MOTOROLA

GR400 & GR500 X-Pand

Repeaters

146-174 MHz
444-474 MHz

Service Manual

Radius®

6880905Z54-O

Computer Software Copyrights

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service manual revision

GENERAL:

This revision outlines changes that have occurred since the printing of your service manual. Use this information to correct your manual.

INSTRUCTION MANUAL AFFECTED:

6880905Z54-O GR400 X-Pand & GR500 X-Pand Repeaters Service Manual

REVISION DETAILS:

1. This supplement contains the schematic diagrams for the HPN9005 and HPN9041 power supplies.

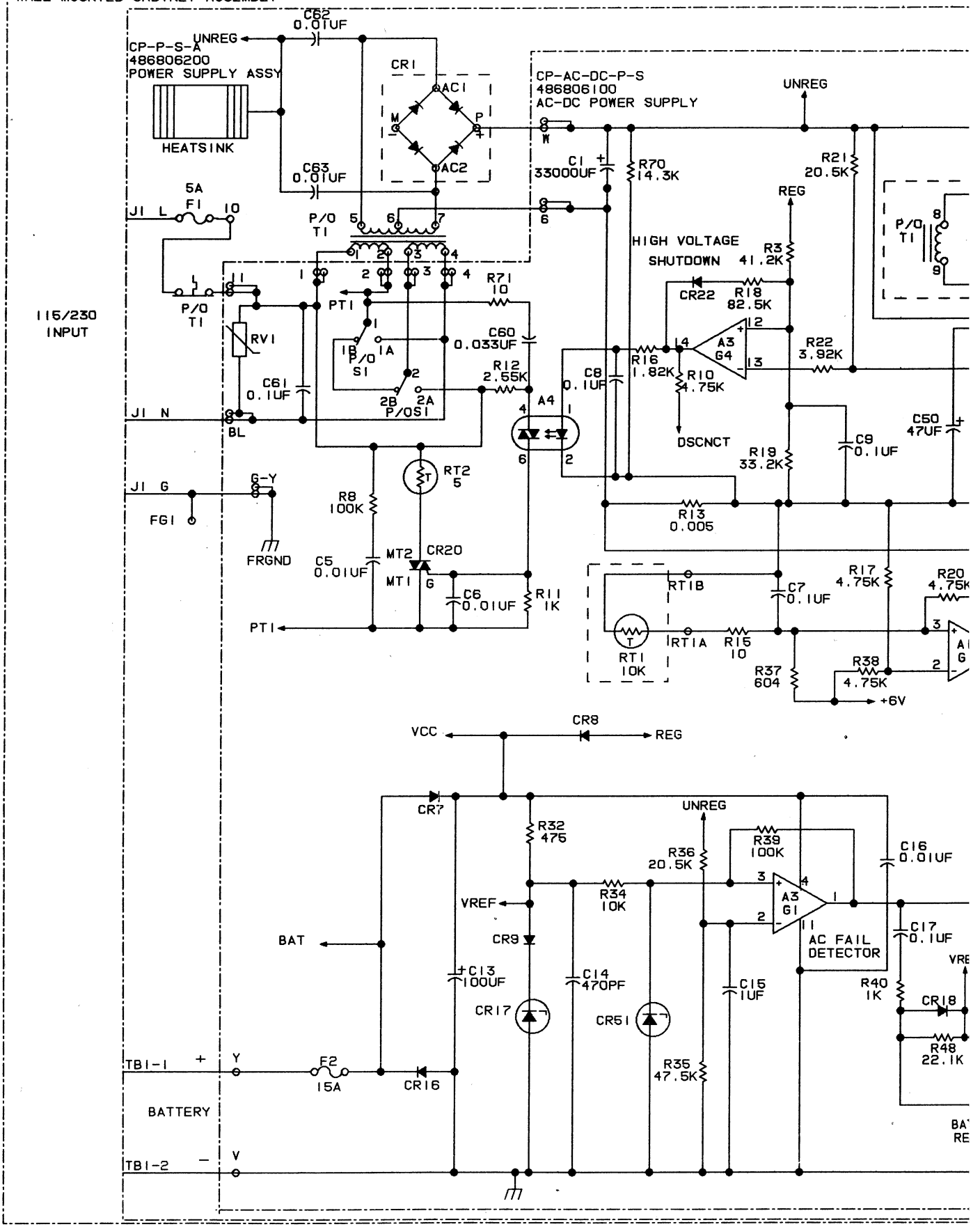
ATTACHMENTS

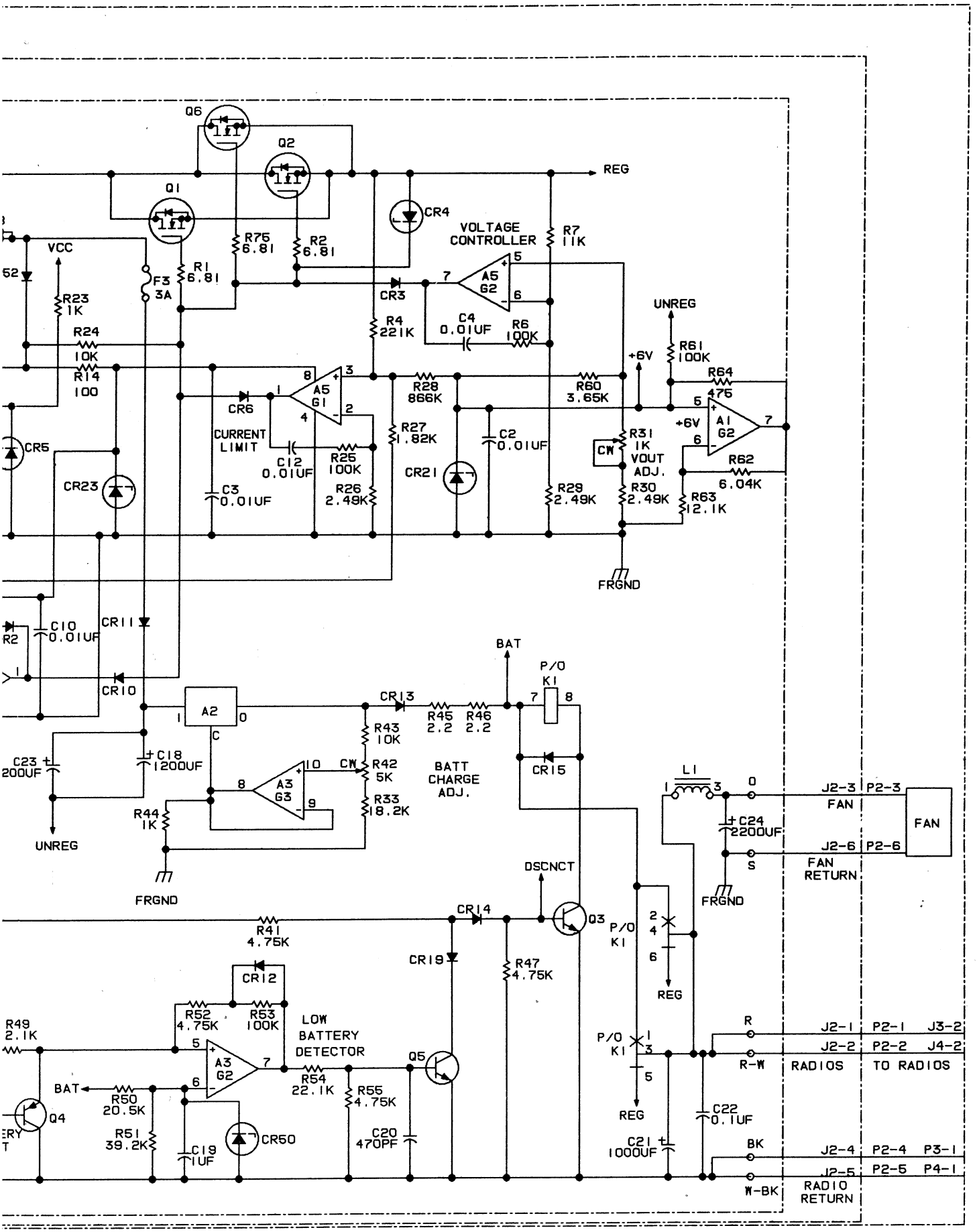
MOTOROLA

1000 W. Washington, Mt. Pleasant, IA 52641

MMR-126
December, 1998

CP-W-M-C-A
522600400
WALL MOUNTED CABINET ASSEMBLY




Q6
Q2
Q1
REG
CR4
VOLTAGE CONTROLLER
R7 11K
VCC
R75 6.81
R2 6.81
F3 3A
R1 6.81
CR3
A5 G2
UNREG
R23 1K
R24 10K
R14 100
R4 221K
C4 0.01UF
R6 100K
+6V
R61 100K
R64 475
A5 G1
R28 866K
R60 3.65K
A1 G2
CR6
CURRENT LIMIT
C12 0.01UF
R25 100K
R27 1.82K
C2 0.01UF
R31 1K VOUT ADJ.
R62 6.04K
CR5
CR23
C3 0.01UF
R26 2.49K
CR21
R29 2.49K
R30 2.49K
R63 12.1K
FRGND
C10 0.01UF
CR11
CR10
BAT
P/O K1
A2
CR13
R45 2.2
R46 2.2
R43 10K
C23 200UF
C18 1200UF
A3 G3
R42 5K
BATT CHARGE ADJ.
CR15
R33 18.2K
R44 1K
L1
J2-3 P2-3
FAN
C24 2200UF
J2-6 P2-6
FAN RETURN
DSCNCT
CR14
Q3
R41 4.75K
CR19
R47 4.75K
CR12
R52 4.75K
R53 100K
LOW BATTERY DETECTOR
R49 2.1K
A3 G2
Q5
R54 22.1K
R55 4.75K
R50 20.5K
Q4
R51 39.2K
CR50
C19 1UF
C20 470PF
C22 0.1UF
C21 1000UF
R
R-W
J2-1 P2-1 J3-2
J2-2 P2-2 J4-2
RADIOS
TO RADIOS
BK
W-BK
J2-4 P2-4 P3-1
J2-5 P2-5 P4-1
RADIO RETURN

Parts List

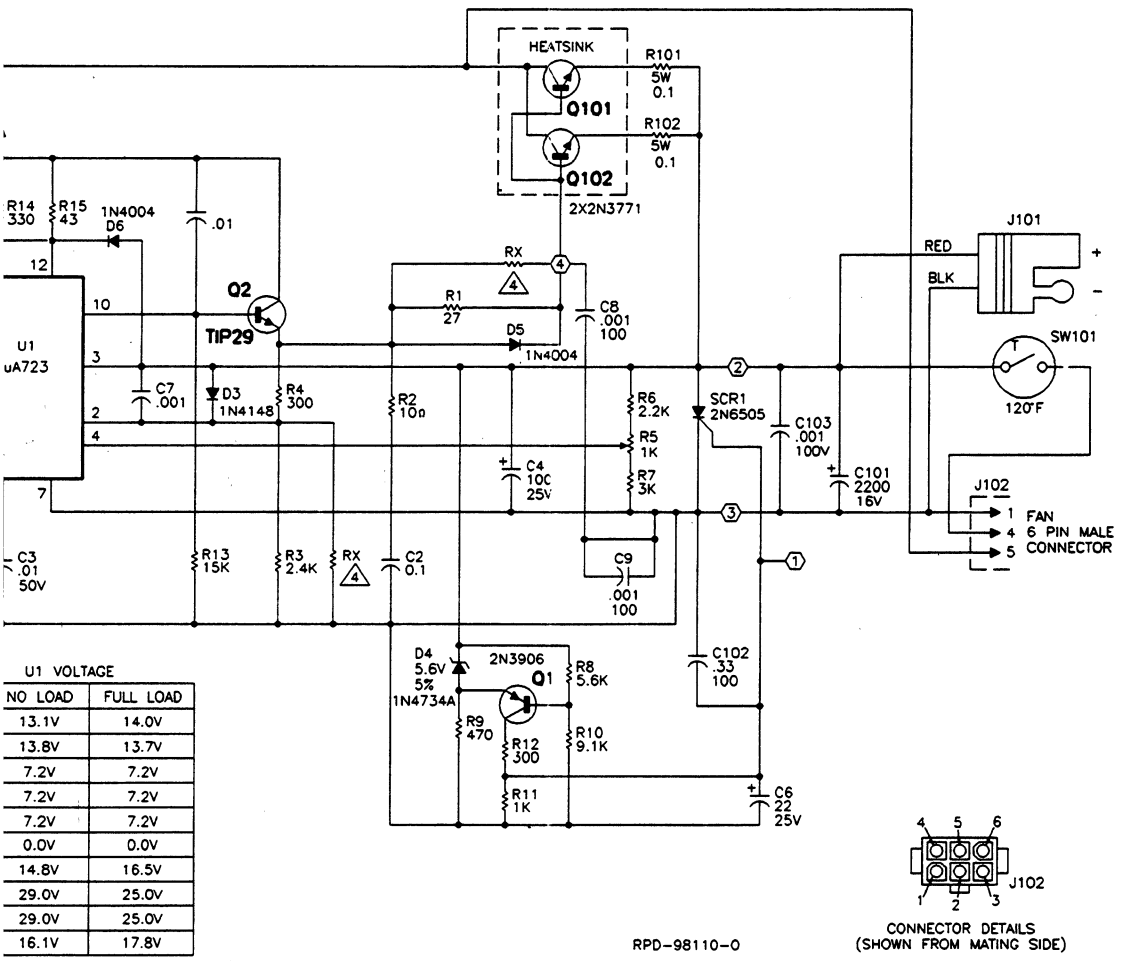
REFERENCE SYMBOL	STAR WERKS, INC PART NO.	DESCRIPTION
		terminal, plug:
		unless otherwise stated
1 thru 4	245775100	
6	355310400	
8, 9	245775100	
11	245775100	
BL	245775100	
BK	245380900	
G-Y	245775100	
O	245380800	
R	245380900	
R-W	245380900	
RT1A	245380600	
RT1B	245380600	
S	245380800	
V	245380900	
W	355310400	
W-BK	245380900	
Y	245380900	
		integrated circuit: (see note)
A1	287114400	LM258N
A2	287133200	MC7805BT
A3	287112400	LM224J
A4	285713200	M0C3023T
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
		fuse:
F2	248326500	15 A
F3	248319200	3 A
		relay:
K1	254331600	DPDT, 12 V

HPN9005 GR500 Power Supply PL-941033-O

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	267511200	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	267511700	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
R60	263462600	3.65 k
R61	263469600	100 k
R62	263463100	6.04 k
R63	263465200	12.1 k
R64	263458200	475 Ω
R70	263465500	14.3 k
R71	263452400	10 Ω
R75	263452100	6.81 Ω
		thermistor:
RT2	267619800	5 Ω; 1/4 W
		varistor:
RV1	267635500	275 V; V275LA40A
		switch:
S1	251370500	115/230 V

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

Schematic Diagram and Parts List for HPN9005 Power Supply for the GR500 X-Pand Repeater

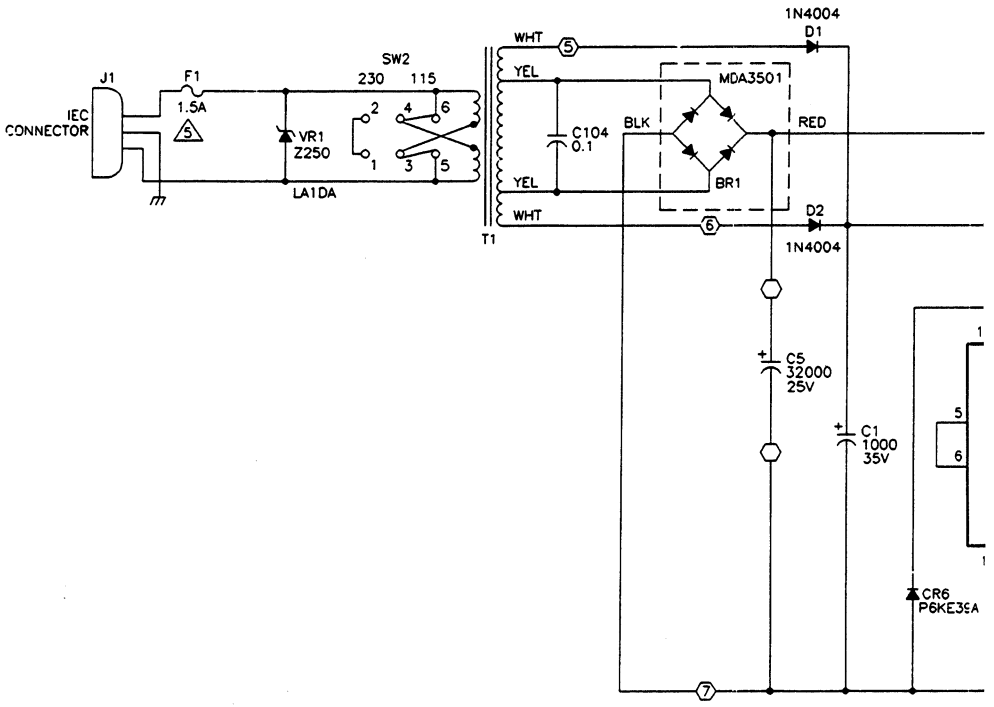


U1 VOLTAGE

NO LOAD	FULL LOAD
13.1V	14.0V
13.8V	13.7V
7.2V	7.2V
7.2V	7.2V
7.2V	7.2V
0.0V	0.0V
14.8V	16.5V
29.0V	25.0V
29.0V	25.0V
16.1V	17.8V

RPD-98110-0

CONNECTOR DETAILS
(SHOWN FROM MATING SIDE)



PIN#
2
3
4
5
6
7
10
11
12
13

UNLESS OTHERWISE NOTED

1. ALL RESISTORS 5%, 0.5W, C.F. IN OHMS
2. ALL CAPACITORS IN MICROFARADS.
3. ⬡ PRINTED CIRCUIT BOARD CONNECTIONS.

4 TO BE SELECTED IN TEST.

5 PART OF J1

Schematic Diagram for HPN9041 Power Supply for the GR400 X-Pand Repeater

Radius®

service manual revision

GENERAL:

This revision outlines changes that have occurred since the printing of your service manual. Use this information to correct your manual.

INSTRUCTION MANUAL AFFECTED:

6880905Z54-O GR400 & GR500 X-Pand Repeaters Service Manual

REVISION DETAILS:

1. Manuals 6880904Z89, Basic use of the R1225 Transceiver; 6880905Z34, R1225 Safety/Licensing Guide; and 6880905Z51, R1225 Accessory Sheet are part of manual kit HLN9535 and cannot be ordered separately.

2. Manual 6880904Z93 is part of kit HVN9054 and cannot be ordered separately.

3. On page v of the Foreword section, a separate ZR340 Controller Operation/Maintenance/Programming manual, (6880905Z90) has been added to Table 1.

4. On page vi, under "Ordering Replacement Parts", a replacement HPN9005 Power Supply for the GR500 X-Pand Repeater is available through Star Werks, Inc. at the following address:

   Star Werks Inc.
   2040 E. Algonquin Rd. (Suite 504)
   Schaumburg, IL 60173
   847-397-3600

5. Refer to the R1225 Transceiver Service Manual (6880905Z53) for the proper installation of an Advantage Board before installing the R1225 transceiver module into the GR400 or GR500 X-Pand repeater.

6. On page 6-3 of the Controller Interconnections section, the following TRA100R Jumper Settings information has been added:

Jumper	Setting
JU8	2
JU9	In
JU14	3-4
JU21	1

7. The Troubleshooting section for the GR400 & GR500 X-Pand repeaters has been revised. Please refer to the attached page.

ATTACHMENTS

Table 8-4. Troubleshooting for External Controllers (General)

Symptom	Problem	Solution
1. Controller dead, no LED indications.	1a. Loose or bad cable from transceiver. 1b. Blown fuse in controller (if applicable).	1a. Check cable from transceiver and replace if necessary. 1b. Replace fuse in controller (if applicable) and check for short or open circuit(s).
2. Transmitter not keying when a properly identified signal is presented to receiver.	2a. Controller not enabled, if applicable. 2b. R1225 transceiver not enabled. 2c. Loose or bad repeater cable. 2d. Accessory connector of transceiver not programmed correctly or not operating correctly. 2e. Incorrect receive frequency or TPL/DPL programmed. 2f. Repeater on wrong channel (mode). 2g. Pin 10 programmed as "repeater knockdown" and activated by a controller or accessory. 2h. No transmit frequency programmed into transceiver.	2a. Enable controller. 2b. Press front panel "RPT EN" pushbutton. 2c. Check repeater cable connection(s) and replace cable, if necessary. 2d. Check programming of accessory connector and reprogram, if necessary. 2e. Check frequency and TPL/DPL code and reprogram, if necessary. 2f. Change repeater channel (mode). 2g. Check wiring to pin 10 and correct, if necessary. 2h. Program transmit frequency.
3. Transmitter keying continuously or keying without a properly identified signal presented to receiver.	3. Pin 3 of accessory connector on controller pulled LOW by an accessory.	3. Remove accessory and correct LOW condition.
4. First part of message not repeated.	4. User speaking too soon after pressing PTT.	4. Delay conversation to allow for delays in repeater and field radios from: • TPL/DPL decoding. • Requirements of signalling systems.
5. Transmitter keys, but low or no audio is transmitted.	5a. "External Mic" input (pin 2) of accessory connector not enabled. 5b. Controller not adjusted correctly.	5a. Use RSS to enable "External Mic Audio". 5b. Adjust controller. Perform alignment procedures.
6. "Tinny" repeated audio (lacks low frequencies).	6. Flat receive audio selected with microphone transmit audio.	6. Use RSS to check "Rx Audio Output" and reprogram, if necessary.
7. "Bassy" repeated audio (lacks high frequencies).	7. EIA de-emphasized receive audio selected with flat transmit audio.	7. Use RSS to check "Rx Audio Output" and reprogram, if necessary.
8. TPL/DPL signalling "passing through" controller.	8. Flat repeat audio selected.	8. Use RSS to reprogram repeat audio as "EIA."
9. TPL/DPL signalling not "passing through" controller.	9. EIA de-emphasized repeat selected.	9. Use RSS to reprogram repeat audio as "Flat."
10. DPL sense inverted in "pass through" mode (flat audios).	10. Inversion caused by processing of signal in receiver circuits.	10. Use RSS to change "Flat Tx DPL Polarity".
11. Undesirable squelch tails and noise transmitted during drop-out delay.	11. Unmuted receive audio selected	11. Use RSS to reprogram for "Muted" audio.

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Table of Contents

Foreword

Section 1
Introduction to the GR400 & GR500 X-Pand Repeater and Components

Section 2
Assembling the GR400 X-Pand Repeater

Section 3
Assembling the GR500 X-Pand Repeater

Section 4
Converting the GR500 Repeater Into the GR500 X-Pand Repeater

Section 5
Tuning the Duplexer

Section 6
Controller Interconnections

Section 7
Controller Adjustments

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, accessories, and specifications, as well as sections that deal with specific service aspects of the GR400 & GR500 X-Pand Retrofit Repeaters. 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 for the GR400 & GR500 X-Pand Retrofit Repeaters.

Table 1. Other Documentations

Information	Location
Basic Use of Transceiver	R1225 Operator Guide (6880904Z89)
Accessories	R1225 Accessory/Feature Sheet (6880905Z51)
Safety and Licensing	R1225 Safety/Licensing Guide (6880905Z34)
Programming	1225 Series RSS Getting Started (6880904Z93) p/o HVN9054
R1225 Service	R1225 Service Manual (6880905Z53)
i750R Operation/Maintenance	i750R Service Manual (6880904Z39)
i750R General Programming	i750R RSS Manual (6880904Z45)
i20R Operation Maintenance	i20R Service Manual (6880904Z40)
i20R General Programming	i20R RSS Manual (6880904Z55)
ZR310 Operation/ Maintenance/ Programming	ZR310 Service Manual (6880904Z64)
ST-853M SmarTrunk II Operation/Programming	ST-853M SmarTrunk II Service Manual (6880905Z59)

Table 1. Other Documentations (Cont'd.)

Information	Location
GR300/GR500 Operation/ Maintenance (includes ZR320, ZR330, ZR340, i50R, TRA100R, & Basic Controllers)	GR300/GR500 Service Manual (6880903Z42)
GR300/GR500 Programming Information (includes ZR320, ZR330, ZR340, i50R, TRA100R, & Basic Controllers)	GR300/GR500 Programming Guide (6880903Z43)

Technical Support

To obtain technical support, you may call Motorola's Radius 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 Radius Product Services, a defective "major" component (such as a repeater controller or the power supply) should be returned. You must obtain authorization from Radius Product Services before returning the component. After 30 days, you must return any defective component to the location shown in Table 1. 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, we will either repair or replace the component as required. If the component is out of warranty, you must pay a service fee.

Table 1. Service After 30 Days

Major Component*	Repair Location
HPN9041_ (Power Supply)	Astron
HLN8388_ (ZR310)	Zetron
HLN9119_ (ZR340)	Zetron
HLN9121_ (TRA100R)	Instrument Associates
HLN9120_ (i750R)	Instrument Associates
HLN9447_ (i20R)	Instrument Associates
HLN3104_ (ST-853M SmarTrunk II)	SmarTrunk Systems, Inc.

