MOTOROLA

MICOR®

EMS Duplex/Repeater UHF Mobile Radio

For Emergency Medical Services
Models Q2033-35A and Q1853-55A

[redacted]

SUPPLEMENT to Instruction Manual 68P81015E70

68P81029E45-C

MICOR
EMS DUPLEX/REPEATER
UHF MOBILE RADIO
FOR EMERGENCY MEDICAL SERVICES

CONTENTS

MOTOROLA INC.
Communications Division

service publications
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68P81029E45-C
3/28/79-PHI

MAINTENANCE AND ADJUSTMENTS

FUNCTIONAL DIAGRAMS AND CABLING

RECEIVER

AUXILIARY RECEIVER

CONTROL HEAD AND ACCESSORIES

SPECIFICATIONS (MAIN RADIO)

GENERAL		
MAXIMUM BATTERY DRAIN	Standby @ 13.8 V	1.2A
	Receive @ 13.8 V	3.2A
	Transmit @ 13.6 V	17.0A
NUMBER OF FREQUENCIES	8 transmit/8 receive	
SQUELCH	"Private-Line" Tone-Coded Squelch and carrier squelch	
DIMENSIONS	13" W x 24-3/4" L x 3-3/8" D (330mm x 629mm x 85mm)	
WEIGHT	Approx. 40 lbs (15.9 kg). 65 lbs (27.24 kg) with accessories	
METERING	A single-scale 0 to 50 microampere meter or Motorola portable test set can be used to make all measurements essential to tuning and testing.	
TRANSMITTER		
RF POWER OUTPUT	30 watts	
OUTPUT IMPEDANCE	50 ohms	
SPURIOUS AND HARMONIC EMISSIONS	75 dB below carrier	
FREQUENCY STABILITY	± .0005% from -30°C to +60°C ambient (+25°C reference) and ± 15% primary voltage variation.	
MODULATION	15F2 and 16F3 ± 5 kHz for 100% @ 1 kHz	
FREQUENCIES	FCC-assigned Emergency Medical Service frequencies: 468.000, 468.025, 468.050, 468.075, 468.100, 468.125, 468.150, and 468.175 MHz	
AUDIO SENSITIVITY	.08 V ± 3 dB for 60% maximum deviation @ 1 kHz	
FM NOISE	60 dB below 60% maximum deviation @ 1 kHz	
AUDIO RESPONSE	+1, -3 dB of a 6 dB/octave pre-emphasis characteristic from .3 to 3 kHz	
AUDIO DISTORTION	Less than 3% @ 1 kHz, 60% maximum deviation	
RECEIVER		
CHANNEL SPACING	25 kHz	
FREQUENCIES	FCC-assigned Emergency Medical Service frequencies: 463.000, 463.025, 463.050, 463.075, 463.100, 463.125, 463.150, and 463.175 MHz	
SPURIOUS AND IMAGE REJECTION	-100 dB (transmitter unkeyed) -85 dB (transmitter keyed)	
EIA MODULATION ACCEPTANCE	± 7 kHz minimum	
FREQUENCY STABILITY	± .0005% (± .0002% with optional channel element) from -30°C to +60°C ambient (+25°C reference) with ± 15% primary voltage variation.	
AUDIO OUTPUT	10 watts @ less than 5% distortion	
20 dB QUIETING SENSITIVITY	0.5 uV	
EIA SINAD SENSITIVITY	0.35 uV	
SELECTIVITY	-90 dB (EIA SINAD)	
INTERMODULATION	-80 dB (EIA SINAD)	
SENSITIVITY: TONE-CODED SQUELCH	0.25 uV or less	
SENSITIVITY: CARRIER SQUELCH	0.25 uV or less (at threshold)	

SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE

FCC LICENSE DESIGNATIONS:
Transmitter — CC4164
Receiver — RC0003

SPECIFICATIONS (AUXILIARY RECEIVER)

GENERAL	
MAXIMUM BATTERY DRAIN	Receive @ 13.8 V 3.2A
NUMBER OF FREQUENCIES	4
SQUELCH	"Private-Line" Tone-Coded Sqsuelch and carrier squelch
DIMENSIONS	11-1/8" W x 10-7/8" L x 3" D (282mm x 276mm x 76mm)
WEIGHT	Approx. 11 lbs (5 kg).
METERING	A single-scale 0 to 50 microampere meter or Motorola portable test set can be used to make all measurements essential to tunng and testing.

RECEIVER	
CHANNEL SPACING	50 kHz
FREQUENCIES	FCC-assigned Emergency Medical Service frequencies: 458.025, 458.075, 458.125, and 458.175 MHz
SPURIOUS AND IMAGE REJECTION	-100 dB (transmitter unkeyed) -85 dB (transmitter keyed)
EIA MODULATION ACCEPTANCE	± 7 kHz minimum
FREQUENCY STABILITY	± .0005% (± .0002% with optional channel element) from -30°C to +60°C ambient (+25°C reference) with ± 15% primary voltage variation.
AUDIO OUTPUT	10 watts @ less than 5% distortion
20 dB QUIETING SENSITIVITY	0.5 uV
EIA SINAD SENSITIVITY	0.35 uV
SELECTIVITY	-90 dB (EIA SINAD)
INTERMODULATION	-80 dB (EIA SINAD)
SENSITIVITY: TONE-CODED SQUELCH	0.25 uV or less
SENSITIVITY: CARRIER SQUELCH	0.25 uV or less (at threshold)

SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE

FCC LICENSE DESIGNATION:
Receiver — RC0129

SAFETY INFORMATION

The United States Department of Labor, through the provisions of the Occupational Safety and Health Act of 1970 (OSHA), has established an electromagnetic radiation safety standard which applies to any two-way mobile radio equipment. Normal use of this radio will result in exposures far below the OSHA limit. There are no reported incidents of physical damage resulting from the use of this type radio. However, the following precautions are recommended:

DO NOT operate the transmitter when someone outside the vehicle is within two feet of the mobile antenna.

DO NOT operate the transmitter near unshielded electrical blasting caps or in an explosive atmosphere.

EMS SYSTEMS

MOTOROLA

MODEL CHART

FOR

EMS DUPLEX REPEATER SYSTEM

450-470 MHz

CODE:

[X] = ONE ITEM SUPPLIED

[2] = NUMBER OF ITEMS SUPPLIED

NOTE: Refer to instruction manual 68P81030E90 for details concerning the Q1508A Dual Control Package.

ITEM	DESCRIPTION	MODEL NUMBER Q2033A	Q2034A	Q2035A
	DESCRIPTION	DUPLEXER/MULTIPLEXER SYSTEM	DUPLEXER/MULTIPLEXER SYSTEM	DUPLEXER/MULTIPLEXER SYSTEM
QLN1919C	ECG MODULATOR PRE-AMPLIFIER MODULE	X	X	X
QKN8638A	CABLE KIT	X	X	X
QLN5680B	ESCUTCHEON AND HARDWARE KIT	X	X	X
QLN7113B	ECG MODULATOR PRE-AMPLIFIER BOARD	X	X	X
QLN7421A	PRE-AMPLIFIER TUNING KIT	X	X	X
QLN7478B	ECG ADAPTOR BOX	X	X	X
QLN8304A	TRUNNION EXTENSION KIT	X	X	
Q1853A	EMS DUPLEX REPEATER	X		
Q1854A	EMS DUPLEX REPEATER		X	
Q1855A	EMS DUPLEX REPEATER			X
Q1508A	EMS HANDS FREE DUAL CONTROL UNIT (SEE NOTE)	X	X	X
THN6227A	HOUSING KIT	X	X	X

EPS-28393-O

EMS PACKAGE RADIO MODELS

MOTOROLA

MODEL CHART

FOR

EMS PACKAGE RADIO MODELS

450-470 MHz

30 WATTS RF POWER

CODE:

[X] = ONE ITEM SUPPLIED

ITEM	DESCRIPTION	MODEL NUMBER Q1853A	Q1854A	Q1855A
	DESCRIPTION	EMS DUPLEX REPEATER	EMS DUPLEX REPEATER	EMS DUPLEX REPEATER
QKN8207A	RADIO CABLE (18-FT)	X	X	X
QLN1918B	AUDIO TELEMETRY MULTIPLEX MODULE	X	X	
QLN5665B	AUDIO/TELEMETRY MULTIPLEX BOARD	X	X	
QLN5679A	ESCUTCHEON AND HARDWARE KIT	X	X	
QLN2042A	AUDIO REPEATER MODULE	X	X	
QKN8352A	CABLE KIT	X	X	
QLN7208A	AUDIO REPEATER BOARD	X	X	
QLN7209A	ESCUTCHEON AND HARDWARE KIT	X	X	
QLN1917B	REPEATER CONTROL MODULE			X
QLN5664A	REPEATER CONTROL BOARD			X
QLN5678A	ESCUTCHEON AND HARDWARE KIT			X
QLN5677A	JUNCTION BOX	X	X	X
Q1506A	EMS DUPLEX REPEATER			X
Q1507A	AUXILIARY RECEIVER	X		
Q1589A	2 "PL" 4-FREQ. AUXILIARY RECEIVER		X	
Q1802A	EMS DUPLEX/MULTIPLEX REPEATER	X	X	
TAE6062B	MOBILE ANTENNA	X	X	X
TCN1112A-SP12	MULTI-FREQ CONTROL HEAD	X	X	X
THN6123A-SP03	HOUSING KIT	X	X	X
TKN6456A	CONTROL HEAD POWER CABLE	X	X	X
TKN6458A	CABLE AND FUSE KIT	X	X	X
TLN4504A	HANDSET HANG-UP BOX	X	X	X
TMN6067A	HANDSET	X	X	X
TSN6016B	MOBILE SPEAKER KIT	X	X	X

EPS-28394-O

EMS BASIC RADIO MODELS
CURRENT VERSIONS
MOTOROLA

MODEL CHART

FOR

450-512 MHz DUPLEX/REPEATER

"MICOR" EMS BASIC RADIO SETS

CODE:

X = ONE ITEM SUPPLIED

/ = ONE ITEM SUPPLIED DEPENDENT ON FREQUENCY RANGE.

4 = NUMBER INDICATES QUANTITY SUPPLIED

ITEM	DESCRIPTION	MODEL NUMBER Q1506A	Q1507A — /	Q1589A	Q1802A
	DESCRIPTION	EMS DUPLEX REPEATER, 450-470 MHz	AUXILIARY RECEIVER, 406-512 MHz	EMS 2 "PL", 4-FREQ. AUXILIARY RECEIVER, 450-470 MHz	EMS REPEATER, 450-470 MHz
KXN1024A	RECEIVER CHANNEL ELEMENT	10	4	4	10
KLN6210A	"VIBRASENDER" RESONANT REED	X			X
OFE1024A	DUPLEXER AND CHASSIS KIT	X			X
OFE6084A	DUPLEXER KIT	X			X
OLN5697A	DUPLEXER HARDWARE KIT	X			X
TFE6252A-SP01	HARMONIC FILTER	X			X
QKN8134A	REPEATER INTERFACE CABLE KIT	X			X
QKN8189A	ANTENNA CABLE KIT		X	X	
QKN8208A	AUXILIARY RECEIVER CABLE KIT		X	X	
QKN8210A	INTERCONNECT CABLE KIT		X	X	
QLE6236A	ANTENNA COUPLER KIT	X			X
QLN1974A	DUAL "PL" DECODER			X	
QLN5936A	DUAL "PL" DECODER BOARD			X	
QLN5937A	DUAL "PL" DECODER HARDWARE KIT			X	
TLN4294B-SP02	"PL" DECODER BOARD			X	
QLN5603A	EMS SQUELCH GATE BOARD	X			
QLN5604A	EMS SQUELCH GATE INTERCONNECT BOARD	X			X
QLN5698A	SQUELCH GATE BOARD		X	X	
QLN5699A	INTERFACE BOARD		X	X	
QLN5800A	RECEIVER INTERFACE BOARD		X	X	
QLN5701A	HARDWARE KIT		X	X	
QLN5855A	AUXILIARY AUDIO BOARD	X			
QLN7225A	AUXILIARY AUDIO BOARD WITH MULTIPLEX				X
QLN5970A	FREQUENCY SELECT MATRIX BOARD	X			X
TLN4294B	"PL" DECODER BOARD	X	X		X
TFE6213A	EXCITER OUTPUT FILTER	X			X
TFE6233B-SP01	DUPLEX ANTENNA FILTER NETWORK	X			X
TFE6262A	DUPLEX INJECTION FILTER	X			X
TLE1483A-SP01	POWER AMPLIFIER AND HEAT SINK	X			X
TLE8192A-SP01	PREAMPLIFIER BOARD	X			X
TLE8423A	EXCITER BOARD	X			X
TLN8381A	"VIBRASPONDER" RESONANT REED	X	X	2	X
TRE1201BA	4-FREQ. 25 kHz RECEIVER BOARD		/		
TRE1203BA	4-FREQ. 25 kHz RECEIVER BOARD		/	X	
TRE1203BA-SP05	4-FREQ. 25 kHz RECEIVER BOARD	X			X
TRE1204BA	4-FREQ. 25 kHz RECEIVER BOARD		/		
TRE1205BA	4-FREQ. 25 kHz RECEIVER BOARD		/		
TLN5165B-SP01	AUDIO AND SQUELCH BOARD	X			X
TLN5732A	"PL" ENCODER	X			X
TLN4290B	AUDIO POWER AMPLIFIER KIT	X			X
TLN4926A-SP02	POWER CONTROL BOARD	X			X
TLN4930C-SP16	INTERFACE BOARD	X			X
TLN4933B-SP02	DUPLEX HARDWARE KIT	X			X
TLN4347A	INSTALLATION KIT	X	X	X	X
TLN5048A	TUNING TOOL	X	X	X	X

EPS-28395-O

EMS BASIC RADIO MODELS
EARLIER VERSIONS
MOTOROLA

MODEL CHART

FOR 450-470 MHz DUPLEX/REPEATER

"MICOR"® EMS BASIC RADIO SET

1-8 FREQUENCY MODEL EQUIPPED

WITH "PRIVATE-LINE"® TONE-CODED SQUELCH

AND AUXILIARY RECEIVER

30-WATTS RF OUTPUT

CODE:

[X] = ONE ITEM SUPPLIED

[⁄] = NUMBER OF ITEMS SUPPLIED DEPENDS ON NUMBER OF FREQUENCIES USED

[O] = TWO ITEMS SUPPLIED

ITEM	DESCRIPTION	MODEL NUMBER Q1305A
	DESCRIPTION: RADIO SET WITH AUX RECEIVER AND ACCESSORIES	
TRE1203BA-SP5	RECEIVER RF & IF BOARD	X
KXN1024A	CHANNEL ELEMENT, RECEIVER/TRANSMITTER	⁄
TLE8423A	EXCITER BOARD	X
TFE6213A	EXCITER OUTPUT FILTER	X
TLE1483A	45-WATT RF POWER AMPLIFIER & HEAT SINK	X
TLN4926A	POWER CONTROL BOARD	X
TFE6233B-SP1	DUPLEX ANTENNA NETWORK	X
TFE6262A	DUPLEX INJECTION FILTER	X
QFE1024A	DUPLEXER & FILTER	X
TLN4930C-SP16	CONTROL (INTERCONNECT) BOARD	X
QLN5603A	SQUELCH GATE BOARD	X
QLN5604A	SQUELCH GATE INTERFACE BOARD	X
QKN8134A	REPEATER INTERFACE CABLE	X
QLN5855A	AUXILIARY AUDIO BOARD	X
TLN5165B-SP1	AUDIO & SQUELCH BOARD	X
TLN4290B	AUDIO POWER AMPLIFIER BOARD	X
TLN5732A	"PRIVATE-LINE" ENCODER BOARD	X
KLN6210A	"VIBRASENDER" RESONANT REED (FORMERLY TLN6824A)	X
TLN4294B	"PRIVATE-LINE" DECODER BOARD	O
TLN8381A	"VIBRASPONDER" RESONANT REED	O
QLN5970A	FREQUENCY SELECT MATRIX BOARD	X
TLN4933B-SP2	HARDWARE KIT	X
TLN5048A	TUNING TOOL	O
TCN1112A-SP12	8-FREQUENCY CONTROL HEAD	X
QKN8207A	CONTROL CABLE, 18-FOOT	X
TKN6456A	CONTROL HEAD POWER CABLE KIT	X
TKN6458A	CABLE & FUSE KIT	X
TMN6067A	HANDSET	X
TLN4504A	HANDSET HANG-UP BOX	X
TSN6016B	MOBILE SPEAKER	X
TAE6062B	ANTENNA	X
THN6123A	HOUSING	X
QLN1917B	REPEATER CONTROL MODULE (FORMERLY QLN1917A)	X
TLN4347A	INSTALLATION KIT	O
TRE1203BA	RECEIVER RF & IF BOARD	X
QLN5677A	JUNCTION BOX	X
QKN8208A	AUX RECEIVER CABLE KIT	X
QKN8189A	AUX RECEIVER ANTENNA CABLE	X
QKN8210A	AUX RECEIVER INTERCONNECT CABLE KIT	X
QLN5701A	AUX RECEIVER HARDWARE KIT	X
QLN5698A	AUX RECEIVER SQUELCH GATE BOARD	X
QLN5699A	AUX RECEIVER CONTROL (INTERCONNECT) BOARD	X
QLN5700A	AUX RECEIVER INTERFACE BOARD	X
QLE6236A	ANTENNA COUPLER	X
TLE8192A-SP1	RF PREAMPLIFIER	X

"MICOR" AND "PRIVATE-LINE" ARE REGISTERED TRADEMARKS OF MOTOROLA, INC.

