller.
17. Follow the procedures in this manual to remount the Basic repeater controller in its tray in the repeater housing.

Table 8-1. CPS Accessory Configuration (Professional Series Radios)

Repeater Audio	“Rx Audio Type”	“Ext PTT Source”
EIA	“Filtered Audio”	“Ext Mic Audio”
Flat	“Flat Audio”	“Flat Tx Audio”

Table 8-2. Basic Repeater Controller Jumper Setting

Jumper	Default	Notes
JU1	Setup	Setup = Both radios turn on at power-up (repeater functional). Knockdown = Only receive radio turns on at power up.

Section 9

Programming the Professional Series Radios for use with a ZR310 Repeater Controller

Overview

This section describes the programming and setup of the Professional Series radios for use with a Zetron ZR310 repeater controller in a “community” repeater configuration. Two Professional Series radios are required; one operates as the receiver for the repeater and the other operates as the transmitter of the repeater. For more information on the ZR310, please refer to the following manual:

6880904Z64 ZR310 Community Repeater Panel
Service Manual

Programming

Programming Tools

Use the Professional Series Customer Programming Software (CPS) to program the receive radio and the transmit radio (or use archived CPS files for the radios) for the desired repeater configuration.

Refer to the ZR310 service manual, 6880904Z64, for ZR310 controller programming information.

Professional Series Radios

Receive Radio Programming

1. Read the Professional Series receive radio.
2. After the radio is read, select “Radio Configuration” from the opening CPS “Tree View” window.
3. Click the “Accessory Configuration” tab.
4. Click the “Rx Audio Type:” dropdown arrow button. Select “Flat Audio”.
5. Click the “Ignition Sense Type:” dropdown arrow button. Select “On/Off & Ignition”. Your screen should appear similar to Figure 9-1.
6. Click the “Accessory Pins” tab.
7. Click the “Accessory Package” dropdown arrow button. Select “Community RPTR (ZR310) Rx”. Verify that pin 4 is “CSQ Detect (Output)”, Active Level “High”. Your screen should appear similar to Figure 9-2.

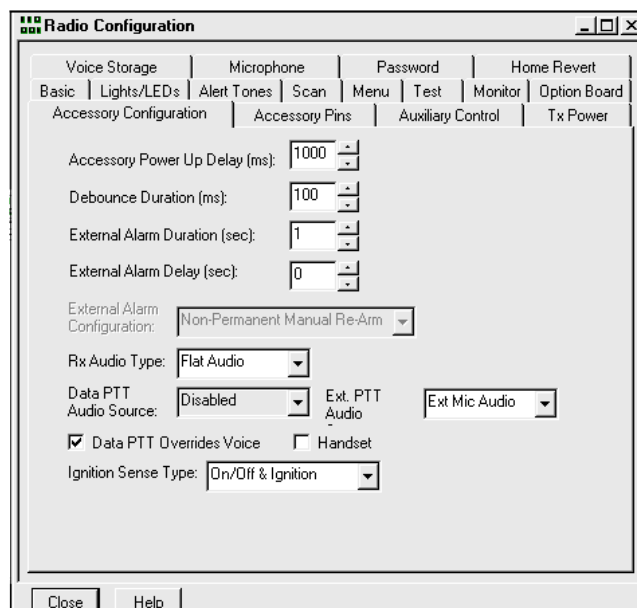


Figure 9-1. Radio Configuration, Accessory Configuration, Receive Radio

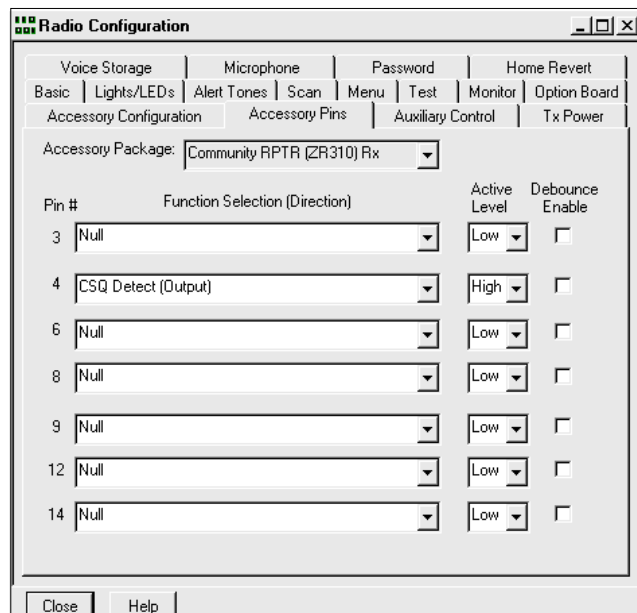


Figure 9-2. Radio Configuration, Accessory Pins, Receive Radio

Programming

8. “Close” the “Radio Configuration” window.
9. Click the + indicator next to “Conventional Personality” selection from the opening CPS “Tree View” window.
10. Double click the “Conventional Personality - 1” selection.
11. Select the “Basic” tab.
12. If the radio is a display model (LCD front panel), you may enter an “Alias” such as “Repeater RX”.
13. Select a “Channel Bandwidth (kHz):” as defined by the radio licensing authority. You have the choice of 12.5, 20 or 25 kHz. (Typical bandwidths in the United States are 12.5 and 25 kHz for VHF Highband and UHF, and 20 kHz for Lowband.)
14. Enter the receive frequency for the repeater in the “Rx” area at “Frequency (MHz)”.
15. Select the “Squelch Type:” as “CSQ” (Carrier Squelch).
16. Check the “Rx Only Personality” box. Your screen should appear similar to Figure 9-3.

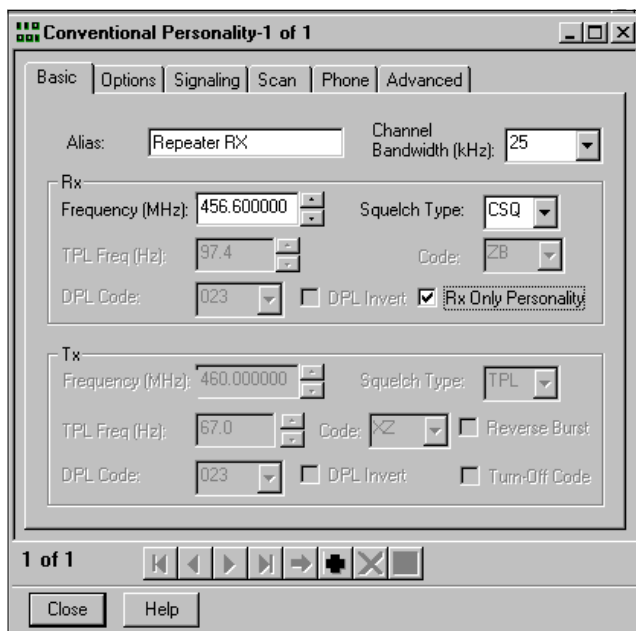


Figure 9-3. Conventional Personality, Basic, Receive Radio

17. Enter any other special programming requirements in the appropriate windows.
18. Assign the personality to a zone in the “Personality Assignment to Zone” selection windows.
19. Program the receive radio.

Transmit Radio Programming

1. Read the Professional Series transmit radio.
2. After the radio is read, select “Radio Configuration” from the opening CPS “Tree View” window.
3. Click the “Accessory Configuration” tab.
4. Click the “Ext. PTT Audio” dropdown arrow button. Select “Ext Mic & Flat TX”.
5. Click the “Ignition Sense Type:” dropdown arrow button. Select “On/Off & Ignition”. Your screen should appear similar to Figure 9-4.

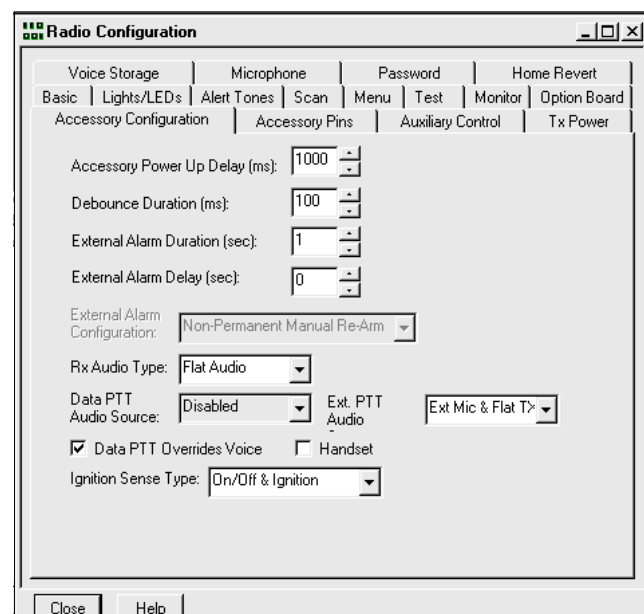


Figure 9-4. Radio Configuration, Accessory Configuration, Transmit Radio

6. Click the “Accessory Pins” tab.
7. Click the “Accessory Package” dropdown arrow button. Select “Community RPTR (ZR310) Tx”. Verify pin 3 is defined as “External Mic PTT (Input)”, Active Level “Low” and pin 4 is defined as “CSQ Detect (Output)”, Active Level “High”. Your screen should appear similar to Figure 9-5.
8. “Close” the “Radio Configuration” window.
9. Click the + indicator next to “Conventional Personality” selection from the opening CPS “Tree View” window.
10. Double click the “Conventional Personality - 1” selection.
11. Select the “Basic” tab.

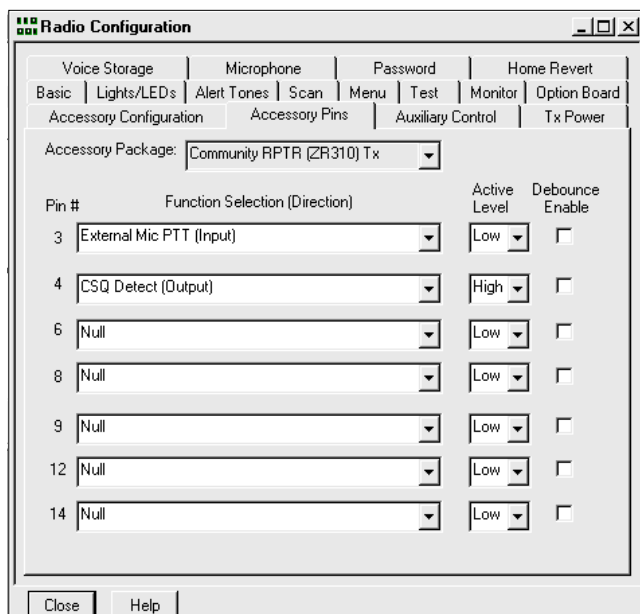


Figure 9-5. Radio Configuration, Accessory Connector, Transmit Radio

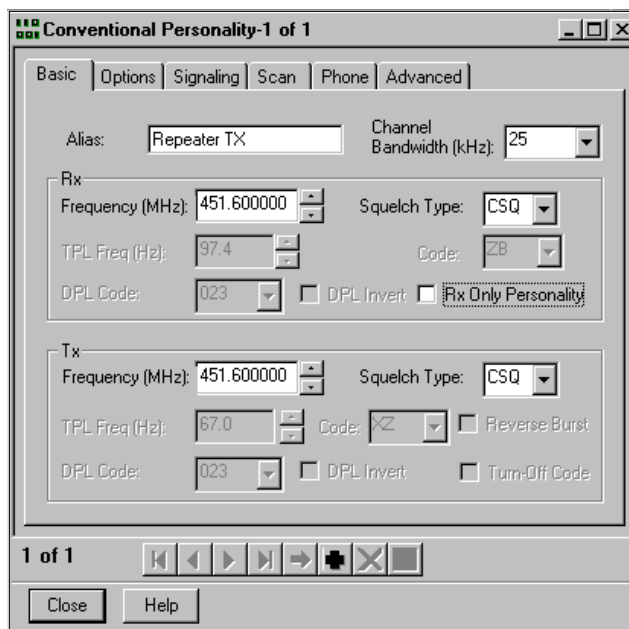


Figure 9-6. Conventional Personality, Basic, Transmit Radio

- If the radio is a display model (LCD front panel), you may enter an "Alias" such as "Repeater TX".
- Select a "Channel Bandwidth (kHz):" as defined by the radio licensing authority.

- Enter any other special programming requirements in the appropriate windows.
- Assign the personality to a zone in the "Personality Assignment to Zone" selection windows.
- Program the transmit radio.

NOTE

In the United States of America, the Professional Series radios may not legally be used as the transmit radio in a UHF (450 to 512 MHz) repeater or base station application with 12.5 kHz channel spacing. The ± 2.5 -ppm frequency stability capability of the radio does not meet the requirements of Part 90 of the Rules and Regulations of the Federal Communications Commission (FCC). In other countries, check local frequency stability requirements before placing a Professional Series radio based repeater or base station in operation.

- Enter the transmit frequency for the repeater in the "Rx" area at "Frequency (MHz)".
- Select the "Squelch Type:" as "CSQ" (Carrier Squelch).
- Enter the transmit frequency for the repeater in the "Tx" area at "Frequency (MHz)".
- Select the "Squelch Type:" as "CSQ". Your screen should appear similar to Figure 9-6.

Zetron ZR310 Community Repeater Panel

ZR310 Jumper Configurations

Set the internal jumpers of the ZR310 controller according to Table 9-1. Refer to the ZR310 service manual, 6880904Z64, for further details.

Table 9-1. ZR310 Jumper Settings

Jumper	Setting
JP1	B (16)
JP3	A (8)

ZR310 Programming

Refer to the ZR310 service manual, 6880904Z64, for programming information. The VHF Professional Series radios require the ZR310 to be programmed for inverted polarity decode and normal polarity encode. The UHF Professional Series radios require the ZR310 to be programmed for normal polarity decode and encode.

Programming

Enter the ZR310 programming mode (the default programming access code is **12310#**). Then enter the following commands depending upon which band of operation for the repeater.

Table 9-2. ZR310 Commands

Band	Commands
VHF	215# and 218#
VHF	215# and 217#

Ignition Sense Wiring

Adding the ignition sense lead to pin 10 of the 16-pin connectors of the radios will ensure that the repeater will automatically power-up whenever power is applied. This is particularly important when the repeater is mounted in a relatively inaccessible location. Refer to Section 12, Ignition Sense Wiring, of this manual.

NOTE

If you haven't already done so, program both of the radios for "Ignition Sense Type:" as "On/Off & Ignition" or "Follow Ignition Only" in the Accessory Configuration window (in Radio Configuration).

Professional Series Radio Adjustments

The application of the Voice and TPL/DPL from the accessory connector of the Professional Series radios

requires a modification to the modulation calibration of the radio.

NOTE

The maximum "voice" deviation of the Professional Series radio must be reduced to allow for the added TPL/DPL signal that is generated by the ZR310.

For example, consider a ZR310 repeater that is setup to operate on 25 kHz channel spacing (maximum system peak deviation equal to ± 5 kHz). If the TPL/DPL deviation is ± 750 Hz, then the maximum deviation of the radio must be less than ± 4.25 kHz in the *Carrier Squelch* mode.

The adjustment to the maximum "voice" deviation is accomplished with the "Tuner" service software provided in the same disk set with the CPS.

WARNING

Failure to follow the above recommendation may cause the peak deviation to exceed the maximum allowed by the local licensing authority (the Federal Communications Commission in the United States of America) and result in the issuance of a citation with possible imposition of monetary fines.