* 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 GR400 & GR500 X-Pand 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 Radius 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 Parts. 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.

Radius 30-Day Warranty
Technical Support
Radius Product Services
1000 W. Washington St.
Mt. Pleasant, IA 52641 USA

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

Radius Major Component Repair
Motorola Radio Support Center
3760 South Central Avenue
Rockford, IL 61102 USA

Astron Major Component Repair
(for power supply)
Astron Corporation
9 Autry
Irvine, CA 92718 USA
1-714-458-7277

IAI Major Component Repair
(for i20R, i750R, and TRA100R)
Instrument Associates
2455 Harbor Ave.
P.O. Box 13127
Memphis, TN 38113-0127 USA
1-901-948-1490

Zetron Major Component Repair
(for ZR310, ZR320, and ZR340)
Zetron Inc.
12335 134th Court N.E.
Redmond, WA 98052-2433 USA
1-206-820-6363

SmarTrunk Systems, Inc.
(for SmarTrunk II)
23278 Bernhardt Street
Hayward, CA 94545-1621
1-510-887-1950

Motorola Parts
Aftermarket Products Division
Attention: Order Processing
1313 E. Algonquin Road
Schaumburg, IL 60196

Aftermarket Products Division
Attention: International Order Processing
1313 E. Algonquin Road
Schaumburg, IL 60196

Customer Service
1-800-422-4210
1-847-538-8198 (FAX)

Parts Identification
1-847-538-0021
1-847-538-8194 (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 Radius GR400 or GR500 X-Pand Repeater Station is activated. In countries other than the United States, contact the local government for licensing rules.

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.

DOC 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 designed 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, 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.

DOC 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.

DOC 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 (DOC)

Le présent appareil numerique n'emet pas de bruits radioélectriques dépassant les limites applicables aux appareils numeriques de la classe A, préscitées dans le règlement sur le brouillage radioélectrique edicté par le Ministère des Communications du Canada.

Accessories

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

Repeater Housing & Control Panel

HLN3102	GR400 X-Pand Repeater Housing
HLN3103	GR500 X-Pand Repeater Housing
HLN3100	R1225 Conversion Kit for GR400/GR500 X-Pand Repeaters

Controller Modules

HLN9447	i20R Controller
HLN3104	SmarTrunk II Controller
HLN9119	ZR340 Controller
HLN8388	ZR310 Community Tone Panel
HLN9120	i750R Advanced Interconnect Signalling
HLN9121	TRA100R Tone Remote Adapter

Duplexer Modules

HFD8188	144-155 MHz, VHF Duplexer
HFD8465	150-160 MHz, VHF Duplexer (Tuned)
HFD8189	155-162 MHz, VHF Duplexer
HFD8190	162-174 MHz, VHF Duplexer
TDN7407	450-470 MHz, UHF Duplexer (Tuned)

Preselector Modules

HFD8461	144-160 MHz, VHF Preselector
HFD8462	160-174 MHz, VHF Preselector
HFE8459	440-474 MHz, UHF Preselector

C100 Desksets

EN1000	Basic Extended Local Control Desk Set
EN1001	Tone Remote Control Desk Set w/F1/F2, w/intercom
EN1002	Tone Remote Control Desk Set w/RapidCall
EN1003	Basic DC Remote Control Desk Set
EN1004	DC Remote Control Desk Set w/F1/F2, w/Intercom
RLN1016	DC Remote Adapter w/F1/F2 & Service Manual
RLN1017	Tone Remote Adapter w/F1/F2 & Service Manual

Microphones

HMN3175	Compact Touch Code Microphone w/ 7 ft. cord
HMN3000	Desk Microphone, black

16-Pin Accessory in Repeater

HLN9457	16-Pin Accessory Kit

Antennas

TDD7559	144-153 MHz, 3 dB Gain
TDD7544	150-158 MHz, 3 dB Gain
TDD7545	158-166 MHz, 3 dB Gain
TDD7546	166-174 MHz, 3 dB Gain
TDE7260	450-470 MHz, 3.8 dB Gain
TDE7760	470-488 MHz, 3.8 dB Gain

Cables

HKN9234	Add-On Controller Cable Kit
HKN9025	GR400/GR500 X-Pand Internal Duplexer RF Cables
HKN9016	GR400/GR500 X-Pand External Duplexer RF Cable
HKN9006	GR1225 SmarTrunk II Controller Cable

General Accessories

HLN9455	GR1225/GR400 X-Pand Battery Revert Kit
RRX4025	Type "N" Connector Coaxial In-line Arrestor
RRX4032	Tower Mount Hardware w/In-line Arrestor
ST788	1/2" Jacketed Heliax Coaxial Ground Clamps
ST853	7/8" Jacketed Heliax Coaxial Ground Clamps
RLN4264	120 V AC, 15 Amp Duplex Surge Protector

Manuals

6880905Z53	R1225 Service Manual
6880905Z54	GR400/GR500 X-Pand Installation/Service Manual
HLN9535	R1225 Operating Manual Kit
HVN9054	1225 Series Radio Service Software

Specifications

GENERAL

	VHF	UHF
Model Series:	M43GRC	M44GRC
Frequency Range:	146-174 MHz	444-474 MHz
RF Output:	25-50 W	25-45 W
Channel Spacing:	Switchable 12.5/25 kHz	
Duty Cycle:	Continuous @ 25 Watts, 50% @ 45/50 Watts (5 min. on / 5 min. standby)	
Dimensions: GR400 X-Pand Repeater GR500 X-Pand Repeater	H 7.0" x W 19.0" x D 19.0" (H 178.0mm x W 483mm x D 483mm) H 7.4" x W 17.4" x D 13.5" (H 188mm x W 442mm x D 343mm)	
Weight: GR400 X-Pand Repeater GR500 X-Pand Repeater	30 lbs. (13.6kg) 43.3 lbs. (19.66kg)	
Channel Capacity:	16 Channels	
Freq. Separation:	28 MHz	30 MHz
Input Voltage: Repeater Transceiver	115/230 V ac ±10% 13.8 V dc ±10%	
Input Drain: Repeater	2.6 A ac (maximum @ 115 V ac 1.3 A ac (maximum) @ 230 V ac	
Transceiver (@13.8 V dc) Standby Receive @ 3 W or 7.5 W audio	0.45 A dc 1.5 A dc	
Transmit @ 50/45 W	14.0 A dc	12.5 A dc
Squelch Code Capabilities:	TPL/DPL/CSQ	

TRANSMITTER

	VHF	UHF
Frequency Stability:	±2.5 ppm	±1.5 ppm
Spurs/Harmonics:	-23 dBm (-70 dBc @50 W)	-23 dBm (-69 dBc @45 W)
Audio Response:	+1/-3 dB, relative to 6 dB/octave pre-emphasis, 300-3000 Hz	
FCC Designation:	ABZ99FT3023	ABZ99FT4023
FCC Modulation: 25 kHz 12.5 kHz	16K0F3E 11K0F3E	
Output Impedance:	50 ohms	
Modulation Sensitivity:	80 mV rms for 60% deviation @ 1000 Hz	
FM Noise: 25 kHz 12.5 kHz	45 dB 40 dB	45 dB 40 dB
Audio Distortion:	<3% EIA (60% of Rated Max. Deviation @1000 Hz)	

RECEIVER

	VHF		UHF	
	12.5 kHz	**25 kHz**	**12.5 kHz**	**25 kHz**
Freq. Stability (-30C to +60C):	±2.5 ppm		±1.5 ppm	
Sensitivity @ 12 dB SINAD*:	0.35 µV (-116.1 dBm)			
Internal Squelch (SINAD):	10 dB nominal setting; adjustable from off to 20 dB			
Selectivity*:	75 dB	80 dB	70 dB	80 dB
Intermodulation*:	80 dB		80 dB	
Spurious Rejection:	85 dB		85 dB	
Image / Half IF Rejection:	80 dB		80 dB	
Audio Output: 8 ohms (external) 22 ohms (internal)	7.5 W 3.0 W Nominal			
Input impedance:	50 ohms			
EIA Usable Bandwidth:	1.2 kHz	2.0 kHz	1.2 kHz	2.0 kHz
Audio Response:	+2/-8 dB, relative to 6 dB/octave de-emphasis, 300-3000 Hz			

* Typical measurements per EIA/TIA-603.

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

Service Aids

The following table lists service aids recommended for working on the GR400 or GR500 X-Pand Repeaters.

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
HVN9054	Radio Service Software	Software on 3-1/2 in. diskettes.

Test Equipment

The following table lists test equipment required to service the GR400 or GR500 X-Pand Repeaters.

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, ±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 the GR400 & GR500 X-Pand Repeater and Components

Overview

This section introduces you to the GR400 & GR500 X-Pand Repeaters; outlines their major components; physical appearance; accessories; general information about duplexers, cables, and antenna spacing; and basic assembly of the repeater stations.

Repeater Stations

The GR400 & GR500 X-Pand Repeater Stations provide low cost communications solutions. In both X-Pand repeaters, all of the necessary components are built into one cabinet. The repeater housing allows space for the R1225 transceiver module and the retrofit control panel, two optional repeater controllers, the power supply, a duplexer, and a preselector.

The transceiver and power supplies in both of the X-Pand repeaters are forced air cooled with 100 cfm 12 V dc fans.

A few features that distinguish the GR400 X-Pand repeater:

- **Mounting**
  The GR400 X-Pand repeater is a rack or cabinet mounted unit.
- **Space for Repeater Interface Options**
  The GR400 X-Pand repeater cabinet has space for **two** repeater interface options or the optional SmarTrunk II controller.
- **Space for Optional Battery Revert Module**

A few features that distinguish the GR500 X-Pand repeater:

- **Mounting**
  The GR500 X-Pand repeater is a wall-mount unit.
- **Space for Repeater Interface Options**
  The GR500 X-Pand repeater cabinet has space for **two** repeater interface options or the optional SmarTrunk II controller.
- **Battery Revert Circuitry in Power Supply**

Repeater Controllers

Basic repeater interfacing circuitry and control are features of the R1225 Transceiver. For advanced features, such as Multiple Tone Encode/Decode or Telephone Interconnect, external controllers may be added inside the GR400 or GR500 X-Pand repeater housings.

The following optional repeater controllers are available for use with the GR400 and GR500 X-Pand Repeaters:

- Multiple Tone Community Repeater Controller (ZR310)
- On-Site Repeater Controller (i20R)
- RapidCall Interconnect Controller (i750R)
- Advanced Interconnect Controller (ZR340)
- Selective Calling Interconnect Controller (ZR320)
- Tone Remote Adapter (TRA100R)
- Digital Trunking Controller (SmarTrunk II ST-853M)

Table 1-1 lists these components and the basic function of the GR400 & GR500 X-Pand repeaters when combined with each component.

Table 1-1. Repeater Function w/ Controller Components

Component	Repeater Function
ZR310	Community Repeater (for up to 70 groups)
ZR320	Full-Featured Telephone Interconnect
ZR340	Advanced Interconnect
i750R	Full-Feature Telephone Interconnect
i20R	Multiple-Tone Panel (up to 10 groups)
TRA100R	Tone Remote Adapter
ST-853M SmarTrunk II	Digital Trunking with Interconnect

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

Table 1-2. Documentation for Controller Components

Component	Service Manual	Software Manual
ZR310	6880904Z64	
i750R	6880904Z39	6880904Z45
i20R	6880904Z40	6880904Z55
ZR340	6880905Z02	
ZR320	6880903Z42	6880903Z43
TRA100R	6880903Z42	6880903Z43
ST-853M SmarTrunk II	6880905Z59	

Physical Description

The following paragraphs describe the physical characteristics of the:

- GR400 X-Pand Repeater Housing
- GR500 X-Pand Repeater Housing
- GR400 & GR500 X-Pand Repeater Fan Assembly
- GR400 X-Pand Repeater Power Supply
- GR500 X-Pand Repeater Power Supply
- R1225 Transceiver
- (Optional) Repeater Controllers
- (Optional) Duplexer
- (Optional) Preselector

Tables 1-9 and 1-10 show the physical dimensions and weight of the GR400 & GR500 X-Pand repeaters.

GR400 X-Pand Repeater Housing

The GR400 X-Pand repeater housing provides mounting for a EIA 19" relay rack or cabinet. The GR400 X-Pand repeater is shipped from the factory with the fan assembly already installed in the repeater housing. The power supply can be ordered as an option.

GR500 X-Pand Repeater Housing

The GR500 X-Pand repeater housing is designed for wall-mounting the repeater station. The GR500 X-Pand 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 GR500 X-Pand repeater is mounted on the wall, some of the repeater components (control head assembly and optional controllers) should be assembled upside-down.

GR400 & GR500 X-pand Repeater Fan Assembly

A fixed-speed 12 Vdc fan is provided for cooling the assembled GR400 & GR500 X-Pand repeater. The fan operates at an air flow rate of approximately 100 cfm.

GR400 X-Pand Repeater Power Supply

(Optional)

The GR400 X-Pand repeater's power supply HPN9041 operates from a 115/230 V ac (switch selectable) power source. The power supply provides power to the fan assembly, the R1225 transceiver, and any optional repeater controller. A battery backup/revert, HLN9455, with trickle charging, is an optional accessory for the GR400 X-Pand repeater's power supply. The power supply has three connectors:

- A "Ford" type 2-prong connector, on a "pigtail", to provide power for the R1225 transceiver.
- A 6-position connector, on a "pigtail", to provide power for the fan and trickle charge current for the optional battery revert module.
- An IEC as a receptacle for various line cords (U.S. standard, 3-prong 115 V ac cord provided).

GR500 X-Pand Power Supply

The GR500 X-Pand repeater's power supply HPN9005 operates from a 115/230 V ac (switch selectable) power source. The power supply provides power to the fan assembly, the R1225 transceiver, and any optional repeater controller. Battery backup/revert with trickle charging is a standard feature of the GR500 X-Pand repeater's power supply. The power supply has three connectors:

- one inside the GR500 X-Pand repeater, which connects power to the R1225 transceiver (the optional controller(s) obtains power from the R1225 transceiver), and the fan
- one outside the GR500 X-Pand repeater, which connects to an external battery
- one IEC ac receptacle for various line cords (US standard, 3-prong 115 V ac cord provided).

Repeater Controllers

The repeater controllers appear almost identical. They each have mounting screw holes on each side with which to secure them into the GR400 or GR500 X-Pand repeater housing.

Connectors for cabling between the R1225 transceiver, and the repeater controller(s) are located on the back of each component. Operating power for the interface components is obtained from the R1225 transceiver. LEDs, **Set-Up** controls, and a **Programming** modular jack (where applicable) are located on the front of the repeater controllers.

R1225 Transceiver

The R1225 transceiver has mounting screw holes on each side in which to secure it to the GR400 or GR500 X-Pand repeater housings. Connectors for interconnecting the transceiver between the duplexer and the corresponding optional, external repeater controller(s) are located at the front and back. Controls, indicators, and the microphone connector are located on the control panel of the R1225 transceiver.

Duplexer

A duplexer allows the R1225 transceiver to operate simultaneously in the same frequency band with a single antenna and transmission line. Without the duplexer installed or connected to the GR400 or GR500

X-Pand repeater, it would be necessary to use two antennas spaced apart, with one connected to the receiver and the other to the transmitter. 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

The preselector is a filter that allows a relatively narrow frequency spread 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 receiver in the R1225 transceiver from the duplexer or a separate receive antenna.

Accessories

Table 1-3 shows general compatibility for general accessories available with the GR400 & GR500 X-Pand repeaters. Table 1-4 shows compatibility for the audio and DTMF accessories with each repeater controller. Additional accessories may be compatible if custom programming is done on the RSS and/or accessory cables are modified.

Duplexers, Preselectors, Cables, and Antenna Spacing

Duplexers

The duplexer "isolates" the receiver from the transmitter in the GR400 & GR500 X-Pand repeaters. Without this isolation, the ability of the receiver to detect weak signals would be severely degraded by the output signal of the transmitter. 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."

Table 1-3. Accessory Compatibility (General)

GR400 X-Pand Repeater	GR500 X-Pand Repeater	Part No.	Accessory
X	X	HSN8145	7.5 Watt External Speaker
X		HLN9402	GR400 X-Pand Center Mount Bracket 19" Panel Mount
	X	HLN9169	GR500 X-Pand Wall & 19" Panel Mount
X	X	HKN9025	GR400/GR500 X-Pand Internal Duplexer RF Cables
X	X	HKN9016	GR400/GR500 X-Pand External Duplexer RF Cables
X	X	HKN9234	Controller Cable
X	X	HKN9006	GR1225 SmarTrunk II Controller Cable

Table 1-4. Accessory Compatibility (Audio & DTMF)

Repeater Controller						Part No.	Accessory
i20R	i750R	TRA100R	ZR310	ZR320	ZR340		
X	X	X	X	X	X	L1473_	Local Deskset
	X		X	X	X	TDN8300_	DC Remote Adapter
	X		X	X	X	TDN8301_	Tone Remote Adapter
						L1474_	DC Remote Deskset
		X				L1475_	Tone Remote Deskset
X	X	X	X	X	X	HMN3000_	Desk Microphone
NOT COMPATIBLE							DTMF and LED Microphones *
* DTMF and LED microphones "load down" the MIC HI line and are therefore not compatible.							

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 GR400 or GR500 X-Pand 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.
- Insertion loss: 3 dB maximum

  Less insertion loss of the duplexer means the receiver is able to discern weaker signals and the transmitter delivers 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 Radius 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.

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 GR1225 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 purchased separately for the GR400 & GR500 X-Pand repeaters mate with a type-N at the duplexer end. Any other type of connector will require you to assemble cables.

Preselectors

- Impeance: 50 Ohms
- Insertion loss: 3 dB maximum

  The 3 dB loss may cause a reduction in possible service coverage area of the repeater but the rejecting of interference may more than offset this coverage reduction. Be aware that insertion loss changes in an opposite way that pass bandwidth does. As the pass bandwidth decreases (narrower filter), the insertion loss increases.
- Pass bandwidth: band and interference dependent

  The pass bandwidth is defined as the difference between the highest frequency and the lowest frequency at which the insertion loss has increased an additional 0.5 dB. As the operating frequency increases, it is more difficult to maintain a "fixed" pass bandwidth. Therefore, VHF preselectors will tend to be narrower than UHF preselectors for equal insertion losses. The required pass bandwidth will be a function of the frequency spacing from the repeater receiver frequency and the inteferring signal(s).
- Rejection: interference dependent

  The amount of rejection or attenuation of the interference varys between situations and the type of interference. In one case, 1 dB of attenuation will yield only 1 dB of interference reduction. In others, intermodulation or spurious responses, 1 dB of attenuation will yield 3 dB or more interference reduction. A typical rejection of 30 dB by the preselector at the closest interferring frequency should suffice.

Cables

The coaxial cables that connect the transceiver 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 end of the "hardline" to the duplexer with a flexible jumper cable to avoid undue stress on the connectors of the cables and the duplexer.

In planning a system, make sure that the various connectors found on the duplexer, feedlines, feedline jumpers and antenna are the correct mating pairs. Avoid using several connectors and adapters, as they may generate interference (IM "hits").

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 or less power loss. Table 1-6 is a list of Motorola part numbers for the various connectors and cables.

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 hardline male	RRX-4007A
type-N hardline female	RRX-4008A
RG58A/U coaxial cable	3000475378
RG400/U coaxial cable	3084173E01
RG214/U coaxial cable	3015068A17
1/2" hardline cable	3080329A22
8 foot 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.

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)

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 receiver and the transmitter 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 about vertically polarized antennas used in land mobile services.

Table 1-7. Vertical Spacing

Frequency (MHz)	Spacing	
	feet	meters
150	59	18
170	52	16
400	22	7
470	20	6

Table 1-8. Horizontal Spacing

Frequency (MHz)	Spacing	
	feet	meters
150	2,600	780
400	960	293

Preventive Maintenance

Preventive maintenance of the GR400 & GR500 X-Pand Repeater Stations 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.

Table 1-9. GR400 X-Pand Repeater Equipment Physical Characteristics

Major Component/Assembly	Height	Width	Depth	Weight
GR400 X-Pand repeater station (includes the weights of chassis, power supply, fan assembly, and controller mounting brackets)	7.0 in. (178mm)	19 in. (482mm)	19 in. (482mm)	30 lbs. (13.6kg)
R1225 Transceiver	2.0 in. (51mm)	7.0 in. (178mm)	8.37 in. (213mm)	5.0 lbs. (2.27kg)
Repeater Controllers (except SmarTrunk II)	1.3 in. (34mm)	7.1 in. (180mm)	8.7 in. (221mm)	1.7 lbs. (0.77kg)
SmarTrunk II Controller	1.3 in. (33mm)	19.0 in. (482.6mm)	6.7 in. (170mm)	2.4 lbs. (1.09kg)
Preselector (maximum dimensions)	1.3 in. (33mm)	4.2 in. (105mm)	9.3 in. (235mm)	2.1 lbs. (0.9kg)
Duplexer (maximum dimensions)	1.3 in. (33mm)	6.3 in. (160mm)	9.5 in. (241mm)	3.5 lbs. (1.59kg)
Power Supply	3.0 in. (76mm)	7.0 in. (178mm)	9.8 in. (249mm)	12 lbs. (5.45kg)
Fan Assembly	4.8 in. (122mm)	4.8 in. (122mm)	1.5 in. (38mm)	1.3 lbs. (0.59kg)

Table 1-10. GR500 X-Pand Repeater Equipment Physical Characteristics

Major Component/Assembly	Height	Width	Depth	Weight
GR500 X-Pand repeater station (includes the weights of all of the components)	7.4 in. (188mm)	17.4 in. (442mm)	13.5 in. (343mm)	43.3 lbs. (19.66kg)
R1225 Transceiver	2.0 in. (51mm)	7.0 in. (178mm)	8.37 in. (213mm)	5.0 lbs. (2.27kg)
Repeater Controllers (except SmarTrunk II)	1.3 in. (34mm)	7.1 in. (180mm)	8.7 in. (221mm)	1.7 lbs. (0.77kg)
SmarTrunk II Controller	1.3 in. (33mm)	19.0 in. (482.6mm)	6.7 in. (170mm)	2.4 lbs. (1.09kg)
Duplexer (maximum dimensions)	1.3 in. (33mm)	6.3 in. (160mm)	9.5 in. (241mm)	3.5 lbs. (1.59kg)
Power Supply	3.7 in. (94mm)	8.3 in. (109mm)	11.5 in. (292mm)	12 lbs. (5.45kg)
Fan Assembly	4.8 in. (122mm)	4.8 in. (122mm)	1.5 in. (38mm)	1.3 lbs. (0.59kg)

Note: Dimensions of GR500 X-Pand housing view assumed while wall mounted.

Section 2
Assembling the GR400 X-Pand Repeater

Overview

This section contains information about the contents of your kit, assembly, mounting, and final assembly of your GR400 X-Pand Repeater Station.

The GR400 X-Pand repeater is designed to be mounted in a standard EIA 19" relay rack or cabinet. Please inspect your GR400 X-Pand repeater for any obvious signs of damage. If you need to send the unit in for repairs, we recommend using the original packaging.

Performance

The GR400 X-Pand repeater is not a high performance repeater, but is designed to withstand constant use. The GR400 X-Pand repeater package is designed for fixed locations where protection from the elements (snow, rain, etc.) can be provided.

The fan is single speed, high airflow (100 cfm). It provides 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.

Contents of the Optional Kits

The following is a checklist of the contents of the optional kits that can be purchased separately for assembling the GR400 X-Pand repeater. These kits are for assembling an internal duplexer, an external duplexer, or an optional controller into the GR400 X-Pand repeater. The quantities are listed in [ ] brackets.