EPS-18697-B

FOREWORD

1. 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 Instruction Manual Revisions (SMR). These SMR's are added to the manuals as the engineering changes are incorporated into the equipment.

2. MODEL AND KIT IDENTIFICATION

Motorola equipments are specifically identified by an overall model number on the nameplate. In most cases, assemblies and kits which make up the equipment also have kit model numbers stamped on them. When a production or engineering change is incorporated, revision suffix numerals are added to the affected kit model number. For example, a TLN4448A becomes a TLN4448A-1 with the first revision, TLN4448A-2 with the second revision, etc.

As diagrams are updated, information about the change is incorporated into a revision column. This revision column appears in the manual next to the parts list or, in some cases, on the diagram. It lists the reference number, part number, and description of the parts removed or replaced when the suffix number changed. With this information, the technician can find the information for the current version, and any previous version, of the equipment covered by the manual.

3. SERVICE

Motorola's National Service Organization offers one of the finest nation-wide installation and maintenance programs available to communication equipment users. This organization includes approximately 800 authorized Motorola Service Stations (MSS) located throughout the United States, each manned by one or more trained, FCC licensed technicians.

These MSS's are independently owned and operated and were selected by Motorola to service its customers. Motorola maintenance is available on either a time and material basis or on a periodic fixed-fee type arrangement.

The administrative staff of this organization consists of national, area and district service managers and district representatives, all of whom are Motorola employees with the objective to improve the service to our customers.

Should you wish to purchase a service contract for your Motorola equipment, contact your Motorola Service Representative, or write to:

National Service Manager
Motorola Communications Division
1303 E. Algonquin Road
Schaumburg, Illinois 60196

4. REPLACEMENT PARTS ORDERING

Motorola maintains a number of parts offices strategically-located throughout the United States. These facilities are staffed to process parts orders, identify part numbers, and otherwise assist in the maintenance and repair of Motorola Communications Division products.

Orders for all parts *except* crystals, active filters, code plugs, channel elements, and "Vibrasender" ® and "Vibrasponder" ® resonant reeds should be sent to the nearest area parts center. Orders for instruction manuals should also be sent to the area parts center.

When ordering replacement parts or equipment information, the complete identification number should be included. This applies to all components, kits, and chassis. If the component part number is not known, the order should include the number of the chassis or kit of which it is a part, and sufficient description of the desired component to identify it.

Orders for crystals, channel elements, active filters, code plugs, and reeds should be sent directly to the factory address listed on the following page. Crystal and channel element orders should specify the crystal or channel element type number, crystal and carrier frequency, and the chassis model number in which the part is used.

Orders for active filters, code plugs, "Vibrasender" and "Vibrasponder" resonant reeds should specify type number and frequency, and should identify the owner/operator of the communications system in which these items are to be used.

5. ADDRESSES

5.1 GENERAL OFFICES

MOTOROLA Communications and Electronics Inc.
Communications and Electronics Parts
1313 E. Algonquin Rd.,
Schaumburg, Illinois 60196
Phone: 312-576-3900

5.2 U.S. ORDERS

WESTERN AREA PARTS
1170 Chess Drive, Foster City,
San Mateo, California 94404
Phone: 415-349-3111
TWX: 910-375-3877

MIDWEST AREA PARTS
1313 E. Algonquin Road
Schaumburg, Ill. 60196
Phone: 312-576-7322
TWX: 910-693-0869

MID-ATLANTIC AREA PARTS
7230 Parkway Drive
Hanover, Maryland 20176
Phone: 301-796-8600
TWX: 710-862-1941

EAST CENTRAL AREA PARTS
12995 Snow Road,
Parma, Ohio 44130
Phone: 216-267-2210
TWX: 810-421-8845

EASTERN AREA PARTS
85 Harristown Road,
Glen Rock, New Jersey 07452
Phone: 201-447-4000
TWX: 710-988-5602

PACIFIC SOUTHWESTERN AREA PARTS
P.O. Box 85036
San Diego, California 92138
Phone: 714-578-2222
TWX: 910-335-1634

GULF STATES AREA PARTS
8550 Katy Freeway
Suite 128
Houston, Texas 77024
Phone: 713-932-8955

SOUTHWESTERN AREA PARTS
P.O. Box 34290
3320 Belt Line Road,
Dallas, Texas 75234
Phone: 214-241-2151
TWX: 910-860-5505

SOUTHEASTERN AREA PARTS
P.O. Box 368
Decatur, Georgia 30031
Phone: 504-981-9800
TWX: 810-766-0876

5.3 CANADIAN ORDERS

CANADIAN MOTOROLA ELECTRONICS COMPANY
National Parts Department
3125 Steeles Avenue,
East Willowdale, Ontario
Phone: 416-499-1441
TWX: 610-492-2713
Telex: 02-29944LD

5.4 ALL COUNTRIES EXCEPT U.S. AND CANADA

MOTOROLA, INC. OR MOTOROLA AMERICAS, INC.
International Parts Dept.
1313 E. Algonquin Road
Schaumburg, Illinois 60196 U.S.A.
Phone: 312-576-6492
TWX: 910-693-0869
Telex: 722443 or 722424
Cable: MOTOL PARTS

5.5 FACTORY ADDRESS FOR CRYSTAL, CHANNEL ELEMENT, ACTIVE FILTER, CODE PLUGS AND RESONANT REED ORDERS

ALL MAIL ORDERS
Motorola, Inc.
Component Products Sales & Service
P.O. Box 66191
O'Hare International Airport
Chicago, Ill. 60666

CORRESPONDENCE
Motorola, Inc.
Component Products Sales & Service
2553 N. Edgington Street
Franklin Park, Illinois 60131

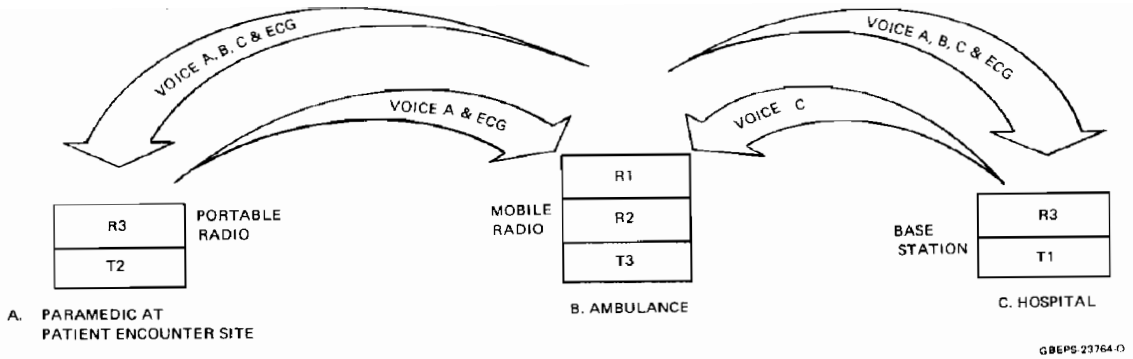


Figure 1. Duplex EMS Radio System in Repeat Mode

1. EMS RADIO SYSTEM

1.1 The Emergency Medical Services (EMS) radio system provides an effective communications link between a paramedic with his patient and the emergency staff at a hospital or trauma center. The system takes advantage of the higher power mobile radio in the ambulance used as a repeater to enhance communications between the EMS portable radio at the site of patient encounter and the staff at the hospital. When the patient is removed to the ambulance, the ambulance radio acts in the normal (non-repeat) mode to keep the paramedic in touch with the hospital. Electrocardiogram (ECG) strips can be sent both from the patient encounter site and from the ambulance (with optional QLN1919B ECG Modulator/preamplifier Module).

1.2 The system incorporates "Private Line" squelch so that several hospitals can share the same frequency. When operating under normal conditions in the repeat mode, the mobile radio will repeat only those transmissions accompanied with the correct PL code. If it becomes necessary to operate with a different hospital (such as during a catastrophic emergency situation) a ROAM switch can be operated to disable the PL squelch repeater requirement; this allows communications with and repeating of all on-frequency signals regardless of PL code. Improper operation will result if REPEAT and ROAM are selected while operating on the dispatch channels, F9 and F10.

2. DUAL CONTROL

Dual control (Q1508A-9A) provides a second radio control group which can be located in the rear of the ambulance accessible to the paramedic while he is attending a patient being transported. This control group allows the paramedic to directly control such functions as frequency selection, repeat and/or roam operation, and use of the telemetry multiplex circuits. A powered rear speaker is available as an option. Intercom capability is provided between the rear control group and the driver's control group. The rear control group can be supplied for handset or hands-free (headset and footswitch) operation. This option is described in Dual Control manual 68P81030E90.

3. ECG TELEMETRY AND MULTIPLEX

3.1 One of the principal functions of the EMS system is the relaying of electrocardiographic data from the patient to the hospital for review and evaluation by the professional staff at the cardiac care unit (CCU) or the intensive care unit (ICU). Since this information has frequency components as low as 1/2 cycle per second, it cannot directly frequency modulate the RF carrier but rather frequency modulates a 1400 Hz carrier and occupies the 1150 Hz to 1650 Hz space of the audio spectrum (see Figure 2).

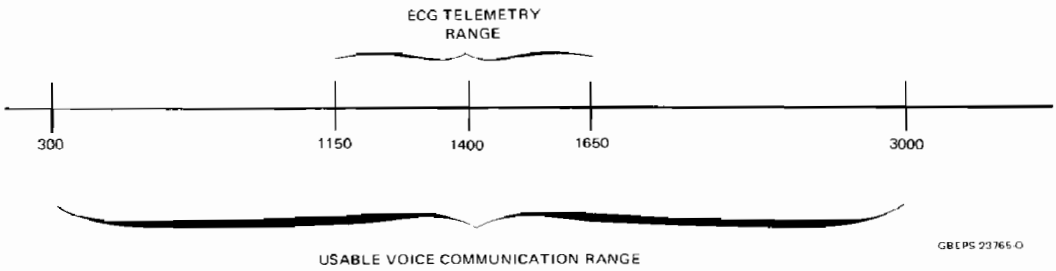


Figure 2. Frequency Spectrum of a Non-Multiplex System

3.2 In a non-multiplex system, either electrocardiographic (ECG) data *or* voice messages are transmitted *but not both simultaneously*. This type of system is adequate for many EMS system applications since an ECG data transmission can be sent in a fraction of a minute. Refer to manual 68P81029E45 for complete description of a non-multiplex system.

3.3 Improved communication between paramedic and doctor are achieved in the "duplex/multiplex" EMS system which is described in this supplement. The duplex/multiplex system allows the paramedic to send an ECG strip, relay vital signs to the hospital, and allows the doctor to give emergency instructions back to the paramedic, ALL SIMULTANEOUSLY. Thus continuous communication is achieved in a situation where time is vital.

3.4 The duplex-multiplex technique is achieved by reserving sections of the transmit audio spectra for different purposes and transmitting the combined audio to the hospital (see Figure 3). The circuit and system technique required to allow the system to operate duplex/multiplex is fully described later is this supplement.

4. EQUIPMENT DESCRIPTION

4.1 RADIO SYSTEMS

Table 1. EMS Radio Systems

MODEL	DESCRIPTION
Q2035A	Duplex/Repeater with Single Receiver
Q2033A	Duplex/Repeater with Auxiliary Receiver and Duplex Multiplex
Q2034A	Duplex/Repeater with Auxiliary Receiver (Dual PL) and Duplex Multiplex

The above radio systems include one of the package radio models shown in Table 2 plus the QLN1919C ECG Modulator/Preamplifier Modulator described in this manual and the Q1508A Hands-Free Dual Control Package described in instruction manual supplement 68P81030E90.

4.2 RADIO PACKAGES

Table 2. EMS Radio Packages with Accessories

MODEL	DESCRIPTION
Q1505A	Duplex/Repeater with Auxiliary Receiver (Non-Multiplex) — No Longer Available
Q1855A	Duplex/Repeater with Single Receiver
Q1853A	Duplex Repeater with Auxiliary Receiver and Duplex Multiplex
Q1854A	Duplex/Repeater with Auxiliary Receiver (Dual PL) and Duplex Multiplex

4.2.1 The Q1505A and Q1853A are the basic mobile EMS duplex/repeater systems. Both systems utilize two separate receivers to receive and repeat messages from both the portable and the hospital at the same time. The only difference between the two models in that the Q1853A has duplex/multiplex capability as described in paragraph 2.3 of the Theory of Operation. The Q1505A radio is no longer available.

4.2.2 The Q1855A is similar to the Q1853A except that it uses only a single receiver. This radio is used in systems where the added capability of two independent receivers are not required. Note that although operation in the repeat mode is simplex (i.e. only one transmission can be repeated at a time), the radio itself is push-to-talk duplex and will allow duplex communications with the hospital and with the portable if the portable unit is duplex.

4.2.3 The Q1854A is similar to the Q1853A and includes duplex/multiplex capability. In addition the auxiliary receiver is equipped with a two PL tone decoder and each frequency can be programmed to respond to one of the two PL codes allowing operation of different portable units thru a single mobile repeater.

4.3 RADIO SETS

Table 3. EMS Radio Sets

MODEL	DESCRIPTION
Q1506A	Duplex/Repeater Radio Set
Q1802A	Duplex/Repeater Radio Set (equipped for duplex-multiplex operation)

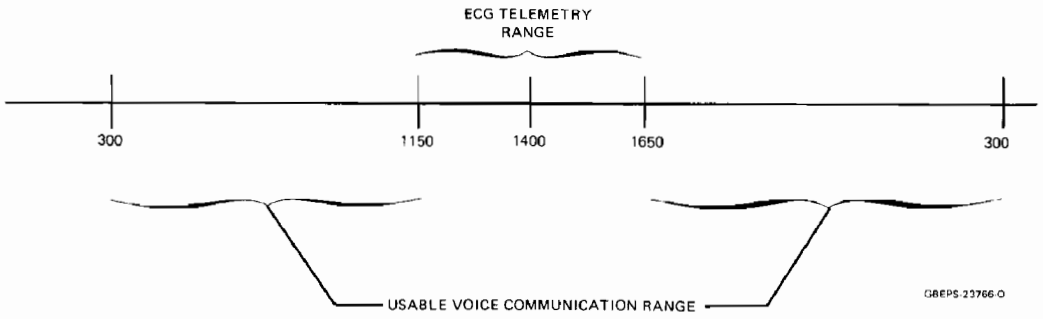


Figure 3. Frequency Spectrum of a Duplex-Multiplex System

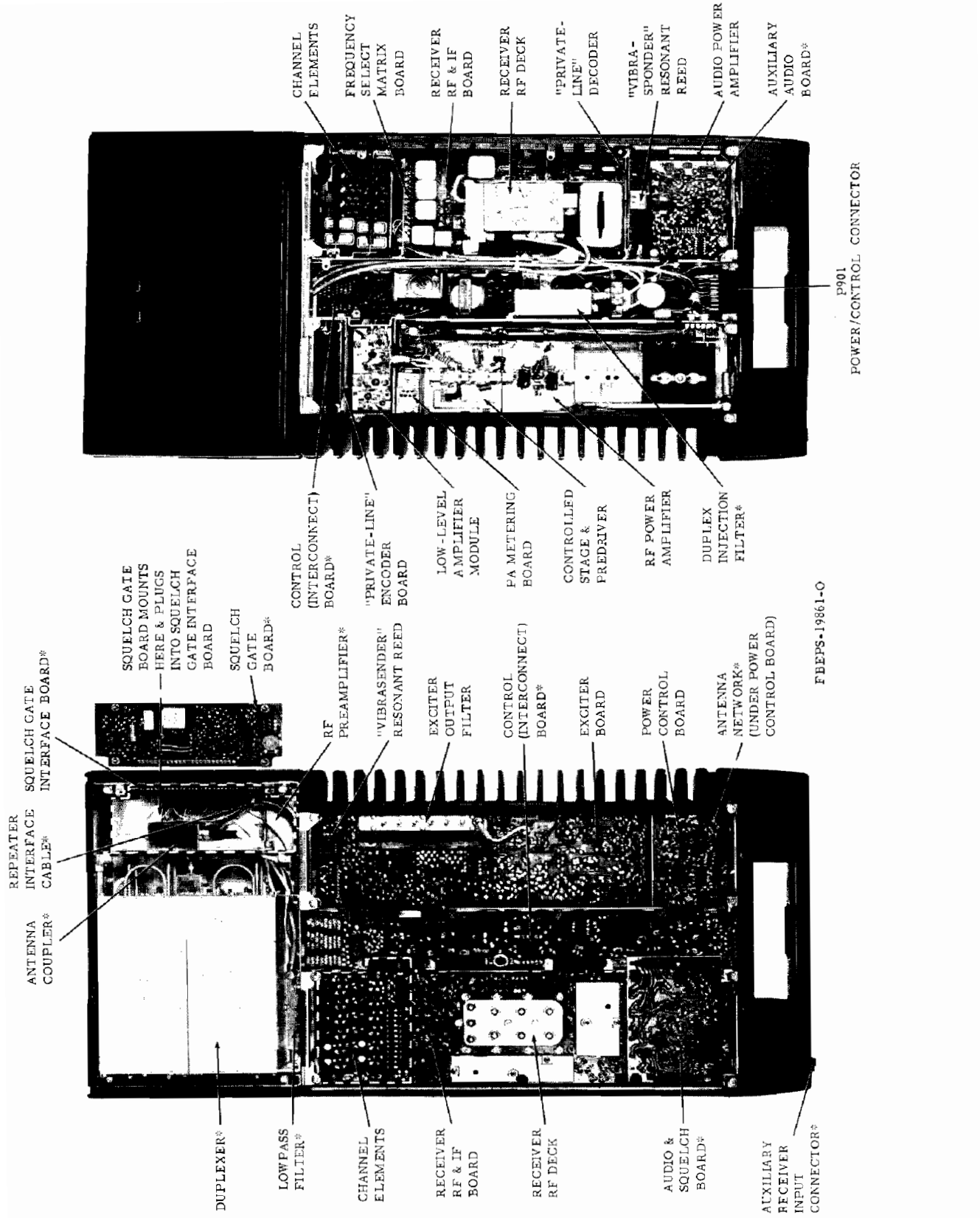


Figure 4. Main Radio Major Component Location

4.3.1 These radio sets are similar except that the Q1802A uses the QLN7225A Auxiliary Audio Board instead of the QLN5855A to facilitate duplex multiplex operation.