Section 10

Programming the Professional Series Radios for use with a i20R Repeater Controller

Overview

This section describes the programming and setup of the Professional Series radios and the Motorola i20R repeater controller for use in a “campus” repeater configuration. Two Professional Series radios are required; one operates as the receiver for the repeater and the other operates as the transmitter of the repeater. For more information on the i20R, please refer to the following manuals:

6880904Z40 i20R Repeater Controller Service Manual

6880904Z55 i20R Repeater Controller Radio Service Software Manual

Programming

Programming Tools

The Professional Series Customer Programming Software (CPS) is used to program the receive radio and the transmit radio (or use archived CPS files for the radios) for the desired repeater configuration.

The Radio Service Software (RSS) for the i20R is used to program the parameters for the i20R controller. Refer to the i20R RSS manual, 6880904Z55, for details.

Professional Series Radios

Receive Radio Programming

1. Read the Professional Series receive radio.
2. After the radio is read, double click the “Radio Configuration” selection from the opening CPS “Tree View” window.
3. Click the “Accessory Configuration” tab.
4. Click the “Rx Audio Type:” arrow button.
5. Select “Flat Audio”.
6. Click the “Ignition Sense Type:” arrow button.
7. Select “On/Off & Ignition”. Your window should appear similar to Figure 10-1.
8. Click the “Accessory Pins” tab.
9. Click the “Accessory Package” arrow button.

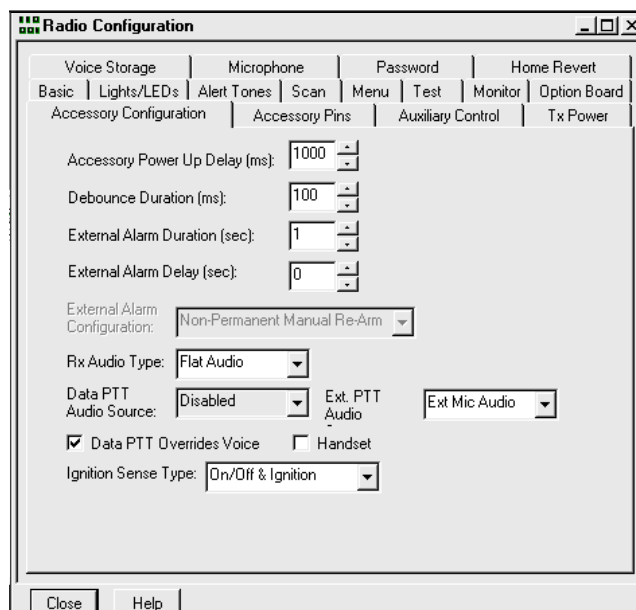


Figure 10-1. Radio Configuration, Accessory Configuration, Receive Radio

10. Select “RICK or I20R Rx”. Verify that pin 8 is “PL and CSQ Detect/Talkgroup Detect (Output)”, Active Level “Low”. Your screen should appear similar to Figure 10-2.
11. “Close” the “Radio Configuration” window.
12. Click on the + indicator next to “Conventional Personality” selection from the opening CPS “Tree View” window.
13. Double click on the “Conventional Personality - 1” selection.
14. Select the “Basic” tab.
15. If the radio is a display model (LCD front panel), you may enter an “Alias” that will be displayed such as “Repeater RX”.
16. Select a “Channel Bandwidth (kHz):” as defined by the radio licensing authority. You have the choice of 12.5, 20 or 25 kHz. (Typical bandwidths in the United States are 12.5 and 25 kHz for VHF Highband and 450 – 512 MHz UHF, and 20 kHz for Lowband.)

Programming

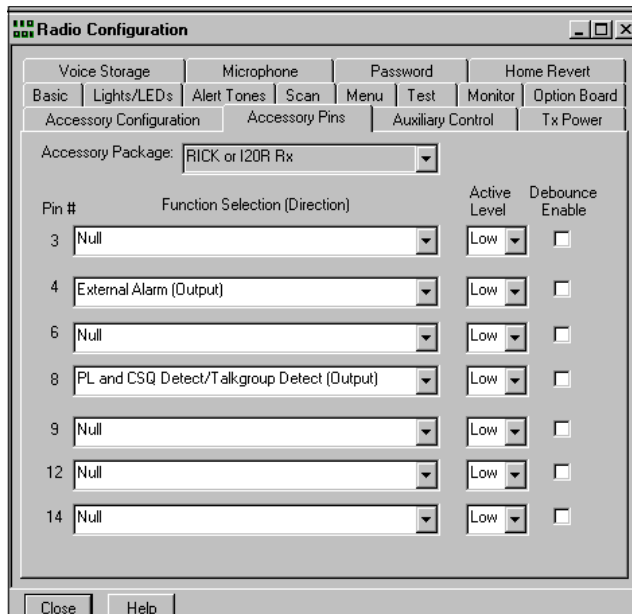


Figure 10-2. Radio Configuration, Accessory Pins, Receive Radio

17. Enter the receive frequency for the repeater in the “Rx” area at “Frequency (MHz)”.
18. Select the “Squelch Type:” as “CSQ” (Carrier Squelch).
19. Check the “Rx Only Personality” box. Your screen should appear similar to Figure 10-3.

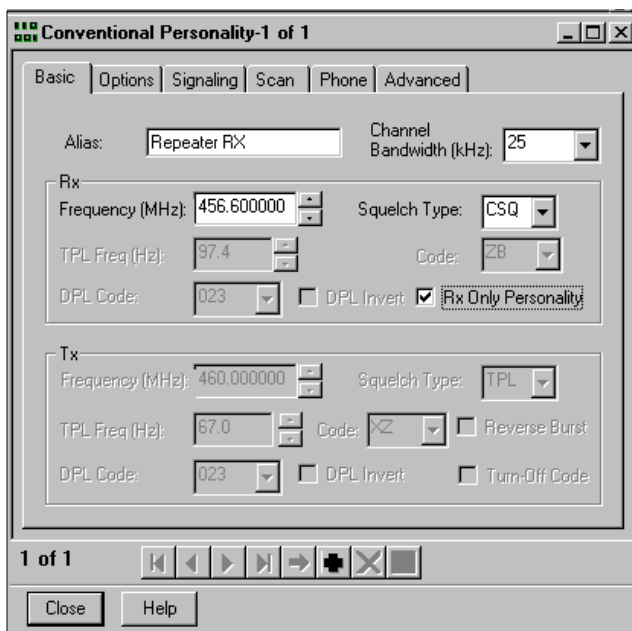


Figure 10-3. Conventional Personality, Basic, Receive Radio

20. Enter any other special programming requirements in the appropriate windows.
21. Assign the personality to a zone in the “Personality Assignment to Zone” selection windows.
22. Program the receive radio.

Transmit Radio Programming

1. Read the Professional Series transmit radio.
2. After the radio is read, double click on “Radio Configuration” from the opening CPS “Tree View” window.
3. Click the “Accessory Configuration” tab.
4. Click the “Ext. PTT Audio” dropdown arrow button. Select “Ext Mic & Flat TX”.
5. Click the “Ignition Sense Type:” arrow button.
6. Select “On/Off & Ignition”. Your screen should appear similar Figure 10-4.

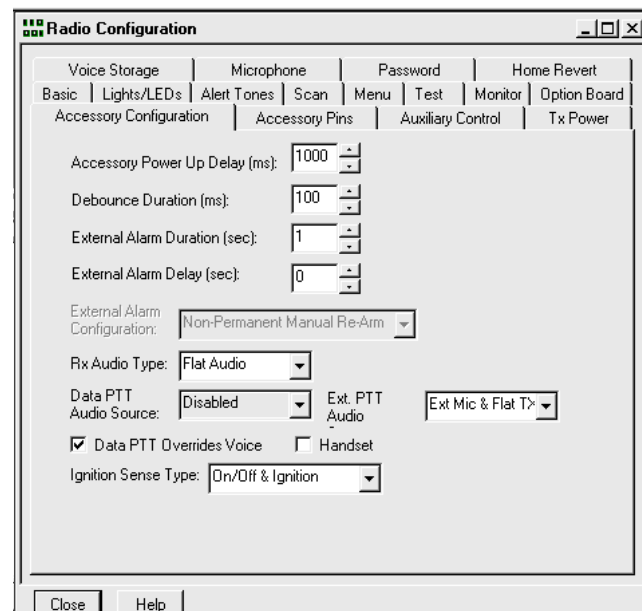


Figure 10-4. Radio Configuration, Accessory Configuration, Transmit Radio

7. Click the “Accessory Pins” tab.
8. Click the “Accessory Package” arrow button.
9. Select “RICK or I2OR Tx”. Verify pin 3 is defined as “External Mic PTT (Input)”, Active Level “Low”. Your screen should appear similar to Figure 10-5.
10. Click the “Microphone” tab.

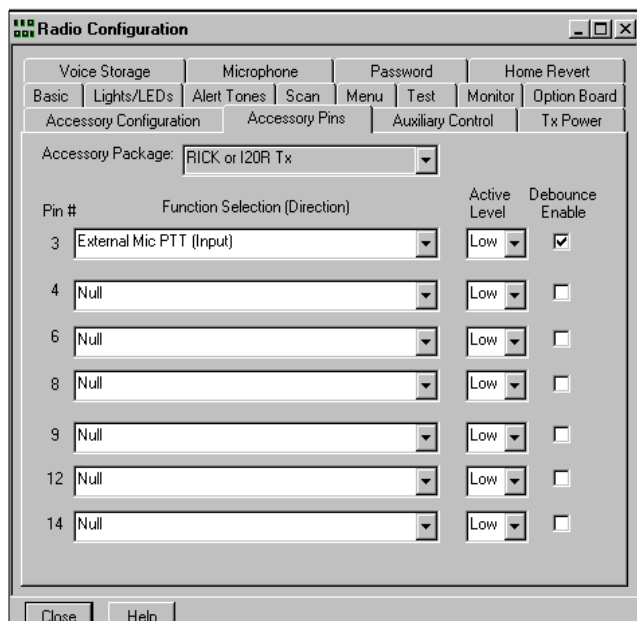


Figure 10-5. Radio Configuration, Accessory Pins, Transmit Radio

- Click on the “Accessory Mic Gain (dB)” up arrow button to increase the gain to “31.5”. Your screen should appear similar Figure 10-6.

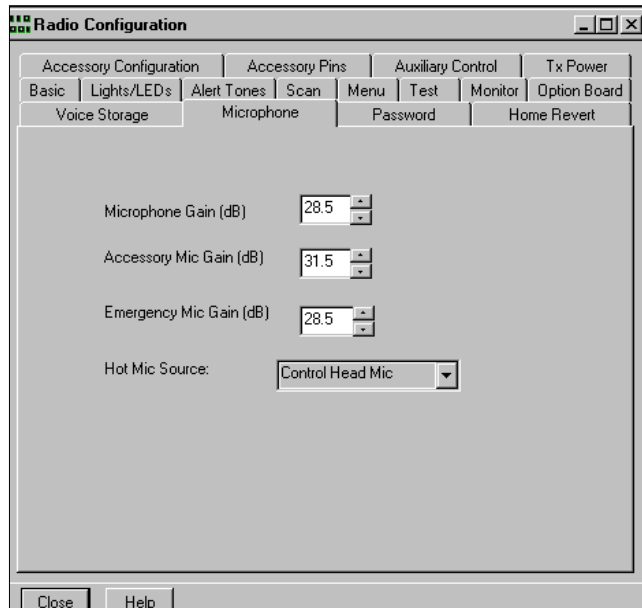


Figure 10-6. Radio Configuration, Microphone, Transmit Radio

- “Close” the “Radio Configuration” window.
- Click the + indicator next to “Conventional Personality” selection from the opening CPS “Tree View” window.

- Double click the “Conventional Personality - 1” selection.
- Select the “Basic” tab.
- If the radio is a display model (LCD front panel), you may enter an “Alias” that will be displayed such as “Repeater Tx”.
- Select a “Channel Bandwidth (kHz):” as defined by the radio licensing authority.

NOTE

In the United States of America, the Professional Series radios may not legally be used as the transmit radio in a UHF (450 to 512 MHz) repeater or base station application with 12.5 kHz channel spacing. The ±2.5-ppm frequency stability capability of the radio does not meet the requirements of Part 90 of the Rules and Regulations of the Federal Communications Commission (FCC). In other countries, check local frequency stability requirements before placing a Professional radio based repeater or base station in operation.

- Enter the transmit frequency for the repeater in the “Rx” area at “Frequency (MHz)”.
- Select the “Squelch Type:” as “CSQ” (Carrier Squelch).
- Enter the transmit frequency for the repeater in the “Tx” area at “Frequency (MHz)”.
- Select the “Squelch Type:” as “CSQ” (Carrier Squelch). Your screen should appear similar to Figure 10-7.
- Enter any other special programming requirements in the appropriate windows.
- Assign the personality to a zone in the “Personality Assignment to Zone” selection windows.
- Program the transmit radio.

i20R Campus Repeater Panel

i20R Programming

Use the information available in the i20R RSS Manual, 6880904Z55, to program the interconnecting jacks, repeater parameters and user parameters.

Programming

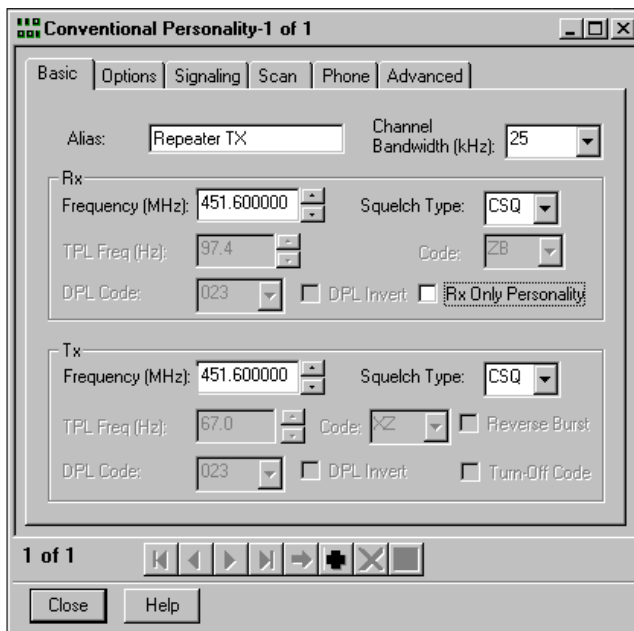


Figure 10-7. Conventional Personality, Basic, Transmit Radio

i20R Jumper Configurations

Table 10-1. i20R Jumper Settings

Jumper	Setting
JU20	IN
JU21	IN

i20R Adjustments

Follow the instructions in the i20R Service Manual, 6880904Z40, to adjust the repeater operation. The TPL/DPL level adjustment, with the “SIG” potentiometer, is “touchy”. The input sensitivity of the Professional Series radios makes adjustment to 15% to 20% of rated system peak deviation rather difficult.

Ignition Sense Wiring

Adding the ignition sense lead to pin 10 of the 16-pin connectors of the radios will ensure that the repeater will automatically power-up whenever power is applied. This is particularly important when the repeater is mounted in a relatively inaccessible location. Refer to Section 12, Ignition Sense Wiring, of this manual.

NOTE

If you haven't already done so, program both of the radios for “Ignition Sense Type:” as “On/Off & Ignition” or “Follow Ignition Only” in the Accessory Configuration window (in Radio Configuration).

Professional Series Radio Adjustments

The application of the Voice and TPL/DPL from the accessory connector of the Professional Series radios requires a modification to the modulation calibration of the radio.

NOTE

The maximum “voice” deviation of the Professional Series radio must be reduced to allow for the added TPL/DPL signal that is generated by the i20R.

For example, consider an i20R repeater that is setup to operate on 25 kHz channel spacing (maximum system peak deviation equal to ± 5 kHz). If the TPL/DPL deviation is ± 750 Hz, then the maximum deviation of the Professional Series radio must be adjusted to less than ± 4.25 kHz in the *Carrier Squelch* mode.