HKN9027 (GR400 X-Pand cable)

- [8] M5 Torx® Machine Screw, 8mm long (Blk)
- [4] Tie Wraps, Nylon, 6"
- [2] 1/4-20 Nut
- [2] 1/4-20 External Lockwashers
- [1] 1/4-20 x 1-1/2" Screw, Phillips Head
- [1] Push Mount Standoff Tie Wrap
- [5] Rubber Pad 0.5" Dia.
- [1] Cable, PS Extention

HKN9016 (with external duplexer)

- [2] RF Cables
- [1] 90-Degree Mini-U RF Adaptor
- [2] Vinyl Caps

HKN9025 (with internal duplexer)

- [4] Tinnerman Nut Clips
- [4] 6 x 32 x 1/2 Machine Screw, Pan Head
- [2] RF Cables
- [1] N Plug to N Bulkhead cable
- [1] Vinyl Cap
- [4] Tie Wraps, Nylon
- [1] 90-Degree Mini-U RF Adaptor

HLN3100 (control head assembly)

HLN9514

- [1] R1225 Transceiver Retrofit Control Head

HKN9015

- [2] Flat Ribbon Cables
- [2] T20 Cap Head Screws
- [4] M5 T25 Machine Head Screws

HLN9510

- R1225 Transceiver Control Head Support Bracket

HLN9613 (optional SmarTrunk II controller)

- [2] SmarTrunk II Brackets
- [4] TT4 x 7.0 Screws

HKN9006 (optional SmarTrunk II controller cable)

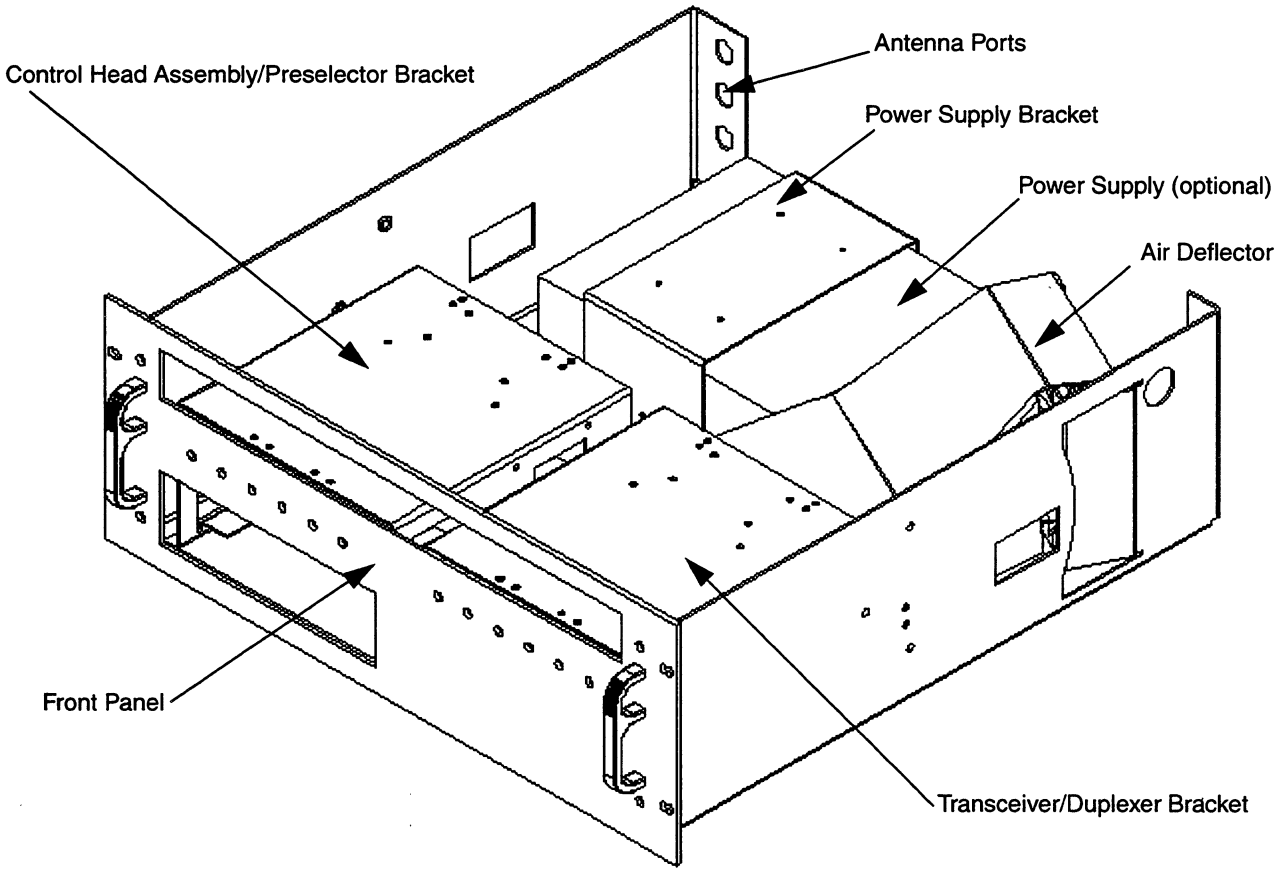
- [1] R1225/SmarTrunk II Cable
- [4] 8-32 Hex Head Screws

HLN9612 (optional GR Series controller brackets)

- [4] Controller Brackets ([2] not required)
- [8] TT4 x 7.0 Screws ([4] not required)
- [2] Cable, 16-Pin (not required)

HKN9234 (GR1225 add-on controller cable)

- [1] Controller Cable
- [2] M5 x 0.8 T25 Machine Screws, Pan Head



Basic GR400 X-Pand Repeater Information

Weight	Height	Width	Depth
30 lbs. (13.6 kg)	7 in. (177.8mm)	19 in. (482mm)	19 in. (482mm)

Figure 2-1. Assembled GR400 X-Pand Repeater (before component installation)

Disassembling the Repeater Housing

When disassembling the housing, retain all screws for reuse. Figure 2-1 shows the repeater before component installation.

1. Remove the bags of hardware from the housing.
2. Remove the four (4) TT6.0 screws from the front panel using a T30 Torx driver.
3. Remove the front panel.
4. Remove the two (2) top backside TT3.5 screws from the air deflector using a T15 Torx driver.
5. Remove the air deflector to aid in equipment installation.
6. Loosen the left side TT4.0 screws on the control head assembly/preselector bracket and the transceiver/duplexer bracket using a T20 Torx driver. One or two turns is sufficient.
7. Remove the right side TT4.0 screws on the transceiver/duplexer bracket using a T20 Torx driver.
8. Slide the transceiver/duplexer bracket slightly toward the right to clear the left side screws and remove the bracket from the repeater housing.
9. Repeat Steps 6 and 7 for the control head assembly/preselector bracket.

NOTE
If an external power supply is to be used, skip Step 10. See "Connecting to an External Power Supply" on page 2-8 for wiring recommendations.

10. If an HPN9041 Power Supply is to be used, remove the two (2) TT4.0 screws from the power supply bracket using a T20 Torx driver.
11. Remove the power supply bracket.

Installing the Ground Lug

(Located in kit HKN9027)

CAUTION

If the GR400 X-Pand repeater is to be reshipped to another location in this box, disregard steps 1 and 2 until the unit is at its final destination. ***Do Not*** reship with ground lug or antenna cable mounted to the unit.

1. Locate the 1/4-20 x 1-1/2" screw in kit HKN9027.
2. Insert the screw, from the inside of the housing, through the small hole beneath the D-shaped holes in the back of the housing.
3. Locate the 1/4-20 lockwasher and 1/4-20 nut in kit HKN9027.
4. Place the lockwasher and nut onto the screw and tighten to 2.25 N-m (20 in.-lbs.) torque.

NOTE

The remaining nut and external washer, in kit HKN9027, are used to ground the repeater to an earth ground, as referenced in the Final Assembly of this section. These can be loosely assembled onto the screw to prevent loss.

Assembling the Control Head to the Control Head Bracket (HLN3100)

1. Locate the two (2) flat ribbon cables in kit HKN9015.
2. Locate the control head in kit HLN9514.
3. Locate the two (2) T20 cap head screws in kit HLN9015.
4. Locate the control head support bracket in kit HLN9510.
5. Align the bracket face to the back of the control head.
6. Attach the control head and bracket by snapping together.
7. Secure the control head to the bracket with the two (2) T20 cap head screws using a T15 Torx driver. Tighten to 1.69 N-m (15 in.-lbs.) torque.
8. Fold the 12-position flat ribbon cable as shown in Figure 2-2.
9. Fold the 15-position flat ribbon cable as shown in Figure 2-3.

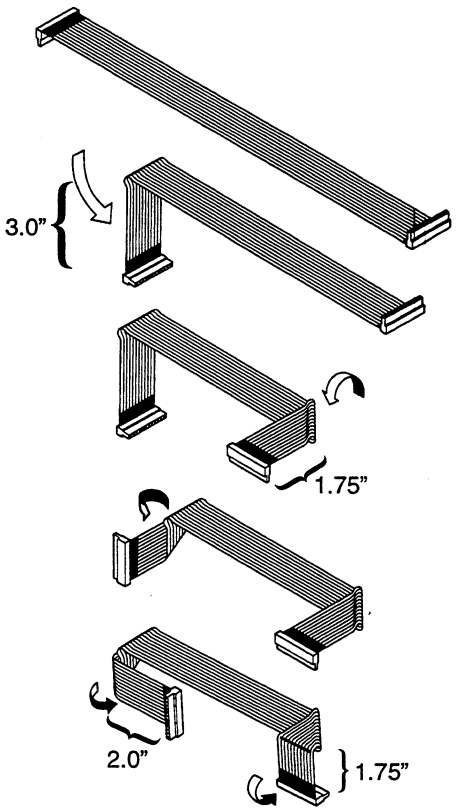


Figure 2-2. Folding the 12-Position Cable

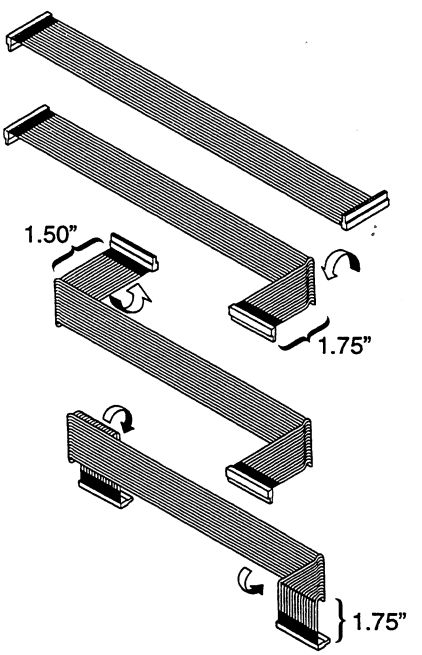


Figure 2-3. Folding the 15-Position Cable

10. Attach the 12-position flat ribbon cable connect to the 12 pins on the control head. Make sure that the cable connector aligns properly with the missing #8 pin.

11. Attach the 15-position flat ribbon cable connect to the 15 pins on the control head. Make sure that the cable connector aligns properly with the missing #3 pin.

Installing the R1225 Transceiver

1. Place the transceiver/duplexer bracket on a flat surface with the open end down and the slotted mounting holes toward the left.

2. Slide the transceiver into the bottom position of the transceiver/duplexer module bracket.

3. Align the holes of the transceiver with the M5 holes of the bracket.

4. Locate two (2) of the M5 x 8.0 machine screws in kit HKN9015.

5. Secure the transceiver to the bracket with the two (2) M5 x 8 machine screws using a T25 Torx driver. Tighten to 3.16 N-m (28 in.-lbs.) torque.

Installing the Control Head Assembly

1. Place the control head assembly/preselector bracket on a flat surface with the open end down and the slotted mounting holes toward the left.

2. Route the two flat ribbon cables from the control head assembly through the upper right slot in the bracket. Refer to Figure 2-5 for reference to the upper right slot.

3. Slide the control head assembly into the bottom position of the bracket.

4. Align the mounting holes of the control head assembly with the M5 holes of the bracket.

5. Locate the remaining two (2) M5 machine screws in kit HKN9015.

6. Secure the control head assembly to the bracket with the two (2) M5 machine screws using a T25 Torx driver. Tighten to 1.80 N-m (16 in.-lbs.) torque.

Installing an Optional Controller

The GR400 X-Pand repeater kit contains one set of controller mounting brackets, HLN9313. This kit consists of brackets and screws needed for mounting a SmarTrunk II controller.

If one of the other GR Series controllers is to be mounted, you will need the optional kits HLN9612 and HKN9234.

Installing the SmarTrunk II Controller Brackets

1. If the SmarTrunk II controller is to be used, locate the brackets in kit HLN9613.

2. Locate the four (4) TT4.0 x 7.0 screws in kit HLN9613.

3. Attach one bracket to the right side of the transceiver/duplexer module bracket, with two (2) of the TT4.0 x 7.0 screws using a T20 Torx driver. Refer to Figure 2-4 for proper orientation.

4. Attach the remaining bracket to the left side of the control head assembly/preselector bracket with the remaining two (2) TT4.0 x 7.0 screws. Tighten all four (4) screws to 1.58 N-m (14 in.-lbs.) torque.

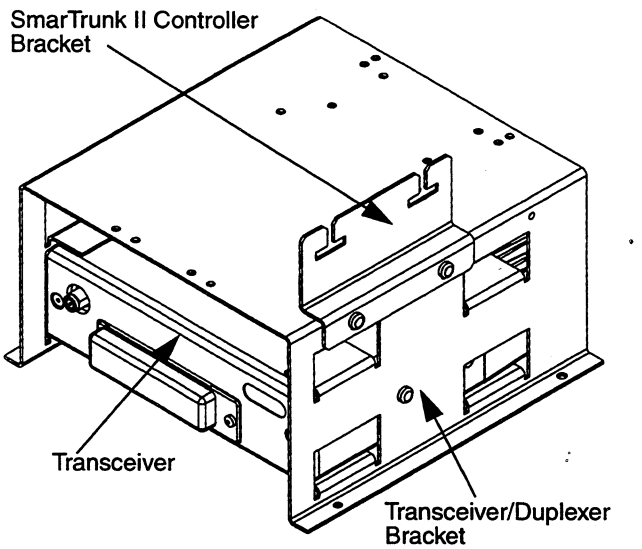


Figure 2-4. SmarTrunk II Controller Brackets

5. Locate the SmarTrunk II controller cable in kit HKN9006 and attach the 16-pin connector of the cable to the accessory connector of the transceiver.

NOTE
The DB25 connector of the cable will be attached after the controller has been installed.

Installing the GR Series Brackets and Controller

(optional kit HLN9612 and HKN9234 required)

1. Locate two (2) of the GR Series controller mounting brackets in kit HLN9612.
2. Locate four (4) of the TT4.0 x 7.0 screws in kit HLN9612.
3. Attach the brackets to the sides of the control head assembly/preselector bracket with the four (4) TT4.0 using a T20 Torx driver. Tighten to 1.58 N-m (14 in.-lbs.) Torque. Refer to Figure 2-5 for proper orientation.

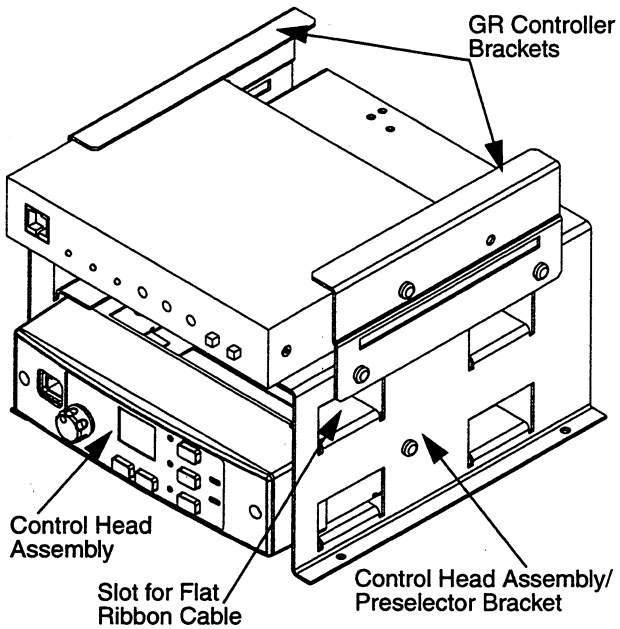


Figure 2-5. GR Series Controller Brackets

4. Locate the two (2) M5 x 8.0 pan head, machine screws in kit HKN9234.
5. Slide the GR Series controller into the controller mounting brackets.
6. Secure the controller with the M5 x 8.0 pan head, machine screws using a T25 Torx driver. Tighten the screws to 1.58 N-m (14 in.-lbs.) torque.
7. Locate the GR Series controller cable from kit HKN9034 and attach the single 16-pin connector of the cable to the accessory connector on the transceiver.

NOTE

The double connector end of the cable will be attached after the transceiver/duplexer and control head assembly/preselector bracket modules have been installed.

Installing an Optional Preselector

If an optional preselector is to be used with the repeater, space has been provided above the control head assembly for installation.

Installing the External Duplexer Cables

1. Locate the two (2) RF type cables and the 90-degree RF connector in kit HKN9016.
2. Attach the 90-degree RF connector to the receiver antenna connector on the front of the transceiver. Tighten 1/16 of a turn past finger tight using gas pliers. The 90-degree RF connector should be facing downward at a seven o'clock position.
3. Attach the long RF cable to the 90-degree RF connector on the front of the transceiver.
4. Route cable below the transceiver underneath the transceiver/duplexer bracket.
5. Attach the short RF cable to the transmitter antenna connector on the back of the transceiver.

Installing the Internal Duplexer Cables

1. Locate the the three (3) RF type cables and the 90-degree RF connector in kit HKN9025.
2. Remove the nut and lockwasher from the bulkhead connector of the longest cable.
3. Align the flat side of the bulkhead connector, of the long cable, with the straight side of the D-shaped hole in the back of the repeater housing and insert, from the inside to the outside, into the middle hole.
4. Secure the bulkhead connector to the repeater housing using the nut and lockwasher removed in Step 2 and tighten to 2.25 N-m (20 in.-lbs.) torque.
5. Attach the 90-degree RF connector to the receiver antenna connector on the front of the transceiver. Tighten 1/16 of a turn past finger tight using gas pliers. The 90-degree RF connector should be facing downward at a seven o'clock position.
6. Attach the medium cable to the 90-degree RF connector on the front of the transceiver.
7. Route the medium cable below the transceiver underneath the transceiver/duplexer bracket.
8. Attach the short cable to the transmitter antenna connector on the back of the transceiver.

Installing the Control Head Assembly/ Preselector Bracket Module

1. Place the assembled control head assembly/ preselector bracket module into the left side position in the GR400 X-Pand housing. See Figure 2-6
2. Tilt the bracket slightly upward at the right side and slide the left side notched mounting tabs on the bracket under the TT4.0 screws.
3. Replace the two (2) TT4.0 screws removed from the right side in Step 7 under "Disassembling the Repeater Housing" on page 2-2. Tighten all four (4) screws to 1.58 N-m (14 in.-lbs.) torque.

Installing the Transceiver/Duplexer Bracket Module

1. Place the transceiver/duplexer bracket module into the right side position in the GR400 X-Pand housing. See Figure 2-6

NOTE
Make sure the RF cable connected to the front of the transceiver is properly routed underneath the transceiver/duplexer bracket module.

2. Route the two (2) flat ribbon cables from the control head assembly/preselector bracket module through the upper left slot of the transceiver/duplexer bracket module as shown in Figure 2-6.

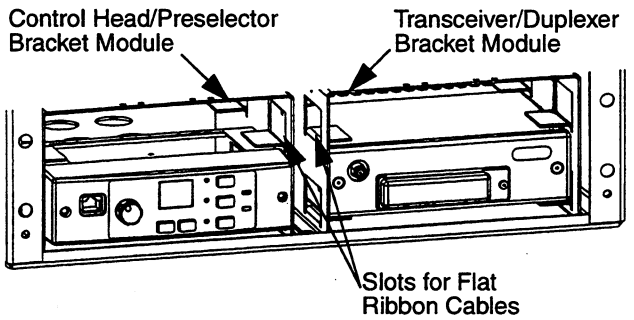


Figure 2-6. Route Flat Ribbon Cables

3. Tilt the module slightly upward at the right side and slide the left notched mounting tabs on the bracket under the TT4.0 screws.
4. Replace the two (2) TT4.0 screws removed from the right side in Step 7 under "Disassembling the Repeater Housing" on page 2-2. Tighten all four (4) screws to 1.58 N-m (14 in.-lbs.) torque.

Connecting the Control Head Assembly to the R1225 Transceiver

1. Remove the flat ribbon cable cover screw on the transceiver using a T10 Torx driver.
2. Connect the 12-position flat ribbon connector from the control head assembly to the 12 pins on the right of the transceiver connector, making sure that the cable connector aligns properly with the missing #8 pin.
3. Connector the 15-position flat ribbon connector from the control head assembly to the 15 pins on the left of the transceiver connector, making sure that the cable connector aligns properly with the missing #3 pin.
4. Replace the flat ribbon cable cover and screw. Tighten to 0.68 N-m (6 in.-lbs.) torque.

NOTE
The flat ribbon cables coming out of the transceiver should be facing upward.

Installing an Internal Duplexer

1. Examine the duplexer that was ordered for the GR400 X-Pand repeater model being assembled. If four (4) of the mounting holes contain Penmuts (threaded inserts), proceed to Step 3. If no Pemnuts are present , locate the four (4) Tinnerman clips in kit HKN9025 and continue with Step 2.
2. Using a pair of needle nose pliers, place Tinnerman clips over four of the mounting holes of the duplexer (refer to Figure 2-7).

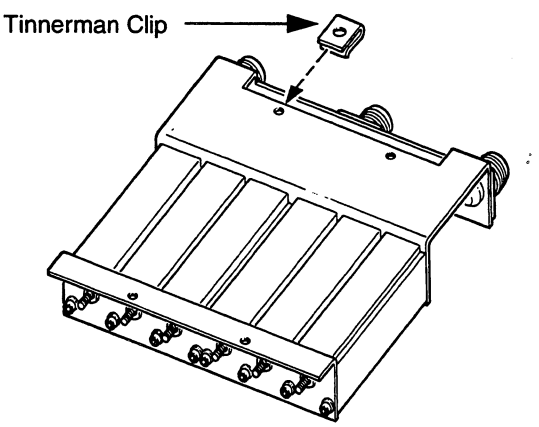


Figure 2-7. Duplexer, Bottom View

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

3. Place the duplexer into the transceiver/duplexer bracket with the six tuning screws facing toward the front panel of the repeater housing. The mounting holes of the duplexer must face upward.

4. Locate the four (4) 6-32 x 1/2" T15 Torx, pan head screws in kit HKN9025.

5. Secure the duplexer to the mounting bracket with four (4) 6-32 x 1/2" T15 Torx, pan head screws. 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.) torque for threaded inserts.

Connecting the Antenna Cables

Connecting External Antenna Cables

1. Remove the nuts and lockwashers from both RF cables from the R1225 transceiver.

2. Locate the transmitter antenna cable from the back of the transceiver.

3. Align the flat side of the bulkhead connector with the straight side of the D-shaped hole in the back of the repeater housing and insert, from the inside to the outside, into the top hole.

4. Locate the receiver antenna cable from the front of the transceiver.

5. Align the flat side of the bulkhead connector with the straight side of the D-shaped hole in the back of the repeater housing and insert, from the inside to the outside, into the bottom hole.

6. Secure the bulkhead connectors to the repeater housing using the nuts and lockwashers removed in Step 1 and tighten to 2.25 N-m (20 in.-lbs.) torque.

Connecting Internal Antenna Cables

1. Connect the type-N male connector from the bulkhead cable to the antenna connector of the duplexer.

2. Connect the type-N male connector of the receiver antenna cable, from the front of the transceiver, to the appropriate port of the duplexer.

3. Connect the type-N male connector of the transmitter antenna cable, from the back of the transceiver, to the empty port of the duplexer.

Replacing the Repeater Housing Front Panel

1. Replace the front panel.

2. Secure front panel to the housing with the four (4) TT6.0 screws removed earlier using a T30 Torx driver. Tighten to 3.16 N-m (28 in.-lbs.) torque.

Installing the SmarTrunk II Controller

1. Carefully remove the front panel of the SmarTrunk II controller and replace it with the shortened front panel supplied with the controller. Replace and tighten the screws.

2. Locate the four (4) 8-32 x 1/2" hex head screws in kit HKN9006.

3. Insert the four (4) 8-32 x 1/2" hex head screws into the four threaded inserts located on the sides of the controller.

4. Mount the SmarTrunk II controller to the top of the control head assembly/preselector and transceiver/duplexer module brackets by sliding the hex head screws into the notched mounting tabs.

5. Slide the controller forward to position into place.

6. Tighten the four (4) 8-32 x 1/2" hex head screws with the appropriate size wrench.

Controller Connections

SmarTrunk II Controller Connections

1. Locate the SmarTrunk II cable previously attached to the transceiver.

2. Attach the DB25 connector to the DB25 connector on the back of the controller.

3. Tighten both screws using a small flat bladed screwdriver.

GR Series Controller Connections

1. Locate the GR Series cable previously attached to the transceiver.

2. Connect the "Tx" plug of the controller cable from the transceiver to the transmitter connector of the repeater controller.

3. Connect the "Rx" plug of the controller cable from the transceiver to the receiver connector of the repeater controller.

Installing the Power Supply (Optional HPN9041)

Orientation for the following steps is with respect to viewing the power supply from the heatsink.

1. Locate the two (2) M5 machine screws in kit HKN9027.
2. Attach the power supply bracket with the slot holes facing to the left.
3. Secure the bracket to the power supply with the two (2) M5 machine screws using a T25 Torx driver. Tighten to 3.16 N-m (28 in.-lbs.) torque.
4. Place the power supply bracket module into the repeater housing.
5. Insert the tab on the power supply bracket module into the slot on the housing to secure into place.
6. Secure the power supply bracket module to the housing with the two (2) TT4.0 screws, removed in Step 10 under "Disassembling the Repeater Housing" on page 2-2, using a T20 Torx driver. Tighten to 1.58 N-m (14 in.-lbs.) torque.
7. Connect the power supply connector to the fan power supply connector.
8. Locate the PS extension cable in kit HKN9027.
9. Attach one end of the cable to the power supply output connector and the other end to the power supply connector on the back of the transceiver.
10. Use the tie wraps supplied in kit HKN9027 to bundle all cords and wires away from the fan.