4.3.2 The UHF "Micor" FM two-way duplex-/repeater radio with auxiliary receiver described in this supplement is designed specifically for use in Emergency Medical Service (EMS) communications systems. The main receiver is tuned for operation on frequencies assigned by the FCC for ambulance/hospital communications. The auxiliary receiver is tuned for operation on frequencies assigned by the FCC for portable/ambulance repeater communications. The two receivers provide full two-way repeat capability, permitting telephone-type communication between portable and base station through the vehicular repeater.

4.3.3 Most components of the radio set are the same as those described in the UHF "Micor" radio set instruction manual. This supplement describes only those major components that are unique to UHF "Micor" duplex/repeater mobile radio models. The model chart in this supplement lists all of the radio set major component assemblies.

4.3.4 The operating modes of this UHF "Micor" duplex/repeater radio are particularly suited to EMS applications. These operating modes are:

- Duplex — The receivers remain in full operation at all times. This permits the radio operator to engage in telephone-type communication with the base station. The mobile unit is continuously able to hear the base station, even while transmitting.
- Repeat — The radio set re-transmits any on-channel signal that contains the proper "Private-Line" (PL) tone code received by either the main or the auxiliary receiver. This, for example, allows a low-power portable coronary telemetry radio to take advantage of the high-power transmitter and efficient antenna system of the mobile radio unit. The radio set monitors all on-channel radio signals. If telemetry signals are being retransmitted, the radio set operator can activate a filter that removes the telemetry signal from the monitored audio. Voice transmissions from the radio set may be made at any time.
- Emergency Repeat — The radio set retransmits all on-channel signals from both receivers, regardless of PL tone code. As in the repeat mode, the radio set operator is able to monitor all on-channel signals and filter telemetry signals out of the monitored audio. Voice transmissions can be made at any time. Repeat priorities can be established by jumper options for portable-to-base, base-to-portable, first-come-first-serve, or simultaneous transmission of the outputs of both receivers.

4.4 AUXILIARY RECEIVER

Table 4. EMS Auxiliary Receivers

MODEL	DESCRIPTION
Q1507A	EMS Auxiliary Receiver
Q1589A	EMS Auxiliary Receiver (Dual PL)

These radio sets are similar except that the Q1589A uses the QLN1974A Dual "Private-Line" Decoder instead of the TLN4294B "Private-Line" Decoder Board.

MAJOR COMPONENTS

1. INTRODUCTION

Figure 4 identifies each of the major components of the main radio set. Those components marked with an asterisk (*) are unique to UHF "Micor" duplex/repeater radio sets and are described in the following paragraphs. All other major components are described in the basic radio set instruction manual 68P81015E70.

2. DESCRIPTION OF MAIN RADIO UNIQUE MAJOR COMPONENTS

2.1 TLN4930C-SP16 CONTROL (INTERCONNECT) BOARD

This control board is a modified version of the TLN4930C Control (Interconnect) Board described in the basic radio set instructrion manual. The modifications facilitate the following radio set features:

a. Interconnections between circuit boards.

b. Duplex operation by disabling receiver audio muting while the transmitter is keyed.

c. Hang-up box disabling for "PL" defeat during emergency repeat operation.

d. Additional decoupling of frequency select lines.

2.2 TLN5165B-SP1 AUDIO & SQUELCH BOARD

The audio & squelch board used in duplex/repeater UHF "Micor" radio sets is basically the same as the TRN6540A Audio & Squelch Board described in the basic radio set instruction manual. The differences are as follows:

a. The audio signal is routed through the audio and squelch board and repeater control module circuitry for the processing and filtering needed for duplex/repeater operation.

b. Several components are added for improved rf filtering.

c. A jumper connects continuous regulated +9.6 volts in place of switched +9.6 volts to allow the audio & squelch board to remain in operation while the transmitter is keyed.

2.3 QLN5855A AUXILIARY AUDIO BOARD

The auxiliary audio board circuits perform the following functions:

a. Receiver audio signal processing — In repeater operation the receiver audio signals are applied to the exciter audio input. The auxiliary audio board circuits combine the audio from both the main and the auxiliary receivers, filter out the "PL" tone, provide de-emphasis, and determine the repeat audio level at the exciter audio input.

b. Monitor audio muting — Monitor audio is muted in the receivers under non-intercom and no-signal conditions.

c. Unsquelched indicator inversion and buffering (main receiver only) — The unsquelched indicator signal from the main receiver audio & squelch board is inverted and amplified before application to the repeater control logic circuits on the squelch gate board.

d. Repeat priority logic — establishes PTT priority between the auxiliary receiver and main receiver in repeat mode.

   1. Main receiver has priority — jumper JU6 used.

   2. Auxiliary receiver has priority — jumper JU5 used.

   3. First come-first serve priority — jumpers JU5 and JU6 used.

   4. No priority — jumpers JU5 and JU6 omitted.

2.4 QLN5603A SQUELCH GATE BOARD

The basic operating modes of the squelch gate board are duplex (non-repeat) and duplex/repeat. The squelch gate circuits provide the following functions:

Duplex and Repeat Modes:

a. Receiver enabling while transmitter is keyed — Regulated +9.6 volts is applied through the squelch gate board to the receiver switched +9.6 volt input. This keeps the receiver in operation while the transmitter is keyed.

b. Audio mute disabling — In duplex and repeater operation the receiver audio circuits must remain in continuous operation. The squelch gate board prevents the receiver audio from being muted while the transmitter is keyed.

Repeat Mode Only:

a. Transmitter keying — When the radio set is operating in the repeat mode, the transmitter keys when the proper rf signal and PL code are received. If the emergency repeat mode is selected, then only the proper rf signal is required to key the transmitter. In the emergency repeat mode the transmitter keys when the proper rf signal is received, regardless of PL code. This permits repeater operation in emergency situations with base stations or portable equipment not having the correct repeater access PL code.

b. "Private-Line" switch disabling — When the radio set is operating in the repeat mode, the squelch gate board circuits disable the handset hang-up box PL switch input to the radio. This converts the radio receiver to carrier squelch operation, permitting the local vehicle operator to monitor the repeater channel.

c. Repeater squelch control — When the radio set is in the repeat mode, the factory set squelch control on the squlech gate board replaces the control head squelch control. The control head suqelch control is then inoperative.

2.5 QLN5604A SQUELCH GATE INTERFACE BOARD

The squelch gate board plugs into the squelch gate interface board, which provides interconnections, via a QKN8134A Repeater Interface Cable, to the radio set control board, auxiliary audio board, and radio set power/control connector P901. A push-pin on the board provides a B+ source for the optional receiver rf preamplifier.

2.6 QKN8134A REPEATER INTERFACE CABLE

This cable interconnects the squelch gate board (via the squelch gate interface board), auxiliary audio board and control (interconnect) board. Two of the four connectors plug onto pins on the control (interconnect) board, one connector connects to the auxiliary audio board, and the remaining connector connects to the squelch gate interface board. Six wires connect to spare pins on radio set power/control connector P901.

2.7 QFE1024A DUPLEXER AND FILTER

2.7.1 The QFE1024A Duplexer permits simultaneous transmission and reception with a single antenna. This is accomplished by isolating the transmitter and

receiver antenna terminals while providing continuous rf paths to the antenna for both the transmitter and receiver. Two notches in the receive leg bandpass of this duplexer permit operation of two receivers and one transmitter from one antenna, if desired. The duplexer is factory tuned and does not require retuning in the field.

2.7.2 A harmonic filter between the transmitter output and the duplexer transmitter leg input attenuates any spurious transmitter signals before they reach the antenna. The filter is not tunable.

2.8 TFE6233B-SP1 DUPLEX ANTENNA NETWORK

The antenna network used in these duplex/repeater radio sets is a modified version of the antenna network used in simplex radio set models. The antenna switch is removed and part of the low pass filter that is at the antenna connector in standard antenna networks is separately housed and mounted near the duplexer. The transmitter rf signal out of the antenna network passes through the separate low-pass filter, through the duplexer, and then to the antenna.

2.9 TFE6262A DUPLEX INJECTION FILTER

The duplex injection filter isolates the exciter offset mixer spurious products from the receiver mixer spurious products. Refer to the ADJUSTMENTS section of this manual for tuning instructions.

2.10 QLE6236A ANTENNA COUPLER

The antenna coupler permits the main receiver and the auxiliary receiver to share a common input from one antenna. The coupler provides, (1) impedance matching between the receiver port of the duplexer and each receiver, and (2) isolation of the two receiver inputs from each other. Due to the signal splitting characteristics of the coupler, a 3 dB insertion loss is present between the input leg (from the duplexer) and each output leg to the receivers. Compensation for this insertion loss is provided by the rf preamplifier. The antenna coupler is a completely sealed unit and contains no adjustable components.

2.11 TLE8192A-SP1 RF PREAMPLIFIER

The rf preamplifier provides compensation for the insertion losses in the duplexer receiver leg and antenna coupler. The rf preamplifier kit includes a printed circuit board and housing. All electrical components are accessible by removing cover plates. The rf preamplifier circuit consists of two tuned-lines and a grounded gate FET amplifier.

2.12 QLN5970A FREQUENCY SELECT MATRIX BOARD

The frequency select matrix board provides the same function performed by the 12-channel diode matrix board in the duplex/repeater radio sets without an auxiliary receiver. This board contains rf chokes and capacitors for additional decoupling of the frequency selection inputs.

2.13 TRE1203BA-SP5 RECEIVER RF AND I-F BOARD

This receiver rf and i-f board is a modified version of the TRE1203BA Receiver RF and I-F Board described in the basic radio set instruction manual. The modification consists of adding four rf chokes in series with the frequency select lines to the control board.

2.14 QLN5677A JUNCTION BOX

This junction box contains interconnection wiring to allow use of the auxiliary receiver with the main radio.

3. DESCRIPTION OF AUXILIARY RECEIVER UNIQUE MAJOR COMPONENTS

Figure 5 identifies each of the major components of the auxiliary receiver. Those components marked with an asterisk (*) are unique to the auxiliary receiver and are described in the following paragraphs. All other major components are described in the basic radio set instruction manual.

3.1 QLN5699A CONTROL (INTERCONNECT) BOARD

This control board provides the following functions:

a. Power distribution and filtering.

b. Interconnection between circuit boards.

c. Frequency selection routing for the auxiliary receiver.

d. Interconnection with the main receiver via the auxiliary radio cable kit and the junction box.

For details, refer to the auxiliary receiver control (interconnect) board schematic diagram and circuit board detail attached to this supplement.

3.2 QLN5698A AUXILIARY RECEIVER SQUELCH GATE BOARD

The squelch gate board used in the auxiliary receiver is simlar to the TRN6540 Audio and Squelch Board described in the basic radio set instruction manual. The differences are as follows:

a. The differential amplifier, complementary amplifier, audio power amplifier circuit board, and all circuitry required for these amplifiers have been deleted.

b. Squelch gate functions required for repeater operation are provided.

Complete information pertaining to the squelch gate and its relation to the basic radio set is contained in the Theory of Operation section.

3.3 QLN5700A RECEIVER INTERFACE BOARD

The receiver interface board plugs into the control (interconnect) board and the receiver rf and i-f board to provide the required interconnections between the two boards.

3.4 QKN8210A INTERFACE CABLE

This cable interconnects the squelch gate functions between the control (interconnect) board and the squelch gate board.

4. ACCESSORIES

4.1 TCN1112A-SP12 CONTROL HEAD

This version of the standard TCN1112A Control Head is modified to isolate the microphone PTT line from the transmit indicator and provide a separate ground return for the frequency selector switch. The "Extender" switch on the back of the control head is inoperative.

4.2 QLN1917B REPEATER CONTROL MODULE

This module mounts in a "Micor" "Systems 90" enclosure and is an integral part of the EMS duplex-/repeater mobile radio system. The repeater control module performs the following functions:

a. Repeater enabling — Closing the RPT switch sets up the radio set to repeat when the proper rf signal and PL tone are received.

b. Emergency repeater enabling — Closing both the RPT and ROAM switches enables the radio set to repeat any received signal, whether or not it has the proper PL tone.

c. Audio filtering — Closing the FLTR switch inserts a 1400 Hz, 35 dB notch filter into the auxiliary receiver audio signal path to attenuate received telemetry signals. This effectively removes telemetry signals from the audio signal monitored at the local vehicle receivers. The repeated telemetry transmission is unaffected.

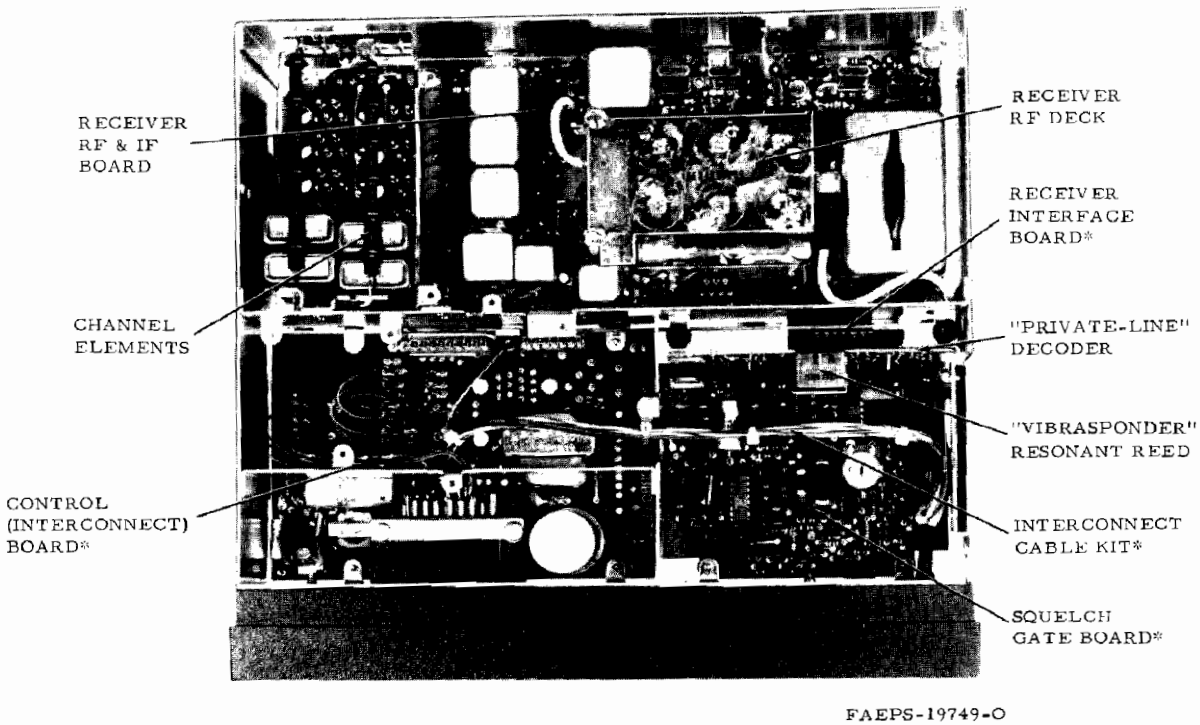


Figure 1. Auxiliary Receiver Major Component Location

d. Monitor audio combining — Combines the monitor audio from the auxiliary receiver with the monitor audio from the main receiver.

e. Microphone audio muting — The microphone audio input is muted during repeater operation to prevent the background noise picked up by the handset microphone from interfering with repeater transmissions. The microphone audio input is unmuted when the handset PTT switch is operated.