The adjustment to the maximum “voice” deviation is accomplished with the “Tuner” service software program provided in the same disk set with the CPS.

WARNING

Failure to follow the above recommendation may cause the peak deviation to exceed the maximum allowed by the local licensing authority (the Federal Communications Commission in the United States of America) and result in the issuance of a citation with possible imposition of monetary fines.

Section 11

Programming the Professional Series Radios for use with a ZR340 Repeater Controller

Overview

This section describes the programming and setup of the Professional Series radios for use with a Zetron ZR340 telephone interconnect repeater controller. Two Professional Series radios are required; one operates as the receiver for the repeater and the other operates as the transmitter of the repeater. For more information on the ZR340, please refer to the following manual:

6880905Z90 ZR340 Advanced Interconnect
Instruction Manual

Programming

Programming Tools

Professional Series Radios

Use the Professional Series Customer Programming Software (CPS) to program the receive radio and the transmit radio (or use archived CPS files for the radios) for the desired repeater configuration.

ZR340 Advanced Telephone Interconnect

The ZR340 Advanced Telephone Interconnect is programmed with DTMF sequences from the DTMF pad on a mobile or portable radio. Refer to the ZR340 instruction manual, 6880905Z90, for programming information and commands.

Professional Series Radios

Receive Radio Programming

1. Read the Professional Series receive radio.
2. After the radio is read, select "Radio Configuration" from the opening CPS "Tree View" window.
3. Click the "Basic" tab.
4. If necessary, uncheck the "Hook (HUB) Defeats PL" selection box. Your screen should appear similar to Figure 11-1.
5. Click the "Accessory Configuration" tab.
6. Click the "Rx Audio Type:" dropdown arrow button. Select "Filtered Audio".

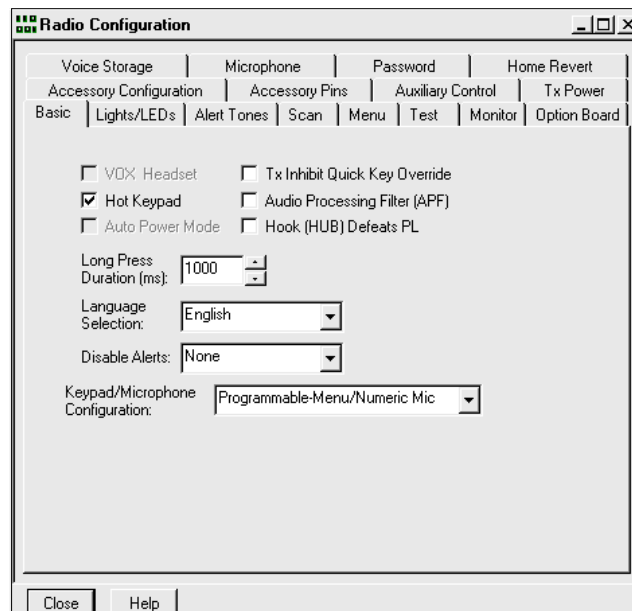


Figure 11-1. Radio Configuration, Basic, Receive Radio

7. Click the "Ignition Sense Type:" dropdown arrow button. Select "On/Off & Ignition". Your screen should appear similar to see Figure 11-2.
8. Click the "Accessory Pins" tab.
9. Click the "Accessory Package" dropdown arrow button. Select "Tel Interconnect (ZR340) Rx". Verify that pin 4 is "CSQ Detect (Output)", Active Level "High" and pin 12 is "PL and CSQ Detect/Talkgroup Detect (Output)", Active Level "Low". Your screen should appear similar to Figure 11-3.
10. "Close" the "Radio Configuration" window.
11. Click on the + indicator next to "Conventional Personality" selection from the opening CPS "Tree View" window.
12. Double click on the "Conventional Personality - 1" selection.
13. Select the "Basic" tab.

Programming

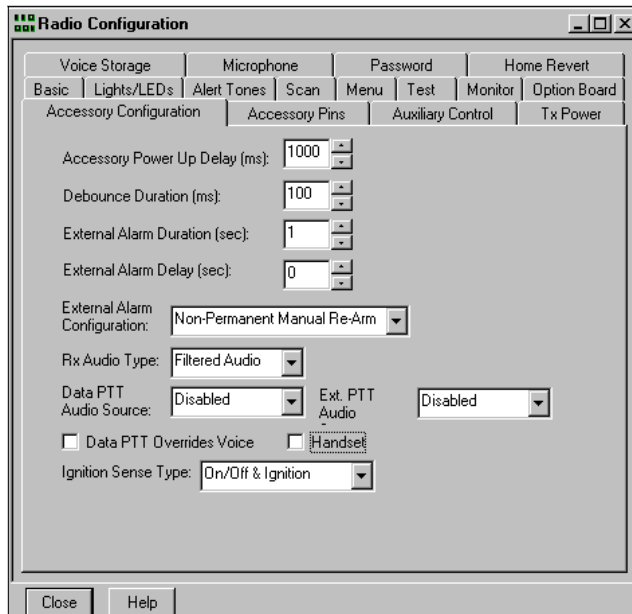


Figure 11-2. Radio Configuration, Accessory Configuration, Receive Radio

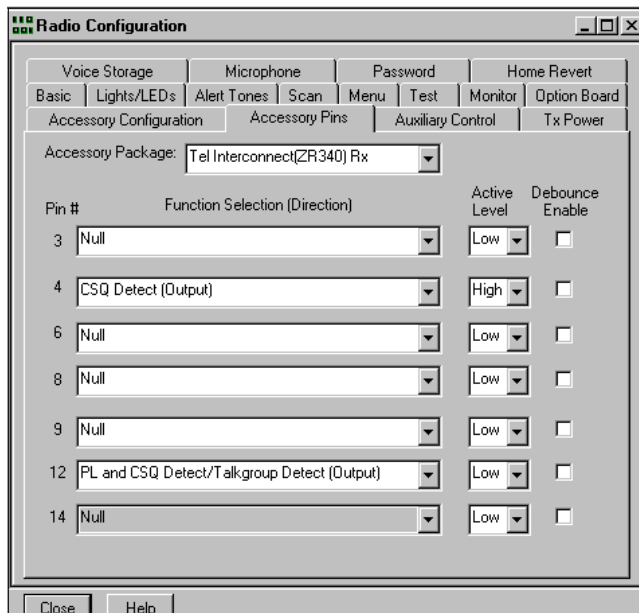


Figure 11-3. Radio Configuration, Accessory Pins, Receive Radio

14. If the radio is a display model (LCD front panel), you may enter an “Alias” that will be displayed, such as “Repeater RX”.

15. Select a “Channel Bandwidth (kHz):” as defined by the radio licensing authority. You have the choice of 12.5, 20 or 25 kHz. (Typical bandwidths in the United States are 12.5 and 25 kHz for VHF Highband and 450 – 512 MHz UHF, and 20 kHz for Lowband.)

16. Enter the receive frequency for the repeater in the “Rx” area at “Frequency (MHz)”.

17. Select the “Squelch Type:” based upon the squelch type that the repeater will use. The selections are: “CSQ” (Carrier Squelch), TPL (Tone Private Line or CTCSS) and DPL (Digital Private Line or CDCSS).

18. Check the “Rx Only Personality” box. Your screen should appear similar to Figure 11-4.

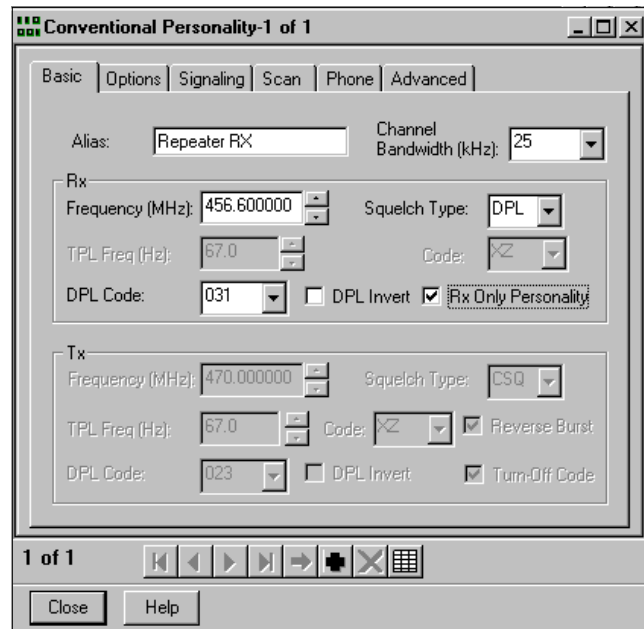


Figure 11-4. Conventional Personality, Basic, Receive Radio

19. Enter any other special programming requirements in the appropriate windows.

20. “Close” the “Conventional Personality” window.

21. Assign the personality to a zone in the “Personality Assignment to Zone” selection windows.

22. Program the receive radio.

Transmit Radio Programming

1. Read the Professional Series transmit radio.
2. After the radio is read, select “Radio Configuration” from the opening CPS “Tree View” window.
3. Click the “Accessory Configuration” tab.
4. Click the “Ext. PTT Audio” dropdown arrow button. Select “Ext Mic Audio”.

- Click the “Ignition Sense Type:” dropdown arrow button. Select “On/Off & Ignition”. Your screen should appear similar to Figure 11-5.

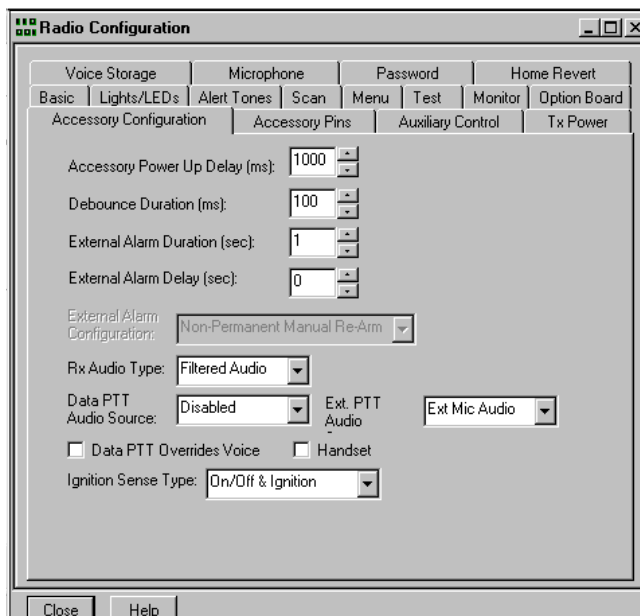


Figure 11-5. Radio Configuration, Accessory Configuration, Transmit Radio

- Click the “Accessory Pins” tab.
- Click the “Accessory Package” dropdown arrow button. Select “Tel Interconnect (ZR340) Tx”. Verify pin 3 is defined as “External Mic PTT (Input)”, Active Level “Low” and pin 4 is defined as “CSQ Detect (Output)”, Active Level “High”. Your screen should appear similar to Figure 11-6.
- Click the “Microphone” tab.
- Click on the “Accessory Mic Gain (dB)” up arrow button to increase the gain to “31.5”. Your screen should appear similar Figure 11-7.
- Close the “Radio Configuration” window.
- Click the + indicator next to “Conventional Personality” selection from the opening CPS “Tree View” window.
- Double click the “Conventional Personality - 1” selection.
- Select the “Basic” tab.
- If the radio is a display model (LCD front panel), you may enter an “Alias” such as “Repeater TX”.

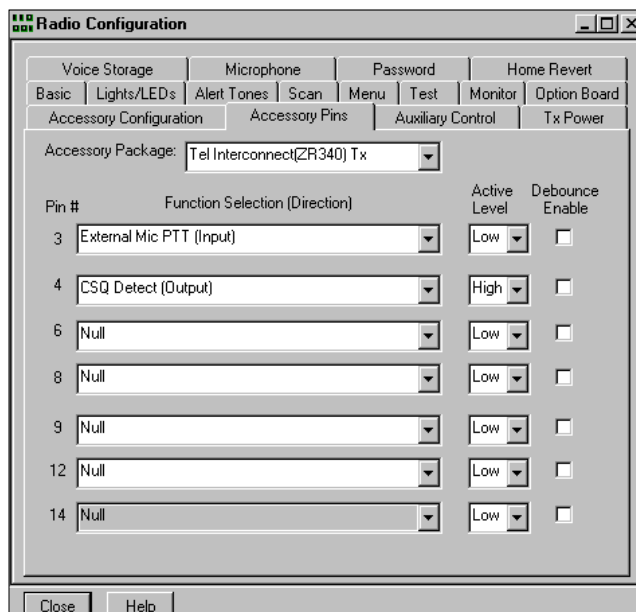


Figure 11-6. Radio Configuration, Accessory Pins, Transmit Radio

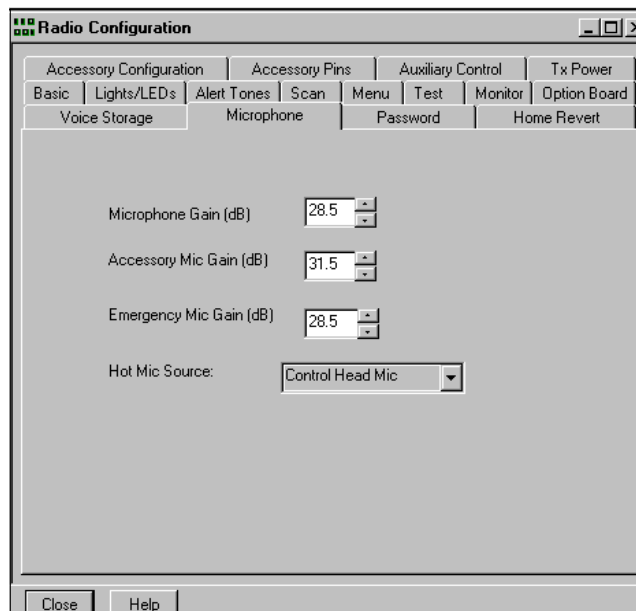


Figure 11-7. Radio Configuration, Microphone, Transmit Radio

- Select a “Channel Bandwidth (kHz):” as defined by the radio licensing authority.

NOTE

In the United States of America, the Professional Series radios may not be used legally as the transmit radio in a UHF (450 to 512 MHz) repeater or base station application with 12.5 kHz channel spacing. The ±2.5-ppm frequency

Programming

NOTE (Cont'd.)

stability capability of the radio does not meet the requirements of Part 90 of the Rules and Regulations of the Federal Communications Commission (FCC). In other countries, check local frequency stability requirements before placing a Professional radio based repeater or base station in operation.

16. Enter the **transmit** frequency for the repeater in the “Rx” area at “Frequency (MHz)”.
17. Select the receiver “Squelch Type:” as “CSQ” (Carrier Squelch).
18. Enter the transmit frequency for the repeater in the “Tx” area at “Frequency (MHz)”.
19. Select the transmitter “Squelch Type:” based upon the type of operation that is required (CSQ, TPL or DPL). Your screen should appear similar to Figure 11-8.

21. Assign the personality to a zone in the “Personality Assignment to Zone” selection windows.
22. Program the transmit radio.

Ignition Sense Wiring

Adding the ignition sense lead to pin 10 of the 16-pin connectors of the radios will ensure that the repeater will automatically power-up whenever power is applied. This is particularly important when the repeater is mounted in a relatively inaccessible location. Refer to Section 12, Ignition Sense Wiring, of this manual.

NOTE

If you haven’t already done so, program both of the radios for “Ignition Sense Type:” as “On/Off & Ignition” or “Follow Ignition Only” in the Accessory Configuration window (in Radio Configuration).