Connecting to an External Power Supply

CAUTION

Any construction technique for connecting to an external power source must ensure that the leads from the transceiver dc extension cable, the fan cable and the power supply cable are properly insulated to prevent accidental shorting and the possibility of fire.

The following procedure is representative of methods to power the repeater assembly from your externally mounted power supply. You will be required to supply insulated crimp butt splices or use equivalent construction to connect the dc power cables for the transceiver and the repeater fan to a power cable from your power supply.

1. Locate the cable attached to the fan of the housing.
2. Cut off the fan cable from the 6-pin connector as close to the connector as possible.
3. Strip approximately 13mm (1/2") of the insulation from the free ends of the red and black wires of the fan cable.
4. Locate the DC power extension cable in kit HKN9027. (This cable connects between the HPN9041 power supply and the R1225 transceiver.)
5. Cut off one of the 2-prong "Ford" connectors from the cable as close to the connector as possible.
6. Identify the wire that is connected to the insulation covered (female) terminal of the remaining 2-prong "Ford" connector. This is the "positive" lead.
7. Strip approximately 13mm (1/2") of the insulation from the free end of the "positive" lead of the extension cable.
8. Twist together the red fan cable wire and the "positive" lead of the extension cable.
9. Insert the twisted together "positive" leads into a butt splice and crimp tightly.
10. Repeat Steps 6 through 9 for the remaining lead of the extension cable and the black lead of the fan.
11. The cable from your externally mounted power supply can be crimped to the above leads. The positive power supply lead connects to the lead with the red fan lead. The negative power supply lead connects to the lead with the black fan lead.

Replacing the Air Deflector

1. Replace the air deflector using the two (2) top backside TT3.5 screws removed in Step 4 under "Disassembling the Repeater Housing" on page 2-2, using a T15 Torx driver. It may be necessary to move cables above or below the air deflector during reinstallation.

CAUTION

Failure to replace the air deflector will cause the transceiver to operate warm and cause power slumps.

NOTE
Use the rubber pads, to stop rattles, between the air deflector and the housing or duplexer if necessary.

Installing the HLN9455 Battery Revert Module

If the optional HLN9455 Battery Revert Module will be used, follow the instructions supplied with the battery revert module for installation.

Mounting the GR400 X-Pand Repeater Station

Mount the GR400 X-Pand repeater in a standard EIA 19" relay rack or cabinet. A cabinet requires the use of a rest slide, and relay racks require the use of a center mount bracket (Motorola Kit No. HLN9402). Rest slides can be purchased from your cabinet manufacturer.

CAUTION
A built-up GR400 X-Pand repeater weighs approximately a maximum of 50 pounds (22.7 kg) when fully assembled. Lifting improperly can cause injury. Get help from a second person and use care when lifting the repeater.

CAUTION
The GR400 X-Pand repeater weighs approximately 50 pounds (22.7 kg) when fully assembled, and can fall if not properly mounted. Use proper hardware to mount the repeater.

CAUTION
The GR400 X-Pand repeater is ***not*** front panel mountable. You ***must*** use either cabinet rest slides, center mount brackets (Motorola Kit No. HLN9402) or rear rail supports.

IMPORTANT
The GR400 X-Pand repeater is designed for indoor use. Install in a location that is protected from the weather and outdoor environment, or use an outdoor cabinet.

IMPORTANT
To operate the GR400 X-Pand repeater, the AC line cord (optional); antenna feed line, ground cable, phone lines (not supplied); and (optional) battery cables must exit from the rear of the unit.

Final Assembly

To operate the GR400 X-Pand repeater, you must connect all of the necessary cables and accessories as follows:

1. If you are using a repeater controller with a grounding wire, connect the wire to the 1/4" threaded ground stud at the far left side of the repeater housing.

2. Attach a ground wire from an absolute earth ground to the 1/4" threaded stud on the far left of the repeater housing, using the remaining external washer and nut provided in kit HKN9027.

3. Connect lightning arrestors.

CAUTION
Lightning can damage the GR400 X-Pand 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.

4. Connect the antenna lead(s) to the antenna connector(s) on the far left of the GR400 X-Pand housing.

5. Connect the AC line cord to the power supply unit, and plug it into an AC main outlet.

6. A standoff tie wrap is provided as a cable tie for the AC line cord, if desired. Push the tie in from the back side of the housing through the hole provided behind the fan. Tie off the AC line cord.

Repackaging

The GR400 X-Pand Repeater Station shipping box is not intended, nor recommended for reshipping. If it is necessary to repackage the repeater as a built-up unit, follow these suggested steps to repackage the unit in its original box.

1. ***Do not*** connect the ground lug and antenna cable to the unit. Disconnect these if previously connected.

2. Discard the front panel filler and the chassis support packing pieces that were orginally packed in the box. These are not needed for repackaging. Refer to Figure 2-8.

CAUTION

The GR400 X-Pand repeater shipping box is not intended for reshipping a built-up unit. Please ship with extreme care.

CAUTION

The Radius Product Group takes no responsibility for reshipping a built-up GR400 X-Pand repeater.

CAUTION

Extreme caution should be taken when reshipping a GR400 X-Pand repeater in its original box. A built-up GR400 X-Pand 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.

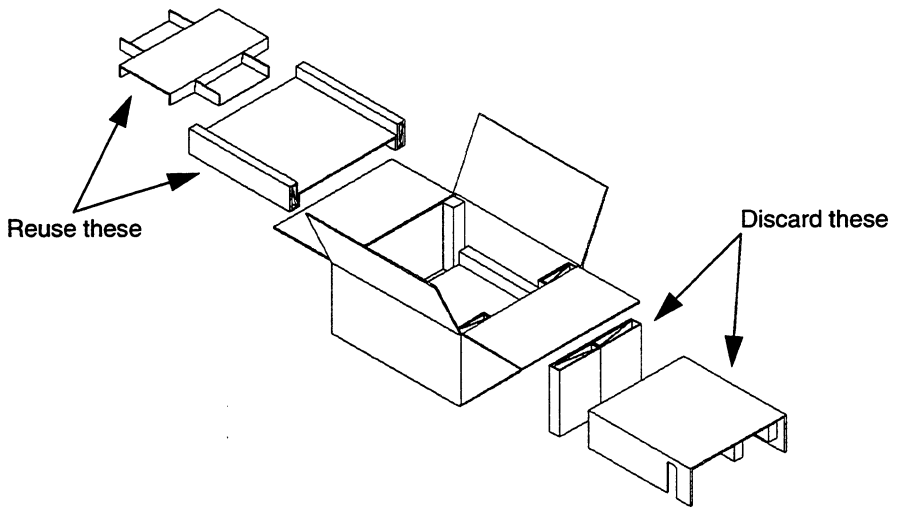


Figure 2-8. Repackaging a Built-up GR400 X-Pand Repeater

Section 3
Assembling the GR500 X-Pand Repeater

Overview

This section contains information about the performance of the GR500 X-Pand Repeater Station, the basic assembly and disassembly, and the steps for tuning the duplexer.

Performance

The GR500 X-Pand is not a high performance repeater, but is designed to withstand constant use. The GR500 X-Pand repeater package is designed for fixed locations where protection from the elements (snow, rain, etc.) can be provided. The station is intended for permanent wall or rack mounting.

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.

Contents of the Optional Kits

The following is a checklist of the contents of the optional kits that can be purchased separately for assembling the GR500 X-Pand repeater. These kits are for assembling an external duplexer, an internal duplexer, or an optional controller into the GR500 X-Pand repeater. The quantities are listed in [ ] brackets.

HKN9016 (with external duplexer)

- [2] RF Cables
- [1] 90-Degree Mini-U RF Adaptor
- [2] Vinyl Caps

HKN9025 (with internal duplexer)

- [4] Tinnerman Nut Clips
- [4] 6-32 x 1/2 Machine Screw, Pan Head
- [2] RF Cables
- [1] N Plug to N Bulkhead RF Cable
- [2] Filler Plugs (not used for this application)
- [1] Vinyl Cap
- [4] Tie Wraps, Nylon
- [1] 90-Degree Mini-U RF Adaptor

HLN3100 (control head assembly)

HLN9514

- [1] R1225 Transceiver Retrofit Control Head

HKN9015

- [2] Flat Ribbon Cables
- [2] M4 x 10 T20 Cap Head Screws
- [4] M5 x 8 T25 Machine Head Screws

HLN9510

- R1225 Transceiver Control Head Support Bracket

HKN9234 (optional controller)

- [1] Controller Cable
- [2] M5 x 0.8 T25 Machine Screws, Pan Head

HLN3043 (optional SmarTrunk II controller)

- [2] SmarTrunk II Controller Brackets
- HKN9010 (Not Used)

HKN9006 (optional SmarTrunk II controller cable)

- [1] R1225/SmarTrunk II Cable
- [4] 8-32 Hex Head Screws

HLN9169 (accessory mounting plate)

- [1] GR500 Accessory Mounting Plate

Disassembling the Repeater Housing

1. From the top of the repeater, turn the quarter-turn front cover fasteners counterclockwise and lift the front cover open.
2. With the appropriate socket tools, remove the two (2) 8-32 nuts that secure the front of the transceiver bracket in the repeater housing.
3. Loosen, but do not entirely remove, the two (2) 8-32 nuts that secure the back of the transceiver bracket (this is the end of the bracket with notched mounting tabs).
4. Lift the front of the bracket and slide forward to remove.

Installing an Optional Controller

(Skip these steps if an optional controller is *Not* going to be used).

5. Remove the two (2) 8-32 screws that secure the repeater controller bracket to the front of the power supply module.

6. Loosen, but do not entirely remove, the two (2) 8-32 screws that secure the repeater controller bracket to the top of the power supply module (this is the end of the bracket with notched mounting tabs).

7. Slide the bracket forward and remove.

Installing the Antenna Cables

Installing with an External Duplexer

1. Locate the two (2) RF type cables in kit HKN9016.

2. Remove the right most filler plug from the D-shaped hole (as viewed from the outside rear of housing) by pushing it out from the inside.

3. Remove the nuts and lockwashers from the bulkhead connectors.

4. Align the flat side of the bulkhead connector, of the short cable, with the straight side of the D-shaped hole in the back of the repeater housing and insert, from the inside to the outside, into the middle hole.

5. Align the flat side of the bulkhead connector, of the long cable, with the straight side of the D-shaped hole in the back of the repeater housing and insert, from the inside to the outside, into the right hole.

6. Secure the bulkhead connectors to the repeater housing using the nuts and lockwashers removed in Step 3 and tighten to 2.25 N-m (20 in.-lbs.) torque.

Installing with an Internal Duplexer

1. Locate the type-N male to type-N female bulkhead cable in kit HKN9025.

2. Remove the nut and lockwasher from the bulkhead connector of the cable.

3. Align the flat side of the bulkhead connector with the straight side of the D-shaped hole in the back of the repeater housing and insert, from the inside to the outside, into the middle hole.

4. Secure the bulkhead connector to the repeater housing using the nut and lockwasher removed in Step 2, and torque to 2.25 N-m (20 in.-lbs.).

Assembling the Control Head to the Control Head Bracket

1. Locate the two (2) flat ribbon cables in kit HKN9015.

2. Locate the control head in kit HLN9514.

3. Attach the 12-position flat ribbon connector to the 12 pins on the control head, making sure that the cable connector aligns properly with the missing #8 pin.

4. Attach the 15-position flat ribbon connector to the 15 pins on the control head, making sure that the cable connector aligns properly with the missing #3 pin.

5. Locate the two (2) M4 x 10 T20 cap head screws in kit HKN9015.

6. Locate the control head support bracket in kit HLN9510.

7. Align the bracket face to the back of the control head.

8. Route the two (2) flat ribbon cables through the bracket.

9. Attach the control head and bracket by snapping together.

10. Secure the control head to the bracket with the two (2) M4 x 10 T20 cap head screws using a T20 Torx® driver. Tighten to 1.69 N-m (15 in.-lbs.) torque.

Connecting the Control Head Assembly to the R1225 Transceiver

1. Remove the flat ribbon cable cover screw on the transceiver using a T10 Torx driver.

2. Attach the 12-position flat ribbon connector from the control head assembly to the 12 pins on the right of the transceiver connector, making sure that the cable connector aligns properly with the missing #8 pin.

3. Attach the 15-position flat ribbon connector from the control head assembly to the 15 pins on the left of the transceiver connector, making sure that the cable connector aligns properly with the missing #3 pin.

4. Replace the flat ribbon cable cover and screw. Tighten to 0.68 N-m (6 in.-lbs.) torque.

NOTE
The flat ribbon cables coming out of the transceiver should be facing upward.

Installing the R1225 Transceiver and Control Head Assembly

1. If an optional controller is to be installed, locate the controller cable in kit HKN9234 for a GR Series controller or locate the controller cable in kit HKN9006 for a SmarTrunk II controller. Otherwise, skip to Step 3A.

2. Attach the controller cable to the accessory connector located on the back of the transceiver.

3A. **For a GR Series Controller:** From the front of the transceiver bracket, removed earlier, slide the transceiver, heatsink first, into the lowest slot of the bracket.

3B. **For a SmarTrunk II Controller:** Locate the shorter SmarTrunk II transceiver bracket in kit HLN3043. Refer to Figure 3-3. From the front of the bracket, slide the transceiver, heatsink first, into the lowest slot of the bracket.

4. Locate the four (4) M5 x 8 T25 machine head screws in kit HKN9015.

5. Lift and align one side of the R1225 transceiver to the hole on the transceiver bracket and secure it with one (1) of the M5 x 8 machine head screws using a T25 Torx driver.

6. Repeat Step 5 for the other side of the R1225 transceiver. Tighten both screws to 3.16 N-m (28 in.-lbs.) torque.

7. **For a Wall Mount:** Turn the control head assembly ***upside down*** and slide it into the transceiver bracket, directly above the transceiver. Make sure the extra ribbon cable is in back of the control head assembly and not in front of the transceiver.

   For a Table Top Mount: Slide the control head assembly ***rightside up*** into the transceiver bracket, directly above the transceiver. Make sure the extra ribbon cable is in back of the control head assembly and not in front of the transceiver.

8. Align both sides of the control head assembly to the holes in the bracket and secure it with the other two (2) M5 x 8 machine head screws using a T25 Torx driver. Tighten both screws to 1.80 N-m (16 in.-lbs.) torque.

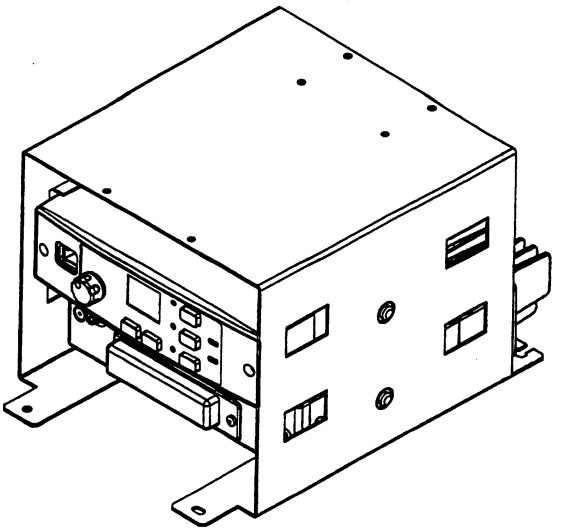


Figure 3-1. Assembled Transceiver Bracket (shown for a table top mount)

Installing the Assembled Transceiver Bracket

Installing with an External Duplexer

NOTE
These instructions are for installing either an optional GR Series Controller or an optional SmarTrunk II Controller.

1. Locate the 90-degree RF connector and the two (2) RF cables in kit HKN9016.

2. Attach the 90-degree RF connector to the connector on the front of the R1225 transceiver. Tighten 1/16 of a turn past finger tight using gas pliers. The 90-degree RF connector should be positioned horizontally to the right so the RF cable can pass in front of the flat ribbon cables.

3. Place the assembled transceiver bracket into the housing. ***Do Not*** yet secure to the repeater.

4. Lift the back end of the transceiver bracket upwards and attach the long RF cable to the back of the transceiver.

5. Attach the short RF cable to the antenna connector on the back of the transceiver. Tighten 1/16 of a turn past finger tight using gas pliers.

6. Route the long RF cable along the inside edge of the housing to the front of the transceiver and attach to the 90-degree RF connector. Tighten 1/16 of a turn past finger tight using gas pliers.

7. From the rear of the transceiver bracket, slide the notched mounting tabs backwards under the two (2) 8-32 nuts.

8. Position the front mounting tabs of the bracket onto the mounting screws and replace the two (2) 8-32 nuts.

9. Tighten all four (4) nuts to 1.80 N-m (16 in.-lbs.) torque.

Installing with an Internal Duplexer used with an Optional GR Series Controller

1. Examine the duplexer that was ordered for the GR500 X-Pand repeater model being assembled. If four (4) of the mounting holes contain Pemnuts (threaded inserts), proceed to Step 3. If no Pemnuts are present, locate the four (4) Tinnerman clips in kit HKN9025 and continue with Step 2.

2. Using a pair of needle nose pliers, place the Tinnerman clips over four of the mounting holes of the duplexer (refer to Figure 3-2).

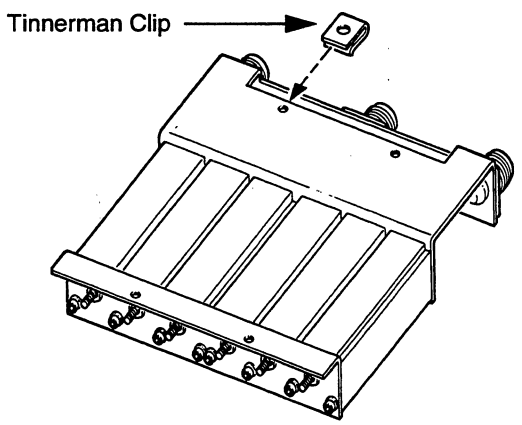


Figure 3-2. Duplexer, Bottom View

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

3. Place the duplexer into the transceiver mounting bracket on top of the control head assembly with the six tuning screws facing in the same direction as the front of the R1225 transceiver. The mounting holes of the duplexer must face upward.

4. Locate the four (4) 6-32 x 1/2" T15 Torx, pan head machine screws in kit HKN9025.

5. Secure the duplexer to the transceiver bracket with the four (4) 6-32 x 1/2" T15 Torx, pan head machine screws. Tighten 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.) torque for Pemnuts.

Installing the SmarTrunk II Controller Bracket

1. Locate the SmarTrunk II controller bracket in kit HLN3043. Refer to Figure 3-3.

2. Place the assembled SmarTrunk II controller bracket onto the repeater power supply. Tilt the bracket slightly upward at the front end and slide the rear notched mounting tabs of the repeater controller bracket under the 8-32 screw heads toward the back of the power supply.

3. Using the two (2) 8-32 screws removed in Step 5 under "Disassembling the Repeater Housing", secure the SmarTrunk II controller bracket to the front of the power supply. Tighten all four (4) 8-32 screws to 1.58 to 1.80 N-m (14 to 16 in.-lbs.) torque.

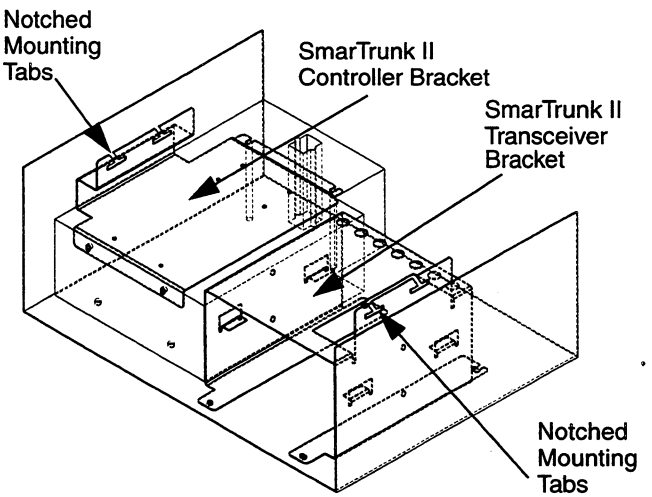


Figure 3-3. SmarTrunk II Brackets

Installing with an Internal Duplexer used with an Optional SmarTrunk II Controller

1. Examine the duplexer that was ordered for the GR500 X-Pand repeater model being assembled. If four (4) of the mounting holes contain Pemnuts (threaded inserts), proceed to Step 3. If no Pemnuts are present,, locate the four (4) Tinnerman clips in kit HKN9025 and continue with Step 2.

2. Using a pair of needle nose pliers, place the Tinnerman clips over four of the mounting holes of the duplexer (refer to Figure 3-2).

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

3. Place the duplexer onto the SmarTrunk II controller bracket with the six tuning screws facing in the same direction as the front of the R1225 transceiver. The mounting holes of the duplexer must face downward.

4. Locate the four (4) 6-32 x 1/2" T15 Torx, pan head machine screws in kit HKN9025.

5. Secure the duplexer to the SmarTrunk II controller bracket with the four (4) 6-32 x 1/2" T15 Torx, pan head machine screws. Tighten 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.) torque for Pemnuts.

6. Place the assembled SmarTrunk II controller bracket onto the repeater power supply. Tilt the bracket slightly upward at the front end and slide the rear notched mounting tabs of the repeater controller bracket under the 8-32 screwheads toward the back of the power supply.

7. Using the two (2) 8-32 screws removed in Step 5 under "Disassembling the Repeater Housing", secure the SmarTrunk II controller bracket to the front of the power supply. Tighten all four (4) 8-32 screws to 1.58 to 1.80 N-m (14 to 16 in.-lbs.) torque.

Connecting the Antenna Cables for an Internal Duplexer

1. Locate the 90-degree RF connector and remaining two (2) RF cables in kit HKN9025.

2. Attach the 90-degree RF connector to the connector on the front of the R1225 transceiver. Tighten 1/16 of a turn past finger tight using gas pliers. The 90-degree RF connector should be positioned horizontally to the right so the RF cable can pass in front of the flat ribbon cables.

3. Connect the mini-UHF end of the short RF cable to the transmitter antenna connector located in the back of the R1225 transceiver. Tighten 1/16 of a turn past finger tight using gas pliers.

4. Connect the mini-UHF end of the long RF cable to the 90-degree RF connector located in the front of the R1225 transceiver. Tighten 1/16 of a turn past finger tight using gas pliers.

5. Place the assembled transceiver bracket into the housing. ***Do Not*** yet secure to the repeater.

6. Lift the back end of the transceiver bracket upwards and attach the longer power connector to the back of the transceiver.

7. Connect the type-N male connector of the transmitter antenna cable, from the back of the transceiver, to the appropriate port of the duplexer.

8. Connect the type-N male connector of the receiver antenna cable, from the front of the transceiver, to the appropriate port of the duplexer.

9. Connect the type-N male connector from the bulkhead cable to the antenna connector of the duplexer.

10. Slide the notched mounting tabs, located at the rear of the transceiver bracket, backwards under the two (2) 8-32 nuts.

11. Position the front mounting tabs of the bracket onto the mounting screws and replace the two (2) 8-32 nuts removed earlier in Step 2 under "Disassembling the Repeater Housing" on page 3-1.

12. Tighten all four (4) nuts to 1.80 N-m (16 in.-lbs.) torque.

Installing an Optional GR Series Controller and Bracket

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

2. **For a Wall Mount:** Turn the repeater controller module ***upside down*** and place it in the lower mounting position of the bracket.

   For a Table Top Mount: Place the repeater controller module ***rightside up*** into the lower mounting position of the bracket.

3. Locate the two (2) M5 x 8, pan head, machine screws in kit HKN9234.

4. Secure the repeater controller to the bracket with the two (2) M5 x 8 screws using a T25 Torx driver, and tighten to 1.58 N-m (14 in.-lbs.) torque.

5. Place the assembled repeater controller bracket onto the repeater power supply. Tilt the bracket slightly upward at the front end and slide the rear notched mounting tabs of the repeater controller bracket under the 8-32 screwheads toward the back of the power supply.

NOTE
Do not yet tighten the back mounting screws to attach the repeater controller-bracket to the power supply.

6. Using the two (2) 8-32 screws removed in Step 5 under "Disassembling the Repeater Housing", secure the repeater controller bracket to the front of the power supply. Tighten all four (4) 8-32 screws to 1.58 to 1.80 N-m (14 to 16 in.-lbs.) torque.
7. Connect the Tx plug of the controller cable from the transceiver to the Tx connector of the repeater controller.
8. Connect the Rx plug of the controller cable from the transceiver to the Rx connector of the repeater controller.

Installing an Optional SmarTrunk II Controller

1. Remove the four (4) screws on the controller's standard 19" front panel using a Phillips screw driver.
2. Carefully remove the front panel and replace with the shortened front panel supplied with the controller. Replace and tighten the screws.
3. Locate the four (4) 8-32 x 1/2" hex head screws, supplied in kit HKN9006.
4. Insert the four (4) 8-32 x 1/2" hex head screws into the four inserts located on the sides of the controller. Do not tighten the screws.
5. Mount the controller to the top of the SmarTrunk II and transceiver brackets by sliding the hex head screws into the notched mounting tabs.