4.3 QLN1918B AUDIO TELEMETRY MULTIPLEX MODULE

This module replaces the repeater control module in EMS Duplex/Repeater radio systems with duplex-multiplex capability and provides for simultaneous voice audio and telemetry (multiplex) transmissions. The module provides all functionsl normally provided by the repeater control module as well as those required for multiplex.

4.4 QLN2042A REPEAT AUDIO PROCESSING (RAP) MODULE

The repeat audio processing module is used in EMS Duplex/Repeater radios which have duplex-multiplex capability. The module processes main receive repeat audio and is described in instruction section 68P81032E77 in this manual.

4.5 QLN7225A AUXILIARY AUDIO BOARD

This auxiliary audio board replaces the standard board in EMS duplex/repeater radios, which have duplex-multiplex capability (Model Q1802A radio set). The board performs all the functions of the standard board (including repeat audio gating logic) except for processing of main receiver repeat audio which is now handled by the repeat audio processing module explained previously. The QLN7225A auxiliary audio board is described in instruction section 68P81032E78 in this manual.

4.6 QLN1974A DUAL "PRIVATE-LINE" DECODER

This board allows the auxiliary receiver to be operated on either of two PL codes to allow monitor and repeat operation in two EMS networks. The receive PL codes are jumper programmable at the frequency select matrix on the auxiliary receiver control board to provide automatic PL selection with channel selection. This module is described in instruction section 5S-SP32751.

4.7 QLN1919C ECG MODULATOR/ PREAMPLIFIER MODULE

A Model QLN1919C "Systems 90" ECG Modulator Preamplifier is a common accessory in EMS systems. This accessory is described in detail in this manual; its interconnections are included on the system interconnect diagram in this supplement. All "Micor" "Systems 90" accessories except the alternate control module and the voice privacy adapter are compatible with this EMS radio system.

4.8 QKN8207A AND QKN8208A RADIO CABLES

These radio cables interconnect the radio set, auxilary receiver, and accessories.

THEORY OF OPERATION

1. INTRODUCTION

1.1 GENERAL

The followng paragraphs describe theory of operation for circuits that are unique to UHF "Micor" duplex/repeater radio sets with auxiliary receiver. Refer to the radio set instruction manual for theory of operation of all other circuits.

1.2 DUPLEX OPERATION

In general, when the radio set is in the duplex mode the receivers operate continuously and the transmitter operates whenever the push-to-talk switch on the handset is closed. The duplexer and antenna coupler allows simultaneous transmitter and receiver operation using a single antenna.

1.3 REPEATER OPERATION

In repeater operation the radio set operates as it does in the duplex mode except that the transmitter keys whenever (1) either receiver unsquelches and (2) the correct PL tone has been received. Depending on the repeat priority option selected, audio from either, or both receivers, is applied to the transmitter exciter. If "emergency repeat" operation is selected, the transmitter keys whenever either receiver unsquelches whether or not the proper PL tone has been received. As in duplex operation, the duplexer and antenna coupler allow simultaneous transmission and reception with a single antenna.

2. FUNCTIONAL OPERATION

2.1 The ECG telemetry signal used in Motorola MICOR EMS repeater systems consists of a frequency-modulated sub-carrier at 1400 Hz with a maximum deviation of ±250 Hz. Prior to being multiplexed with the telemetry signal, voice audio signals are passed through a notch filter which attenuates all signals in the frequency range from 1150 Hz

with microphone and ECG telemetry transmission before it is fed to the exciter. Main receiver emitter follower audio is picked up at the control head and coupled to the repeat audio processing module where it passes through noise cancelling amplifier U1A to remove common mode noise components on both the audio and shield wires. The audio is then gated by Q2 so that receive audio from the base leg is retransmitted only when the proper repeat conditions are met. The audio is then adjusted for proper repeat level by R14 and the PL tones are removed. Finally U1B provides the de-emphasis characteristic and also the amplification necessary to compensate for loss through the PL filter. The processed base leg repeat audio is routed directly to the limiter input on the audio/telemetry module. From this point the audio path is identical to that described in paragraph 3.3.

3.3 MICROPHONE AUDIO FLOW

3.3.1 Microphone audio is gated by series switch Q1 which allows audio to pass when the microphone PTT switch is depressed. In dual control systems, front microphone audio is gated with rear microphone audio in the front interface module QLN1920A and the combined handset audio output is routed to the microphone audio gate input on the audio/telemetry multiplex module.

3.3.2 From the output of Q1, microphone audio is applied to limiter U101 and filter bypass Q101 simultaneously. If MUX is not selected filter bypass Q101 is enabled, which connects a low impedance path bypassing the limiter and transmit notch circuitry thus providing normal microphone output level to the exciter. If, however, MUX is selected, Q101 is inhibited and microphone audio passes through limiter Q101 and limit adjust control R110, which limits microphone audio deviation to 2 kHz in the multiplex mode. From there, microphone audio is passed through the transmit notch filter which provides a minimum of 13 dB attenuation of all audio frequencies in the ECG telemetry band from 1150 Hz to 1650 Hz. This is required so that voice audio will not interfere with telemetry information.

3.3.3 From the output of the transmit notch filter (or filter bypass), the microphone audio is combined with ECG telemetry at U3A, is buffered by Q2 and then fed via the cable kit to the radio where it connects with outboard receiver repeat audio at the exciter input.

3.3.4 ECG TELEMETRY AUDIO FLOW

3.3.4.1 The following discussion applies specifically to mobile repeater systems equipped with the ECG Modulator/Preamplifier Module option. If ECG telemetry is being repeated from a portable unit, the audio flow will be identical to that explained previously in paragraph 3.2.

3.3.4.2 ECG telemetry is only applied to the input to the Audio/Telemetry Multiplex Module if the ECG button is depressed and the mobile radio is therefore keyed.

3.3.4.3 If the mobile unit is selected for MUX operation, telemetry deviation reduction switch Q301 in combination with ECG level adjust pot R67 limits the ECG telemetry deviation to 2 kHz. If the system is not selected for MUX, Q301 is off and ECG telemetry is transmitted at maximum deviation level. From R67 the ECG signal is applied to ECG gate Q10 which blocks the telemetry in the event REPEAT is selected or microphone PTT is pressed in the MUX mode thus providing push-to-talk interrupt capability. The local ECG inhibit condition eliminates the possibility of ECG from the mobile interfering with repeated telemetry from the portable.

3.3.4.4 From Q10 the telemetry signal is applied to a low pass filter which attenuates second and higher order harmonics. This is required in multiplex systems so that annoying ECG signal harmonics are not transmitted and heard at the demodulator console. From the low pass filter, the telemetry is applied to combining amplifier U3A where it is combined with voice audio, to buffer Q2, and then via the radio cable where it is combined with repeat audio at the exciter input.

INSTALLATION

1. RADIO SET AND ANTENNA

Refer to the installation instructions in the radio set instruction manual and in the instruction section packed with the antenna.

2. CABLE, CONTROL HEAD, AND ACCESSORIES

Because of the radio cable and the "Systems 90" accessories used with the EMS system, disregard the cable and control head installation instructions in the UHF "Micor" radio set instruction manual. Refer instead to the "Systems 90" installation sheet for mechanical installation information and to the interconnect diagram in this supplement for wiring information. Except for the "Systems 90" Alternate Control Module and Voice Privacy Adapter all "Micor" "Systems 90" accessories are compatible with this EMS radio system and may be added at any time.

OPERATION

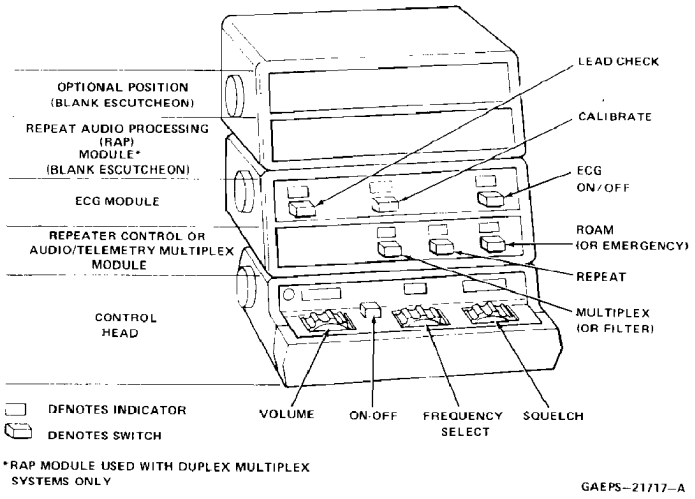


Figure 1. Control Group Operating Controls and Indicators

1. RADIO SET

1.1 CONTROLS AND INDICATORS (See Figure 1)

ON/OFF Switch — Controls all power to the radio (main power switch), a green tab appears when power is on.

VOLUME Control — This control adjusts the audio level to the handset or speaker.

Radio Channel Selector — Selects the desired channel for transmitting and receiving.

SQUELCH Control — Controls the received signal strength required to turn on the receiver audio circuits and mutes radio noise when no signal is being received.

MUX Switch — Alternately enables/disables the multiplex mode of operation. The MUX switch must be activated to enable two-way simultaneous repeating of voice and telemetry or simultaneous transmission of voice and telemetry from the mobile ECG module.

NOTE

Some systems are equipped with a FLTR button instead of a MUX button.

FLTR Switch — Alternately enables/disables the telemetry filter to prevent the telemetry tones from being heard at the mobile speaker. Enabling the telemetry filter ***alone*** will ***not*** permit the ***simultaneous*** transmission of telemetry and voice. When activated, the FLTR switch allows the transmission of either ECG telemetry or voice — NOT simultaneous transmissions.

FLTR or MUX Indicator — Illuminates (brightly) when the filter or multiplex operation is selected.

RPT Switch — Alternately enables/disables the Repeat mode of operation and also allows the radio operator to monitor all on-channel carrier squelch transmissions.

RPT Indicator — Illuminates (brightly) when the Repeat mode is selected.

ROAM Switch — When the radio is in the Repeat mode AND the Roam mode, all on-channel transmissions will be repeated regardless of the "Private-Line" (PL) code. The Roam button should ***never*** be pressed unless the repeat mode is selected.

NOTE

The ROAM switch and indicator are labeled EMER on some earlier systems.

ROAM Indicator — Illuminates (brightly) when the Roam mode is selected.

Transmit Indicator (Red) — Illuminates when the radio vehicle transmitter is keyed, in the Repeat mode when a message is being repeated, or when ECG information is being transmitted.

1.2 OPERATION

1.2.1 Receiving Radio Messages

Step 1. Set the control head ON-OFF switch to the ON position. The receiver(s) operates continuously while the radio is turned on.

Step 2. Select the desired radio channel.

Step 3. Remove the handset from its hang-up cradle. The receiver now operates with carrier squelch. All signals on the selected channel can be heard.

Step 4. Turn the SQUELCH control fully counter-clockwise. Adjust the control head VOLUME control for a comfortable listening level.

Step 5. Turn the control head SQUELCH control clockwise until the speaker noise just stops.

Step 6. Replace the handset in its hang-up cradle. The receiver now operates with PL tone coded squelch. Only signals from your radio system can unsquelch the receiver.

1.2.2 Transmitting Radio Messages

Step 1. Select the desired radio channel.

Step 2. Remove the handset from its hang-up cradle and monitor the channel for activity.

Step 3. If the radio channel is not in use, hold down the PTT button on the handset handle and speak slowly and distinctly into the handset microphone.

NOTE

It is not necessary to release the PTT button to receive a reply. The receiver operates at all times.

1.2.3 Repeating Radio Messages

Step 1. Set the control head controls as described in the procedure entitled RECEIVING RADIO MESSAGES.

Step 2. Depress the RPT button on the control head. The RPT indicator brilliance increases and the radio set is now enabled to re-transmit any received radio signal that contains the proper PL tone frequency. All radio signals on the selected channel are monitored in the radio set speaker, but only those signals with the proper PL tones are able to activate the repeater transmitter. The control head transmit indicator light turns on whenever the transmitter is "on the air".

NOTE

The radio set handset can be used to transmit messages while the radio set is in the Repeat mode. If the repeater is enabled during your voice transmission, the two messages are transmitted simultaneously.

Step 3. To return to non-repeat operation, depress the control head RPT button and allow it to return to the "out" position. The RPT indicator is then dimly illuminated.

1.2.4 Roam Repeat Operation

Step 1. Set the control head operating controls as described under "Repeating Radio Messages".

Step 2. Depress the ROAM pushbutton. The RPT and ROAM indicators are then brightly lit. The radio set operates as described under "Repeating Radio Messages", except that all received radio signals are repeated, whether or not they contain a PL tone.

2. ECG MODULATOR

Two models of the ECG Preamplifier are used in MEMCOM mobile repeater systems. The current model has three pushbuttons on the front panel ON, CAL, and LD CHK. The earlier model has three pushbuttons on the front panel ECG, OFF, and CAL and a TT jack for patient monitor cable.

2.1 CONTROLS AND INDICATORS

ON Switch — Alternately enables/disables the transmission of ECG information. Depressing the ON switch allows information from the patient-attached electrodes, inputted through the ECG input jack, to be transmitted directly to the hospital. With ECG ON the radio is keyed; pressing the ON switch a second time turns the ECG off and the radio may then be used for normal two-way communications.

ECG Input Jack — This 6-pin jack, located on an adapter box near the control group, is used to connect the patient monitor cable. A TT jack is provided for connection of a patient monitor oscilloscope or for connection of the older style patient monitor cable.

CAL Switch — Alternately enables/disables the Calibrate function. With the CAL switch on, a 1-millivolt squarewave signal is transmitted that may be used at the hospital for adjustment of equipment.

LD CHK Switch — Allows patient lead impedance to be checked. With the CAL switch on and the momentary LD CHK button held in, the squarewave signal is superimposed on the ECG signal and the squarewave amplitude is an indication of the impedance of patient-connected electrodes.

2.2 OPERATING TRANSMISSION OF ECG INFORMATION

Step 1. Place the associated radio in operation and check for the desired operating frequency.

Step 2. When a clear channel has been determined, depress the ON and CAL switches. Indicators will be brightly illuminated. Allow sufficient time for initial adjustment of the receiver and monitoring equipment at the hospital.

NOTE

Transmitter is "on the air" when the ON button is depressed.

Step 3. Attach the patient electrodes and insert the plug in the ECG input jack. Press and hold the momentary LD CHK button.

NOTE

When the cable is connected at the ECG input jack and the LD CHK button is pressed, the signal level at the receiver end will indicate the electrode contact impedance (greater signal indicates poorer contact). If the signal after connection does not increase to more than two times the level before connection at the ECG jack, the electrode and cable connection will be judged adequate.

Step 4. When the reception and electrode contact have been verified, depress the CAL switch a second time (indicator dimly illuminated) to remove the calibration signal.

Step 5. With the ECG cable connected and the ON indicator illuminated (ON switch depressed), the ECG signal is connected into the transmitter and the transmitter is keyed for normal continuous operation until disabled. It can be disabled by pressing the ON switch a second time.

CAUTION

Failure to properly connect the ECG Adapter (i.e. LEAD I to LEAD I or LEAD II to LEAD II) will result in ECG artifact. Also, precaution should be taken to prevent the patient from making contact with the ECG ground.

MAINTENANCE AND ADJUSTMENTS

1. INTRODUCTION

Refer to the SERVICING INFORMATION section of the UHF "Micor" radio set instruction manual for maintenance and adjustment instructions for the basic radio. Maintenance and adjustment of circuits unique to EMS duplex/repeater UHF "Micor" radio sets with auxiliary receiver are covered in the following paragraphs.

2. DUPLEXER

2.1 GENERAL

The duplexer has been factory-tuned for proper operation on channels allocated by the FCC for the Emergency Medical Service. Field adjustment of the duplexer is neither necessary nor advisable. DO NOT attempt to disassemble or repair the duplexer in the field. If the duplexer is damaged or malfunctions, replace it as a unit. If faulty duplexer operation is suspected, this can be verified by measuring the notch attenuation and insertion loss of each leg of the duplexer.

2.2 TEST EQUIPMENT

2.2.1 An rf generator-voltmeter pair capable of 65 dB of dynamic range is required for checking the duplexer. Two possible combinations of equipment are as follows:

a. HP608 RF Generator and HP8405A Vector Voltmeter with 50-ohm feedthrough tees.

b. Motorola S1239A RF Generator used with 30 dB gain amplifier (such as Boonton Type 230A) as the generator assembly, and Boonton 91CA RF Voltmeter with 50-ohm tip. If the harmonic content of the generator is high, a low-pass filter such as the TFE6130A or TFE6252A at the output of the amplifier may be necessary.

2.2.2 In addition to the generator and voltmeter, a frequency counter capable of operation in the 450-470 MHz range and a 50-ohm load are required. To maintain a low VSWR 50-ohm system it is recommended that 3 dB and/or 6 dB 50-ohm pads are used at generator output and voltmeter input. Also, cable lengths should be kept as short as possible between the pads and the duplexer.