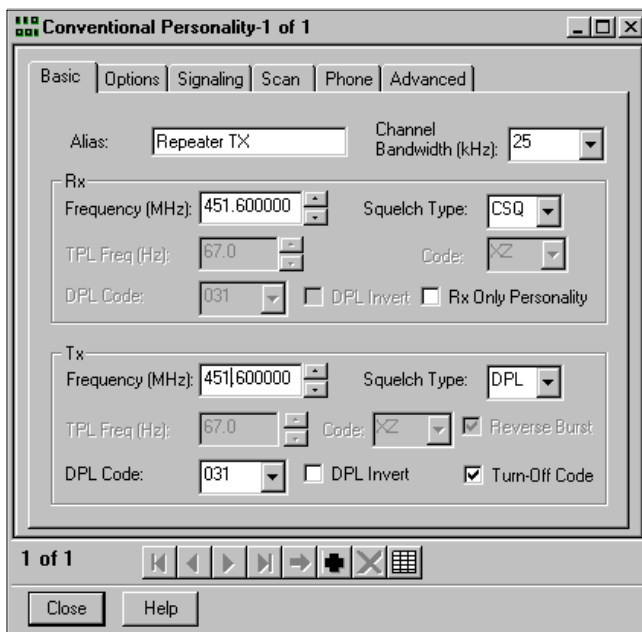


Figure 11-8. Conventional Personality, Basic, Transmit Radio

20. Enter any other special programming requirements in the appropriate windows.

ZR340 Advanced Telephone Interconnect

ZR340 Jumper Configurations

Set the internal jumper settings of the ZR340 according to Table 11-1.

Table 11-1. ZR340 Jumper Settings

Jumper	Setting
JP7	B (16)
JP8	B (16)
JP9	A (8) or B (16)

ZR340 Programming

The system and interconnect parameters of the ZR340 are programmed with DTMF commands. Refer to the ZR340 Advanced Interconnect Instruction Manual, 68-80905Z90, for detailed instructions and a list of commands.

ZR340 Adjustments

Refer to the ZR340 Advanced Interconnect Instruction Manual, 6880905Z90, for detailed instructions and a list of commands for adjusting and aligning the ZR340 controller.

Section 12

Ignition Sense Wiring

Overview

Adding the ignition sense lead to pin 10 of the 16-pin connectors of the radios will ensure that the repeater will automatically power-up whenever power is applied. This is particularly important when the repeater is mounted in a relatively inaccessible location.

Required Kit

The HKKN4000 Repeater Power Sense Cable Kit allows connecting the 13.6 Vdc output of the repeater station power supply to the ignition sense input of the Professional-series radios. Depending upon the repeater and the repeater controller being used, the connection of the ignition sense is made to one of the following:

- Only the repeater controller
- The repeater controller and one of the Professional-series radios
- Both of the Professional-series radios

Preparation

These steps are common to all of configurations listed above under “Required Kit”.

1. If required, remove the ac line cord of the repeater from ac mains outlet.
 2. If required, remove the repeater housing top cover of the CDR700 or open the cover of the CDR500.
 3. Locate the split-Y repeater power sense cable in kit HKKN4000. This cable has two pre-lugged wires joined to an unterminated wire.
 4. Locate the power tap connector (0982845L01) in kit HKKN4000.
 5. Place the “through” portion of the tap connector around the positive (red) lead of the dc power cable for the receive radio. The position of the tap will depend upon which repeater is being assembled.
- 5A. If the repeater is a CDR700, locate the tap approximately 3” (76 mm) from the 2-prong

“Ford” connector of the power cable. Orient the tap to allow the power sense cable to exit away from the “Ford” connector.

- 5B. If the repeater is a CDR500, locate the tap at the midpoint of the power cable. The tap will be approximately in the middle of the top of the fan. Orient the tap to allow the power sense cable to exit toward the “Ford” connector.
6. Place the end of the unterminated wire into the “tap” portion of the tap connector.
 7. Firmly press the metal tap into both wires with gas pliers. The metal tap should be flush with the tap connector body.
 8. Fold the insulating cover of the tap connector over the exposed portion of the metal tap and lock it into place on the tap connector body.
 9. Locate the 16-pin accessory connector housing in kit HKKN4000.

Proceed to the appropriate subsection for you particular repeater controller.

Basic and i20R Repeater Controllers

The HLN3948 Basic Repeater Controller and the i20R Onsite Repeater Controller allow connecting to the ignition sense of both of the Professional-series radios in the CDR500 and CDR700 repeaters. This is accomplished through the accessory connectors on both repeater controllers.

1. At the double (lugged) end of the cable, cutoff one of the wires at the Y junction. Insulate the exposed end of the cut wire with shrink tubing or electrical tape.
2. Plug the terminal of the remaining lugged wire of the power sense cable into position 10 of the 16-pin accessory connector housing from kit HKKN4000. Ensure that the small locking tab of the terminal is facing down toward the large strain relief tab of the housing and the terminal clicks into place.
3. Plug the connector into “J4-ACC” of the Basic repeater controller or the i20R controller.

ZR310 and ZR340 Repeater Controllers in the CDR700 Repeater

The ZR310 Community Repeater Panel and the ZR340 Advanced Telephone Interconnect repeater controllers allow connecting to the ignition sense of the receive radio in the CDR700 repeater via the “Accessory” connector on both repeater controllers. The transmit radio requires removing the wire from location 10 of the repeater cable connected to the transmit radio.

1. At the double (lugged) end of the cable, plug the terminal of the one of the lugged wires of the power sense cable into position 10 of the 16-pin accessory connector housing. Ensure that the small locking tab of the terminal is facing down toward the large strain relief tab of the housing and the terminal clicks into place.
2. Plug the connector into the “Accessory” connector of the ZR310 or ZR340 controller.
3. If required, unplug the repeater cable from the accessory connector of the transmit radio.
4. Use the terminal removal tool (66B80947W01 or equivalent) to remove the terminal and lead from position 10 of the repeater cable 16-pin connector housing. You may have to cut and remove the tie wrap that secures the cable to the strain relief tab of the connector housing.
5. Plug the terminal of the remaining lugged wire of the power sense cable into position 10 of the housing. Ensure that the small locking tab of the terminal is facing down toward the large strain relief tab of the housing and the terminal clicks into place.
6. If you cut the tie wrap in step 4, replace it with one from the HKKN4000 kit.
7. Plug the repeater cable into the accessory connector of the transmit radio.

Generic Repeater Controllers and ZR310/ZR340 Repeater Controllers in the CDR500 Repeater

The distance between the radios and the controllers in the CDR500 repeater does not allow connecting simul-

taneously to one radio and the controller. Generic repeater controllers and the SmarTrunk and LTR repeater controllers offered by Motorola do not have 16-pin compatible accessory connectors. For the above cases, both the transmit radio and the receive radio require connecting the power sense cable to location 10 of the repeater cables connected to the radios.

1. If required, unplug the repeater cable from the accessory connector of the transmit radio.
2. If the repeater cable has a terminal and lead in position 10, use the terminal removal tool (66B80947W01 or equivalent) to remove it from the 16-pin connector housing. You may have to cut and remove any tie wrap that secures the cable to the strain relief tab of the connector housing.
3. Plug the terminal of one of the lugged wires of the power sense cable into position 10 of the housing. Ensure that the small locking tab of the terminal is facing down toward the large strain relief tab of the housing and the terminal clicks into place.
4. If you cut the tie wrap in step 2, replace it with one from the HKKN4000 kit.
5. Plug the repeater cable into the accessory connector of the transmit radio.
6. Repeat steps 1 through 5 for the repeater cable connected to the receive radio.

Final Assembly

Follow the steps outlined earlier in this manual to reassemble the repeater housing.

NOTE

If you haven't already done so, program both of the radios for “Ignition Sense Type:” as “On/Off & Ignition” or “Follow Ignition Only” in the Accessory Configuration window (in Radio Configuration).

Section 13

Troubleshooting

Table 13-1. Troubleshooting for Repeaters (General)

Symptom	Problem(s)	Possible Solution(s)
1. Repeater controller dead (power indicating LED does not light).	1a. Power supply ac line cord not plugged into ac mains outlet. 1b. Receive radio not turned ON. 1c. Loose or bad repeater cable from radio to controller. 1d. Open fuse in controller (if applicable).	1a. Plug power supply cord into ac mains outlet. 1b. Turn receive radio ON. 1c. Check repeater cable connections to radio and controller or replace repeater cable, if necessary. 1d. Check fuse in controller and replace as necessary.
2. No field radios can access system.	2a. Receive radio programmed with wrong TPL/DPL code. 2b. Incorrect I/O programming of accessory connector of receive radio or transmit radio. 2c. Loose or bad repeater cable from receive radio to controller. 2d. Incorrect programming of field radios. 2e. Repeater controller not enabled or set up (if applicable).	2a. Check TPL/DPL code of receive radio and reprogram, if necessary. 2b. Check accessory connectors and reprogram, if necessary. 2c. Check repeater cable connections to radio and controller and replace repeater cable if necessary. 2d. Check programming on field radios and reprogram, if necessary. 2e. Check repeater enable and setup condition(s).
3. First part of message not repeated.	3. User speaking too soon after pressing PTT.	3. Delay conversation to allow for delays in system due to: <ul style="list-style-type: none"> • TPL/DPL decoding. • Requirements of signalling systems.
4. Loss of receiver sensitivity when transmit radio is keyed (repeater toggles from transmit to receive repeatedly when attempting to communicate through it).	4a. Leaky coaxial cable(s). 4b. Loose antenna connector(s). 4c. Faulty antenna connector(s). 4d. Duplexer not tuned correctly (if applicable). 4e. Inadequate distance between receiver and transmitter antennas (if applicable). 4f. Improper or faulty coaxial cable(s) to antenna(s).	4a. Check coaxial cables and replace if necessary. 4b. Check antenna connector(s) and replace, if necessary. 4c. Replace antenna connector(s). 4d. Re-tune duplexer. 4e. Read "Antenna Spacing" on page 1-5 and adjust distance between antennas. 4f. Read "Cables" on page 1-5 to determine the types of cables required or replace cable(s), if necessary.
5. Repeater toggles from transmit to receive cyclically without an input signal to the receive radio.	5. Transmit radio programmed with "COR" signal on same pin of accessory connector as receive radio and is receiving a signal.	5. Reprogram transmit radio accessory connector pin to "NULL."

Table 13-1. Troubleshooting for Repeaters (General) (Cont'd.)

Symptom	Problem(s)	Possible Solution(s)
6. "Tinny" repeated audio (lacks low frequencies).	6. Flat receive audio selected with microphone transmit audio.	6. Reprogram receive radio for "Filtered Audio".
7. "Bassy" repeated audio (lacks high frequencies).	7. EIA de-emphasized receive audio selected with flat transmit audio.	7. Reprogram receive radio for "Flat Audio".
8. Audio OK using local microphone on a repeater radio, but background audio/noise heard when repeater is operating.	8. Microphone with "live," un gated audio path (such as a handset) plugged into repeater radio.	8. Remove microphone or handset.
9. Partial (RapidCall) PTT ID message repeated.	9a. Pre-time too short. 9b. "Pre" PTT ID used.	9a. Increase pre-time in field radio. 9b. Use "Post" PTT ID.
10. Fan in the repeater runs all the time.	10a. Fan switch on CDR700 power supply in "Continuous ON" position. 10b. Not a problem in CDR500. 10c. Battery revert module installed in CDR700.	10a. Move fan switch to "Thermo Control" position. 10b. The CDR500 is designed with continuous cooling. 10c. Nature of the beast – fan runs continuously regardless of fan power switch on power supply.
11. Fan in CDR700 turns on intermittently even though radios are turned off.	11. No problem. Power supply has heated to point of requiring cooling.	11. Unplug CDR700 repeater from ac mains (less expensive than an exorcist).
12. Repeater does not power-up when AC mains returns	12a. HKKN4000 Power Sensing Cable kit not installed. 12b. One or both radios not programmed for ignition sense.	12a. Install power sensing cable. 12b. Reprogram radios for "Follow Ignition Only" or "On/Off & Ignition" sensing.

Table 13-2. Troubleshooting for Repeater Receive Radio

Symptom	Problem	Solution
1. No speaker audio heard from receive radio.	1a. Volume of receive radio turned down. 1b. Speaker not connected in control head. 1c. External speaker (if applicable) not connected between pins 1 and 16 of accessory connector on controller. 1d. Defective speaker (internal or external, if applicable).	1a. Turn up volume. 1b. Connect speaker. 1c. Connect external speaker between pins 1 and 16. 1d. Check speaker and replace if necessary.
2. Receive radio stays ON with radio power switch OFF.	2. Voltage entering receive radio ignition sense (pin 10) and receive radio programmed for "Follow Ignition Only" ignition sensing.	2. Reprogram receive radio to disable ignition sensing. This is NOT recommended if repeater is NOT mounted in a readily accessible location.
3. Receive radio constantly keyed.	3a. Accessory connector of receive and/or transmit radio not programmed correctly or not operating correctly. 3b. Receive radio PTT pin pulled LOW by an accessory.	3a. Check programming of accessory connector and reprogram, if necessary. 3b. Remove or correct accessory.

Table 13-3. Troubleshooting for Repeater Transmit Radio

Symptom	Problem	Solution
1. Transmit radio not keying when a properly identified signal is presented to receive radio.	1a. Controller's repeater function not enabled (if applicable). 1b. Controller not in Setup state (if applicable). 1c. Pin 3 of accessory connector programmed incorrectly. 1d. Loose or bad repeater cable(s). 1e. Receive radio on wrong channel (personality). 1f. No transmit frequency programmed into transmit radio. 1g. Incorrect frequency or TPL/DPL programmed into receive radio. 1h. Accessory connector of receive radio not programmed correctly or not operating correctly. 1i. "Busy Channel Lockout" programmed into transmit radio and channel is active.	1a. Enable controller repeater function. 1b. Place controller in setup state (locally or remotely). 1c. Reprogram pin 3 for "External Mic PTT". 1d. Check repeater cable connection(s) and replace cable, if necessary. 1e. Set receive radio to correct channel (personality). 1f. Program transmit frequency for transmit radio. 1g. Check receive radio frequency and TPL/DPL and reprogram, if necessary. 1h. Check programming of accessory connector and reprogram, if necessary. 1i. Disable the function or wait until channel is inactive.
2. Transmit radio keying continuously or keying without a properly identified signal presented to receive radio.	2a. Receive radio on wrong channel (personality). 2b. Wrong TPL/DPL programmed into receive radio. 2c. Pin 3 of accessory connector on controller pulled LOW by an accessory. 2d. Accessory connector of receive radio not programmed correctly or not operating correctly. 2e. Active level for "External Mic PTT" incorrect.	2a. Set receive radio to correct channel (personality). 2b. Check TPL/DPL and reprogram, if necessary. 2c. Remove accessory and correct LOW condition 2d. Check programming of accessory connector and reprogram, if necessary. 2e. Reprogram pin 3 of accessory connector "External Mic PTT" for correct active level.

Table 13-3. Troubleshooting for Repeater Transmit Radio (Cont'd.)