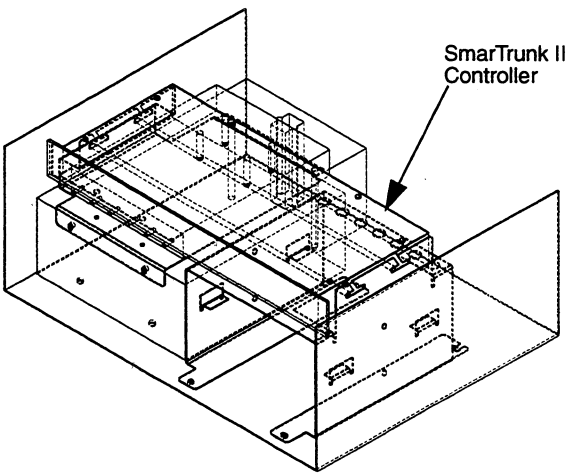


Figure 3-4. SmarTrunk II Controller

6. Slide the controller forward to position into place.
7. Tighten the four (4) 8-32 x 1/2" hex head screws with a wrench.
8. Attach the DB25 connector of the controller cable from the transceiver to the DB25 connector of the repeater controller. Tighten both screws using a small straight bladed screw driver.

Mounting the GR500 X-Pand Repeater Station

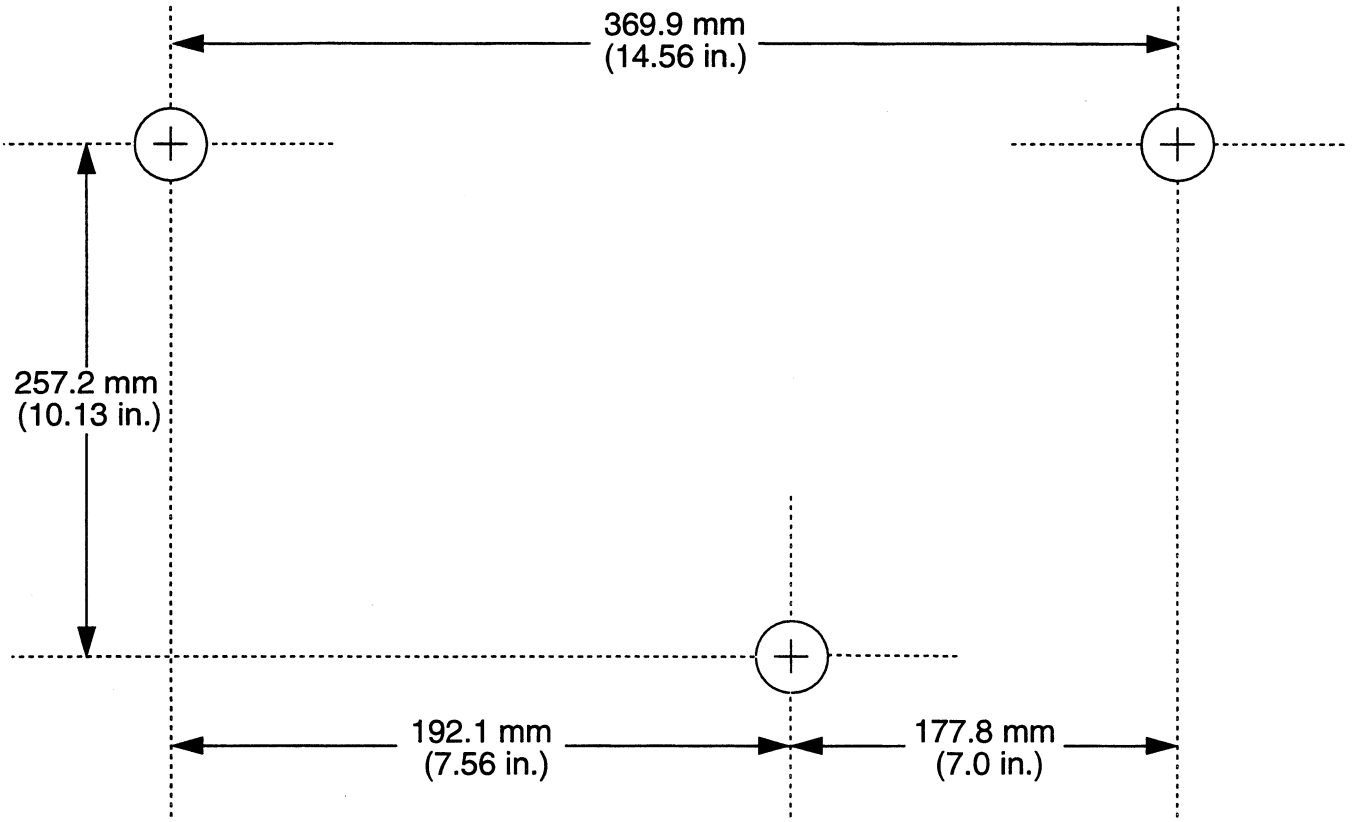
To mount the GR500 X-Pand repeater to a wall or other mounting surface, we recommend using the accessory mounting plate (HLN9169). If you use the accessory mounting plate to mount the repeater, follow the directions included with it. If you do not use the mounting plate, refer to Figure 3-5 (not to scale) for the locations of the wall mounting holes for the GR500 X-Pand repeater.

CAUTION
The GR500 X-Pand repeater weighs approximately 50 pounds (22.7kg) when assembled. Lifting improperly can cause injury. Get help from a second person and use care when lifting the repeater.

CAUTION
The GR500 X-Pand repeater weighs approximately 50 pounds (22.7kg) when fully assembled, and can fall if not properly mounted. Use proper hardware and mount the repeater only to a structurally sound wall or mounting surface.

CAUTION
If the GR500 X-Pand 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 repeater.

CAUTION
Dirty or plugged fan grills can cause overheating or improper operation. Clean dust and debris periodically from the grills, and allow sufficient air flow to the fan.



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

Figure 3-5. Locations of Wall Mounting Holes for GR500 (without Mounting Plate)

IMPORTANT
The GR500 X-pand repeater is designed for indoor use. Install in a location that is protected from the weather and outdoor environment.

IMPORTANT
To operate the GR500 X-pand 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 repeater, plan for cable access to the bottom of the unit.

Final Assembly

To operate the GR500 X-Pand repeater, you must connect all of the necessary cables and accessories to the bottom of the repeater.

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

CAUTION
Lightning can damage the GR500 X-Pand 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 to the antenna connectors on the repeater.
4. If necessary, feed phone line(s) through the vane grommet, located on the back of the repeater, and connect to the repeater controller.
5. If you are using a repeater controller with a grounding wire, use a lockwasher and nut to connect the wire to the 1/4" threaded grounding stud on the **inside** of the 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.
6. Connect the ac line cord to the repeater, attach the retaining clip and plug the other end of the cord into the AC main outlet.

CAUTION

A retaining clip for the AC power cord is provided with your GR500 X-Pand repeater to keep the power cord plug in the connector. To prevent accidental disconnection of the power cord, plug it into the repeater and attach the retaining clip to the repeater housing with the center top mounting screw of the power supply before connecting the cord to an AC power source (refer to Figure 3-6).

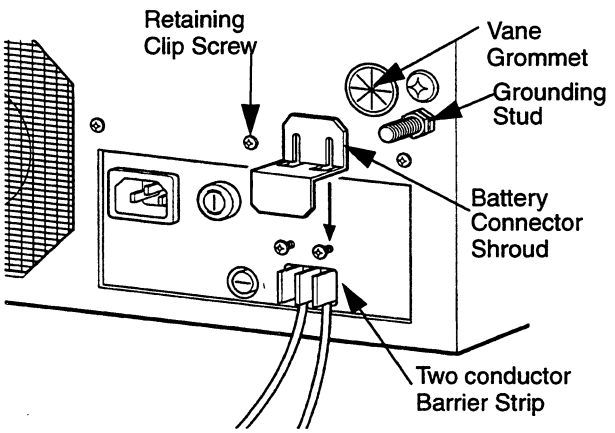


Figure 3-6. Placement of Battery Connector Shroud

7. If you are using a battery backup, check the float maintenance charger output voltage:

7A. Connect a digital multimeter to the two-conductor barrier strip.

7B. Adjust the "BAT CHG ADJ" potentiometer, accessible through the round hole in the housing near the barrier strip, for 13.6 Vdc ±0.1 Vdc. 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 Vdc.

NOTE

A more accurate setting of the charge 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.

7C. Disconnect the digital multimeter from the battery cable.

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.

⚠ WARNING

For safety, it is strongly recommended that BOTH the positive and negative leads of the battery cable be fused at the battery terminals.

7D. 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 repeater housing or any uninsulated metal connected to the repeater. To prevent damage, connect the positive [+] wire **before** connecting the negative [-] wire.

7E. Attach the negative [-] wire from the battery to the negative [-] pole on the two-conductor barrier strip.

8. Install the battery connector shroud, even if you do not connect a backup battery.

CAUTION

Contacts on the battery connector are live at all times while the repeater is attached to an ac power source. Keep the connector shroud installed at all times.

Serial Identification Tag

Included in the transceiver kit is a serial identification tag. Please peel off the backing and affix the tag to the repeater housing above the antenna connectors. This ensures efficient assistance if service is required.

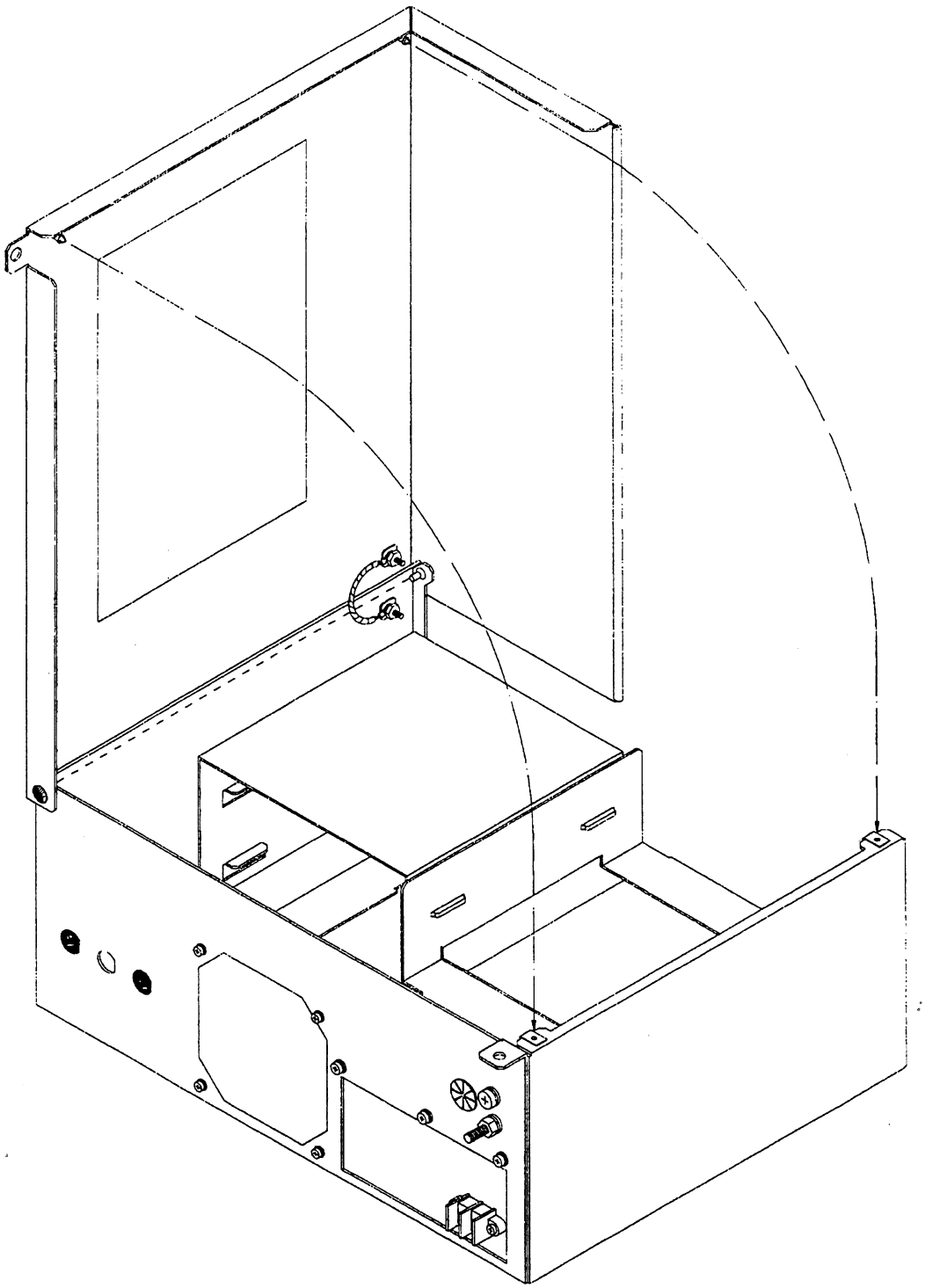


Figure 3-7. GR500 X-Pand Repeater, Rear Isometric View

Section 4
Converting the GR500 Repeater Into the GR500 X-Pand Repeater

Disassembling the Repeater

Disassembling the Controller Mounting Bracket

1. Disconnect the controller cables from the controller.
2. Remove the two (2) 8-32 screws that secure the repeater controller bracket to the front of the power supply module.
3. Loosen, but do not entirely remove, the two (2) 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).
4. Remove the repeater controller bracket.

Removing the Controller

1. **For a SmarTrunk II Controller:** Loosen the four (4) 8-32 x 1/2" hex head screws from both sides of the controller using a wrench.

1A. Slide the controller out of the notched mounting tabs and remove from the bracket.

2. **For a GR Series Controller:** Remove the two (2) M5 x 8 T25, pan head screws that secure the controller to the bracket.

2A. Remove the controller from the bracket.

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 to remove.

Removing the Duplexer

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

Removing the Receive and Transmit Radios

1. Disconnect the controller cables and RF 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.

Disconnecting the Antenna Cable

1. Remove the nut and lockwasher from the bulkhead connector located at the back of the housing.
2. Remove antenna cable from the repeater.

Assembling the Repeater

Refer to "Section 3, Assembling the GR500 X-Pand Repeater" of this manual for instructions on how to convert the GR500 repeater to a GR500 X-Pand repeater.

Section 5
Tuning the Duplexer

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 repeater is fully assembled and the R1225 transceiver and duplexer are mounted in the brackets. The transceiver should be connected to the proper ports of the duplexer with the RF coaxial cables provided.

Programming the R1225 Transceiver

1. Use WINRSS to program the R1225 transceiver with an additional "receive only" mode for the normal transmit frequency of the R1225 transceiver.

2. Disconnect the transmitter RF cable from the duplexer

3. Terminate the transmitter port of the duplexer with a 50 ohm load.

4. 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
Disable the repeater before proceeding by momentarily pressing the RPT EN pushbutton. The "RPT EN" LED should not be illuminated.

Tuning the Receiver Section

NOTE
Tuning the receiver section of the duplexer begins with the tuning screw closest to the antenna port of the duplexer.

1. Adjust the CSA or generator to the normal transmit frequency of the R1225 transceiver.

2. Place the R1225 transceiver on the transmitter frequency mode defined in Step 1 under "Programming the R1225 Transceiver."

3. Adjust the level of the CSA or generator until a weak signal is heard from the receiver.

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 thru 5B for each of the tuning screws on the receiver section of the duplexer. Begin with the tuning screw closest to the

antenna port and work in order toward the tuning screw closest to the receiver 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 receiver section of the duplexer.

Tuning the TransmitterSection

NOTE

Tuning the transmitter 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 frequency of the R1225 transceiver.
2. Place the R1225 transceiver on the normal repeater receive frequency mode.
3. Remove the 50 ohm load from the transmitter port of the duplexer.
4. Disconnect the receiver RF cable from the receiver port of the duplexer.
5. Connect the receiver RF cable to the transmitter port of the duplexer.
6. Connect the 50 ohm load to the receiver port of the duplexer.
7. Adjust the level of the CSA or generator until a weak signal is heard from the transmitter.
8. Increase the level of the CSA or the generator by approximately 20 dB.
9. Adjust the tuning screw of the duplexer for the greatest rejection of the signal. This will appear as a noisier signal. **If necessary:**

9A. Slightly loosen the locking nuts of the tuning screws to allow the tuning screws to turn more freely (but not "sloppy") **and**

9B. Increase the level of the CSA or the generator to maintain an audible 1 kHz tone.

10. Repeat Steps 8 thru 9B 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 transmitter port.
11. 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.

12. Readjust the tuning screws of the duplexer for the greatest rejection of the signal. This will fine-tune the transmitter section of the duplexer.
13. Remove the 50 ohm load from the receiver port of the duplexer.
14. Disconnect the receiver RF cable from the transmitter port of the duplexer.
15. Reconnect the receiver RF cable to the receiver port of the duplexer.
16. Reconnect the transmitter RF cable to the transmitter port of the duplexer.
17. Use the WINRSS to remove the mode programmed in Step 1 under "Programming the R1225 Transceiver."

Operational Tests

Before reassembling the housing cover to the chassis, 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.

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 transceiver (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 kHz	1.5 kHz
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. Disable the repeater ("RPT EN" LED OFF). Adjust the level of the duplex generator until 12 dBS sensitivity is reached.
3. Increase the RF output of the duplex generator by 1 dB (this increases the SINAD).
4. Enable the repeater ("RPT EN" LED ON). The transmitter keys ("TX" LED ON).
5. 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 ("RPT EN" LED OFF). Adjust the duplex generator level for a strong (full "quieting") signal into the receiver.
3. Enable the repeater ("RPT EN" LED ON). The transmitter keys ("TX" LED ON).
4. Read the transmitter deviation. It should be within ±10% of the deviation of the duplex generator.

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

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	35 W	28 W	22 W
50 W	39 W	31 W	25 W

Section 6
Controller Interconnections

Overview

This section describes the programming and setup of the optional external controllers for use with the R1225 transceiver module in the GR400 and GR500 X-Pand repeaters.

The controllers discussed are the Zetron ZR310, ZR320 and ZR340; the Instrument Associates i20R, i750R and TRA100R; and the SmarTrunk Systems ST-853M.

The Radio Service Software (RSS) for the GM300/GR300 may be used to program most of the parameters for the Zetron ZR310 and ZR320. This RSS runs only under DOS and will not operate from the MS-DOS Prompt in Windows™. You **Must** exit Windows to start the GM300/GR300 RSS.

The ZR340 must be programmed from the DTMF pad on a mobile or portable radio. Some parameters in newer versions of the microprocessors and EEPROMs of the ZR310 and ZR320 controllers must be programmed with DTMF as the GM300/GR300 RSS does not provide support.

The i20R and i750R, and the SmarTrunk Systems ST-853M are programmed with special software provided by the manufacturer. Refer to the instructions contained in those software applications.

The TRA100R is programmed with DIP switch settings. Refer to the "Radius GR300/GR500 Repeater Stations and Controllers, Supplement to GM300 RSS Manual", 6880903Z43.

It assumed that the R1225 transceiver has already been "read" by the WINRSS (or an archive file for the transceiver has been read).

GR Series Controllers

ZR310 Community Repeater Panel

ZR310 Jumper Configurations

ZR310 Jumper Settings

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

R1225 Transceiver Programming

From the opening WINRSS window, click the Radio Wide icon to open the Radio Wide Configuration windows. In the General Options window, for the Operation Mode select "Repeater w/Ext Controller".

Select the External Accessories tab. For the Acc External select the "ZR310". Verify or select these receive and transmit audios and the accessory connector pins.

R1225 Receive and Transmit Audios (ZR310)

Source/Muting	Value
Rx Audio Output	Flat
Rx Audio Muting	Unmuted
External Mic	External Mic Audio
Tx Flat Audio Input	Post

R1225 Accessory Connector Pins (ZR310)

Pin #	Function	Active Level
4	CSQ Detect	High

ZR310 Programming

The ZR310 can have most of the system and user parameters programmed with the GM300/GR300 RSS. However, DPL polarity must be programmed with DTMF commands. The VHF R1225 transceiver requires the ZR310 to be programmed for inverted polarity decode and normal polarity encode. The UHF R1225 transceiver requires the ZR310 to be programmed for normal polarity decode and encode. Enter the ZR310 DTMF programming mode (default programming access code is **12310#**). Then enter the following commands depending upon which band of operating for the R1225 transceiver.

ZR310 DTMF Command

Band	ZR310 Commands
VHF	215# and 218#
UHF	215# and 217#

ZR320 Selective Calling Interconnect

R1225 Transceiver Programming

From the opening WINRSS window, click the Radio Wide icon to open the Radio Wide Configuration windows. In the General Options window, for the Operation Mode select "Repeater w/Ext Controller".

Select the External Accessories tab. For the Acc External select the "ZR340". Verify or select these and the accessory connector pins.

R1225 Receive and Transmit Audios (ZR320)

Source/Muting	Value
Rx Audio Output	De-emphasized
Rx Audio Muting	Muted
External Mic	External Mic Audio
Tx Flat Audio Input	Post

R1225 Accessory Connector Pins (ZR320)

Pin #	Function	Active Level
4	CSQ Detect	High
12	PL/DPL-CSQ Detect	Low

As originally designed, the ZR320 will produce 50% transmitter peak system deviation for a receiver input signal with 60% peak system deviation. A normal repeater audio, 60% out for 60% in, can be obtained by bridging a 10kΩ-5%-1/4W composition resistor across resistor R9 (2.2kΩ) on the ZR320 Controller Board. This can be important in systems using the X-Pand feature.

ZR340 Telephone Interconnect

Jumper Configurations

ZR340 Jumper Settings

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

R1225 Transceiver Programming

From the opening WINRSS window, click the Radio Wide icon to open the Radio Wide Configuration windows. In the General Options window, for the Operation Mode select "Repeater w/Ext Controller".

Select the External Accessories tab. For the Acc External select the "ZR340". Verify or select these receive and transmit audios and the accessory connector pins.

R1225 Receive and Transmit Audios (ZR340)

Source/Muting	Value
Rx Audio Output	De-emphasized
Rx Audio Muting	Muted
External Mic	External Mic Audio
Tx Flat Audio Input	Pre or Post

R1225 Accessory Connector Pins (ZR320)

Pin #	Function	Active Level
4	CSQ Detect	High
12	PL/DPL-CSQ Detect	Low

i20R On-Site Repeater

Jumper Configurations

i20R Jumper Settings

Jumper	Setting
JU20	Out

R1225 Transceiver Programming

From the opening WINRSS window, click the Radio Wide icon to open the Radio Wide Configuration windows. In the General Options window, for the Operation Mode select "Repeater w/Ext Controller".

Select the External Accessories tab. For the Acc External select the "I20R". Verify or select these receive and transmit audios and the accessory connector pins.

R1225 Receive and Transmit Audios (i20R)

Source/Muting	Value
Rx Audio Output	Flat
Rx Audio Muting	Unmuted
External Mic	External Mic Audio
Tx Flat Audio Input	Post

R1225 Accessory Connector Pins (i20R)

Pin #	Function	Active Level
8	CSQ Detect	Low

i750R Telephone Interconnect

R1225 Transceiver Programming

From the opening WINRSS window, click the Radio Wide icon to open the Radio Wide Configuration windows. In the General Options window, for the Operation Mode select "Repeater w/Ext Controller".

Select the External Accessories tab. For the Acc External select the "I750R". Verify or select these receive and transmit audios and the accessory connector pins.

R1225 Receive and Transmit Audios (i750R)

Source/Muting	Value
Rx Audio Output	De-emphasized
Rx Audio Muting	Muted
External Mic	External Mic Audio
Tx Flat Audio Input	Post

R1225 Accessory Connector Pins (i20R)

Pin #	Function	Active Level
6	PL/DPL Strip	Low
8	PL/DPL-CSQ Detect	Low
14	CSQ Detect	Low

TRA100R Tone Remote Adapter

R1225 Transceiver Programming

From the opening WINRSS window, click the Radio Wide icon to open the Radio Wide Configuration windows. In the General Options window, for the Operation Mode select "Repeater w/Ext Controller".

Select the External Accessories tab. For the Acc External select the "TRA100R". Verify or select these receive and transmit audios and the accessory connector pins.

R1225 Receive and Transmit Audios (TRA100R)

Source/Muting	Value
Rx Audio Output	De-emphasized
Rx Audio Muting	Muted
External Mic	External Mic Audio
Tx Flat Audio Input	Pre

R1225 Accessory Connector Pins (TRA100)

Pin #	Function	Active Level
8	PL/DPL-CSQ Detect	Low
14	I/O Hook	Low

If channel steering is required, program pins 6, 9, and 12 as shown in the following table. NOTE: "Debounce" must be selected as "On" for the channel steering pins. An extra wire must be added to the cable to connect pin 9 of the R1225 connector to pin 9 of the "Tx" connector for the TRA100R.