2.3 DUPLEXER RECEIVER LEG ATTENUATION CHECK

Step 1. Set the rf generator frequency to 468.288 MHz.

Step 2. Connect the rf generator through both pads to the rf voltmeter.

Step 3. Set the rf generator output level to obtain a reading on the upper scales of the rf voltmeter. This reading should be at least 65 dB above the rf voltmeter noise level. Note rf voltmeter level.

Step 4. Connect the rf generator to the duplexer antenna terminal. Connect the rf voltmeter to the duplexer receiver terminal. Connect the 50-ohm load to the duplexer transmitter terminal.

Step 5. The rf voltmeter level should be greater than 65 dB below the reference level noted in Step 3.

Step 6. Retune the rf generator to 467.888 MHz and repeat Step 2 through Step 5.

2.4 DUPLEXER TRANSMITTER LEG ATTENUATION CHECK

Step 1. Set the rf generator frequency to 463.288 MHz.

Step 2. Connect the rf generator through both pads to the rf voltmeter.

Step 3. Set the rf generator output level to obtan a reading on the upper scales of the rf voltmeter. This reading should be at least 65 dB above the rf voltmeter noise level. Note rf voltmeter level.

Step 4. Connect the rf generator to the duplexer transmitter terminal. Connect the rf voltmeter to the duplexer antenna terminal. Connect the 50-ohm load to the duplexer receiver terminal.

Step 5. The rf voltmeter level should be greater than 65 dB below the reference level noted in Step 3.

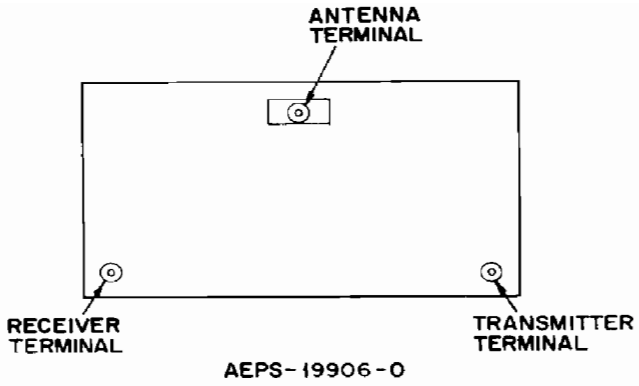


Figure 1. Duplexer Front Plate

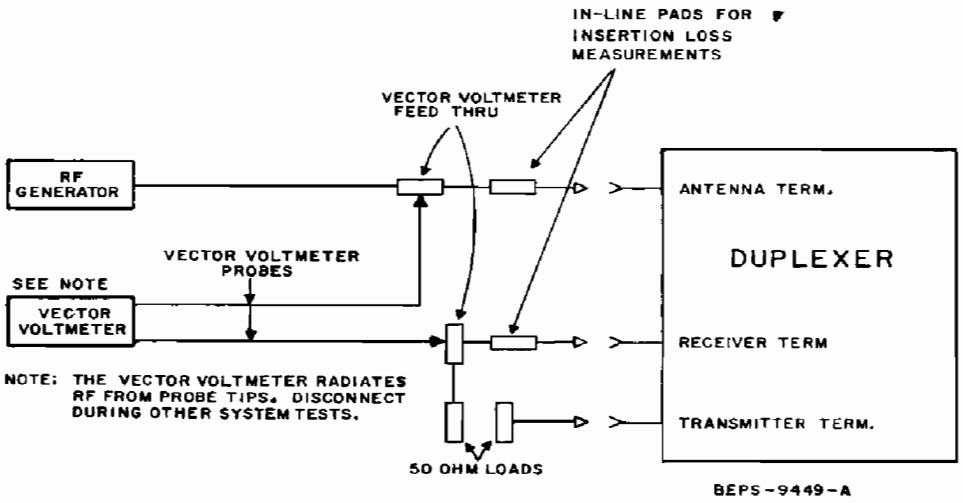


Figure 2. Receiver Leg Measurement Using Vector Voltmeter

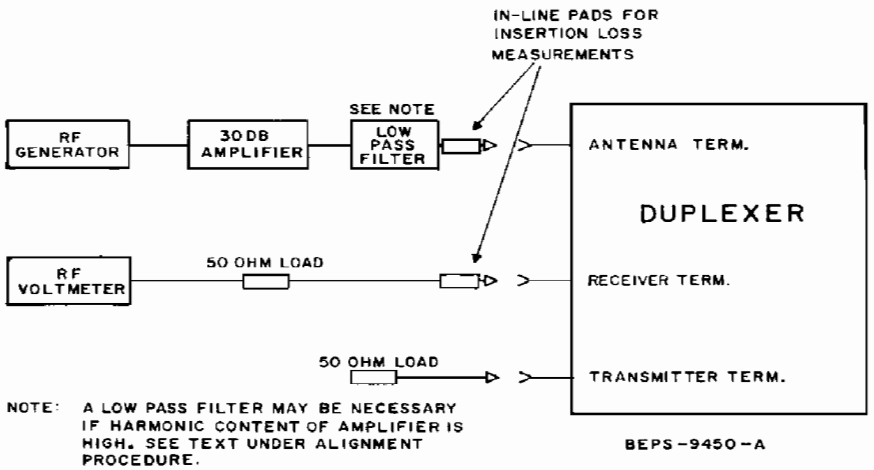


Figure 3. Receiver Leg Measurement Using RF Voltmeter

Step 6. Retune the rf generator to 462.888 MHz and repeat Step 2 through Step 5.

2.5 DUPLEXER RECEIVER LEG INSERTION LOSS CHECK

Step 1. Set the rf generator frequency to 463.175 MHz.

Step 2. Connect the rf generator through both pads to the rf voltmeter.

Step 3. Adjust the rf generator output level for a convenient reference on the rf voltmeter.

Step 4. Connect the rf generator to the duplexer antenna terminal. Connect the rf voltmeter to the duplexer receiver terminal. Connect the 50-ohm load to the duplexer transmitter terminal.

Step 5. The rf voltmeter reading should be less than 1.5 dB below the reference level noted in Step 3.

2.6 DUPLEXER TRANSMITTER LEG INSERTION LOSS CHECK

Step 1. Set the rf generator frequency to 468.000 MHz.

Step 2. Connect the rf generator through both pads to the rf voltmeter.

Step 3. Adjust the rf generator output level for a conveient reference on the rf voltmeter.

Step 4. Connect the rf generator to the duplexer transmitter terminal. Connect the rf voltmeter to the duplexer antenna terminal. Connect the 50-ohm load to the duplexer receiver terminal.

Step 5. The rf voltmeter reading should be less than 1.5 dB below the reference level noted in Step 3.

3. ANTENNA NETWORK

3.1 GENERAL

Field servicing of the antenna network is not recommended. When an antenna network is found to be defective, it must be replaced as a unit.

3.2 PERFORMANCE TESTS

A check of the forward and reflected power meter readings (refer to paragraph 7, Power Control Board, in the attached instruction manual, for procedure and proper meter readings) can be made to determine if the power detector circuits on the antenna network are functioning properly or are defective. The transmitter leg insertion loss of the antenna network should be approximately 1 dB (a power loss of 20%). use the following procedure to check the insertion loss.

Step 1. Connect a thru-line wattmeter, a dummy load, and a second thru-line wattmeter (a wattmeter with attached load could replace the dummy load and second thru-line wattmeter) to the antenna connector and calibrate the wattmeters relative to each other.

Step 2. Connect the load and second wattmeter to the antenna network output and, using adapter cables, connect the thru-line wattmeter between the transmitter final amplifier and the antenna network.

NOTE

To insure accurate readings take care that low VSWR cable connections are made at all points.

Step 3. Check the readings on the two power meters for a loss of approximately 1 dB (20% power loss).

4. DUPLEX INJECTION FILTER

CAUTION

The duplex injection filter cannot be aligned using exciter meter readings. Peaking this filter while operating into the exciter will cause loss of receiver mixer injection and degradation of receiver performance.

4.1 TEST EQUIPMENT

4.1.1 General

The duplex injection filter adjustments can be accomplished with an rf voltmeter and an rf signal generator rated for stable operation at 450 MHz. Because the injection filter is peak-tuned, neither the rf generator nor the rf voltmeter needs to have a wide dynamic range. To maintain a low VSWR 50-ohm 3 dB or 6 dB pads should be used between the rf signal generator output and the injection filter input, and between the injection filter output and the rf voltmeter.

4.1.2 RF Signal Generator Frequency Measurement

The rf signal generator frequency must be accurately determined for proper injection filter alignment. If the rf signal generator does not have an accurate frequency readout, a frequency counter capable of stable operation at 450 MHz must be used to measure the rf signal generator output frequency.

4.2 ADJUSTMENT PROCEDURE

Step 1. Remove the duplex injection filter from the radio set. Figure 1 of this instruction manual supplement shows the mounting location.

CAUTION

The duplex injection filter *must* be disconnected from the radio set for proper adjustment.

Step 2. Connect the rf signal generator through both 50-ohm pads to the rf voltmeter.

Step 3. Set the rf signal generator output frequency to 451.388 MHz.

Step 4. Set the rf signal generator output level to at least 10 dB above the rf voltmeter noise level. Write down both the signal generator attenuator reading and the rf voltmeter reading for later reference.

Step 5. Connect the rf signal generator through one of the 50-ohm pads used in Step 2 to the injection filter INPUT connector. Connect the rf voltmeter through the other 50-ohm pad used in Step 2 to the injection filter OUTPUT connector.

Step 6. Increase the rf signal generator output level until an indication is seen on the rf voltmeter.

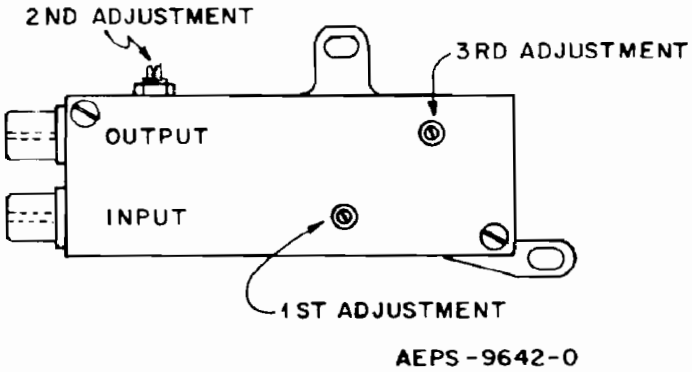


Figure 4. Duplex Injection Filter Adjustment Locations

Step 7. Refer to Figure 4. Tune the 1st adjustment for a peak rf voltmeter reading.

Step 8. Set the rf signal generator output level so the rf voltmeter reading is the reference recorded in Step 4.

Step 9. Tune the 2nd adjustment for an rf voltmeter peak reading. Reduce the rf signal generator output until the rf voltmeter reference reading is obtained.

Step 10. Repeat Step 8, but tune the 3rd adjustment.

Step 11. If the three adjustments have been peak-tuned and the rf voltmeter reading is at the reference established in Step 4, the rf signal generator output level should be no more than 3.5 dB higher than the Step 4 rf signal generator reference level. If the rf signal generator is more than 3.5 dB above reference, this adjustment procedure must be repeated.

5. MAIN RECEIVER SQUELCH GATE BOARD

5.1 METER READINGS

The metering receptacle on the squelch gate board provides an easy means to determine if the squelch gate board is receiving appropriate inputs and is functioning properly. Using a metering adapter cable with a Motorola portable test set, plug the adapter cable white "metering" plug into the squelch gate board metering receptacle. The adapter cable red "control" plug need not be connected to the control board. Table 1 lists the minimum acceptable test set readings at meter positions 1 through 4 under various conditions.

5.2 ADJUSTMENT PROCEDURE

Step 1. Connect an rf signal generator to the radio set antenna connector.

Step 2. Set up the rf signal generator to produce an unmodulated signal at the selected channel main receiver frequency.

Step 3. Depress the RPTR pushbutton on the radio set control head.

CAUTION
Do not depress the ROAM pushbutton.

Step 4. Set the rf signal generator output level to the receiver 14 dB quieting point.

Table 1. Squelch Gate Metering Limits

METER POSITION	METER SET	POINT METERED	CONDITION	LIMIT (uA)
1	METER "REV" REF A	RECEIVER UNSQUELCHED INDICATOR	NO SIGNAL INTO RECEIVER	0
			20 dB QUIETING	20 MIN
2	METER "REV" REF A	"PL" DECODER OUTPUT	NO TONE PRESENT	0
			NO TONE PRESENT	30 MIN
3	METER "REV" REF A	KEYED 9.6 V	RECEIVE ONLY	0
			TRANSMIT	30 MIN
4	METER "REV" REF A	PUSH-TO-TALK	RECEIVE ONLY	30 MIN
			TRANSMIT	0

Step 5. Turn squelch gate SQUELCH control R1217 counterclockwise until the main receiver unsquelches, then turn R1217 clockwise until the main receiver just squelches.

Step 6. Disconnect the signal generator and return the radio set to the duplex operating mode.

6. AUXILIARY AUDIO BOARD REPEAT AUDIO LEVEL ADJUSTMENT

NOTE

The main receiver and transmitter and the auxiliary receiver must be properly aligned before this adjustment procedure is performed.

Step 1. Connect an rf wattmeter to the radio set antenna terminal. Terminate the wattmeter in a 50-ohm dummy load.

Step 2. Disconnect the large tan coaxial cable from the receiver rf deck rf input terminal.

Step 3. Connect an rf signal generator to the main receiver rf deck rf input terminal.

Step 4. Turn on the radio set.

Step 5. Set up the rf signal generator to produce a signal on the selected channel receive frequency. Set the signal generator 1 kHz modulation for 3.3 kHz deviation. Set the rf signal generator output level for full receiver quieting.

Step 6. Press the RPT and the ROAM pushbuttons on the radio set control head. The radio set transmitter should key.

Step 7. Adjust REPEAT AUDIO LEVEL ADJUST control R1313 on the auxiliary audio board to obtain ±3.3 kHz transmitter modulation deviation.

Step 8. Transfer the rf signal generator connection to the auxiliary receiver rf deck rf input terminal.

Step 9. Set the rf signal generator to produce a signal on the selected channel receive frequency of the auxiliary receiver. Set the signal generator 1 kHz modulation for 3.3 kHz deviation. Set the rf signal generator output level for full receiver quieting.

Step 10. Repeat Step 6 and then adjust AUXILIARY RECEIVER AUDIO ADJUST R1309 on the auxiliary audio board to obtain ±3.3 kHz transmitter modulation deviation.

Step 11. Disconnect the test equipment and reconnect the coaxial cables to the receiver rf deck rf input terminals. Return the radio set to the duplex operating mode.

7. AUXILIARY RECEIVER SQUELCH GATE BOARD

CAUTION

Do not key the radio or select the emergency repeat mode while making these adjustments.

7.1 AUXILIARY RECEIVER SQUELCH ADJUSTMENT

Step 1. Connect an rf signal generator to the radio set antenna connector.

Step 2. Set up the rf signal generator to produce an unmodulated signal at the selected channel auxiliary receiver frequency.

Step 3. Set the rf signal generator output level to the receiver 14 dB quieting point.

Step 4. Turn auxiliary receiver squelch gate SQUELCH control R232 counterclockwise until the auxiliary receiver unsquelches, then turn R232 clockwise until the receiver just squelches.

Step 5. Disconnect the signal generator.

7.2 AUXILIARY RECEIVER MONITOR AUDIO LEVEL ADJUSTMENT

Step 1. Connect an rf signal generator to the radio set antenna connector.

Step 2. Set up the rf signal generator to produce a signal at the select channel main receiver frequency. Set the signal generator 1 kHz modulation for 3 kHz deviation. Set the rf signal generator output level for full receiver quieting.

Step 3. Connect an ac voltmeter across the speaker terminals and adjust control head VOLUME control to obtain a convenient reference audio level.

Step 4. Without changing the rf signal generator output level or the VOLUME control setting, retune the rf signal generator to the selected channel auxiliary receiver frequency.

Step 5. Set the MONITOR AUDIO LEVEL pot R235 on the auxiliary receiver squelch gate board clockwise to obtain the same audio level on the ac voltmeter noted in Step 3.

Step 6. Disconnect the rf signal generator.

8. RF PREAMPLIFIER ALIGNMENT

CAUTION

The rf preamplifier cannot be aligned using receiver meter readings. Peaking this amplifier while operating into both receivers will result in improper alignment and degradation of receiver quieting sensitivity.

8.1 TEST EQUIPMENT

The rf preamplifier can be aligned with an rf signal generator rated for stable operation at 450-470 MHz and an rf voltmeter with a 50-ohm tip. If the rf signal generator does not have an accurate frequency readout, a frequency counter capable of stable operation at 450 MHz must be used to measure the rf signal generator output frequency.

8.2 ALIGNMENT PROCEDURE

CAUTION

Do not key the radio transmitter or damage to the signal generator will result.

NOTE

Before proceeding with adjustment of the rf preamplifier, both receivers should be properly aligned and checked for 20 dB quieting sensitivity at the rf deck inputs.