Symptom	Problem	Solution
<p>3. Low or erratic output power level, or no output power level from transmit radio.</p>	<p>3a. Loose RF cable connector(s).</p> <p>3b. Faulty antenna or feedline.</p> <p>3c. Faulty duplexer (if applicable).</p> <p>3d. Output voltage from power supply drops during transmit.</p> <p>3e. Excessive power supply current drain.</p>	<p>3a. Tighten RF cable connectors to</p> <ul style="list-style-type: none"> • radios • duplexer • antenna <p>3b. Replace faulty component.</p> <p>3c. Check:</p> <ul style="list-style-type: none"> • Tuning of duplexer • Tightness of locking nuts on tuning screws. <p>Replace duplexer if duplexer is correctly tuned and nuts are properly tightened.</p> <p>3d. Check:</p> <ul style="list-style-type: none"> • Correct position of “115/230” switch on power supply. • Output power of transmit radio; do not set greater than 10% over rated RF output power (measured at radio, NOT at duplexer antenna connector). <p>3e. Disconnect components, one at a time, to locate faulty piece. Replace faulty piece.</p> <ul style="list-style-type: none"> • If Lowband radio, reduce output power to 40 Watts or less.
<p>4. Transmit radio keys but low or no audio is transmitted.</p>	<p>4a. Loose or bad repeater cable(s).</p> <p>4b. “Accessory Mic Gain” set too low.</p> <p>4c. Transmit radio audio loaded down due to connections to accessory connector of controller.</p> <p>4d. Receive radio audio loaded down due to connections to accessory connector of controller.</p> <p>4e. “Ext PTT Audio” source incorrect.</p>	<p>4a. Check repeater cable connection(s) and replace cable, if necessary.</p> <p>4b. Reprogram “Accessory Mic Gain”.</p> <p>4c. Remove accessory and correct.</p> <p>4d. Remove accessory and correct.</p> <p>4e. Select and reprogram transmit radio “Ext PTT Audio”:</p> <ul style="list-style-type: none"> • “Ext Mic Audio” for EIA mic audio only (pin 2). • “Flat Tx Audio” for flat audio only (pin 5). • “Ext Mic & Flat Tx” for both audios (pin 2 and 5).
<p>5. No speaker audio heard from transmit radio in bi-directional repeater configuration.</p>	<p>5a. Volume control of transmit radio turned down.</p> <p>5b. Speaker not connected in control head.</p> <p>5c. External speaker (if applicable) not connected between pin-1 and pin-16 of accessory connector of transmit radio.</p> <p>5d. Defective speaker (internal or external, if applicable).</p>	<p>5a. Turn volume up.</p> <p>5b. Check speaker connections in control head.</p> <p>5c. Remove repeater cable wires from pin-1 and pin-16 of accessory connector of transmit radio. Plug in external speaker wires.</p> <p>5d. Replace speaker.</p>

Table 13-3. Troubleshooting for Repeater Transmit Radio (Cont'd.)

Symptom	Problem	Solution
6. Excessive deviation of signal input on pin-5 (flat Tx audio) of accessory connector or transmitter randomly keys off frequency.	6. Original design of controller circuitry of radio.	6. Do one of the following: <ul style="list-style-type: none"> • Contact Motorola Product Services for replacement (newer version) radio. • Use in receive radio position. • Use as a field radio that does not require flat transmit audio.
7. Radio does not enable “Ext Mic Audio” when “Flat Tx Audio” from accessory connector is selected.	7. Original design of controller circuitry of radio.	7. Do one of the following: <ul style="list-style-type: none"> • Contact Motorola Product Services for replacement (newer version) radio. • Use in receive radio position. • Use as a field radio that does not require flat transmit audio.
8. Radio does not generate TPL/DPL when “Flat Tx Audio” from accessory connector is selected.	8. No problem.	8. Install the Generic Controller Option Board (“GCOB”) in radio and program.

Table 13-4. Troubleshooting for Basic Repeater Controller

Symptom	Problem	Solution
1. Basic repeater controller dead, green LED does not light when “Enable” pushbutton is pressed.	1a. Power supply ac line cord not plugged into ac mains outlet. 1b. Receive radio not turned ON. 1c. Loose or bad cable from receive radio. 1d. Open fuse, F1. 1e. External supply not turned ON (if applicable).	1a. Check that ac line cord is plugged in. 1b. Turn receive radio ON. 1c. Check cable from receive radio and replace if necessary. 1d. Replace fuse F1. 1e. Turn on external supply (if applicable).
2. Transmit radio not keying when a properly identified signal is presented to receive radio.	If COR LED does not light: 2a. Controller not enabled. 2b. Pin 3 of accessory connector of transmit radio not programmed correctly. 2c. Loose or bad repeater cable from receive radio. 2d. Accessory connector of receive radio not programmed correctly or not operating correctly. 2e. S2 not configured correctly. 2f. Incorrect frequency or TPL/DPL programmed into receive radio. 2g. Receive radio on wrong channel (personality). If COR LED lights: 2h. Controller not in Setup state. 2i. No transmit frequency programmed into transmit radio. 2j. Loose or bad repeater cable from transmit radio.	2a. Push S1, Enable, in (ON position). 2b. Reprogram pin 3 of transmit radio for “External Mic PTT”, active level “Low”. 2c. Check repeater cable connection(s) and replace cable, if necessary. 2d. Check programming of accessory connector and reprogram, if necessary. 2e. Check S2 and reconfigure, if necessary. 2f. Check frequency and TPL/DPL code and reprogram, if necessary. 2g. Change receive radio channel (personality). 2h. Set up controller locally or remotely. 2i. Program transmit frequency. 2j. Check repeater cable connection(s) and replace cable, if necessary.

Table 13-4. Troubleshooting for Basic Repeater Controller (Cont'd.)

Symptom	Problem	Solution
3. Transmit radio keying continuously or keying without a properly identified signal presented to receive radio.	3a. Pin 3 of "J4-ACC" pulled LOW by an accessory. 3b. If using VOX in receive radio, accessory connector "Rx Audio Type" programmed for "Flat Audio". 3c. Pin 3 of accessory connector of transmit radio programmed active level "High".	3a. Remove accessory and correct LOW condition. 3b. Reprogram "Rx Audio Type" for "Filtered Audio". 3c. Reprogram pin 3 of transmit radio for active level "Low".
4. First part of message not repeated.	4a. User speaking too soon after pressing PTT. 4b. If using VOX: <ul style="list-style-type: none"> • User speaking too softly. • Inadequate handset audio level from receive radio. 	4a. Delay conversation to allow for delays in repeater and field radios from: <ul style="list-style-type: none"> • TPL/DPL decoding. • Requirements of signalling systems. 4b. Educate users to hold microphone closer to mouth, or speak more loudly into it. <ul style="list-style-type: none"> • Verify low handset audio output from the receive radio and repair.
5. Transmit radio keys but low or no audio is transmitted.	5a. S2-5 or S2-6 of controller not turned ON. 5b. R23 of controller not adjusted correctly. 5c. "Accessory Mic Gain" of transmit radio set too low. 5d. "Ext PTT Audio" source incorrect.	5a. Turn S2-5 ON for flat transmit audio; turn S2-6 ON for EIA microphone audio. 5b. Adjust R23. 5c. Reset "Accessory Mic Gain" of transmit radio. 5d. Select and reprogram transmit radio "Ext PTT Audio": <ul style="list-style-type: none"> • "Ext Mic Audio" for EIA mic audio only (pin 2). • "Flat Tx Audio" for flat audio only (pin 5). • "Ext Mic & Flat Tx" for both audios (pin 2 and 5).
6. "Tinny" repeated audio (lacks low frequencies).	6. "Flat" receive audio selected with "Ext Mic" transmit audio.	6. Check positions of: <ul style="list-style-type: none"> • S2-5 (ON) • S2-6 (OFF)
7. "Bassy" repeated audio (lacks high frequencies).	7. "Filtered" receive audio selected with "Flat" transmit audio.	7. Check positions of: <ul style="list-style-type: none"> • S2-5 (OFF) • S2-6 (ON)
8. TPL/DPL signalling "passing through" controller.	8. "Flat" receive audio selected.	8. Check positions of: <ul style="list-style-type: none"> • S2-5 (ON) • S2-6 (OFF)
9. TPL/DPL signalling not "passing through" controller.	9. "Filtered" receive audio selected.	9. Check positions of: <ul style="list-style-type: none"> • S2-5 (OFF) • S2-6 (ON)
10. DPL sense inverted in "pass through" mode (flat audios).	10. Inversion caused by processing of signal in receive radio circuits.	10. Add unity gain inverting amplifier in audio path (either receive radio audio output or transmit radio audio input). This amplifier is not available from Motorola. or Reprogram field radios for "INV DPL" Receiver SQUELCH Mode.

Table 13-4. Troubleshooting for Basic Repeater Controller (Cont'd.)

Symptom	Problem	Solution
11. Undesirable long squelch tails or noise transmitted during drop-out delay.	11a. Audio gate enabled with flat receive audio selected, S2-7 ON. 11b. Field radio reverse burst not compatible with receive radio TPL decoder.	11a. Set S2-7 OFF. 11b. Reprogram receive radio personality for "And Unmuting, Or Muting" (under "Options").
12. Audio OK in repeater operation (between field radios) but noisy when using local microphone on a repeater radio.	12. "Flat" audio has been selected.	12. Reprogram for "Rx Audio Type" as "Filtered" audio on repeater radios. If flat audio is required, set S2-7 to OFF.
13. Long delay in audio from microphone plugged into transmit radio.	13. S2-5 and S2-6 simultaneously ON.	13. Set S2-5 (flat audio) ON and S2-6 (EIA audio) OFF, or set S2-6 ON and S2-5 OFF.

Table 13-5. Troubleshooting for Basic Repeater Controller Bi-Directional Repeater

Symptom	Problem	Solution
1. Part or all of the reverse conversation not repeated.	1a. 0-second drop-out delay not selected. 1b. User speaking too soon after pressing PTT. 1c. Receive radio programmed as "Rx Only Personality" 1d. Transmit radio programmed as "Tx Only Personality". 1e. Receive radio is operating in another repeater system and is keeping transmit radio keyed during drop-out delay.	1a. Set S2-11 ON. 1b. Delay conversation to allow for delays in repeater and field radios from: • TPL/DPL decoding. • Requirements of signalling systems. 1c. Reprogram receive radio: • Uncheck "Rx Only Personality". • Add transmit frequency. 1d. Reprogram transmit radio: • Uncheck "Tx Only Personality". • Add receive frequency. 1e. Try using VOX circuit in controller instead of COR detect. Works best with strong signals.
2. Transmitter of receive radio not keying.	2a. S2-1 not ON. 2b. Accessory connector of transmit radio not programmed correctly or not operating correctly. 2c. No transmit frequency programmed into receive radio. 2d. Receive radio programmed as "Rx Only Personality" 2e. Transmit radio programmed as "Tx Only Personality". 2f. Pin 3 of accessory connector of receive radio not programmed correctly. 2g. Loose or bad repeater cable(s).	2a. Set S2-1 ON. 2b. Check programming of accessory connector and reprogram, if necessary. 2c. Program transmit frequency. 2d. Reprogram receive radio: • Uncheck "Rx Only Personality". • Add transmit frequency. 2e. Reprogram transmit radio: • Uncheck "Tx Only Personality". • Add receive frequency. 2f. Reprogram pin 3 of receive radio for "External Mic PTT", active level "Low". 2g. Check repeater cable connection(s) and replace cable(s), if necessary.

Table 13-5. Troubleshooting for Basic Repeater Controller Bi-Directional Repeater (Cont'd.)

Symptom	Problem	Solution
3. Low or no transmitter audio from receive radio.	3a. S2 not configured correctly. 3b. "Ext PTT Audio" source incorrect. 3c. R24 not adjusted correctly. 3d. Receive radio "Accessory Mic Gain" set too low. 3e. Audio loaded by an accessory connected to "J4-ACC." 3f. Loose or bad repeater cable(s).	3a. Reconfigure S2. 3b. Select and reprogram transmit radio "Ext PTT Audio": <ul style="list-style-type: none"> • "Ext Mic Audio" for EIA mic audio only (pin 2). • "Flat Tx Audio" for flat audio only (pin 5). • "Ext Mic & Flat Tx" for both audios (pin 2 and 5). 3c. Adjust R24. 3d. Reprogram "Accessory Mic Gain" of receive radio. 3e. Remove accessory and correct condition. 3f. Check repeater cable connection(s) and replace cable, if necessary.
4. Receive radio constantly keyed.	4a. S2 not configured correctly. 4b. Accessory connectors of receive and transmit radios not programmed correctly. 4c. Pin 8 of the "J4-ACC" connector pulled LOW by an accessory. 4d. Transmit radio turned OFF. 4e. Pin 3 of accessory connector of receive radio programmed active level "High".	4a. Reconfigure S2. 4b. Check programming of accessory connectors and reprogram, if necessary. 4c. Remove accessory and correct LOW condition. 4d. Turn transmit radio ON. 4e. Reprogram pin 3 of receive radio for active level "Low".
5. "Tinny" repeated audio (lacks low frequencies).	6. "Flat" receive audio selected with "Ext Mic" transmit audio.	6. Check positions of: <ul style="list-style-type: none"> • S2-8 (OFF) • S2-9 (ON)
7. "Bassy" repeated audio (lacks high frequencies).	7. "Filtered" receive audio selected with "Flat" transmit audio.	7. Check positions of: <ul style="list-style-type: none"> • S2-8 (ON) • S2-9 (OFF)

Table 13-6. Troubleshooting for Basic Repeater Controller Setup/Knockdown

Symptom	Problem	Solution
1. Repeater not in "Setup" mode at power-up, yellow LED not lighted and/or transmit radio front panel not ON.	1a. JU1 in wrong position or missing. 1b. Loose or bad repeater cable to transmit radio. 1c. Transmit radio turned OFF. 1d. Power cable not connected to transmit radio. 1e. Ignition sense function not programmed in transmit radio.	1a. Replace JU1, if necessary, and place in position 1-2. 1b. Check repeater cable connection(s) and replace cable, if necessary. 1c. Turn transmit radio ON. 1d. Connect power cable to transmit radio. 1e. Reprogram transmit radio for desired ignition sense function.
2. Repeater not in "Knockdown" state at power-up, yellow LED lighted and/or transmit radio front panel ON.	2a. JU1 in wrong position. 2b. Ignition sense function not programmed in transmit radio.	2a. Place JU1 in position 2-3. 2b. Reprogram transmit radio for "Follow Ignition Only".

Table 13-6. Troubleshooting for Basic Repeater Controller Setup/Knockdown (Cont'd.)

Symptom	Problem	Solution
3. Transition from "Setup" to "Knockdown" state not occurring when front panel switch (S3) is pressed and released.	3a. JU1 missing. 3b. Loose or bad repeater cable to transmit radio. 3c. Transmit radio turned OFF. 3d. Power cable not connected to transmit radio. 3e. Ignition sense function not programmed in transmit radio.	3a. Replace JU1. 3b. Check repeater cable connection(s) and replace cable, if necessary. 3c. Turn transmit radio ON. 3d. Connect power cable to transmit radio. 3e. Reprogram transmit radio for "Follow Ignition Only".
4. Remote Setup/Knockdown function not working.	4a. S2-4 turned OFF. 4b. Ignition sense function not programmed in transmit radio. 4c. Transmit radio turned OFF. 4d. Power cable not connected to transmit radio. 4e. JU1 in wrong position or missing. 4f. Loose or bad repeater cable(s). 4g. Incorrect MDC-1200 programming of receive radio or console radio. 4h. Receive radio is a CDM750 or PRO3100.	4a. Turn S2-4 ON. 4b. Reprogram transmit radio for "Follow Ignition Only". 4c. Turn transmit radio ON. 4d. Connect power cable to transmit radio. 4e. Check position of JU1 or replace, if necessary. 4f. Check repeater cable connection(s) and replace cable(s), if necessary. 4g. Check signalling mode and Call Lists in both radios. 4h. CDM750 or PRO3100 radio does not have external alarm output capability. Use CDM1250, CDM1550, PRO5100, or PRO7100 radios.