R1225 Accessory Connector Pins for Channels Steering (TRA100R)

Pin #	Function	Debounce	Active Level
6	Channel Steering 0	On	Low
9	Channel Steering 1	On	Low
12	Channel Steering 2	On	Low

SmarTrunk Systems ST-853M

R1225 Transceiver Programming

From the opening WINRSS window, click the Radio Wide icon to open the Radio Wide Configuration windows. In the General Options window, for the Operation Mode select "Repeater w/Ext Controller".

Select the External Accessories tab. For the Acc External select the "SmarTrunk II". Verify or select these receive and transmit audios and the accessory connector pins..

R1225 Receive and Transmit Audios (ST-853M)

Source/Muting	Value
Rx Audio Output	Flat
Rx Audio Muting	Unmuted
External Mic	External Mic Audio
Tx Flat Audio Input	Post

R1225 Accessory Connector Pins (ST-853M)

Pin #	Function	Active Level
8	PL/DPL-CSQ Detect	High

R1225 Transceiver Audio and I/O Pins

The following table describes, in a compact format, the functions and programming of the audios and I/O pins of the R1225 transceiver for use with the controllers listed. Most of the I/O pins are automatically programmed by the Radio Service Software (WINRSS), but do not rely solely on the WINRSS. The transmit and receive audios will probably require you to set them manually.

Transceiver Pin #	ZR310	ZR340	i20R	i750R	TRA100R	ZR320	SmarTrunk II ST-853M
Pin 1 (Ext Spkr -) :Function	N/U	N/U	N/U	N/U	N/U	N/U	N/U
:Act Level	---	---	---	---	---	---	---
:To pin #	---	---	---	---	---	---	---
Pin 2 (External Mic) :Function	Ext. Mic Audio	Ext. Mic Audio	Ext. Mic Audio	Ext. Mic Audio	Ext. Mic Audio	Ext. Mic Audio	Ext. Mic Audio
:To pin #	N/A Tx - 2	N/A Tx - 2	N/A Tx - 2	N/A Tx - 2	N/A Tx - 2	N/A Tx - 2	N/A DB25-16
Pin 3 (PTT) :Function	PTT	PTT	PTT	PTT	PTT	PTT	PTT
:Act Level	Low	Low	Low	Low	Low	Low	Low
:To pin #	Tx - 3	Tx - 3	Tx - 3	Tx - 3	Tx - 3	Tx - 3	DB25-19
Pin 4 (Prog Output) :Function	CSQ Detect	CSQ Detect	Null/Output	Null/Output	CSQ Detect	CSQ Detect	Null/Output
:Act Level	High	High	High	High	Low	High	High
:To pin #	Rx - 4	Rx - 4	Rx - 4	Rx - 4	Rx - 4	Rx - 4	---
Pin 5 (Tx Flat Audio Input) :Function	Tx PL/DPL Audio	N/U	Tx PL/DPL Audio	Tx PL/DPL Audio	N/U	Tx PL/DPL Audio	Tx System Tone
:Act Level	(Post-Limiter)	(Pre or Post	(Post-Limiter)	(Post-Limiter)	(Pre-Limiter)	(Post-Limiter)	(Post Limiter)
:To pin #	Tx - 5	Tx - 5	Tx - 5	Tx - 5	Tx - 5	Tx - 5	DB25-17
Pin 6 (Prog Input) :Function	Null/Input	Null/Input	Null/Input	PL/DPL Strip	Channel Steer 0	Null/Input	Null/Input
:Act Level	Low	Low	Low	Low	Low	Low	Low
:To pin #	Tx - 6	Tx - 6	Tx - 6	Tx - 6	Tx - 6	Tx - 6	---
Pin 7 (Gnd) :Function	Gnd	Gnd	Gnd	Gnd	Gnd	Gnd	Gnd
:Act Level	N/A	N/A	N/A	N/A	N/A	N/A	N/A
:To pin #	Rx - 7	Rx - 7	Rx - 7	Rx - 7	Rx - 7	Rx - 7	DB25-2**
Pin 8 (Prog I/O) :Function	Null/Input	Null/Input	CSQ Detect	PL/DPL-CSQ Det	PL/DPL-CSQ Det	Null/Input	PL/DPL-CSQ Det
:Act Level	Low	Low	Low	Low	Low	Low	High
:To pin #	---	--	Rx - 8	Rx - 8	Rx - 8	--	DB25-25
Pin 9 (Prog Input) :Function	Null/Input	Null/Input	Null/Input	Null/Input	Channel Steer 1	Null/Input	Null/Input
:Act Level	Low	Low	Low	Low	Low	Low	Low
:To pin #	---	---	---	---	Tx-9*	---	---
Pin 10 (Prog Input) :Function	Null/Input	Null/Input	Null/Input	Null/Input	Null/Input	Null/Input	Null/Input
:Act Level	Low	Low	Low	Low	Low	Low	Low
:To pin #	---	---	---	---	---	---	---
Pin 11 (Rx Audio Output/ Muting) :Function	Rx Audio	Rx Audio	Rx Audio	Rx Audio	Rx Audio	Rx Audio	Rx Audio
:Act Level	(Flat/Unmuted)	(De-emph/Muted)	(Flat/Unmuted)	(De-emph/Muted)	(De-emph/Muted)	(De-emph/Muted)	(Flat/Unmuted)
:To pin #	Rx - 11	Rx - 11	Rx - 11	Rx - 11	Rx - 11	Rx - 11	DB25-15
Pin 12 (Prog I/O) :Function	Null/Input	PL/DPL-CSQ Det	Null/Input	Null/Input	Channel Steer 2	PL/DPL-CSQ Det	Null/Input
:Act Level	Low	Low	Low	Low	Low	Low	Low
:To pin #	Rx - 12	Rx - 12	Rx - 12	Rx - 12	Rx - 12	Rx - 12	---
Pin 13 (SW A + Output) :Function	SW A+	SW A+	SW A+	SW A+	SW A+	SW A+	SW A+
:Act Level	N/A	N/A	N/A	N/A	N/A	N/A	N/A
:To pin #	Rx - 13	Rx - 13	Rx - 13	Tx - 13	Tx - 13	Rx - 13	DB25-13
Pin 14 (Prog I/O) :Function	Null/Input	Null/Input	Null/Input	CSQ Detect	I/O Hook	Null/Input	Null/Input
:Act Level	Low	Low	Low	Low	Low	Low	Low
:To pin #	Rx - 14	Rx - 14	Rx - 14	Rx - 14	Rx - 14	Rx - 14-	---
Pin 15 (Int. Spkr +) :Function	N/U	N/U	N/U	N/U	N/U	N/U	N/U
:Act Level	---	---	---	---	---	---	---
:To pin #	---	---	---	---	---	---	---
Pin 16 (Ext. Spkr +) :Function	N/U	N/U	N/U	N/U	N/U	N/U	N/U
:Act Level	---	---	---	---	---	---	---
:To pin #	---	---	---	---	---	---	---

Note: "To pin #" refers to pin on connector of controller; transceiver pins are listed in bold in the first column.
"N/A" = Not Applicable
"N/U" = Not Used
If remote channel steering with the TRA100R is not required, program pins 6, 9, and 12 as "Null /Input".
* This wire must be added if channel steering is used.
**Jumper pins 2 an 18 together on the DB25.

Section 7
Controller Adjustments

Overview

This section is to confirm the proper operation of an external controller with your GR400 or GR500 X-Pand repeater prior to putting the system into operation with end users. It is assumed that the transceiver has already been programmed with its RF channel assignments.

The following steps should be performed with a Communications System Analyzer (CSA) or service monitor, such as the Motorola R2000 , R2550, or R2600, connected to the antenna jack of the duplexer (or the transmitter, if applicable). The CSA must be operating in the duplex mode. Set the CSA to monitor the frequency of the transmitter while generating the duplex signal at the frequency of the receiver. Refer to the operating instructions of your CSA manual. Adjust the deviation of the duplex generator for 60% of rated system peak deviation with a 1 kHz modulating tone.

For all of the controllers:

1. Connect the line cord from the repeater to a suitable 50/60 Hz ac power source.
2. Turn on the repeater. Any power indicating LED on the controller will illuminate.

IMPORTANT

The maximum deviation for "voice" audio from the R1225 transceiver module must not exceed the rated maximum system deviation minus any PL/DPL deviation generated by the external controller. For example: if a system with a maximum deviation of 5 kHz has its PL deviation set at 750 Hz, then the "voice" audio deviation would be set to 5000 Hz - 750 Hz = 4250 Hz, or 4.25 kHz or less. Use the 1225 Series RSS (version R02.00.00 or later) service mode to adjust the maximum "voice" deviation for this lower value.

ZR310 Controller Adjustments

It is not necessary for the ZR310 controller to have been programmed in order to complete these tests. If the ZR310 controller has been programmed, these tests should not effect any of that programming.

1. Use a DTMF equipped keypad radio to enter into the programming mode by keying up and sending the programming access code (default is "12310#"). Un-key the radio and listen for the acknowledgment prompt from the ZR310 controller in the CSA speaker. The transmitter will remain keyed.

Transmit TPL/DPL Encode Level

1. Key your portable or mobile radio and send "305# 27#" to the ZR310 controller. The repeater should key and transmit a PL tone of 159.8 Hz. Adjust the **PL/DPL** potentiometer on the front panel of the ZR310 controller for approximately 15% of full channel deviation (e.g. 750 Hz in a 5 kHz system or 375 Hz in a 2.5 kHz system). When you have finished checking/adjusting, key-up and send "305# 0#" to turn the encode off.

Transmit Audio Level

1. Key-up and send "304#" to open the repeat audio path in the ZR310 controller. Observe the deviation of the re-transmitted 1 kHz tone of the duplex generator on the CSA. Adjust the **Audio** potentiometer on the front of the ZR310 controller for "unity gain" in the repeat mode (60% out for 60% in). When you are finished, send "303#" to close the repeat audio path.

To Exit

1. Enter the DTMF command "99#" to exit the alignment mode.

This concludes the test and adjustments for the ZR310 controller and the repeater. You can now program the controller with its users (refer to the ZR310 controller service manual, 6880904Z64, for more information) or, if you have already programmed the unit, you are ready to place the system in service.

ZR320 Controller Adjustments

NOTE
At any time while programming these settings, if a time period of 60 seconds elapses without a DTMF key press, the ZR320 controller will exit the program mode automatically.

Receive Audio Level

1. Using a DVM or oscilloscope, adjust the **Audio** potentiometer on the ZR320 controller until 470 mV rms (1.33V p-p) is present at pin 8 of the ZR320 controller programming connector J2 on the front of the ZR320 controller (refer to Figure 7-1), or on either pin of JP5 inside the ZR320 controller.

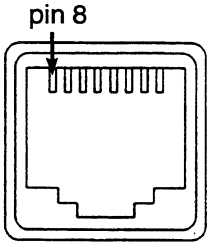


Figure 7-1. J2 Programming Connector, Front View

TPL/DPL Encode Level

1. Use either a DTMF equipped radio, or a DTMF equipped telephone calling the ZR320 controller to enter the ZR320 controller programming mode (default access code is "12320#").

2. Enter command "93#" to start TPL generation. The ZR320 controller will generate 134.4 Hz (the DPL turn-off tone).

3. Adjust the **PL/DPL** control for 15% of maximum rated system deviation (e.g., 750 Hz in a 5 kHz system or 375 Hz in a 2.5 kHz system).

4. Press any DTMF digit to end the test.

Hybrid Adjustment

If the ZR320 controller is to be used in the full-duplex mode, the hybrid must be adjusted. Perform the following steps to adjust the hybrid.

1. Enter the program mode of the ZR320 controller using a telephone so that the hybrid may be balanced into the central office to which the ZR320 controller is connected.

NOTE
The telephone must have a telephone number (or extension) different from the the ZR320 controller.

2. Once in the programming mode, enter command "95#". The ZR320 controller will generate two tones that are sent to the telephone. Audio coming from the telephone is then presented to the transmit radio so that any hybrid imbalance will appear as transmitted audio.

3. Alternately adjust the **R** and **C** controls on the ZR320 controller for minimum transmitted audio (lowest deviation measured on the CSA).

4. Repeat Step 3 until no further minimizing of the transmitted audio can be attained. The hybrid is now balanced.

5. Press any DTMF digit to terminate the test.

Dial Click Decode Level

If you are installing a ZR320 controller and you are planning on using rotary telephones for over-dialing user numbers into the ZR320 controller, perform the following steps.

1. Enter command "96#" to enable the dial click decode test.

2. For each rotary digit you enter, the ZR320 controller will send "beeps" back.

3. Adjust the **Click** control until the number of beeps matches the digit dialed.

To Exit

1. Enter the DTMF command "99#" to exit the alignment mode.

Refer to the ZR320 controller service manual (6880903Z42) or programming manual (6880903Z43) for more information.

ZR340 Controller Adjustments

1. Use a DTMF equipped radio to enter into the ZR340 controller programming mode (default programming access code is "12123").

Transmit Audio Level

1. Key in the DTMF command "92#" (Tx test). The ZR340 controller will generate a 1 kHz tone.

2. Adjust the **TX Setup** potentiometer on the ZR340 controller for 70% of full rated system

deviation (3.5 kHz for a 5 kHz system or 1.75 kHz for a 2.5 kHz system).

3. Press any DTMF digit to end the test.

Repeated Audio Level

1. Complete the "Transmit Audio Level" adjustment, described above, before continuing.
2. Key in the DTMF command "93#" (repeated audio test).
3. Adjust the **RX Setup** potentiometer on the ZR340 controller for 60% of full rated system deviation of the transmit radio.
4. Press any DTMF digit to end the test.

To Exit

1. Enter the DTMF command "99#" to exit the alignment mode.

Refer to the ZR340 controller operation/maintenance/programming manual (6880905Z02) for more information.

i750R Controller Adjustments

1. Place the i750R controller into the diagnostic/test mode by simultaneously pressing the **Up** and **Down** buttons. (The i750R controller will be in Test #1.)

Transmit Audio Level

1. In Test #1, the i750R controller generates a 1 kHz tone. use the UP or DOWN button to adjust the deviation by the tone to 70% of peak rated system deviation (3.5 kHz in a 5 kHz system or 1.75 kHz in a 2.5 kHz system).

MDC/TPL/DPL Encode Level

1. Select Test #11 (Tx Audio Port).
2. In Test #11, the i750R generates an 1800 Hz tone, TPL or DPL. The 1800 Hz tone is generated upon entry to the test.
3. Use the **Up** or **Down** button to adjust the deviation of the 1800 Hz tone to 70% of peak rated system deviation.
4. Press the **Up** and **Down** buttons simultaneously to go to the TPL generation.
5. Use the **Up** or **Down** button to adjust the deviation of the TPL tone to 15% of peak rated system deviation.
6. Press the **Up** and **Down** buttons simultaneously to go to the DPL generation.
7. Use the **Up** or **Down** button to adjust the deviation of the DPL data to 15% of peak rated system deviation.

To Exit

1. Press the **Up** and **Patch On/Off** buttons simultaneously to exit the alignment mode.

Refer to the i750R controller operation maintenance manual (6880904Z39) or programming manual (6880904Z45) for more information.

i20R Controller Adjustments

1. Place the i20R controller into test/setup mode #1 by pressing once the **Test** push-button on the front panel.

Repeated Audio Level

1. Adjust the **FWD** Audio Level on the i20R controller for 60% peak deviation of the transmit radio.

TPL/DPL Encode Level

1. Turn off the 1 kHz tone modulation of the duplex generator.
2. Press the **Test** push-button twice to place the i20R controller into test/setup mode #3.
3. Adjust the **SIG** Audio Level potentiometer for 15% of peak rated system deviation of the test TPL tone.

To Exit

1. Simultaneously press the **Test** and **RPTR** push-buttons to end the test/setup modes.

Refer to the i20R controller operation maintenance manual (6880904Z40) or programming manual (6880904Z55) for more information.

TRA100R Controller Adjustments

To gain access to the controls and programming DIP switches of the TRA100R controller, it is necessary to remove the 4 small Phillips head screws that retain the protective front cover.

1. If the **Rptr** LED of the TRA100R controller is not on, press the **Repeater Enable** switch.

Repeated Audio Level

1. Apply the proper TPL/DPL, if required for a coded squelch repeater.

2. Adjust the **Rptr** control on the TRA100R controller for 60% of full rated system deviation of the transmitter by the 1 kHz tone. Take into account any deviation by TPL/DPL on the transmitted signal.

Transmit Level

1. Enter the diagnostic test mode of the TRA100R controller by simultaneously pressing the **Repeater Enable/Test** and **Line Disable/Reset** buttons.

2. Select test mode #4 by pressing the **Repeater/ Enable/Test** button. Test #4 is indicated when the **COR** led illuminates.

3. Disconnect the remote control line from the **Phone Line** modular connector on the back of the TRA100R controller.

4. Connect an audio generator with a 600 Ω output impedance between pins 2 and 3 of the **Phone Line** connector. Set the frequency to 1 kHz at a level of 0 dBm (775 mV rms at 600 Ω).

5. Adjust the **TX Level** control on the TRA100R controller for 60% of full rated system deviation by the 1 kHz tone. Take into account any deviation by TPL/DPL on the transmitted signal.

Line Audio Level

1. Select test mode #5 by pressing the **Repeater Enable/Test** button. Test #5 is indicated when the **COR** and **PTT** LEDs illuminate.

2. Reconnect the remote control line to the TRA100R controller.

3. Adjust the **Line Level** control on the TRA100R controller for the desired line audio level (typically 0 dBm or 775 mVrms at 600 Ω).

To Exit

1. Press the **Line Disable/Reset** button to end the alignment and test mode.

Control Line Level

The TRA100R controller provides automatic level compensation within a range of 20 dB. The unit uses the level of the high level guard tone burst to establish the transmit level. By convention, this high level guard tone is 3 dB above the maximum audio level. The TRA100R controller will operate outside this 20 dB range, but the output level of the transmitter will vary. The only requirement during installation is to make sure that the level at the TRA100R controller from each remote desk set is between 0 dBm and -20 dBm.

Refer to the TRA100R controller service manual (6880903Z42) or programming manual (6880903Z43) for more information.

ST-583M SmarTrunk II Adjustments

Refer to the ST-583M SmarTrunk II controller service manual (6880905Z59) for adjustment instructions.

Section 8
Troubleshooting

Table 8-1. Troubleshooting for R1225 Transceiver (General)

Symptom	Problem(s)	Possible Solution(s)
1. GR400 or GR500 X-Pand repeaters dead (7-segment LED display does not light).	1a. AC line cord not plugged into power supply or AC mains outlet. 1b. Repeater not turned ON. 1c. Loose or bad cable from front panel to transceiver. 1d. DC cord not plugged into the R1225 transceiver. 1e. Open fuse in power supply.	1a. Plug power supply cord into power supply CEE receptable or AC mains outlet. 1b. Turn on repeater. 1c. Check cable connections to front panel and transceiver or replace cable, if necessary. 1d. Plug DC cable into connector at the rear of the R1225 transceiver. 1e. Check fuse in power supply and replace as necessary.
2. No field radios can access system.	2a. Repeater programmed with wrong TPL/DPL code. 2b. Loose or bad coaxial cable from receiver antenna connector to duplexer or receiver antenna. 2c. Incorrect programming of field radios. 2d. Repeater not enabled or set up (if applicable).	2a. Check TPL/DPL code of repeater and reprogram, if necessary. 2b. Check repeater cable connections to receiver antenna connector and replace cable if necessary. 2c. Check programming on field radios and reprogram, if necessary. 2d. 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: • TPL/DPL decoding. • Requirements of signalling systems.
4. Loss of receiver sensitivity when repeater 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 of this manual and adjust distance between antennas. 4f. Read "Cables" on page 1-5 of this manual to determine the types of cables required or replace cable(s), if necessary.
5. Partial (RapidCall) PTT ID message repeated.	5a. Pre-time too short. 5b. "Pre" PTT ID used.	5a. Increase pre-time in field radio. 5b. Use "Post" PTT ID.

Table 8-1. Troubleshooting for R1225 Transceiver (General) (Cont'd.)

Symptom	Problem(s)	Possible Solution(s)
6. Fan in the repeater runs all the time.	6a. GR500 X-Pand repeater. 6b. Repeater environment is hot (>60°C). 6c. Defective temperature switch in GR400 X-Pand power supply 6d. Only happens if battery revert module is used in GR400 X-Pand repeater.	6a. Normal operation of GR500 X-Pand repeater. 6b. Normal operation at elevated ambient temperatures or extended repeater keying. 6c. Replace GR400 X-Pand power supply. 6d. Normal operation with battery revert in GR400 X-Pand repeater.
7. Fan still runs with repeater power switch turned OFF.	7a. Normal operation if repeater was transmitting prior to turning OFF. 7b. Repeater environment is hot (>60°C). 7c. Battery revert module is installed in GR400 X-Pand repeater.	7a. Wait until repeater cools. 7b. Move repeater to cooler environment. 7c. Normal operation with battery revert module in GR400 X-Pand repeater. 7d. Disconnect AC cord from AC mains outlet.
8. Power supply stays ON with repeater power switch OFF.	8. Normal operation.	8. Power switch on front panel turns OFF B+ only to transceiver.
9. Repeater constantly keyed.	9a. Accessory connector of transceiver not programmed correctly or not operating correctly. 9b. Transceiver PTT pin pulled LOW by an accessory.	9a. Check programming of accessory connector and reprogram, if necessary. 9b. Remove or correct accessory.
10. Front panel display does not light but repeater is warm.	10. Power supply is in overvoltage/overcurrent protection.	10a. Disconnect AC cord from AC mains outlet; wait 5 seconds, then reconnect AC cord to AC mains outlet. 10b. If step 10a dos not reset power supply, transceiver or external controller may have a short circuit.
11. Repeater will not enable with "RPT EN" pushbutton.	11a. Repeater programmed as Base Station only. 11b. Pin 10 of accessory connector programmed for "Repeater Knockdown" and is activated.	11a. Use RSS to reprogram for repeater operation. 11b. Check wiring from pin 10 to an external controller or accessory and correct, if necessary.
12. Remote "Repeater Knockdown" (pin 10 of accessory connector) not functioning.	12. Pin 10 programmed with "Null" default.	12. Use RSS to reprogram pin 10 as "Repeater Knockdown".
13. CWID stops and starts many times.	13. CWID programmed as interruptible.	13. Use RSS to reprogram CWID as non-interruptible.
14. Desk Mic does not put station in monitor mode when monitor button is pushed.	14. "Permanent On-Hook" enabled.	14. Use RSS to reprogram "Permanent On-Hook" as disabled.
15. Local microphone (front panel jack) overrides repeat audio.	15. None.	15. Normal operation. PTT priorities are (low to high): COR, External, Local, Page.
16. I hear voices coming from my repeater mounted in a closet.	16a. "PA Mute" not enabled. 16b. Ghosts/spirits.	16a. Use RSS to program "PA Mute" as enabled. 16a. Exorcism.

Table 8-2. Troubleshooting for Transceiver Receiver

Symptom	Problem	Solution
1. No speaker audio heard.	1a. No speaker connected to volume/mcirophone board or to pins 1 and 16 of accessory connector.	1a. Normal operation. No speaker is supplied with GR400 and GR500 X-Pand conversion kits. Use handset for servicing.
	1b. Volume control turned down.	1b. Turn up volume.
	1c. Speaker cable not plugged into volume/microphone board.	1c. Connect speaker cable.
	1d. External speaker (if applicable) not connected between pins 1 and 16 of accessory connector on controller.	1d. Connect external speaker between pins 1 and 16.
	1e. Defective speaker (internal or external, if applicable).	1e. Check speaker and replace if necessary.
	1f. "PA Mute" enabled.	1f. Use RSS to reprogram "PA Mute" as disabled.