Step 1. Set control head ON/OFF switch to the OFF position.

Step 2. Remove the squelch gate board.

Step 3. Connect pin 11 to pin 13 on the squelch gate interface board connector P1201.

Step 4. Remove rf cable connection between radio set and auxiliary receiver at the radio set connector.

Step 5. Connect rf voltmeter 50-ohm tip to radio set auxiliary receiver antenna connector.

Step 6. Turn on radio power and connect rf signal generator to main radio antenna connector.

Step 7. Set the rf signal generator output frequency to 460.500 MHz.

Step 8. Set the rf signal generator output level to 1000 uV.

Step 9. Adjust C2 on rf preamplifier for a peak reading on the rf voltmeter. This adjustment is critical and care should be used to ensure peak tuning. For maximum sensitivity, reduce rf signal generator output as necessary to obtain a near full-scale reading on a lower scale of the rf voltmeter.

Step 10. Set the rf signal generator output frequency to 463.100 MHz.

Step 11. Readjust rf signal generator output level to 1000 uV.

Step 12. Adjust C1 on rf preamplifier for a peak reading on the rf voltmeter.

Step 13. Reset the rf signal generator output frequency to 460.500 MHz.

Step 14. Readjust C2 on rf voltmeter for a peak reading on the rf voltmeter following procedure detailed in Step 9.

Step 15. Disconnect rf voltmeter and reconnect auxiliary receiver antenna cable to radio set.

Step 16. Leaving rf signal generator connected to radio set antenna terminal, perform 20 dB quieting sensitivity checks on both receivers. If either, or both receivers fail to meet the specified quieting sensitivity specification, repeat the rf preamplifier adjustment procedure.

Step 17. Disconnect rf signal generator, remove jumper from squelch gate interface board connector and replace squelch gate board.

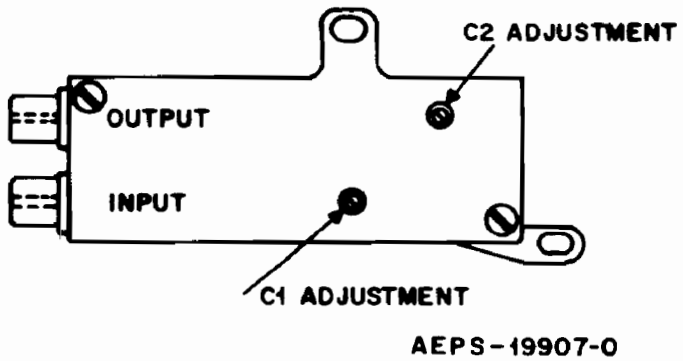


Figure 5. RF Preamplifier Adjustment Locations

FIELD CONVERSION

1. ADVANTANGES OF CURRENT SYSTEMS

1.1 Table 1 below lists the original three basic EMS mobile radio models and the current models which have replaced them. This table shows the advantages of the current radio model over the earlier radio model. In each case, the later system model contains *all* features of the earlier one plus additional capability.

1.2 The Q1855A is the same as the Q1853A except it does not have the second receiver or the multiplex modules. The Q1854A is the same as the Q1853A except that the auxiliary receiver also has dual PL capability.

2. DUPLEX-MULTIPLEX CONVERSION

2.1 The Q2106A Duplex-Multiplex Field Conversion Kit has been established to facilitate conversion of-Q1505A systems into the equivalent of Q1853A Systems. Full details on conversion procedures are given in section 68P81108E49.

2.2 Conversions of other EMS systems to include such features as duplex-multiplex, dual receiver, and two-PL decode capability on auxiliary receiver is possible. Table 2 presents a summary of field conversion possibilities. Consult your Motorola representatives for advice and help in making these conversions.

Table 2. Comparison of Current EMS Models to Earlier Models

EARLIER SYSTEM MODEL	CURRENT SYSTEM MODEL	ADVANTAGES OF CURRENT MODEL OVER EARLIER MODEL
Q1503A	Q1855A	System can easily be upgraded to two receivers and duplex-multiplex.
Q1505A	Q1853A	Duplex-Multiplex capability.
Q1588A	Q1854A	Duplex-Multiplex capability

Table 2. Summary of Field Conversion Possibilities

PRESENT SYSTEM		EQUIVALENT UPGRADED SYSTEM		HARDWARE MODIFICATION REQUIRED	
Model No.	Capability	Model No.	Added Capability	New Kit	Replaces
Q1503A*	Single Receiver System	Not Easily Field Convertable To Two Receiver System			
Q1505A*	Dual Receiver System (Non-Multiplex)	Q1853A	Duplex/Multiplex	QLN1918B Audio/Telemetry Multiplex Module (p/o QLN2106A)	QLN1917B Repeater Control Module
				QLN2106A Duplex/Multiplex Field Conversion Kit	Added
Q1588A*	Dual Receiver System (Non-Multiplex) with 2 PL Decode on Aux. Rcvr	Q1854	Duplex/Multiplex	Same as above	Same as above
Q1855A	Single Receiver System (Non-Multiplex)	Q1505A*	Dual Receiver System (Non-Multiplex)	Q1507A Auxiliary Receiver	Added
Q1855A	Same as above	Q1588A*	Dual Receiver System (Non-Multiplex) w/2 PL Decode on Aux Rcvr	Q1589A Auxiliary Receiver	Added
Q1855A	Same as above	Q1853A	Dual Receiver System Duplex Multiplex	Q1507A Auxiliary Receiver	Added
				QLN1918B Audio/Telemetry Multiplex Module (p/o QLN2106A)	QLN1917B Repeater Control Module
				QLN2106A Duplex/Multiplex Field Conversion Kit	Added
Q1855A	Same as above	Q1854A	Dual Receiver System Duplex Multiplex 2 PL Decode on Aux Rcvr	Q1589A Auxiliary Receiver with Two-Code PL Receiver	Added
				QLN1918B Audio/Telemetry Multiplex Module (p/o QLN2106A)	QLN1917B Repeater Control Module
				QLN2106A Duplex /Multiplex Field Conversion Kit	Added
Q1853A	Dual Receiver System with Duplex Multiplex	Q1854A	2 PL Decode on Aux Rcvr	QLN5936A Dual PL Decoder Board	Added
				QLN5937A Mounting Hardware Kit	Added
				TLN4294B-SP2 PL Decoder	TLN4294B PL Decoder

NOTES:

1. The ECG Modulator/Preamplifier Module QLN1919C can be added to any of the above systems in the field if not already equipped. Refer to instruction section 68P81037E76 in this manual.

2. The Q1508A/Q1509A Dual Control Accessory packages are compatible with all of the above systems. For details refer to the duplex/multiplex with dual control interconnect in this manual and dual control manual 68P81030E90.

3. Model numbers followed by an asterisk (*) are earlier version systems and have been replaced with models which have expanded capability. They are included here for reference only for field modification assistance.

to 1650 Hz by 13 dB. In this way, voice signal interference to the ECG telemetry signal is eliminated when the two signals are combined for transmission.

2.2 The peak amplitudes of the voice and telemetry signals are limited and adjusted before combining so that the maximum transmitter deviation produced by the composite signal does not exceed 4 kHz and each signal makes up 50% of the peak amplitude of the composite signal. The 4 kHz deviation limit ensures that the composite signal level is below the normal clipping level of the transmitter IDC circuits to prevent possible intermodulation distortion between the voice and telemetry signals.

2.3 Duplex/multiplex provides a variety of operational transmit and repeat transmit modes with multiplexed voice and ECG telemetry signals.

- *In the repeat mode* it allows simultaneous transmission through the mobile repeater of multiplexed voice and ECG telemetry signals from the portable unit with voice messages from the hospital base unit. The base unit voice signal received at the mobile repeater is processed and filtered prior to retransmission to eliminate interference to multiplexed ECG telemetry from the portable.

- *In the repeat mode* it allows simultaneous transmission of voice messages from the mobile repeater control position with multiplexed voice and ECG telemetry signals from the portable that are being repeated. The mobile handset (or headset) microphone audio signal is processed and filtered prior to transmission to eliminate interference to the ECG telemetry signal from the portable.

- *In the local, or non-repeat, mode* it allows multiplexed voice and ECG telemetry transmissions to be made from the mobile unit using the optional QLN1919B ECG Modulator/Preamplifier module.

2.4 The additional circuits required for the duplex-multiplex option are included on the QLN1918B Audio/Telemetry Multiplex Module and the QLN2042A Repeat Audio Processing modules which are located at the control group, and the QLN7225A Auxiliary Audio Board which is located in the radio. The former two modules mount in a "MICOR" "Systems•90" accessory housing to form an integral part of the EMS duplex/repeater mobile radio system. The QLN1918B Audio/Telemetry Multiplex Module replaces the QLN1917B Repeater Control module, providing the same repeater control functions and the added circuits required for multiplexing of the audio and ECG telemetry.

2.5 In the repeat mode, the QLN2042A Repeat Audio Processing Module takes the mobile radio main receiver audio signal, which is received from the hospital base unit and processes the signal for repeat purposes. The processed signal is then passed through the transmit audio path of the QLN1918B Audio/Telemetry Multiplex Module before being routed to the radio for retransmission. In the multiplex mode, the repeat audio passes through the transmit audio multiplex circuits prior to retransmission, thus eliminating possible interference to repeated ECG telemetry signals from the portable unit.

2.6 The QLN7225A Auxiliary Audio Board replaces the QLN5855A in the repeater radio and contains the necessary circuitry to provide a suitable gating level output to interface with the QLN2042A Repeat Audio Processing Module. In addition, the QLN7225A provides all the circuitry required to process repeater audio from the portable unit (paramedic audio).

3. TRANSMIT AUDIO FLOW FUNCTIONAL DESCRIPTION

3.1 INTRODUCTION

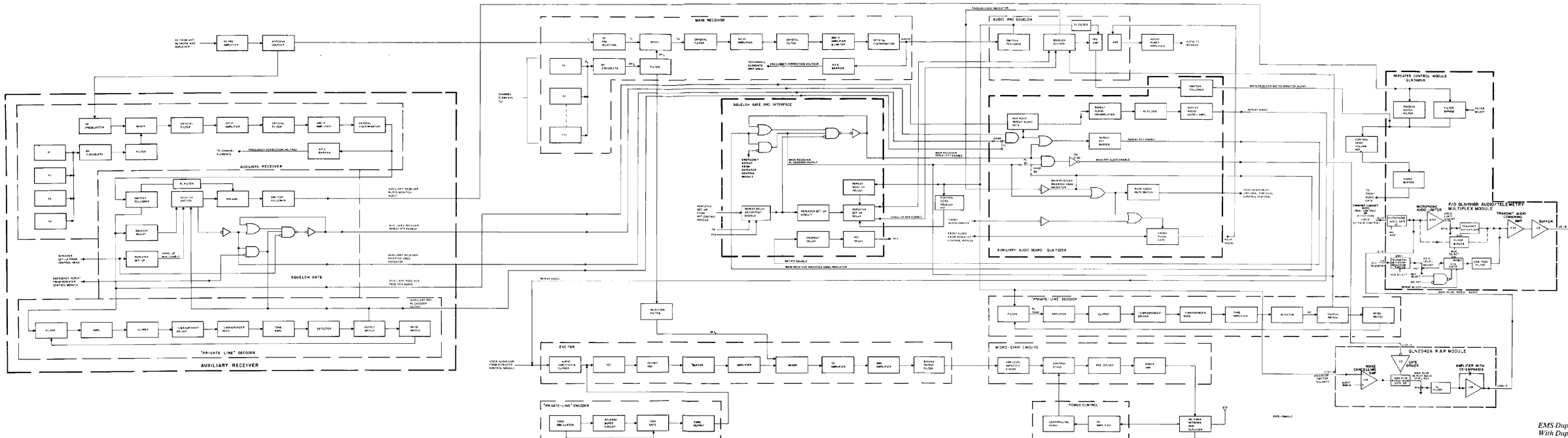
The duplex/multiplex EMS system differs from a non-multiplex system in three specific areas: (1) transmit audio filtering and gating is added (located on QLN1918A Audio/Telemetry Multiplex Module), (2) main receiver repeat audio is now processed at the control group (via QLN2042A Repeat Audio Processing module), and (3) new repeat audio gating circuits are required (located on QLN7225A Auxiliary Audio Board) to interface with the control group repeat audio circuitry. Refer to figure 4 for details of the transmit audio flow scheme for non-multiplex and duplex-multiplex systems.

3.2 REPEAT AUDIO FLOW

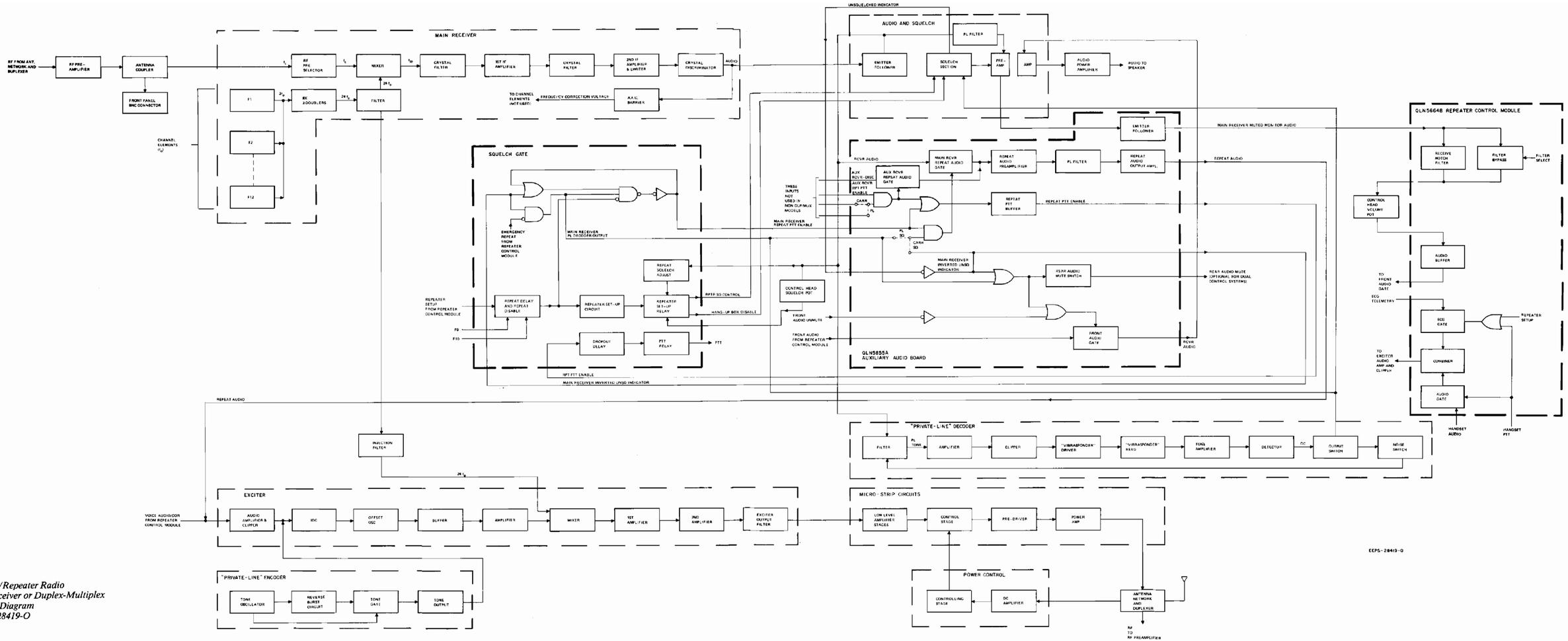
3.2.1 The repeat audio flow for duplex-multiplex systems differs from non-multiplex systems because of the requirement that the doctor's transmission (from base station leg) be filtered in the ECG passband so that the doctor does not interfere with the patient ECG signal he is monitoring. A description of the repeat audio flow for duplex-multiplex systems is given below.

3.2.2 Auxiliary receiver emitter follower audio is first gated by Q1302 so that the receive audio from the portable leg is retransmitted only when the proper repeat conditions are met. The audio is then preamplified by U1301A, adjusted for proper repeat level by R1313, and the PL tones are removed. Finally, U1301B provides the necessary amplification to compensate for signal loss through the PL filter. The processed portable leg repeat audio is then coupled with transmit audio from the control group and fed to the exciter for transmission.