Table 13-7. Troubleshooting for ZR310 Controller

Symptom	Problem	Solution
1. No field radios can access system.	1a. No valid user(s) defined in ZR310 database. 1b. Receive radio on wrong channel (personality). 1c. Receive radio programmed for "Filtered" accessory connector receiver audio. 1d. Incorrect I/O programming of accessory connectors of receive and transmit radios. 1e. Incorrect position for JP1 in ZR310. 1f. Loose or bad repeater cable from receive radio. 1g. Incorrect programming of field units.	1a. Program ZR310 database. 1b. Set receive radio to correct channel (personality). 1c. Reprogram "Rx Audio Type" as "Flat Audio". 1d. Reprogram accessory connectors of both radios. 1e. Set JP1 to position "B". 1f. Check repeater cable connection(s) and replace cable, if necessary. 1g. Reprogram field units.
2. Some field radios cannot access system.	2a. User ID not valid in ZR310 database. 2b. Incorrect programming of field units. 2c. If DPL users, then inverted DPL sense from receive radio.	2a. Reprogram ZR310 database. 2b. Reprogram field units. 2c. Use DTMF programming mode to program inverted receive DPL sense in ZR310 (command 218#).

Table 13-7. Troubleshooting for ZR310 Controller (Cont'd.)

Symptom	Problem	Solution
3. ZR310 does not detect TPL/DPL signals (functions properly in CSQ mode).	3. Receive radio programmed for "Filtered" accessory connector receiver audio.	3. Reprogram "Rx Audio Type" as "Flat Audio".
4. No or intermittent decode of proper TPL/DPL codes by field radios.	4a. Improper TPL/DPL level to transmit radio. 4b. Transmit radio programmed for TPL/DPL (interferes with ZR310 TPL/DPL). 4c. Incorrect position for JP3 in ZR310. 4d. Loose or bad repeater cable from ZR310 to transmit radio.	4a. Adjust "TPL/DPL" control on ZR310. 4b. Reprogram transmit radio for CSQ. 4c. Place in "A" position and adjust "TPL/DPL" control on ZR310. 4d. Check repeater cable connection(s) and replace cable, if necessary.
5. No decode of proper DPL codes by ZR310; PL tones OK.	5. Inverted DPL sense from receive radio.	5. Use DTMF programming to program inverted receive DPL sense in ZR310 (command 218#)
6. Transmit radio not keying when a properly identified signal is presented to receive radio.	6a. User group not enabled in ZR310. 6b. Normal operation of ZR310 when channel is active.	6a. Enable user group by reprogramming. 6b. Wait until channel is inactive.
7. Transmit radio keying without a properly identified signal presented to receive radio.	7a. Wrong user group programmed. 7b. CSQ ("OPEN") user defined but not desired.	7a. Reprogram ZR310. 7b. Reprogram ZR310.
8. Transmit radio keys but low or no audio is transmitted.	8a. "AUDIO" potentiometer of ZR310 not adjusted correctly. 8b. "Accessory Mic Gain" set too low in transmit radio. 8c. "Ext PTT Audio" source for transmit radio incorrect.	8a. Readjust "AUDIO" potentiometer on front panel of ZR310 8b. Reprogram "Accessory Mic Gain" of transmit radio. 8c. Reprogram "Ext PTT Audio" for "Ext Mic & Flat Tx" audios.
9. No PL/DPL transmitted.	9a. No PL or DPL users defined in ZR310 database. 9b. "Ext PTT Audio" source for transmit radio incorrect.	9a. Program ZR310 database. 9b. Reprogram "Ext PTT Audio" for "Ext Mic & Flat Tx" audio.
10. Low frequency (400 Hz) "beep" heard just before transmit radio unkeys.	10. Possible ZR310 memory checksum problem.	10. Use remote diagnostics to determine cause. Reprogram database as required.
11. Memory automatically resets to default settings.	11. Greater than 15 errors were detected at resets or power-up.	11. Reprogram ZR310 database.
12. ZR310 fails to operate. No repeat functions. Appears "locked up".	12. ZR310 in "Never-Neverland" due to transient.	12. Reset ZR310 by sending any DTMF digit from a mobile or portable radio for more than 15 seconds.
13. Morse Code (CW) ID sounds QLF.	13. CW operator is a lid.	13. Recall your novice days.

Table 13-8. Troubleshooting for ZR340 Controller

Symptom	Problem(s)	Possible Solution(s)
1. No "Rx" LED indication when signal is received.	1a. Improper programming of accessory connector of receive radio. 1b. Loose or bad repeater cable to receive radio. 1c. JP7 and/or JP8 in ZR340 in wrong position(s).	1a. Reprogram: • Pin 4 ("CSQ Detect," active "High") • Pin 12 ("PL and CSQ Detect/Talkgroup Detect," active "Low"). 1b. Check cable connections and replace cable, if necessary. 1c. Check position(s) and correct.
2. No "Tx" LED indication in repeater mode when properly identified signal is received or transmit radio does not key.	2a. Receive radio not programmed for proper TPL/DPL code. 2b. Improper programming of accessory connector of receive radio. 2c. Incorrect programming of ZR340. 2d. Improper programming of accessory connector of transmit radio. 2e. Pin 3 of transmit radio accessory connector programmed incorrectly. 2f. Transmit frequency "busy."	2a. Reprogram correct "Rx Squelch Code." 2b. Reprogram: • Pin 4 ("CSQ Detect," active "High") • Pin 12 ("PL and CSQ Detect/Talkgroup Detect," active "Low"). 2c. Use DTMF to select half-duplex and repeater enabled (40# then 18#). 2d. Reprogram: • Pin 4 ("CSQ Detect," active "High") • Pin 12 ("NULL," active Low"). 2e. Reprogram pin 3 for "External Mic PTT". 2f. Wait for channel to clear.
3. Some field radios can not access telephone.	3a. Incorrect setup of ZR340. 3b. Incorrect programming of field radios. 3c. Incorrect access codes being sent by field radios. 3d. Low DTMF deviation in field radios.	3a. Check "Rx" (receive) control setting of ZR340. 3b. Reprogram field radios. 3c. Reprogram field radios or reeducate radio users. 3d. Readjust DTMF deviation for 60% to 70% rated system.
4. Transmit radio keys but low or no audio is transmitted.	4a. "Rx" and/or "Tx" control(s) of ZR340 not adjusted correctly. 4b. "Accessory Mic Gain" set too low in transmit radio. 4c. "Ext PTT Audio" source incorrect.	4a. Adjust "Rx" and/or "Tx" control(s) on ZR340. 4b. Reprogram "Accessory Mic Gain". 4c. Reprogram for "Ext Mic Audio."
5. No "Phone" LED indication when attempting to access telephone line (PSTN).	5a. Improper programming of field radios or ZR340. 5b. Wrong access code transmitted by field radios.	5a. Reprogram field radios or ZR340. 5b. Reprogram field radios or reeducate radio users.
6. ZR340 will not pulse dial PSTN from field unit DTMF.	6a. Not programmed for pulse dial. 6b. Too much time has elapsed between digits. 6c. What is "pulse dial"?	6a. Reprogram the ZR340. 6b. Do not allow more than 5 seconds between digits. 6c. One step above calling "Ernestine".
7. Unreliable dialing or misdialed numbers.	7a. Low DTMF deviation of field radios. 7b. Incorrect setting of "Rx" control on ZR340.	7a. Readjust DTMF deviation for 60% to 70% of rated system deviation. 7b. Reset "Rx" control on ZR340.

Table 13-8. Troubleshooting for ZR340 Controller (Cont'd.)

Symptom	Problem(s)	Possible Solution(s)
8. Unable to access dial tone or answer a call.	8. Incorrect positions for JP7, JP8, and JP9 in ZR340.	8. Check positions of JP7 to JP9 and correct, if necessary. All three jumper plugs should be in the "B" position.
9. Intermittently disconnects from call.	9a. Noisy phone line may false "busy" tone detector. 9b. Single character deaccess code may voice false.	9a. Disable the "busy" tone detector (cmd 86#). 9b. Use more than one character in the deaccess code.

Table 13-9. Troubleshooting for i20R Controller

Symptom	Problem	Solution
1. No field radios can access system.	1a. No valid user(s) defined in i20R database. 1b. Receive radio on wrong channel (personality). 1c. Receive radio programmed for "filtered" accessory connector "Rx Audio Type". 1d. Incorrect I/O programming of accessory connectors of receive and transmit radios. 1e. Incorrect I/O programming of accessory connectors of i20R. 1f. Incorrect position for JU20 in i20R. 1g. Loose or bad repeater cable from receive radio. 1h. Incorrect programming of field units.	1a. Program i20R database. 1b. Set receive radio to correct channel (personality). 1c. Reprogram receive radio "Rx Audio Type" to "Flat". 1d. Reprogram accessory connectors of both radios. 1e. Use i20R RSS to reprogram accessory connectors of i20R. 1f. Set JU20 to "Out". 1g. Check repeater cable connection(s) and replace cable, if necessary. 1h. Reprogram field units.
2. Some field radios cannot access system.	2a. User ID not valid in i20R database. 2b. Incorrect programming of field units. 2c. If DPL users, then inverted DPL sense from receive radio.	2a. Reprogram i20R database. 2b. Reprogram field units. 2c. Use i20R RSS to reprogram DPL polarity (Installation/Radio Characteristics).
3. i20R does not detect TPL/DPL signals (functions properly in CSQ mode).	3. i20R programmed to enable "Forward Carrier Repeater Operation".	3. Use i20R RSS to reprogram "Forward Carrier Repeat Operation" as "Disabled".
4. No or intermittent decode of proper TPL/DPL codes by field radios.	4a. Improper TPL/DPL level to transmit radio. 4b. Transmit radio programmed for TPL/DPL (interferes with i20R TPL/DPL). 4c. "Ext PTT Audio" source for transmit radio incorrect. 4d. Loose or bad repeater cable from i20R to transmit radio.	4a. Adjust "SIG" control on i20R. 4b. Change transmit radio to CSQ. 4c. Reprogram "Ext PTT Audio" for "Ext Mic & Flat Tx". 4d. Check repeater cable connection(s) and replace cable, if necessary.
5. No decode of proper DPL codes by i20R; PL tones OK.	5. Inverted DPL sense from receive radio.	5. Use i20R RSS to reprogram DPL polarity (Installation/Radio Characteristics).

Table 13-9. Troubleshooting for i20R Controller (Cont'd.)

Symptom	Problem	Solution
6. Transmit radio not keying when a properly identified signal is presented to receive radio.	6a. User group not enabled. 6b. "Busy Channel Lockout" programmed into transmit radio or i20R and channel is active.	6a. Enable user group by reprogramming. 6b. Reprogram transmit radio or i20R to remove option or wait until channel is inactive.
7. Transmit radio keying without a properly identified signal presented to receive radio.	7a. Wrong user group programmed. 7b. i20R programmed to enable "Forward Carrier Repeat Operation". 7c. Transmit radio "External Mic PTT" active level does not match i20R "Tx PTT". 7d. Pin 3 of i20R accessory connector activated by an accessory.	7a. Use i20R RSS to reprogram i20R. 7b. Use i20R RSS to reprogram "Forward Carrier Repeat Operation" as "Disabled". 7c. Reprogram "External Mic PTT" of transmit radio and "Tx PTT" of i20R for same active level (either "Low" or "High"). 7d. Remove accessory and correct the condition.
8. Transmit radio keys but low or no audio is transmitted	8a. "FWD" potentiometer of i20R not adjusted correctly. 8b. Transmit radio "Accessory Mic Gain" set too low. 8c. Transmit radio "Ext PTT Audio" source incorrect.	8a. Readjust "FWD" potentiometer on front panel of i20R 8b. Reprogram "Accessory Mic Gain" of transmit radio. 8c. Reprogram "Ext PTT Audio" for "Ext Mic & Flat Tx" audios.

i20R:

a repeater controller that provides service for up to 10 different user groups (TPL/DPL).

Linked Repeater:

a uni-directional repeater that sends receiver audio and COR signals to an external "link" radio (or another repeater) for the purpose of relaying repeated information to another location. Receiver audio and COR signals from the "link" radio are applied to the CDR500 or CDR700 repeater transmit radio as transmit audio and PTT signals. For example, VHF coverage can be extended between two cities with a UHF link between the two VHF, uni-directional repeaters.

LTR:

Logic Trunked Radio. A trunking system protocol based upon low speed (300 bauds), subaudible signalling to control radio traffic.

LTR Repeater Controller:

a repeater controller that supports the LTR protocol. Provides the interfacing and controlling of the receiver and the transmitter of a repeater. May include other features for telephone interconnect and support for "older" TPL and DPL based systems.

Normal receiver audio:

see EIA de-emphasized audio.

Normal transmitter audio:

see EIA pre-emphasized audio.

"On Battery" Alert Tone:

an alert tone ("beep") transmitted periodically to indicate to field radio operators that the repeater is operating on a battery backup power source and they should limit their transmissions (number and duration). Requires external switching source such as battery revert module.

PAC*RT:

Portable Area Communications RepeaTer; a specialized cross band, bi-directional repeater configuration. Example: paramedics at an accident scene may use 450-470 MHz UHF portable radios to communicate with a highband VHF dispatcher.

Power-up:

the initial application of operating potential (voltage) to the radios and the repeater controller.

"Properly" identified signal:

all signals being received on a CSQ receiver or those signals with the correct TPL tone or DPL code being received on a coded squelch receiver.

Receive radio:

the radio that performs the receiving functions in the CDR500/CDR700 repeater station.

Repeater controller:

a module or option card that fits into the CDR500/

CDR700 repeater station and provides the control of the repeater radios.

Repeater knockdown:

to deactivate a repeater or to remove it from service.

Repeater setup:

to activate a repeater or to place it into service.

Revertive signalling (paging):

accessing a repeater with one signalling format (e.g., DTMF) and selective signalling with a different format (e.g., MDC-1200).

R*I*C*K:

a repeater interface component that connects between two Professional series mobile radios to construct an intermittent duty radio repeater (identical to the Basic Repeater Controller).

Selective signalling (calling):

a method of signalling with TPL, DPL, multiple tones or digital words to alert an individual radio user in a group.

Single band repeater:

a repeater in which both the receive radio and the transmit radio operate in the same frequency band.

Example: receive at 456.650 MHz and transmit at 451.650 MHz in the 450-470 MHz UHF band.

ST-853M SmarTrunk II:

a repeater controller that allows trunking operation. Up to 4096 subscriber units (field radios) with individual identification can be serviced. Telephone interconnect, individual and group selective calling are supported.

Transmit radio:

the radio that performs the transmitting functions in the CDR500/CDR700 repeater station.

Unidirectional repeater:

a repeater configuration in which the receive radio receives signals only from the field radios and the transmit radio transmits signals only to the field radios.

VOX:

voice controlled transmission; the transmit radio is keyed by a circuit that detects the presence of voice output from the receive radio or from a telephone line.

ZR310:

a repeater controller that provides individualized repeater service for up to 70 different customer groups (TPL/DPL).

ZR340:

a repeater controller that provides telephone interconnect with expanded sign-on/sign-off code features and CWID for the single user repeater.