Table 8-3. Troubleshooting for Transceiver Transmitter

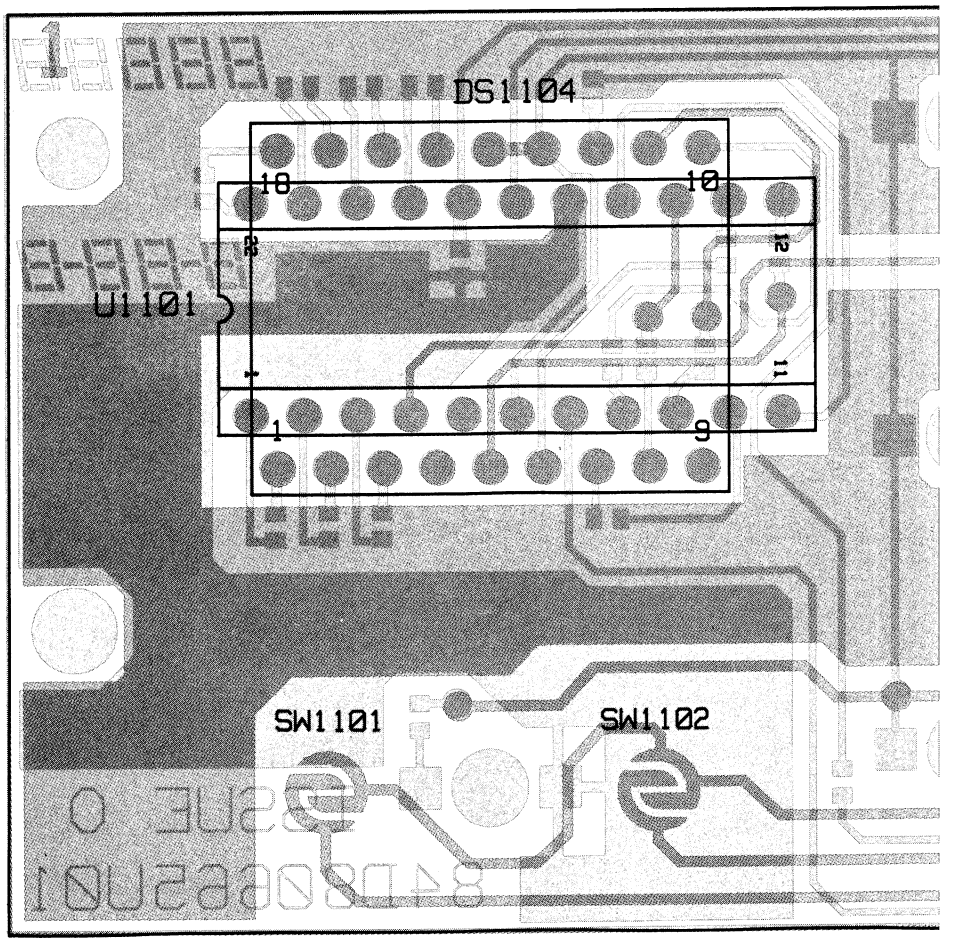
Symptom	Problem	Solution
1. Transmitter not keying when a properly identified signal is presented to receiver.	1a. Repeater not enabled. 1b. Repeater on wrong channel (mode). 1c. No transmit frequency programmed. 1d. Incorrect receive frequency or TPL/DPL programmed. 1e. Accessory connector pin 10 (remote knockdown) activated or not operating correctly.	1a. Enable repeater. 1b. Set repeater to correct channel (mode). 1c. Program transmit frequency. 1d. Check receive frequency and TPL/DPL and reprogram, if necessary. 1e. Check connections to pin 10 of accessory connector and correct, if necessary.
2. Transmitter keying continuously or keying without a properly identified signal presented to the receiver.	2a. Repeater on wrong channel (mode). 2b. Wrong TPL/DPL programmed. 2c. Pin 3 of accessory connector pulled LOW by an accessory. 2d. Accessory connector not programmed correctly or not operating correctly.	2a. Set repeater to correct channel (mode). 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.
3. Low or erratic output power level, or no output power level from the transmitter.	3a. Loose RF cable connector(s). 3b. Faulty antenna or feedline. 3c. Faulty duplexer (if applicable). 3d. Output voltage from power supply drops during transmit. 3e. Excessive power supply current drain.	3a. Tighten RF cable connectors to • transmitter output • duplexer • antenna 3b. Replace faulty component. 3c. Check: • Tuning of duplexer • Tightness of locking nuts on tuning screws. • Replace duplexer if duplexer is correctly tuned and nuts are properly tightened. 3d. Check: • Correct position of "115/230" switch on power supply. • High output power from transmitter; do not set greater than 10% over rated RF output power (measured at transmitter output, NOT at duplexer antenna connector). 3e. Disconnect components, one at a time, to locate faulty piece. Replace faulty piece.
4. Transmitter keys but no or low audio is transmitted.	4a. Repeater gain improperly set. 4b. Incorrect "Operation Mode" programmed.	4a. Use RSS to set repeater gain. 4b. Use RSS to reprogram "Operation Mode."

Table 8-4. Troubleshooting for External Controllers (General)

Symptom	Problem	Solution
1. Controller dead, no LED indications.	1a. Loose or bad cable from transceiver. 1b. Blown fuse in controller (if applicable).	1a. Check cable from transceiver and replace if necessary. 1b. Replace fuse in controller (if applicable) and check for short or open circuit(s).
2. Transmitter not keying when a properly identified signal is presented to receiver.	2a. Controller not enabled, if applicable. 2b. Loose or bad repeater cable. 2c. Accessory connector of transceiver not programmed correctly or not operating correctly. 2d. Incorrect receive frequency or TPL/DPL programmed. 2e. Repeater on wrong channel (mode). 2f. Pin 10 programmed as "repeater knockdown" and activated by a controller or accessory. 2g. No transmit frequency programmed into transceiver.	2a. Enable controller. 2b. Check repeater cable connection(s) and replace cable, if necessary. 2c. Check programming of accessory connector and reprogram, if necessary. 2d. Check frequency and TPL/DPL code and reprogram, if necessary. 2e. Change repeater channel (mode). 2f. Check wiring to pin 10 and correct, if necessary. 2g. Program transmit frequency.
3. Transmitter keying continuously or keying without a properly identified signal presented to receiver.	3. Pin 3 of accessory connector on controller pulled LOW by an accessory.	3. Remove accessory and correct LOW condition.
4. First part of message not repeated.	4. User speaking too soon after pressing PTT.	4. Delay conversation to allow for delays in repeater and field radios from: • TPL/DPL decoding. • Requirements of signalling systems.
5. Transmitter keys, but low or no audio is transmitted.	5a. "External Mic" input (pin 2) of accessory connector not enabled. 5b. Controller not adjusted correctly.	5a. Use RSS to enable "External Mic". 5b. Adjust controller. Perform alignment procedures.
6. "Tinny" repeated audio (lacks low frequencies).	6. Flat receive audio selected with microphone transmit audio.	6. Use RSS to check "Rx Audio Output" and reprogram, if necessary.
7. "Bassy" repeated audio (lacks high frequencies).	7. EIA de-emphasized receive audio selected with flat transmit audio.	7. Use RSS to check "Rx Audio Output" and reprogram, if necessary.
8. TPL/DPL signalling "passing through" controller.	8. Flat repeat audio selected.	8. Use RSS to reprogram repeat audio as "EIA."
9. TPL/DPL signalling not "passing through" controller.	9. EIA de-emphasized repeat selected.	9. Use RSS to reprogram repeat audio as "Flat."
10. DPL sense inverted in "pass through" mode (flat audios).	10. Inversion caused by processing of signal in receiver circuits.	10. Use RSS to change "Flat Repeat Audio Polarity".
11. Undesirable squelch tails and noise transmitted during drop-out delay.	11. Unmuted receive audio selected	11. Use RSS to reprogram for "Muted" audio.

Table 8-4. Troubleshooting for External Controllers (General) (Cont'd.)

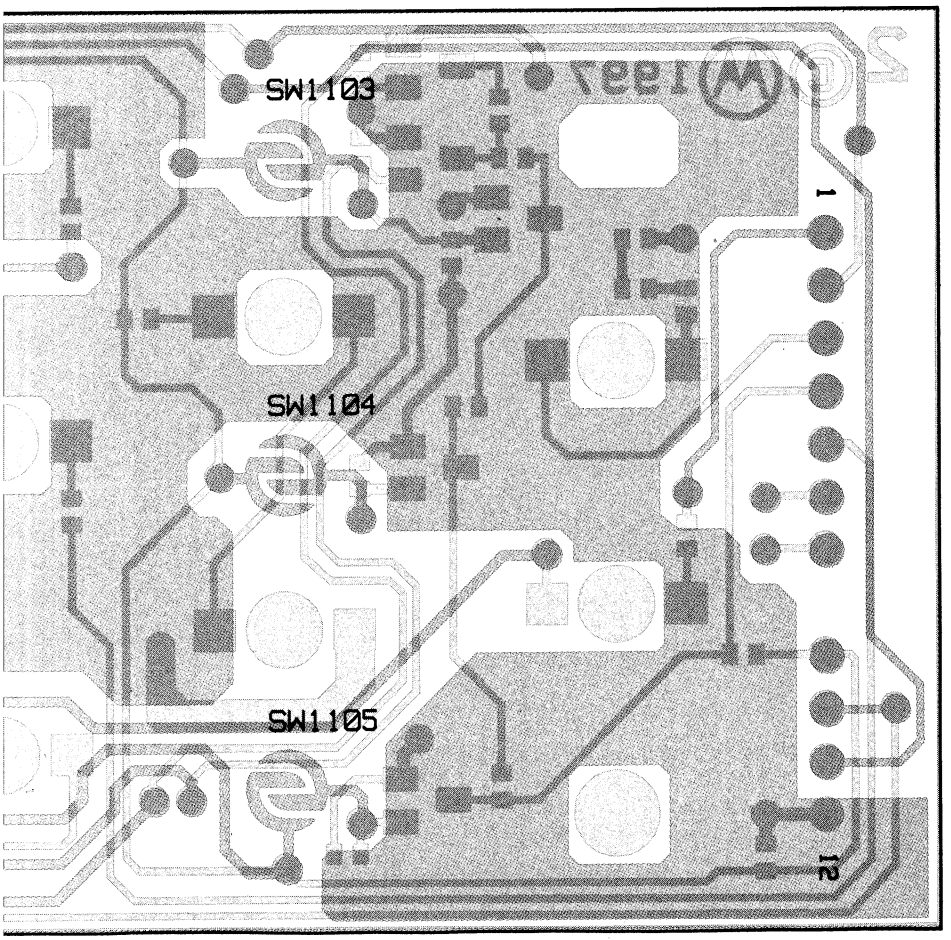
Symptom	Problem	Solution
12. Cannot remotely setup repeater with Call Alert.	12a. No option board installed into the R1225 transceiver. 12b. Both external controller and R1225 transceiver are programmed for remote setup/knockdown and are operating out of sequence.	12a. Install an option board into the R1225 transceiver. 12b. Disable remote setup/knockdown function in the external controller or R1225 transceiver.
13. TRA100R will not channel steer or will not channel steer to channels (modes) 2, 3, 6 or 7.	13a. R1225 transceiver accessory connector pins are not programmed. 13b. Wire missing in cable from pin 9 of R1225 transceiver connector to pin 9 of "Tx" connector. 13c. R1225 transceiver channel steering pins are programmed with debounce "Off."	13a. Program R1225 transceiver accessory connector: Pin 6 - Chan Steer 0 Pin 9 - Chan Steer 1 Pin 12 - Chan Steer 2 All active Low, Debounce On. 13b. Add wire from pin 9 of R1225 transceiver connector to pin 9 of "Tx" connector. 13c. Use RSS to reprogram channel steer pins with debounce "On."



COMPONENT SIDE 84

COMPONENT SIDE (
SOLDER SIDE (PINK
OVERLAY -----

COMPONEN

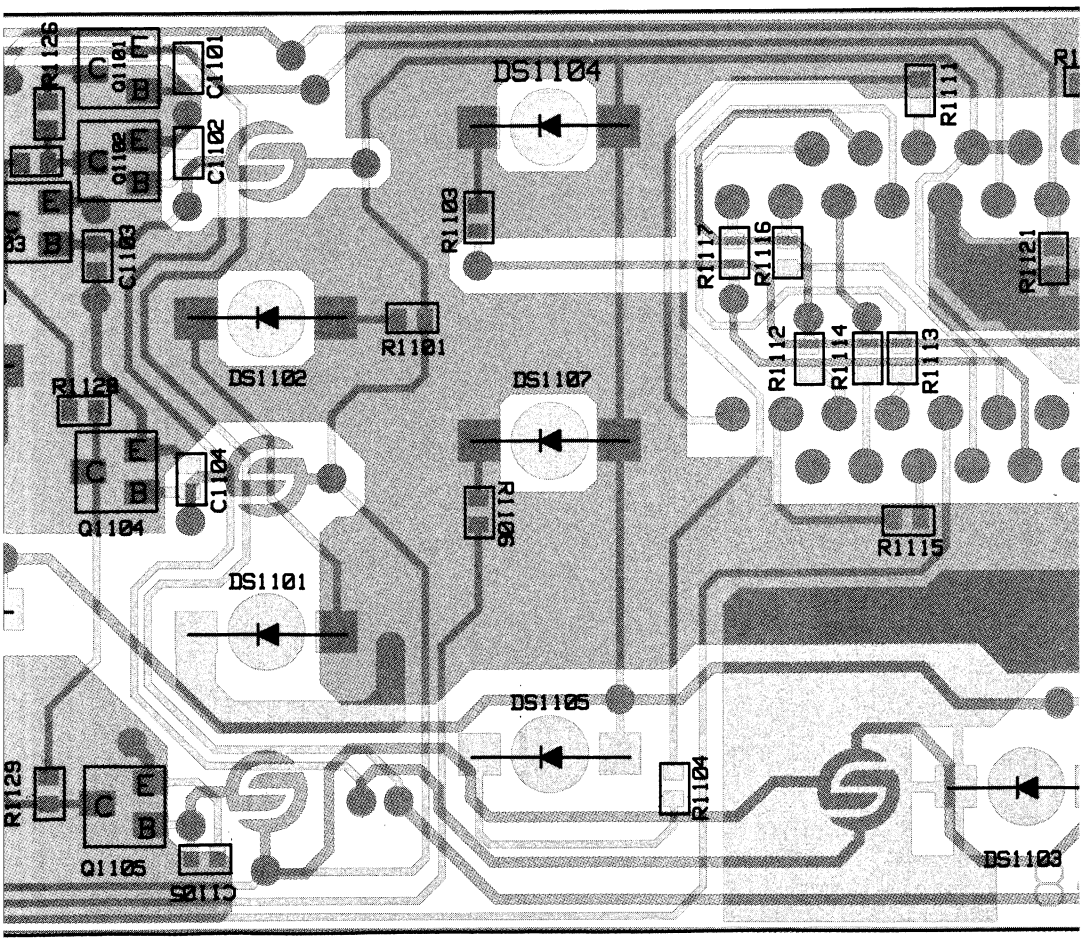


-80665U01 ISSUE O

RAY) RCB-97187-O
RCB-97188-O
RCB-97189-O

T SIDE VIEW

SOLDE



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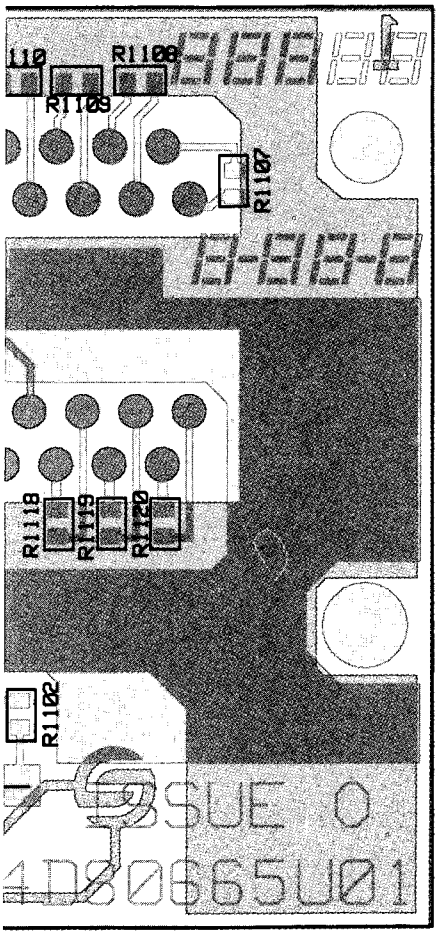
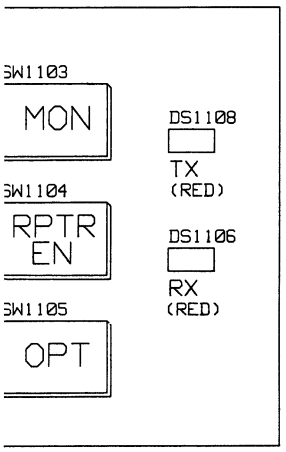
COMPONENT SIDE (GRAY) RCB-97187-O (REV)
SOLDER SIDE (PINK) RCB-97188-O (REV)
OVERLAY ----- RCB-97190-O

SOLDER SIDE VIEW

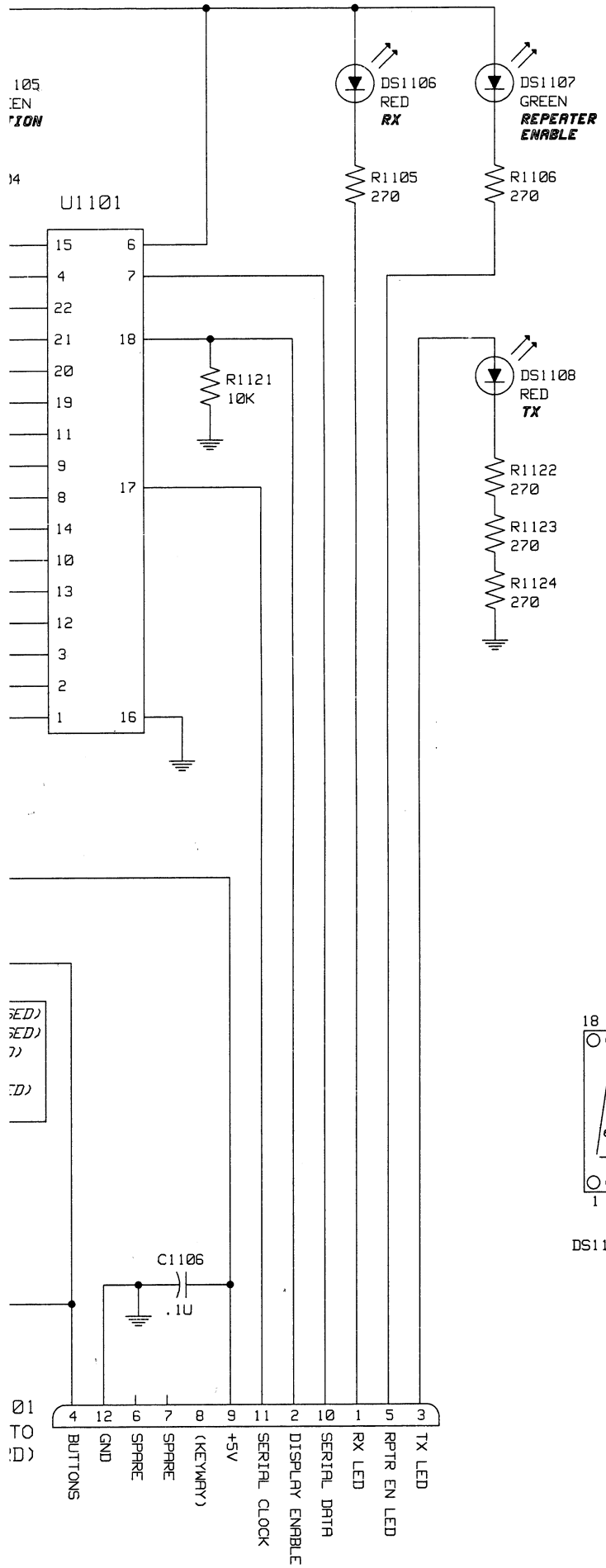


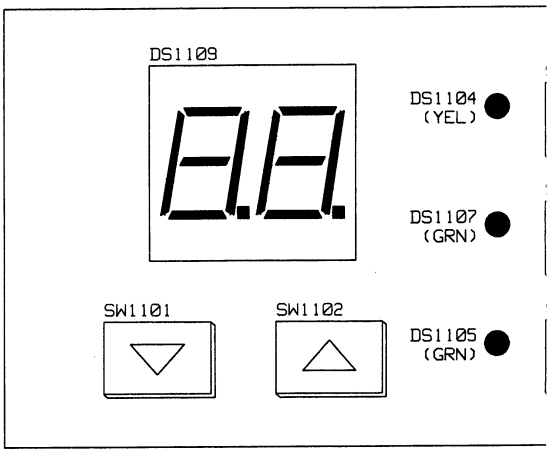
SSUE 0

Circuit Board Details for Display Board

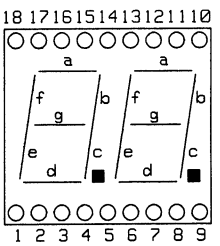

SW1103
MON
DS1108
TX
(RED)
SW1104
RPTR
EN
DS1106
RX
(RED)
SW1105
OPT

R LAYOUT





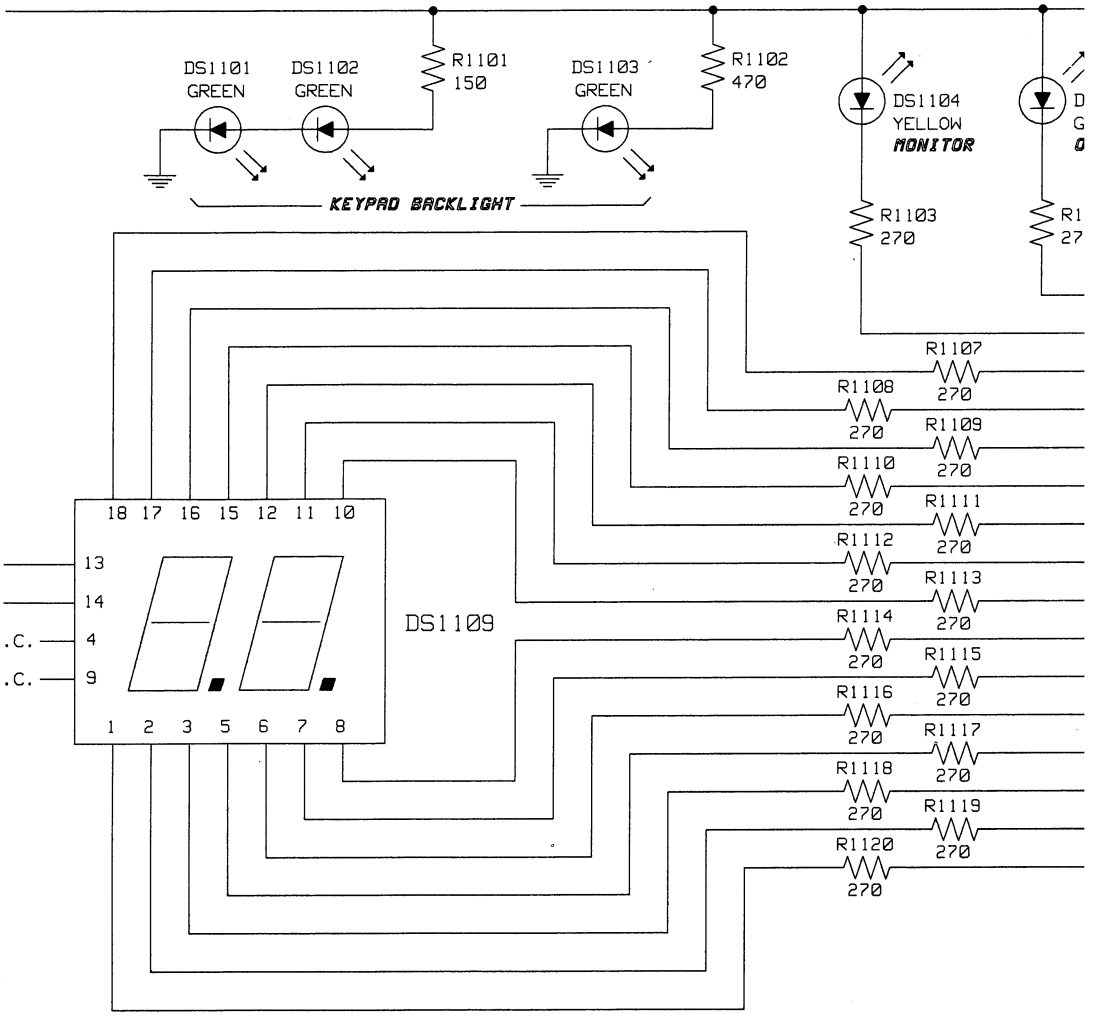
PUSHBUTTON AND INDICATO

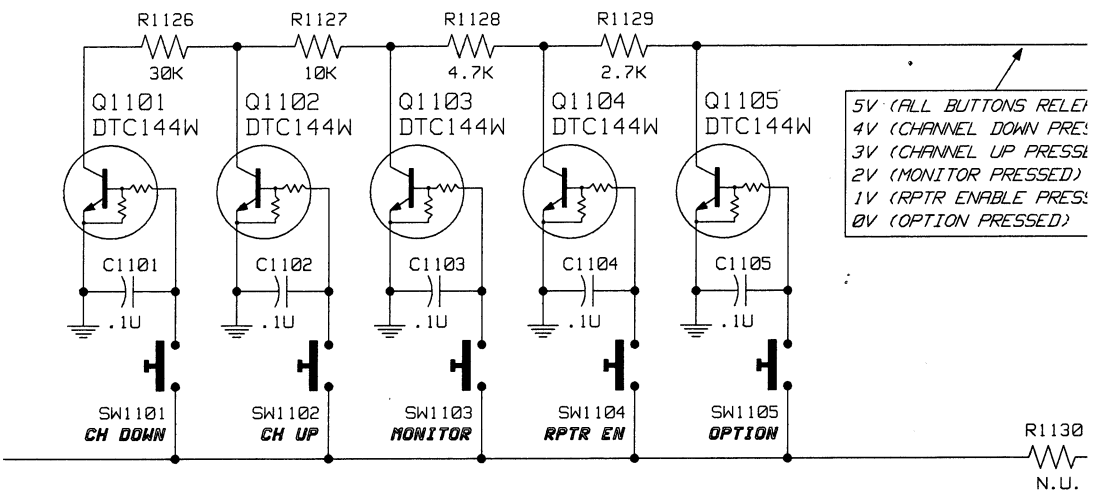


DS1104 PIN ASSIGNMENTS

PIN	ASSIGNMENT
1	CATHODE e1
2	CATHODE d1
3	CATHODE c1
4	CATHODE dp1
5	CATHODE e2
6	CATHODE d2
7	CATHODE g2
8	CATHODE c2
9	CATHODE dp2
10	CATHODE b2
11	CATHODE a2
12	CATHODE f2
13	ANODE digit 2
14	ANODE digit 1
15	CATHODE b1
16	CATHODE a1
17	CATHODE g1
18	CATHODE f1