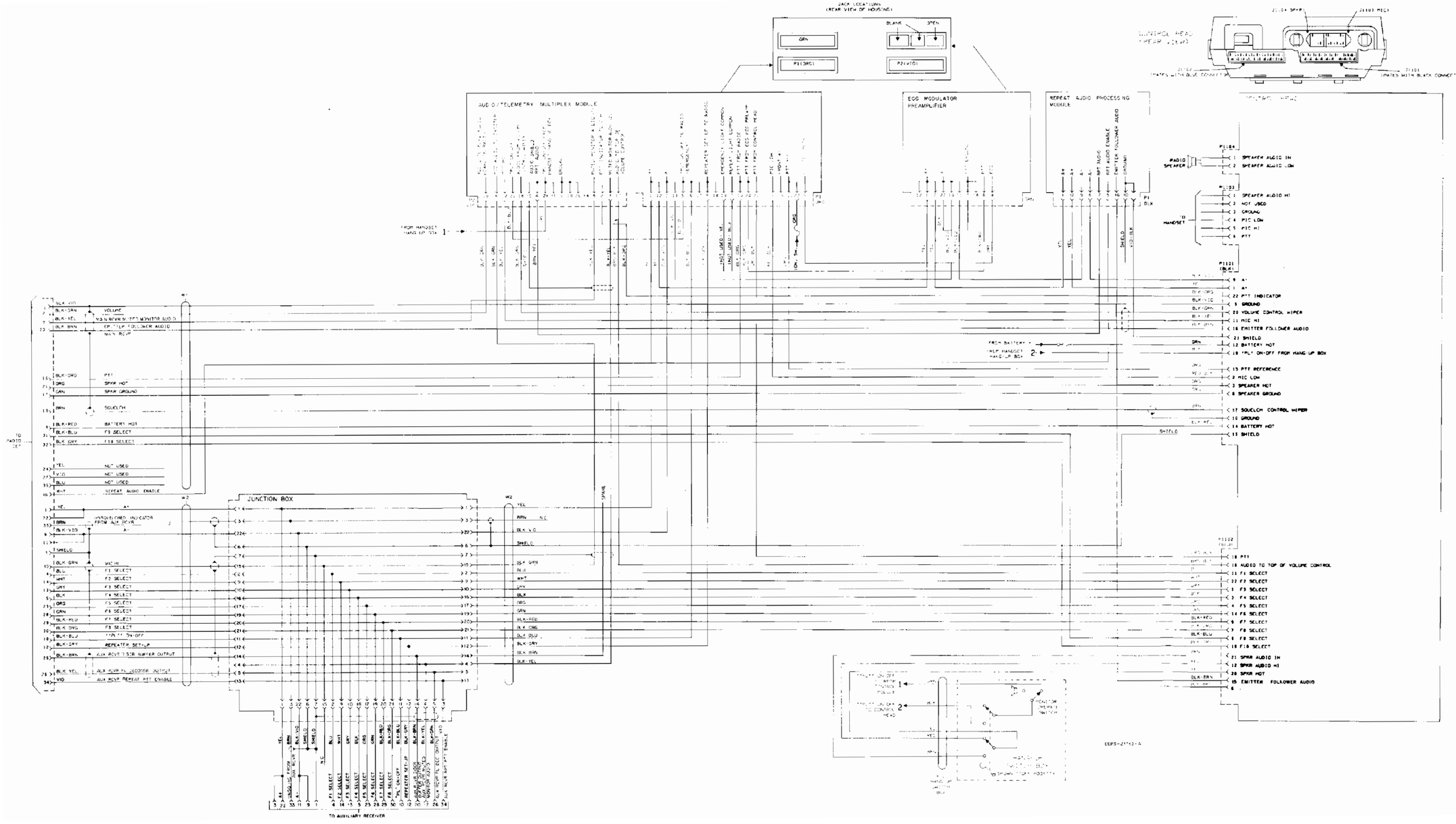
3.2.3 In order to allow main receiver repeat audio to pass through the transmit notch filter, this audio is processed entirely at the control group and combined



EMS Duplex/Repeater Radio Set
With Duplex-Multiplex
Overall System Block Diagram
Motorola No. EEPS-28443-O
3/28/79- PHI

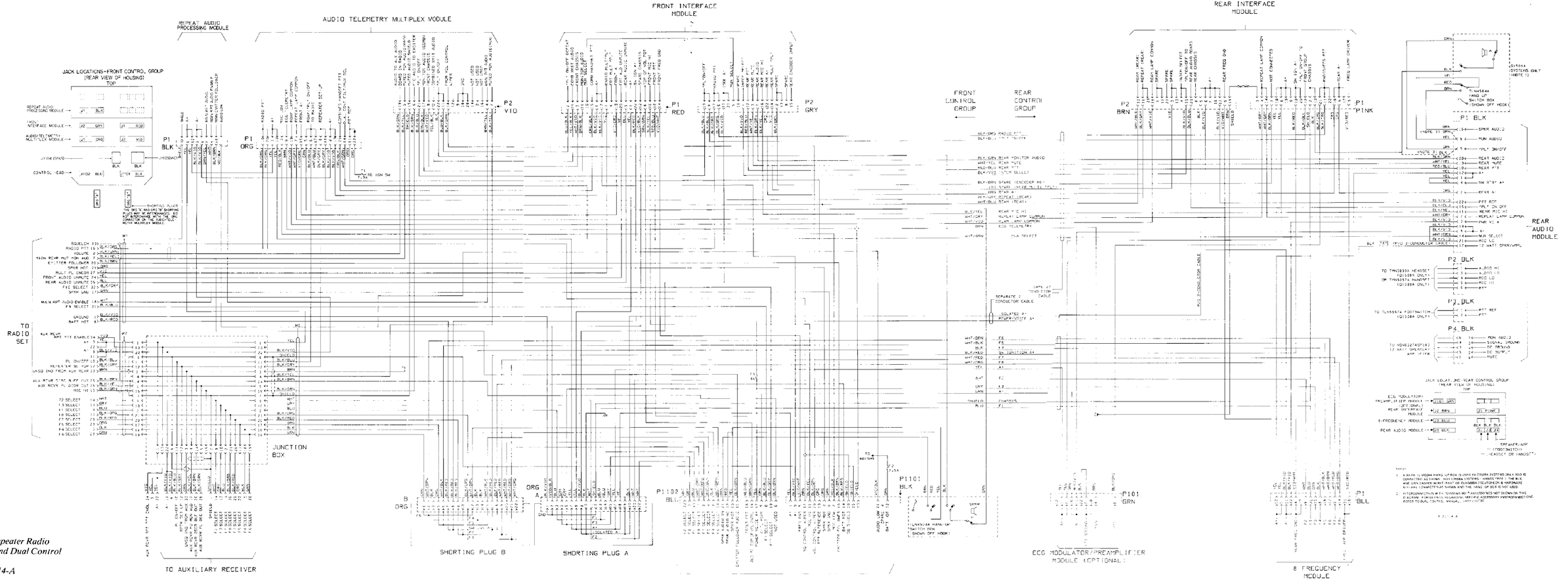


Q1855A EMS Duplex/Repeater Radio
Without Auxiliary Receiver or Duplex-Multiplex
Overall System Block Diagram
Motorola No. EEPS-28419-O
3/28/79- PHI

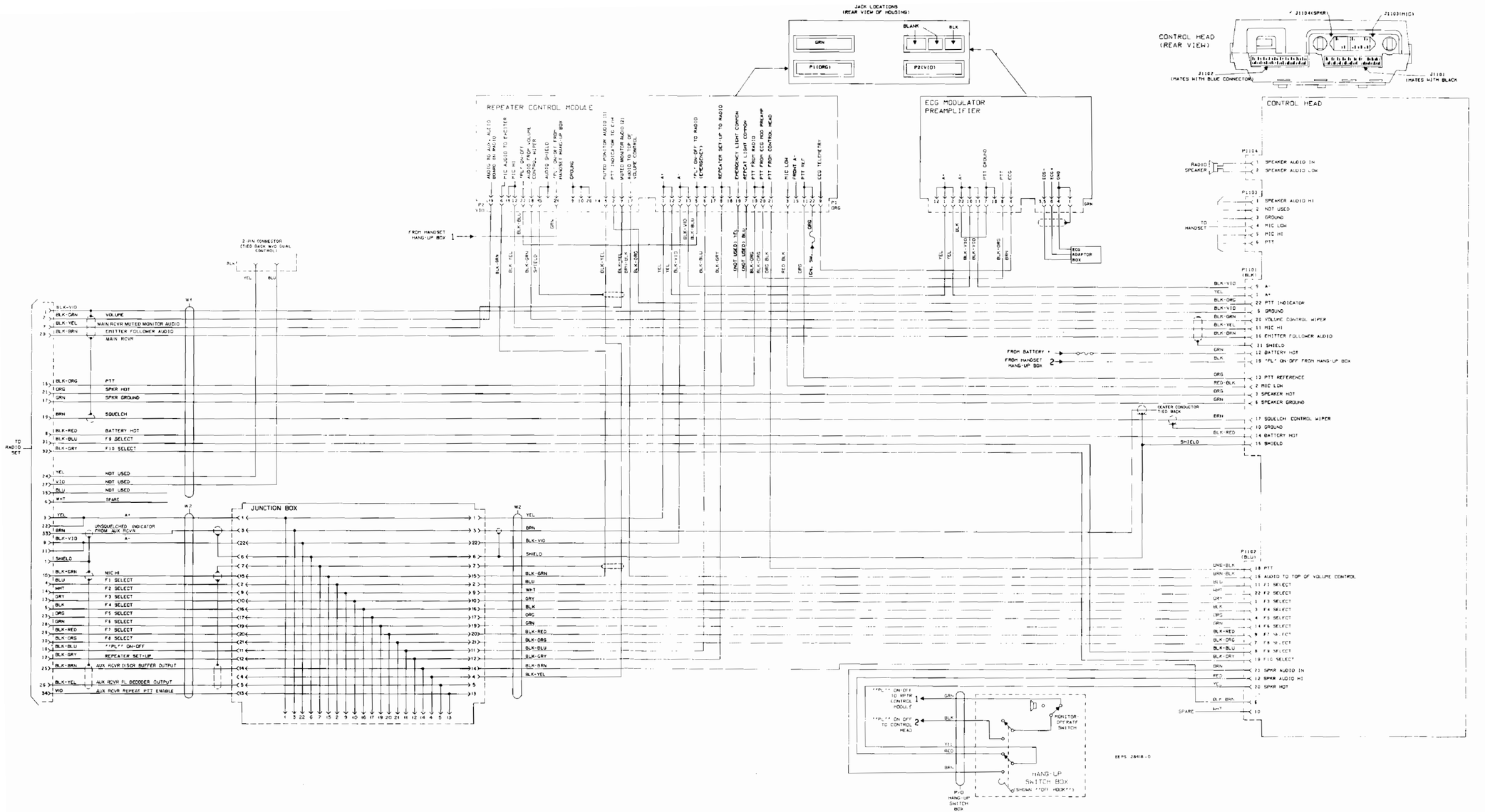


Q1853A EMS Duplex/Repeater Radio With Duplex-Multiplex and Single Control Interconnection Diagram
Motorola No. EEPS-21713-A
3/28/79- PHI

SINGLE CONTROL/DUAL CONTROL INTERCONNECTION DIAGRAM



Q1853A EMS Duplex/Repeater Radio
With Duplex-Multiplex and Dual Control
Interconnection Diagram
Motorola No. EEPS-21714-A
*3/28/79-*PHI



PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

Q1855A EMS Duplex/Repeater Radio With Single Receiver Interconnection Diagram and Schematic
Motorola No. PEPS-28417-O
3/28/79- PHI

PARTS LIST

IMPORTANT

USE ONLY THE FOLLOWING MOTOROLA PART NUMBERS WHEN ORDERING REPLACEMENT PARTS

CABLE KITS

QKN8207A Control Cable
QKN8208A Auxiliary Receiver Cable
TKN6456A Control Head Power
TKN6458A Cable and Fuse Kit PL-4077-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
F1101, 1102	65-86099	FUSE, cartridge: 1-1/4" x 1/4"; 7.5 A; 32 V (see XF1101, 1102 for fuseholder) (TKN6456A)
F1103	65-84161B01	1-1/8" x 13/32"; 40 A; 32 V (TKN6458A)
		NOTE See XF1103 for fuseholder
P3, 4, 5, 1101		CONNECTOR, plug: includes: 14-84556B01 BODY: (BLK): 20-contact type 9-84151B01 TERMINAL, contact; female; 19 req'd.
P1102		14-84556B02 BODY: (BLUE): 20-contact type 9-84151B01 TERMINAL, contact: female: 11 req'd.
P1105A, 1105B		includes: 9-84086B01 BODY: 37-contact type; includes only "A" and "B" contacts
		WIRE, electrical: stranded;
	30-10286C70	No. 16 ga., coded GRN; 88" length req'd. (TKN6456A)
	30-10310A63	No. 18 ga., coded GRN; 12' length req'd. (TKN6456A)
	30-851875	No. 8 ga., coded BLK; 5-1/2' length req'd. Requires (but does not include) 29-84528B03 LUG, ring tongue
	30-10310A62	No. 18 ga., coded ORG; 5' length req'd. (TKN6456A)
	30-10310A62	No. 18 ga., coded ORG; 9' length req'd. (TKN6456A)
	30-812505	No. 8 ga., coded RED; 2' length req'd. Requires (but does not include) 29-824434 LUG, ring-tongue (TKN6458A)
	30-812505	No. 8 ga., coded RED; 25-1/2' length req'd.
	30-864650	Cable, 17-conductor; 18' length req'd.
		FUSEHOLDER, "in-line" type: consists of:
XF1101, 1102	14-82882A01	BODY
	14-82883A01	CAP
	42-82884A01	TERMINAL, contact; 2 req'd.
	41-82885A01	SPRING (TKN6456A)
XF1103	9-84277B02	(TKN6458A)
NON-REFERENCED ITEMS		
	54-8498B01	LABEL (negative ground); for P1105
	42-867839	CLAMP, cable; requires (but does not include) 42-893464 HOOK, cable clamp ("S" hook)
	42-84275B01	BRACKET, fuseholder mounting (for XF1103)
	9-84151B01	TERMINAL, contact; female; 20 supplied
	37-31922	SLEEVE, neoprene: 2 supplied
	42-84046C01	CLAMP, cable strain relief
	3-132127	SCREW, tapping: 6-20 x 3/4" plain hex head
	15-84044C01	SHELL (front)
	15-84045C01	SHELL (rear)
	3-122330	SCREW, machine: 6-32 x 3/8" Phillips binder head; 2 supplied
	3-138133	SCREW, machine: 6-32 x 3/4" Phillips binder head

QLN5677A Junction Box PL-4036-O

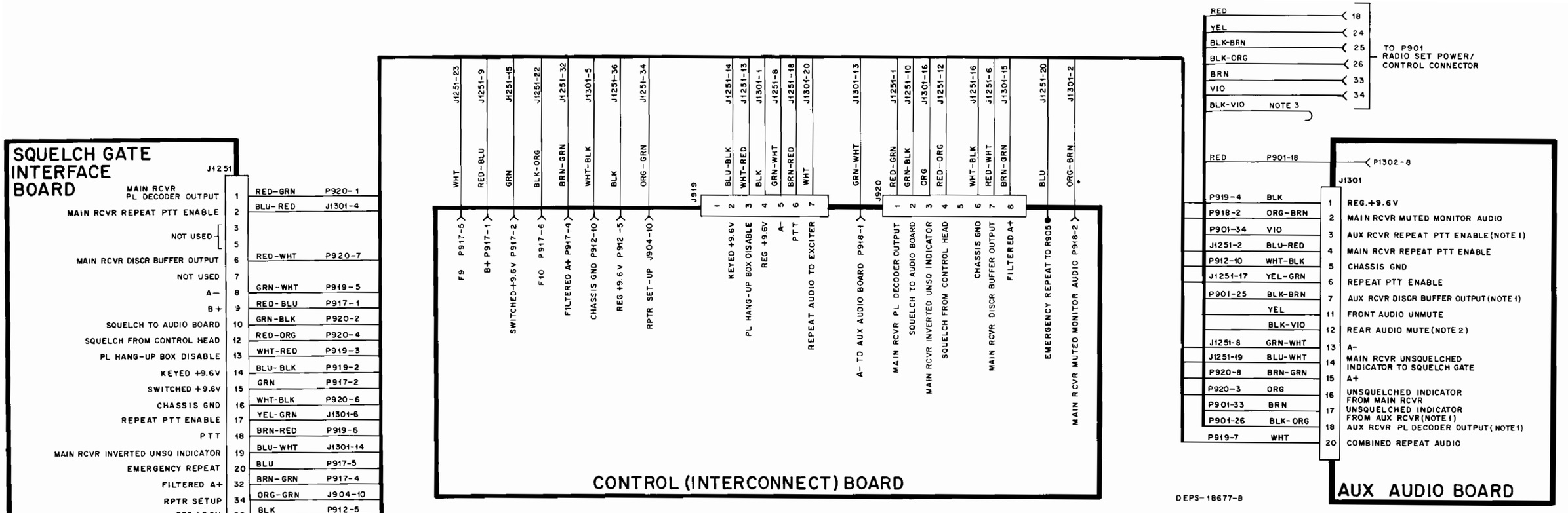
J1, 2, 3	1-06707B82 29-84547B03	CONNECTOR, circuit board: includes: CONTACT, pin; 60 req'd.
MECHANICAL PARTS		
	3-134175	SCREW, machine; 4-40 x 5/16"; 2 req'd.
	3-136926	SCREW, tapping; 4-40 x 5/16"; 4 req'd.
	3-138133	SCREW, machine; 6-32 x 3/4"
	3-400465	SCREW, tapping; 10-12 x 3/4"; 2 req'd.
	3-488006	SCREW, machine; 6-32 x 1/2"; 3 req'd.
	4-7651	LOCKWASHER, #10 internal; 2 req'd.
	4-84516B01	WASHER, screw retainer; 4 req'd.
	15-84828K01	HOUSING
	15-84829K01	COVER
	37-103664	GROMMET, rubber; 3 req'd.
	42-802007	CLAMP, cable; 3 req'd.