Parts List

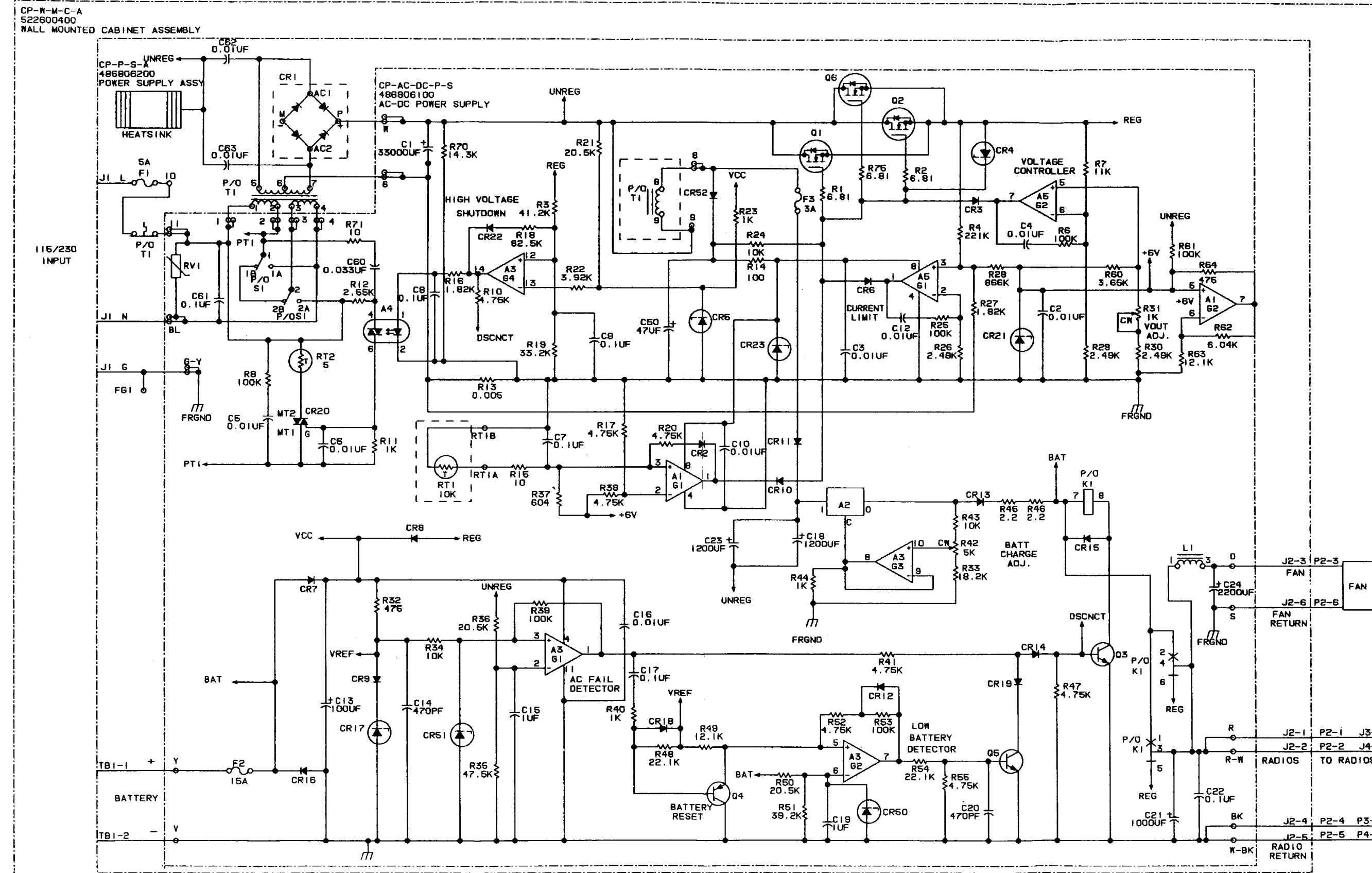
HPN9005 & HKPN4001 Power Supply, electrical PL-941033-B

REFERENCE SYMBOL	STAR WERKS, INC. PART NO.	DESCRIPTION
		terminal plug: unless otherwise stated
1 thru 4	245775100	
6	355310400	
8, 9	245775100	
11	245775100	
BL	245775100	
BK	245380900	
G-Y	245775100	
O	245380800	
R	245380900	
R-W	245380900	
RT1A	245380600	
RT1B	245380600	
S	245380800	
V	245380900	
W	355310400	
W-BK	245380900	
Y	245380900	
		integrated circuit: (see note)
A1	287114400	LM258N
A2	287133200	MC7805BT
A3	287112400	LM224J
A4	285713200	MOC3023T
A5	287114400	LM258N
		capacitor, fixed: uF +/-1%; 50 V: unless otherwise stated
C1	273138810	33,000; 40 V; electrolytic
C2 thru 6	272458000	0.01
C7 thru 9	272450900	0.1
C10	272458000	0.01
C12	272458000	0.01
C13	273113200	100; 25 V; electrolytic
C14	272465000	470 pF
C15	272450700	1
C16	272458000	0.01
C17	272450900	0.1
C18	273125100	1200; 16 V; electrolytic
C19	272450700	1
C20	272465000	470 pF
C21	273121300	1000; 35 V; electrolytic
C22	272450900	0.1
C23	273125100	1200; 16 V; electrolytic
C24	273125800	2200; 16 V
C50	273112500	47; 50 V; electrolytic
C60	272468200	0.033; 200 V
C61	271451700	0.1; 250 V
		diode: (see note)
CR2, 3	281110100	1N4148
CR4	283623500	1N4744A
CR5	283532500	1N823; 6.2 V; zener
CR6	281110100	1N4148
CR7, 8	281222200	1N4003
CR9, 10	281110100	1N4148
CR11	281242000	BYV27-200
CR12	281110100	1N4148
CR13	281242000	BYV27-200
CR14	281110100	1N4148
CR15	281222200	1N4003
CR16	281303500	MR756
CR17	283541100	1N4736A; 6.8 V; zener
CR18, 19	281110100	1N4148
CR20	286503800	MAC223A8
CR21	283532500	1N823; 6.2 V; zener
CR22	281110100	1N4148
CR23	283651500	1N4751A; 30 V; zener
CR50	283627300	1N4745ARL; 16 V; zener
CR51	283651500	1N4751A; 30 V; zener
CR52	281242000	BYV27-200
		thermistor:
RT2	267619800	5 Ω; 1/4 W
		varistor:
RV1	267635500	275 V; V275LA40A
		switch:
S1	251370500	115/230 V
		relay:
K1	254331600	DPDT, 12 V

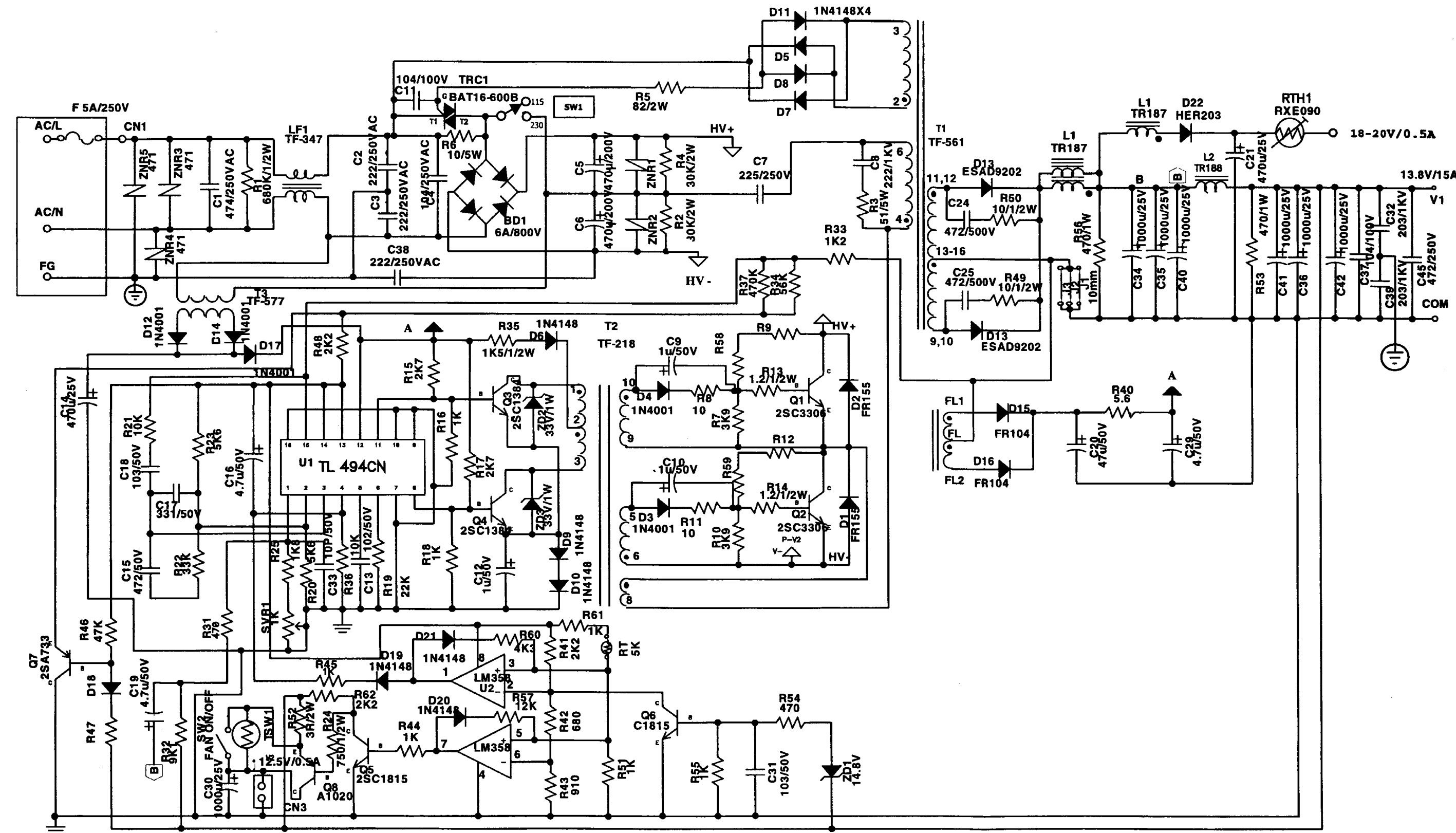
HPN9005 & HKPN4001 Power Supply, electrical PL-941033-B

REFERENCE SYMBOL	STAR WERKS, INC. PART NO.	DESCRIPTION
		choke, filter:
L1	441165000	
		transistor: (see note)
Q1, 2	285226900	MTH40N10
Q3	284106100	2N3904
Q4	284305600	2N3906
Q5	284106100	2N3904
Q6	285226900	MTH40N10
		resistor, fixed: +/-1%; 1/4 W: unless otherwise stated
R1, 2	263452100	6.81 Ω
R3	263467800	41.2 k
R4	263471400	221 k
R6	263469600	100 k
R7	263465100	11 k
R8	263469600	100 k
R10	263463200	4.75 k
R11	263459700	1 k
R12	263564400	2.55 k; 1 W
R13	266310000	0.005 Ω; 3 W
R14	263455700	100 Ω
R15	263452400	10 Ω
R16	263460900	1.82 k
R17	263463200	4.75 k
R18	263469300	82.5 k
R19	263467300	33.2 k
R20	263463200	4.75 k
R21	263466400	20.5 k
R22	263462700	3.92 k
R23	263459700	1 k
R24	263464800	10 k
R25	263469600	100 k
R26	263461600	2.49 k
R27	263460900	1.82 k
R28	263474300	866 k
R29, 30	263461600	2.49 k
R31	287511200	1 k; 1/2 W; variable
R32	263458200	475 Ω
R33	263466200	18.2 k
R34	263464800	10 k
R35	263468100	47.5 k
R36	263466400	20.5 k
R37	263458800	604 Ω
R38	263463200	4.75 k
R39	263469600	100 k
R40	263459700	1 k
R41	263463200	4.75 k
R42	287511700	5 k; 1/2 W; variable
R43	263464800	10 k
R44	263459700	1 k
R45, 46	263760300	2.2 Ω
R47	263463200	4.75 k
R48	263466500	22.1 k
R49	263465200	12.1 k
R50	263466400	20.5 k
R51	263467600	39.2 k
R52	263463200	4.75 k
R53	263469600	100 k
R54	263466500	22.1 k
R55	263463200	4.75 k
R56	263462600	3.65 k
R57	263469600	100 k
R58	263463100	6.04 k
R59	263465200	12.1 k
R60	263458200	475 Ω
R61	263465500	14.3 k
R62	263452400	10 Ω
R63	263452100	6.81 Ω
		thermistor:
RT2	267619800	5 Ω; 1/4 W
		varistor:
RV1	267635500	275 V; V275LA40A
		switch:
S1	251370500	115/230 V
		relay:
K1	254331600	DPDT, 12 V

note1: For optimum performance, diodes, transistors, and integrated circuits must be ordered from Star Werks, Inc.



Schematic Diagram, Circuit Board, and Parts List for HPN9005 & HKPN4001 Power Supply



Schematic Diagram, Circuit Board, and Parts List for HPN9033 & HKPN4000 Power Supply

HPN9033 & HKPN4000 Test Voltages

	DC	AC	DC	AC
Q1 pinC (+) to Q1 pinE (-)	151 V	108 V	C10 + (+) to C10 - (-)	1.61 V
Q1 pinB (+) to Q1 pinE (-)	-1.71 V	2.39 V	C12 + (+) to C12 - (-)	1.47 V
Q2 pinC (+) to Q2 pinE (-)	154 V	108 V	C14 + (+) to C14 - (-)	21.95 V
Q2 pinB (+) to Q2 pinE (-)	-1.76 V	2.4 V	C19 + (+) to C19 - (-)	10.9 V
Q4 pinC (+) to Q4 pinE (-)	7.3 V	13 V	C20 + (+) to C20 - (-)	22.9 V
Q4 pinB (+) to Q4 pinE (-)	0.3 V	0.63 V	C21 + (+) to C21 - (-)	19.1 V
Q5 pinC (+) to Q5 pinE (-)	7.3 V	13 V	C29 + (+) to C29 - (-)	22.7 V
Q5 pinB (+) to Q5 pinE (-)	0.3 V	0.63 V	C30 + (+) to C30 - (-)	11.83 V
Q7 pinE (+) to Q7 pinC (-)	4.73 V	---	C40 + (+) to C40 - (-)	13.91 V
Q7 pinB (+) to Q7 pinC (-)	4.93 V	---	C42 + (+) to C42 - (-)	13.85 V
C5 + (+) to C6 - (-)	310 V	---	L1 and D13 (+) to COM (-)	13.99 V
C9 + (+) to C9 - (-)	1.57 V	---		14.6 V

Test Conditions Input: 230 V ac / 115 V ac
 Output: V1 13.8 V dc 15A
 V2 12.5 V dc 0.5A
 V3 19 V dc 0.5A