7/1/97





J1
(CONNECTS VIA FLEX
J9 ON LOGIC BOA

Parts List

HLN9502A Display Board PL-971043-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, chip:
		unless otherwise stated
C1101 thru 1106	21-13743E20	0.1 uF 10%; 16 V
		displays and indicators:
DS1101 thru 1103	48-82565T07	diode LED GRN
DS1104	48-82565T06	diode LED YEL
DS1105	48-82565T07	diode LED GRN
DS1106	48-82565T05	diode LED RED
DS1107	48-82565T07	diode LED GRN
DS1108	48-82565T05	diode LED RED
DS1109	48-80055M01	dual 7 segment LED
		connector, receptacle:
J1101	28-80129R05	12-pin (pin 8 removed)
		transistor: (see note)
Q1101 thru 1105	48-80947V01	digital NPN; type DTC144W
		resistor, chip: +/-5%; 1/16 W:
		unless otherwise stated
R1101	06-62057A29	150
R1102	06-62057A41	470
R1103 thru 1120	06-62057A35	270
R1121	06-62057A73	10k
R1122 thru 1124	06-62057A35	270
R1126	06-62057A84	30k
R1127	06-62057A73	10k
R1128	06-62057A65	4.7k
R1129	06-62057A59	2.7k
R1130	---	Not Used
		integrated circuit: (see note)
U1101	51-84437N25	driver, serial to parallel

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

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Schematic Diagram and Parts List for Display Board

Parts List

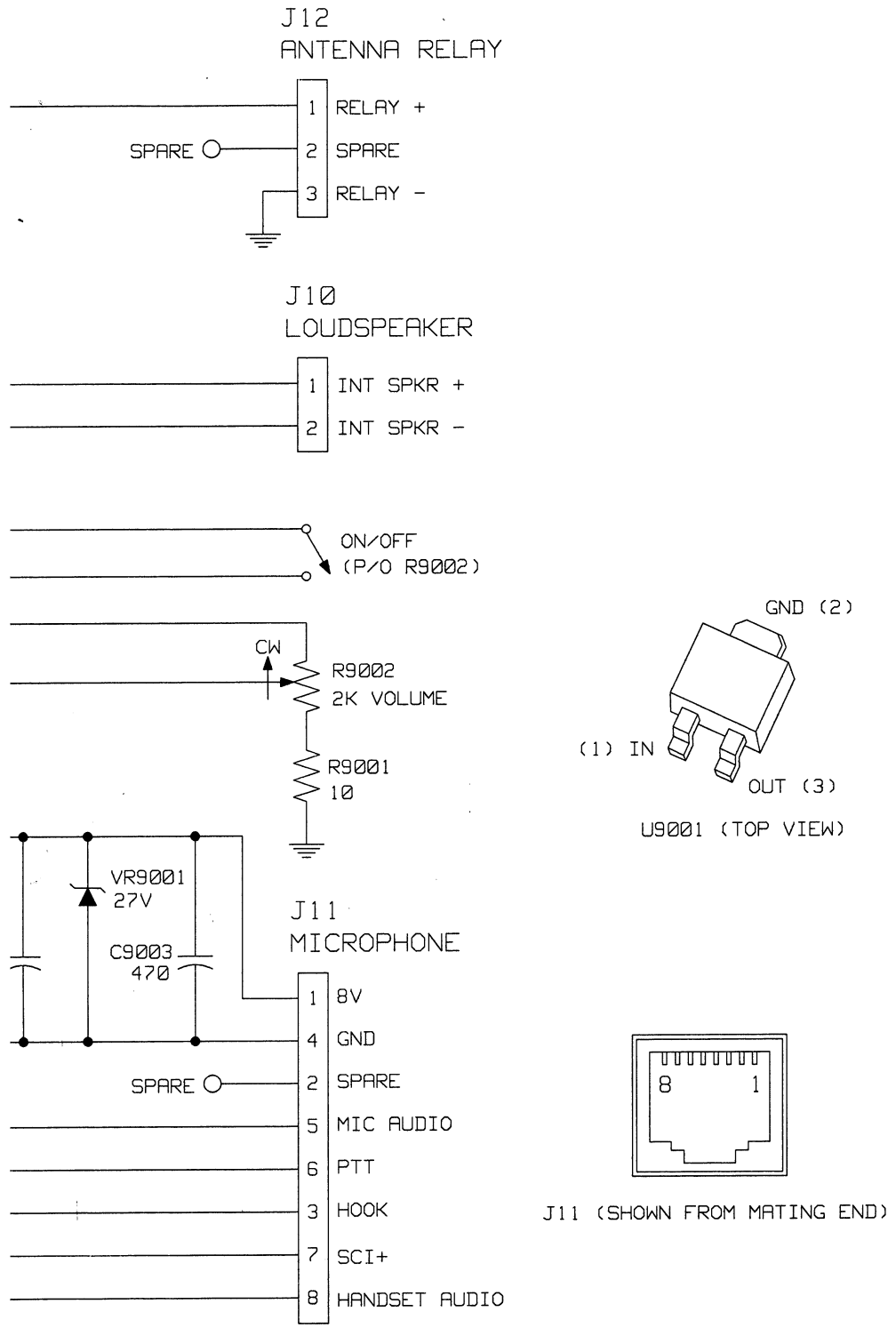
HLN9509A Volume/Microphone Board PL-971044-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: uF +/-5%; 50 V: unless otherwise stated
C9001	21-13741W01	1 uF 10%; 25 V
C9002	21-13743E20	0.1 uF 10%; 16 V
C9003	21-13741F17	470 pF
		diode: (see note)
CR9001	48-05129M76	silicon SOT
		connector, receptacle:
J10	28-80128M02	2-pin, internal speaker
J11	09-80132M01	telephone type, 8 contact, microphone
J12	28-80128M07	3-pin, antenna relay
J9001	28-80129R06	15-pin (pin 3 removed)
		resistor, fixed: +/-5%; 1/16 W: unless otherwise stated
R9001	06-62057A01	10
R9002	18-04405J01	variable 2k with switch
		integrated circuit: (see note)
U9001	51-13816A08	8 V regulator MC78M08BDT
		voltage regulator: (see note)
VR9001	48-80948V01	zener diode 27V SOT

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

Circuit Board Details, Schematic Diagram, and Parts List for Volume Microphone Board

-97151-O



U9001 (TOP VIEW)

J11 (SHOWN FROM MATING END)

CR9001
8V REGULATOR
MC78M08
1
U9001
3
2
C9001
1U
C900
.1
SPARE
11 10 6 5 8 7 1 2 12 14 13 15 9 4
SPARE
RELAY
INT SPKR +
INT SPKR -
B+
SW B+
VOL CONT TOP
VOL CONT WIPER
GND
MIC AUDIO
PTT
HOOK
SCI+

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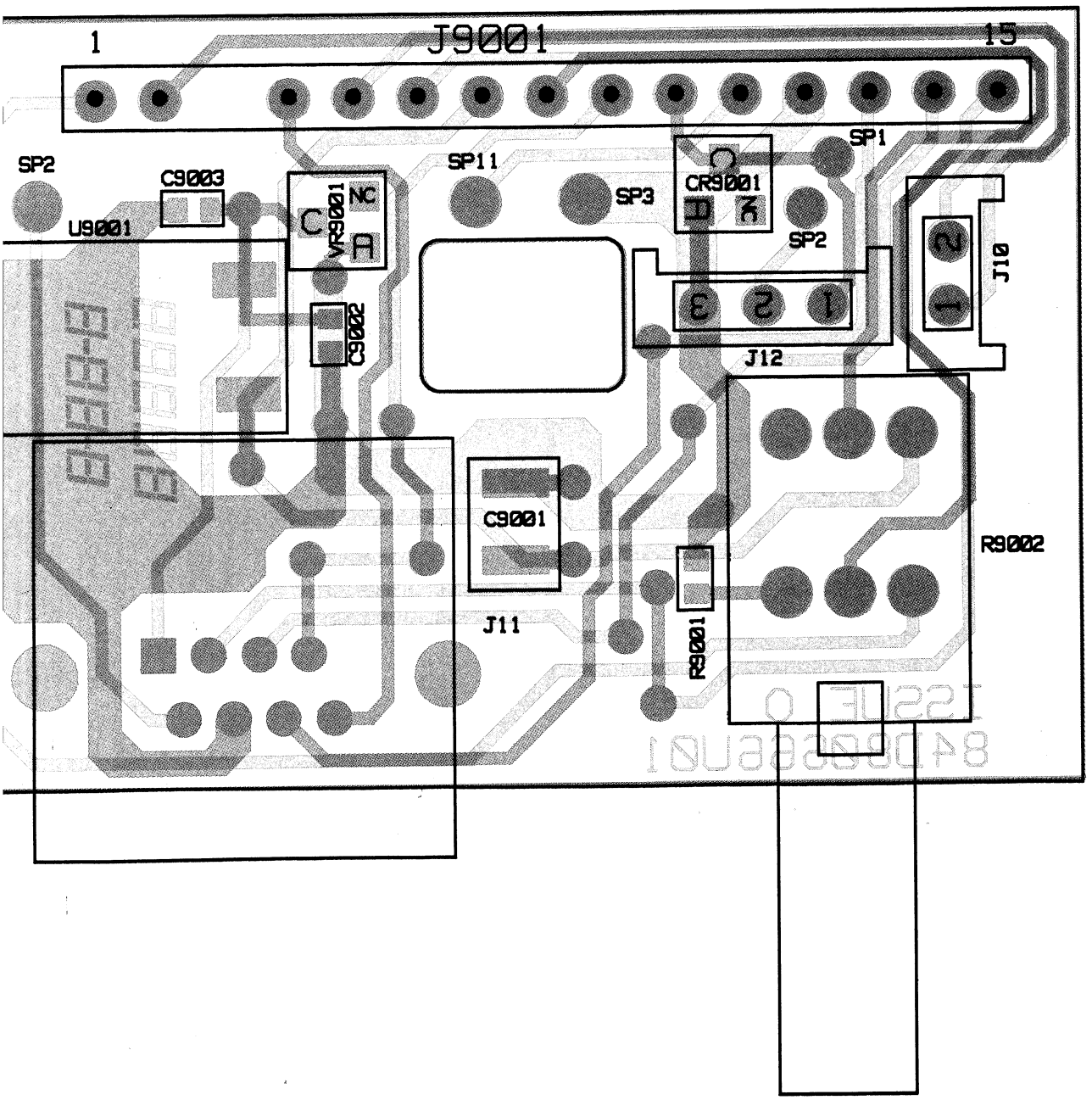
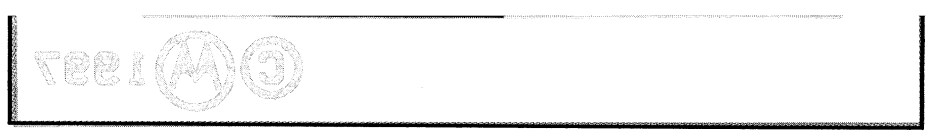
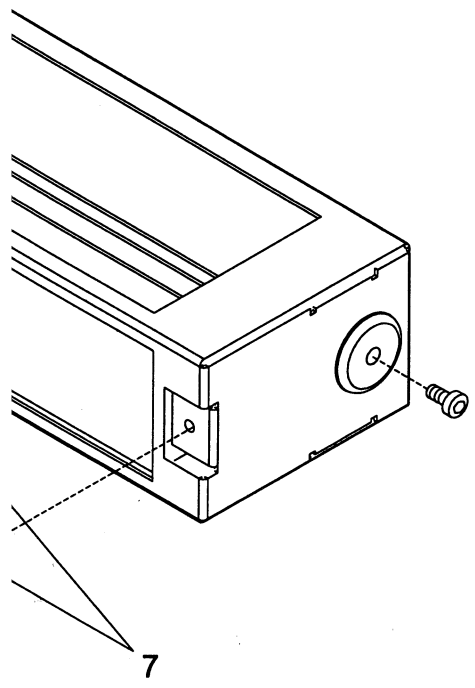
COMPONENT SIDE



COMPONENT SIDE (GRAY)	RCB-97191-O
SOLDER SIDE (PINK)	RCB-97192-O
OVERLAY -----	RCB-97193-O

COMPONENT SIDE VIEW





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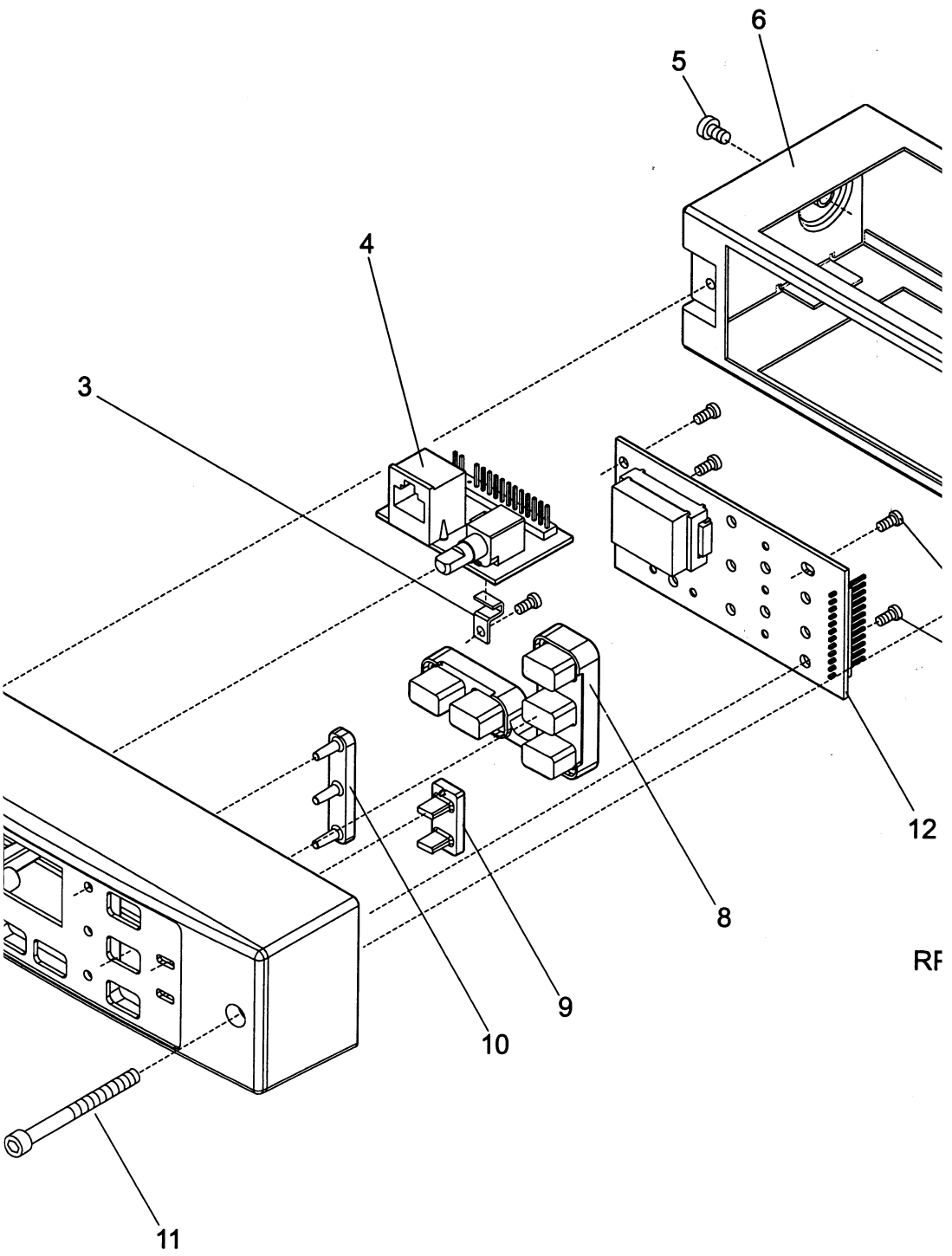
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12
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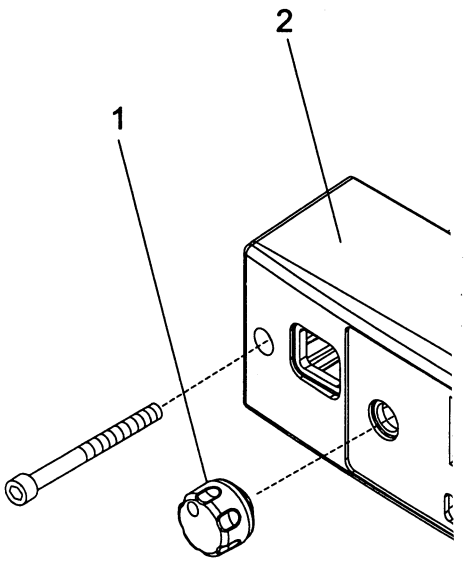
Parts List

R1225 Control Head Assembly, Mechanical PL-971041-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
1	3680106M03	KNOB
2	1580668U01	HOUSING, control head
3	0780037M01	BRACKET, PC board retainer
4	HLN9509	BOARD, volume
5	0310907B08	SCREW, M5 x 0.8 x 8 star pan; 2 used
6	0780411V01	BRACKET, control head
7	0310945A11	SCREW, P3.12 x 1.27 x 8, star pan; 5 used
8	7580471U01	KEYPAD
9	6180491U01	LIGHTPIPE
10	6180491U02	LIGHTPIPE
11	0380270L01	SCREW, cap; 2 used
12	HLN9502	BOARD, display
non-referenced items		
	1380670U01	ESCUTCHEON
	3080519U03	CABLE, ribbon, 12-pin
	3080519U04	CABLE, ribbon, 15-pin



Exploded View and Parts Lists for Control Head Assembly

Glossary

Base Station:
Simple receive then transmit functions of the R1225 transceiver module. The two functions occur one at a time (simplex operation). Also see Full Duplex Base Station.

Bi-directional Repeater:
A repeater configuration in which two R1225 transceiver modules or two radios are interconnected. The audio and COR signals from the receiver of the first radio are routed to the transmitter of the second radio. Unlike the unidirectional case, though, the audio and COR signals of the receiver of the second radio are also routed to the transmitter of the first radio. Example: the first radio receives a signal on 456.550 MHz which is re-transmitted by the second radio on 451.550 MHz. The second radio then receives a signal on 451.550 MHz which is re-transmitted by the first radio on 456.550 MHz.

Console radio:
A fixed (base station) or a mobile radio installation that has been designated as the controlling radio for the repeater or as the "hub" for communications. The console radio is not part of the repeater hardware.

Courtesy "Over" Beep:
An alert tone ("beep") transmitted by the repeater to denote reset of the Time-Out Timer of the repeater. Used to indicate when the next field radio can transmit.

COR ("Carrier Operated Relay"):
A carry-over term from the early days of repeater operation. COR is used in its generic sense and does not necessarily mean only Carrier Squelch operation. For the R1225 transceiver, the COR signal may be programmed on pin 4, pin 8, pin 12, or pin 14 of the 16-pin accessory jack (J3). Whenever a "properly" identified signal is received, a dc level change occurs on pin 4, pin 8, pin 12, or pin 14.

COR PTT:
An internal PTT to the R1225 transceiver generated by the presence of a properly identified signal to the receiver of the R1225 transceiver.

CSQ:
Carrier **SQ**uelch.

Cross band Repeater:
A repeater in which the receiver operates in a different frequency band than the transmitter. The R1225 transceiver module cannot operate crossband by itself. A second R1225 transceiver or a radio must be used. Example: the receiver operates on 159.420 MHz in the highband VHF and the transmitter operates on 451.650 MHz in the 450-470 MHz UHF band. Crossband repeaters may be either unidirectional or bi-directional.

CWID:
Morse code station identification. Sometimes called SID (Station Identification).

Drop Out Delay:
The time, in seconds, that the transmitter remains keyed, or on the air, after the input signal to the receiver ceases. Also known as "transmit (tx) hang time."

EIA De-emphasized Audio:
The audio frequency response of the receiver that is measured at the speaker and at pin 11 of the accessory connector when "Rx Audio Output" is "EIA."

EIA Pre-emphasized Audio:
The audio frequency response of the transmitter for an audio input to the microphone, front panel jack, or pin 2 of the accessory connector on the R1225 transceiver module.

External PTT:
The PTT signal on pin 3 of the accessory connector on the R1225 transceiver module.

External Repeater Controller:
An optional repeater interface component providing enhanced features that processes receiver audio and COR signals, and generates transmitter audio and PTT signals and is external to the R1225 transceiver. Depending upon the model, the external controller may be mounted inside or outside of the GR400 & GR500 X-Pand repeater housing. Also see Internal Repeater Controller.

Field Radio:
A mobile or portable radio that is neither a part of the repeater hardware nor a console radio. Field radios may intercommunicate via the repeater or directly.

Flat Audio:
Receiver or transmitter audio level that does not change appreciably in amplitude as the frequency of that audio is varied from 1 Hz to 3 kHz. The receiver audio response from pin 11 of the radio accessory connector when "Rx Audio Output" is "Flat" and the

transmitter audio response for input to pin 5 of the radio accessory connector are "flat."

Full Duplex Base Station:
A base station with which a dispatcher can hear receiver activity (if any occurs) while transmitting. An advantage of this mode is the ability of field radios to interrupt the dispatcher for "instantaneous" repeating of information without the need to wait until the dispatcher terminates transmission. Requires two operating frequencies and a duplexer or separate receive and transmit antennas.

i20R:
A repeater controller that provides service for up to 10 different user groups (TPL/DPL).

i750R:
A repeater controller that provides telephone interconnect and revertive, selective calling. TPL, DPL, Quik-Call II and MDC-1200 signalling formats are supported.

Internal Repeater Controller:
The repeater controller functions of the R1225 transceiver module. Also see R1225 Transceiver.

Linked Repeater:
A uni-directional repeater that sends receiver audio and COR signals to an external "link" radio (or another repeater such as a GR1225) for the purpose of relaying repeated information to another location. Receiver audio and COR signals from the "link" radio are applied to the R1225 transceiver 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.

Local PTT:
The PTT signal from a microphone plugged into the front panel of the repeater.

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. The R1225 transceiver "On Battery" alert is a 100 millisecond long, 1400 Hz tone transmitted every 5 seconds.

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.

Page PTT:
A PTT signal that is a programmable function on an input or input/output pin of the accessory connector. May be used to gate either EIA transmit audio (microphone on pin 2) or flat transmit audio (on pin 5) of the accessory connector of the R1225 transceiver. "Debounce" of page PTT may be eliminated to reduce transmitter turn on/turn off times.

PTT Priority:
Defines which PTT signal will override or be overridden by other PTT signals. The highest priority (overrides all other PTT's) in the R1225 transceiver module is Page PTT, followed by Local PTT, then External PTT, and, finally, COR PTT.

Post Limter:
Flat transmit audio from pin 5 of the R1225 accessory connector that is combined with the microphone or repeater audio after the transmitter audio limiter. This is the preferred method for externally generated TPL, DPL and other subaudible signalling.

Power-up:
The initial application of operating potential (voltage) to the R1225 transceiver and any optional, external repeater controller.

Pre-Limiter:
Flat transmit audio from pin 5 of the R1225 accessory connector that is combined with the microphone or repeater audio before application to the transmitter audio limiter.

"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.

R1225 Transceiver:
A specialized transceiver module capable of full duplex operation. Basic and a few advanced repeater controller features are standard in the hardware and software of the module.

Repeater Controller:
A module or option card that fits into the GR400 & GR500 X-Pand repeater station and provides advanced features beyond the basic repeater operation of the R1225 transceiver module.

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., QCII).

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 receiver and the transmitter 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 of the R1225 transceiver module. Up to 4096 subscriber units (field radios) with individual identification can be serviced. Telephone interconnect, individual and group selective calling are supported.

TRA100R:
A repeater controller that provides tone remote control capability to the repeater.

Unidirectional Repeater:
The basic repeater function of the R1225 transceiver module.

VOX:
Voice controlled transmission; the transmitter is keyed by a circuit that detects the presence of voice output from the receiver or from a telephone line.

ZR310:
A repeater controller that provides individualized repeater service for up to 70 different customer groups (TPL/DPL).

ZR320:
A repeater controller that acts as an interface to the telephone line, providing selective calling telephone interconnect features and repeater operation. TPL, DPL, and Quik-Call II signalling formats are supported.

ZR340:
A repeater controller that provides telephone interconnect with expanded sign-on/sign-off code features and CWID for the single user repeater.

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