Parts List

HPN9033 & HKPN4000 Power Supply, electrical PL-991009-0

REFERENCE SYMBOL	DURACOMM PART NO.	DESCRIPTION
BD1	1CD1A6R0C801-XS	bridge rectifier: 6A/800V Silicon Bridge Rectifier
C1	1BC1F474C251K-J	capacitor, fixed: μ F \pm 10%; 100 V: 0.47 μ F 250 V ac, 20%
C2, 3	1BC1D222C251K-7	2.2 nF 250 V ac, 20%
C4	1BC1F104C251K-F	0.1 μ F 250 V ac, 20%
C5, 6	1BCAC471C201M22	470 μ F 200 V 85°C electrolytic
C7	1BC2G225C251K-L	2.2 μ F 250 V
C8	1BC3D222D102M-5	2.2 nF 1K V, 20% Z5U
C9, 10	1BCDA1R0B500M05	1 μ F 50 V, 20% 105°C electrolytic
C11	1BC2F104C101K-5	0.1 μ F
C12	1BCDA1R0B500M05	1 μ F 50 V, 20% 105°C electrolytic
C13	1BC4D102C101J-2	1 nF, 5%
C14	1BCG471B250M10	470 μ F 25 V, 20% electrolytic
C15	1BC4D472C101J-2	4.7 nF, 5%
C16	1BCDA4R7B500M05	4.7 μ F 50 V, 20% 105°C electrolytic
C17	1BC3C331C101K-5	330 pF Y5P
C18	1BC4E103C101J-2	10 nF, 5%
C19	1BCDA4R7B500M05	4.7 μ F 50 V, 20% 105°C electrolytic
C20	1BCB470B500M08	47 μ F 50 V, 20% electrolytic
C21	1BCG471B250M10	470 μ F 25 V, 20% electrolytic
C24, 25	1BC3D472C501M-5	4.7 nF 500 V, 20% Z5U
C29	1BCDA4R7B500M05	4.7 μ F 50 V, 20% 105°C electrolytic
C30	1BCGD102B250M12	1000 μ F 25 V, 20% electrolytic
C31	1BC3E103C101M-5	10 nF, 20% Z5U
C32	1BC6E203D102M-9	20 nF 1K V, 20% Z5U EPOXY
C33	1BC3B100B500K-5	10 pF 50 V, NPO
C34 thru 36	1BCGD102B250M12	1000 μ F 25 V, 20% electrolytic
C37	1BC2F104C101K-5	0.1 μ F
C38	1BC1D222C251K-7	2.2 nF 250 V ac, 20%
C39	1BC6E203D102M-9	20 nF 1K V, 20% Z5U EPOXY
C40 thru 42	1BCGD102B250M12	1000 μ F 25 V, 20% electrolytic
C45	1BC1D472C251K-7	4.7 nF 250 V ac, 20%
CN3	1FF12022-02	connector: 8812-02, 2-position fan
D1, 2	1CD3A1R5C601-H	diode: (see note) FR155, 1.5A/600 V
D3, 4	1CD2A1R0B500-H	1N4001, 1A/50 V
D5 thru 11	1CDA1N4148-T	1N4148, switching diode
D12	1CD2A1R0B500-H	1N4001, 1A/50 V
D13A, B	1CD5ESAD92-02	ESAD9202, 20A/200 V fullwave rectifier
D14	1CD2A1R0B500-H	1N4001, 1A/50 V
D15, 16	1CD3A1R0C401-H	FR104, 1A/400 V
D17	1CD2A1R0B500-H	1N4001, 1A/50 V
D18	---	Not Used
D19 thru 21	1CDA1N4148-T	1N4148, switching diode
D22	1CD5HER203	HER203, 2A/200 V
F	1EE2A5R0C251F11	fuse: 5A, 250 V, GFE/GMA
FAN	1EE6B120A6R0B8M	fan: KD1206PHB2, 12 V dc, 1.9 W DC
L1	1DL3TR187	filter choke: TR187, Toroidal
L2	1DL3TR188	TR188 3.2 μ H, Toroidal
L3	1DL5TF347	TF347 1.9 mH Line
TRC1	1CQ3BTA16-600B	Triac: BTA16-600B
Q1, 2	1CQ12SC3306	transistor: (see note) 2SC3306 10A/400 V NPN
Q3, 4	1CQ12SC1384	2SC1384 1A/50 V NPN
Q5, 6	1CQ12SC1815GR	2SC1815 0.1A/40 V NPN
Q7	1CQ12SA733	2SA733 -0.1A/-50 V PNP
Q8	1CQ12SA1020	2SA1020 -2A/50 V PNP
R1	1AR1-R50F684JH	resistor, fixed: \pm 5%; 1/4 W: unless otherwise stated 680k, 1/2 W
R2	1AR2A2R0E303JH	30k, 2 W metal oxide
R3	1AR6A5R0B510JH5	51, 5 W R/CE
R4	1AR2A2R0E303JH	30k, 2 W metal oxide
R5	1AR2A2R0B20JH	82, 2 W metal oxide
R6	1AR7A5R0B100K	10, 5 W R/FS
R7	1AR1-R25D392JH9	3.9k
R8	1AR1-R25B100JH9	10
R9	---	Not Used
R10	1AR1-R25D392JH9	3.9k
R11	1AR1-R25B100JH9	10
R12	---	Not Used
R13, 14	1AR1-R50A1R2JH	1.2, 1/2 W
R15	1AR1-R25D272JH9	2.7k
R16	1AR1-R25D102JH9	1k
R17	1AR1-R25D272JH9	2.7k
R18	1AR1-R25D102JH9	1k
R19	1AR1-R25E223JH9	22k
R20	1AR1-R25D562JH9	5.6k
R21	1AR1-R25E103JH9	10k
R22	1AR1-R25E333JH9	33k
R23	1AR1-R25D562JH9	5.6k
R24	1AR1-R50C751JH	750, 1/2W
R25	1AR1-R25D182JH9	1.8k
R31	1AR1-R25C471JH9	470
R32	1AR1-R25D912JH9	9.1k
R33	1AR1-R25D122JH9	1.2k
R34	1AR1-R25E563JH9	56k
R35	1AR1-R50D152JH	1.5k, 1/2W
R36	1AR1-R25E103JH9	10k
R37	1AR1-R25F474JH9	470k
R40	1AR1-R25A5R6JH9	5.6k
R41	1AR1-R25D222JH9	2.2k
R42	1AR1-R25C681JH9	680
R43	1AR1-R25C911JH9	910
R44, 45	1AR1-R25D102JH9	1k
R46	1AR1-R25E473JH9	47k
R47	---	Not Used
R48	1AR1-R25D222JH9	2.2k
R49, 50	1AR1-R50B100JH	10, 1/2 W
R51	1AR1-R25D102JH9	1k
R52	1AR2A2R0A3R0JH	3, 2 W metal oxide
R53	1HR3104C	3W, 2 W metal oxide
R54	1AR2A1R0C471JH	470, 1 W metal oxide
R55	1AR1-R25C471JH9	470
R56	1AR2A1R0C471JH	470, 1 W metal oxide
R57	1AR1-R25E123JH9	12k
R58, 59	---	Not Used
R60	1AR1-R25D432JH9	4.3k
R61	1AR1-R25D102JH9	1k
R62	1AR1-R25D222JH9	2.2k
RT	1ARC-TDC05C250L	thermistor: TDC05C250L 5k Ω
RTH1	1ARCRXE090	RXE090 0.9A/60 V PSW
SVR1	1ARB-R30D102S2S	variable resistor: 1k, 0.3 W, 10%
SW1	1EE1L21-22A1	switch: Slide (115/230 V ac)
SW2	1EE1SSFZC22-062	Slide (Fan Continuous On)
T1	1DL5TF561	transformer: TF-561, output power
T2	1DL5TF218	TF-218-R2, driver
T3	1DL5TF577	TF-57, low voltage supply
TRC1	1CQ3BTA16-600B	Triac: BTA16-600B
TSW1	1ARENR	thermal switch: 50°C 2.6A
U1	1CU4TL494T1	integrated circuit: (see note) TL494CN, pulse width modulator
U2	1CU5LM358	LM358, dual operational amplifier
ZD1	1CDB-R50B14R8G	voltage regulator: (see note) 14.8 V 1/2 W, 2% Zener diode
ZD2, 3	1CDBA1R0B33R0G	1N4752, 33 V, 1 W, 2% Zener diode
ZNR1, 2	---	metal oxide varistor: Not Used
ZNR3 thru 5	1ARD-R60C471K97	TNR15G471K, 470 V, 0.6 W

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by DuraComm part numbers.

Parts List

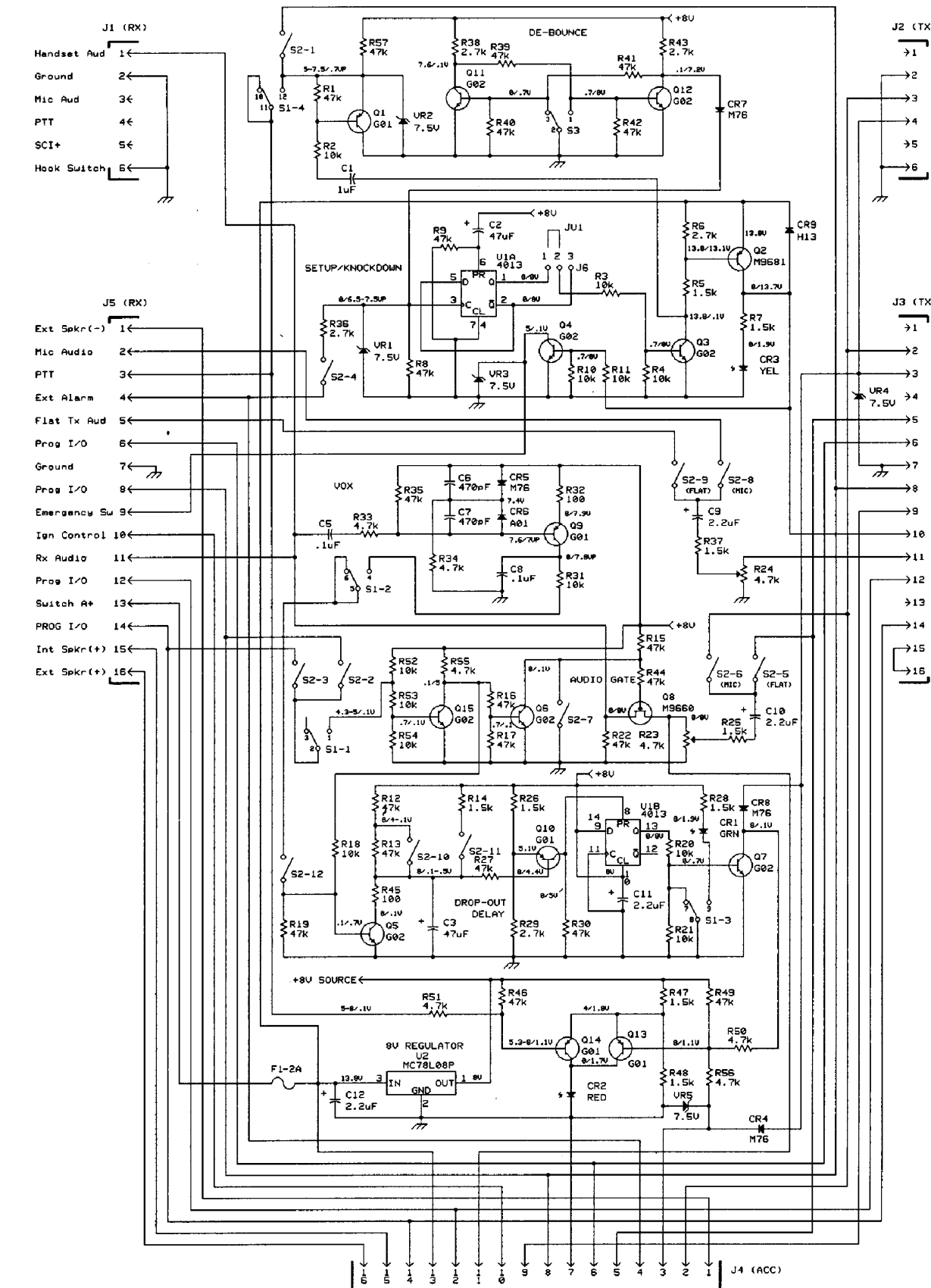
Basic Repeater Controller, electrical PL-941033-B

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
C1	0811051A19	capacitor, chip: 10 ⁶ ±5%; 50 V; unless otherwise stated
C2, 3	2311048B19	1; 63 V; polyester
C5	2113741B69	47; ±20%; 16 V; electrolytic
C6, 7	2113740B65	0.1
C8	2113741B69	470 pF
C9 thru 12	2311048B06	0.1
		2.2; ±20%; electrolytic
CR1	4888245C22	diode: (see note) LED, green
CR2	4888245C24	LED, red
CR3	4888245C23	LED, yellow
CR4, 5	4805129M76	silicon, MMDB914
CR6	4884616A01	hot carrier
CR7, 8	4805129M76	silicon, MMDB914
CR9	4880008E01	silicon, 1N4005
F1	6505214E04	fuse: 2 A
JU1	0984181L01	jumper: push-on, 2-pin
J1, 2	0983112N01	connector, receptacle: 6-pin TELCO
J3 thru 5	2880923V01	male, 16-pin
J6	2880002R03	3-pin header
Q1	4880214G01	transistor: (see note) PNP; MMBT3906
Q2	4800869681	PNP; M9681
Q3 thru 7	4880214G02	NPN; MMBT3904
Q8	4800869660	P-channel; J-FET; 2N5461
Q9, 10	4880214G01	PNP; MMBT3906
Q11, 12	4880214G02	NPN; MMBT3904
Q13, 14	4880214G01	PNP; MMBT3906
Q15	4880214G02	NPN; MMBT3904
R1	0611077B15	resistor, fixed: ±5%; 1/8 W; unless otherwise stated
R2 thru 4	0611077A98	47k
R5	0611077A78	10k
R6	0611077A78	1.5k
R7	0611077A78	2.7k
R8, 9	0611077A78	1.5k
R10, 11	0611077A98	47k
R12, 13	0611077A98	10k
R14	0611077A78	47k
R15 thru 17	0611077B15	47k
R18	0611077A98	10k
R19	0611077B15	47k
R20, 21	0611077A98	10k
R22	0611077B15	47k
R23, 24	1805500L05	4.7k, variable
R25, 26	0611077A78	47k
R27	0611077B15	47k
R28	0611077A78	1.5k
R29	0611077A84	2.7k
R30	0611077B15	47k
R31	0611077A98	10k
R32	0611077A50	100 Ω
R33, 34	0611077A90	4.7k
R35	0611077B15	47k
R36	0611077A84	2.7k
R37	0611077A78	1.5k
R38	0611077A84	2.7k
R39 thru 42	0611077B15	47k
R43	0611077A84	2.7k
R44	0611077B15	47k
R45	0611077A50	100 Ω
R46	0611077B15	47k
R47, 48	0611077A78	1.5k
R49	0611077B15	47k
R50, 51	0611077A90	4.7k
R52 thru 54	0611077A98	10k
R55, 56	0611077A90	4.7k
R57	0611077B15	47k

Basic Repeater Controller, electrical PL-941033-B

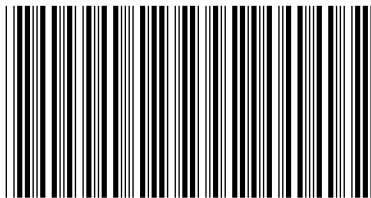
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
S1	4084324C10	switch: 4 PDT
S2	4083022M04	SPDT, 12-pos
S3	4080065E02	DPDT
U1	5184887K13	integrated circuit: (see note) MC14013 - CMOS dual D-flip-flop
U2	5184621K73	MC78L08P - 3-terminal LP pos reg
VR1 thru 5	4880140L11	voltage regulator: (see note) Zener, 7.5 V 5% 250 mW SOT
non-referenced items		
	1484360C01	INSULATOR, S1, 2 used; S3, 1 used

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.



NOTES: 1. Pin assignments for J1 and J2 are identical.
 2. Pin assignments for J3, J4 and J5 are identical.
 3. JU1-At power up=1-2 for rptr on/2-3 for rptr off.
 4. All voltages are dc and measured with hi-z DMM.
 5. S1 and all sections of S2 are shown "OFF".
 6. Voltages shown are Inactive/Active state.
 7. Measure voltages with RMRCK in normal operation with radios attached to J3-TX AND J5-RX. S1: "Repeater Enable", S2-4 and either S2-2 or S2-3 must be "ON". S2-12 must be "ON" to check VOX.
 P after a voltage means pulsed (not continuous).

Schematic Diagram, Circuit Board, and Parts List for Basic Repeater Controller



6864110R66-O

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