QKN8126A Cable Kit PL-4113-O

P1		CONNECTOR, plug: includes:
	14-84556B05	BODY, 20-circuit (ORG)
	9-84151B01	CONTACT, terminal, female; 13 req'd.
P2		includes:
	14-84556B09	BODY, 20-circuit (VIO)
	9-84151B01	CONTACT, terminal, female; 11 req'd.

QKN8189A Auxiliary Receiver Antenna Cable PL-4114-O

P1002A	28-844876	CONNECTOR, plug: male; single contact
P1002B	28-82021G01	male; single contact
MECHANICAL PARTS		
	58-854020	ADAPTER
	30-475378	CABLE, coaxial RG58/AU; 78" req'd.



NOTES:

1. AUX RCVR SIGNALS FOR AUX AUDIO BOARD USED ONLY IN SYSTEMS EQUIPPED WITH AN AUXILIARY RECEIVER.
2. REAR AUDIO MUTE SIGNALS FOR AUX AUDIO BOARD USED ONLY IN SYSTEMS EQUIPPED FOR DUAL CONTROL.
3. THE WIRES FROM J1301-11 (YEL) AND J1301-12 (BLK-VIO) ARE TIED BACK AT P901.

PARTS LIST

QKN8134A Repeater Interface Cable PL-3842-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
J919		Connector, includes body 14-84277D05 (7 contact) and female contacts 9-84279D01
J920		Connector, includes body 14-84277D06 (8 contact) and female contacts 9-84279D01
J1251		Connector, includes body 14-84277D10 (36 contact) and female contacts 9-84279D01
J1301		Connector, includes body 14-84277D14 (20 contact) and female contacts 9-84279D01
	39-10184A24	Connector, female, single contact; 9 required
	29-10134A48	Connector, female, single contact, 1 required
	29-10134A53	Connector, female, single contact, 6 required

QKN8314A Repeater Interface Cable Schematic Diagram and Parts List Motorola No. PEPS-18701-B 3/28/79-PHI

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

PARTS LIST

QLN5701A Auxiliary Receiver Mechanical Parts PL-4033-O

P104	28-84282D01	CONNECTOR, plug: male; single contact
	MECHANICAL PARTS	
	3-7247	SCREW, machine 6-32 x 3/16"; 3 req'd.
	3-132285	SCREW, machine 6-32 x 7/16"; 3 req'd.
	3-134168	SCREW, tapping 4-40 x 1/4"; 4 req'd.
	3-135111	SCREW, tapping 4-40 x 3/8"; 3 req'd.
	3-138294	SCREW, tapping 8-32 x 5/8"; 5 req'd.
	3-138959	SCREW, tapping 8-32 x 7/8"
	4-7651	LOCKWASHER, #8 internal; 2 req'd.
	7-84657K01	BRACKET, lock retainer
	7-84823K01	BRACKET, connector (strain relief)
	14-83512F01	INSULATOR, channel element
	15-84650K01	HOUSING
	22-10133A22	PIN, drive
	33-84655K01	NAMEPLATE
	41-84890G01	SPRING, retainer; (blk)
	41-84890G02	SPRING, retainer; (gray)
	41-84653K01	SPRING, mounting
	41-84658K01	SPRING, lock
	42-10128A10	RING, retainer; 2 req'd.
	45-84656K01	PLATE, slide
	64-84654K01	PANEL, front
	75-84838E01	BUMPER, rubber; 2 req'd.
	64-84652K01	PLATE, mounting
	55-84101B01	LOCK
	55-84300B01	HANDLE, nylon; 3.52"; 2 req'd.
	55-84300B02	HANDLE, nylon; 2.12"
	58-84824K01	HANDLE, radio set
	1-06708A16	TERMINATION 50 OHM
		ASSEMBLY; includes:
	6-125A19	RESISTOR, 56 ±5%; 1/2 W
	26-82604A03	SHIELD, choke
	28-84282D01	CONNECTOR, male; phono
	7-84442E01	BRACKET, support
	7-84447E01	BRACKET, hold-down
	7-84448E01	BRACKET, mounting board
	7-84660K01	BRACKET, mounting UHF pre-amp
	2-10101A53	NUT, spring; 4 req'd.
	46-84090C01	STUD, retainer; 4 req'd.
	26-84825K01	SHIELD, audio and squelch
	15-84745F01	HOOD, receptacle
	29-129883	LUG, soldering #6
	9-82442E06	CONNECTOR, chassis
	41-84658K01	SPRING, lock
	45-84656K01	PLATE, slide lock

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

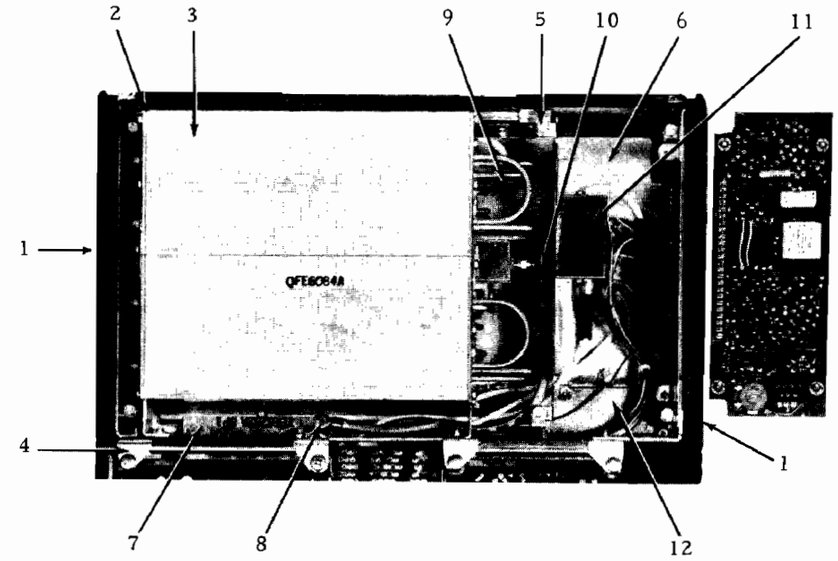
MECHANICAL PARTS LIST

Additional Mechanical Parts for Duplex/Repeater Radio Sets PL-4031-O

1	64-84165G01	Panel Side (right and left are the same)
2	27-06541G01	Rear chassis
3	QFE6084A	Duplexer
4	IV06705B97	Plate, rear, radio
5	7-84382K01	Bracket, rear support
6	26-84385K01	Squelch Gate Shield
7	TFE6252A-SP1	Harmonic Filter
	15-84821E01	Cover, top
8	9-84886E02	MBC Connector, right-angle
9	9-84886E01	MBC Connector, right-angle
10	9-87318C10	Connector, right-angle, threaded
	43-865308	Spacer, used to mount TFE6252A-SP1 Harmonic Filter, 2 req'd.
11	QLE6236A	Antenna Coupler
12	TLE8192A-SP1	RF Preamplifier

QKN8210A Interconnect Cable PL-4034-O

P902	14-84277D03 9-84279D01	CONNECTOR, plug: includes: INSULATOR, 10-circuit CONTACT, female; 7 req'd.
	MECHANICAL PARTS	
	29-10134A53	LUG
	37-82603D26	SLEEVING, shrink #26
	37-82603D33	SLEEVING, shrink #33
	37-82603D34	SLEEVING, shrink #34
	37-82603D60	SLEEVING, shrink blank
	39-10134A24	CONTACT, chain-form; 4 req'd.
	42-10217A02	STRAP, cable harness; 4 req'd.



FAEPS-19748-O

ANTENNA NETWORK COUPLER AND DUPLEXER

MODELS TFE6233B-SP1, QLE6236A, AND QFE1024A

1. DESCRIPTION

The antenna network connects the transmitter final power amplifier stage to the transmitter output connector; it replaces the antenna switch in the standard radio. The duplexer allows a single antenna to be used for both transmit and receive signals at the same time. The antenna coupler allows two receivers to be connected to the receive port of the duplexer.

2. THEORY OF OPERATION

2.1 QLE6236A ANTENNA COUPLER

The antenna coupler permits the main receiver and the auxiliary receiver to share a common input from one antenna. The coupler provides (1) impedance matching between the receiver port of the duplexer and each receiver, and (2) isolation of the two receiver inputs from each other. Due to the signal splitting characteristics of the coupler, a 3 dB insertion loss is present between the input leg (from the duplexer) and each output leg to the receivers. Compensation for this insertion loss is provided by the rf preamplifier.

2.2 TFE6233B-SP1 DUPLEX ANTENNA NETWORK

2.2.1 Refer to the Antenna Network and Duplexer diagram. This circuit provides the following functions.

- Connects the transmitter final power amplifier stage to the transmitter output connector at all times.
- Provides the transmitter final power output stage with a low VSWR 50-ohm load during transmit independent of the load presented to the transmitter output connector.
- Attenuates all transmitter carrier harmonics.
- Provides dc voltages proportional to forward and reverse power appearing at the transmitter output connector.

2.2.2 Circulator

The circulator is a 3-port device which takes advantage of the unique magnetic properties of yttrium iron garnet (YIG). By subjecting a transmission line circuit sandwiched between two YIG discs to a critical value of static magnetic field, a device can be made which is non-reciprocal in nature. That is, a signal entering port 1 of the circulator leaves at port 2 and a signal entering port 2 leaves at port 3. In general a signal entering any port will leave at an adjacent port (in the direction of the arrow). This characteristic is used to advantage in the antenna network. The transmitter is always connected to the circulator at port 1 and the antenna is always connected to port 2 of the circulator through the duplexer, and port 3 is connected to a 50-ohm, 50-watt load. This circuit arrangement provides the transmitter power amplifier output stage with a low VSWR 50-ohm load independent of the condition of the load connected to the antenna connector. Whenever a mismatched load appears at the antenna connector, the reflected power from the mismatched load enters port 2 of the circulator and is routed to port 3 and to the 50-ohm load inside the unit.

2.2.3 Power Detectors

To provide an input to the power control board indicating the power level out of the transmitter, a peak voltage detector is coupled through a capacitive divider to the coaxial line at the transmitter input port of the circulator. This detector provides a dc output voltage proportional to the square root of the power entering port 1 of the circulator. A peak voltage detector is also

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used to sense the peak voltage across the 50-ohm load in the unit. Under most normal operating conditions, the power dissipation in the load is only a few watts. However, under extreme conditions of antenna mismatch and a high power radio, the reflected power could approach the power dissipation (50 watts) capability of the load. To protect the load against such a condition, the rf voltage across the load is sensed and a dc voltage proportional to the rf voltage is fed back to the power control board. When the rf voltage across the load starts to increase beyond the normal safe range, the power control decreases the power output of the transmitter to maintain a safe dissipation in the 50-ohm load.

2.2.4 50-Ohm Load

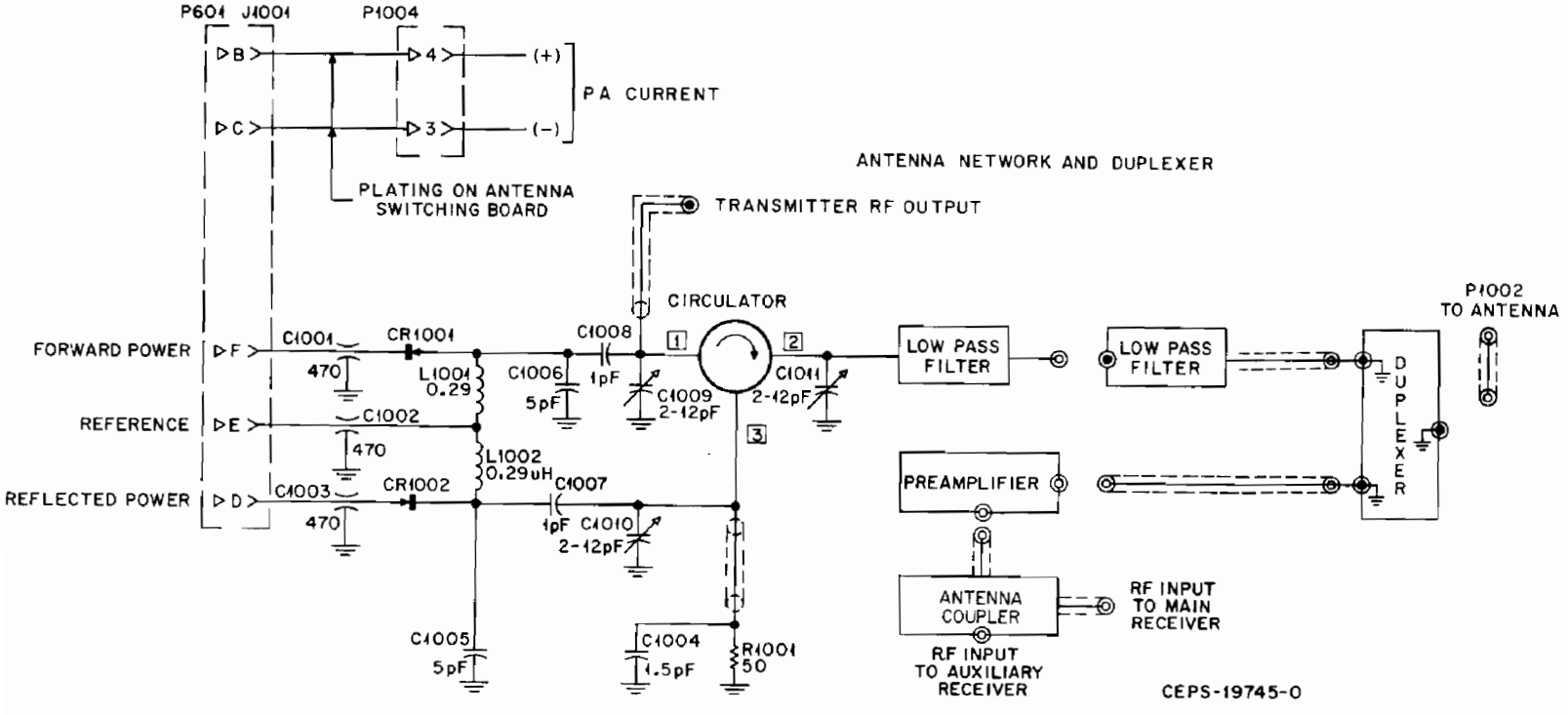
The 50-ohm load has a low VSWR in the UHF band. It absorbs the maximum reflected power from the antenna while monitoring this VSWR. To accomplish this, the load is constructed using thick-film techniques and is mounted on a beryllia block to achieve good thermal conduction of the dissipated power to the heat sink.

2.3 QFE1024A DUPLEXER AND FILTER

2.3.1 The duplexer is a three-port circuit that allows the simultaneous use of a single antenna by the receiver and transmitter. It performs the following functions:

- Connects transmitter output and receiver input to antenna at all times.
- Provides attenuation in the transmitter leg of duplexer at receiver frequency to essentially eliminate receiver desensitization due to transmitter sideband noise.
- Provides attenuation in the receiver leg of duplexer at transmitter frequency to essentially eliminate receiver desensitization and to minimize receiver spurious responses due to transmitter carrier frequency energy.

2.3.2 The duplexer contains four resonant cavities in the transmitter leg and three resonant cavities in the receiver leg. These cavities are coupled together and to the duplexer antenna connector through resonant sections of coaxial cable. The transmitter output signal passes through an additional low pass filter to further attenuate transmitter carrier harmonics before entering the duplexer.



Antenna Network and Duplexer

RF PREAMPLIFIER

MODEL TLE8192A-SP1

PARTS LIST

TLE8192A-SP1 Preamplifier (450-512 MHz) PL-4030-0

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, variable: (includes standard tuning "piston"):
C1, 2	20-83693H03 or 20-83693H01	0.9-9.0 pF (406-450 MHz) 0.8-6.0 pF (450-512 MHz) (NOTE: Also order 76-84425B01 PISTON, tuning; special: SEE NOTE II)
		CAPACITOR, fixed:
C3, 4	21-861441	500 pF ±10%; 75 V; N4700
C5	21-861219	.001 uF +100-0%; 500 V; coded RED
C6	23-84762H04	2.2 uF ±20%; 25 V
		CONNECTOR, receptacle:
J1, 2	9-84135B01	female; coaxial; miniature type
		COIL, RF:
L1	47-84330B02	(straight rod; 1.75" long)
L2, 3	24-800484	choke; 0.31 uH
L4	47-84330B03	(straight rod; 2.19" long)
		TRANSISTOR: (SEE NOTE I)
Q1	48-869533	field-effect "N Channel"; type M9533; does not include 42-83660C01 CLIP, transistor retaining
		RESISTOR, fixed:
R1	6-10401C25	100 ±10%; 1/4 W
R2	6-185B73	330 ±10%; 1/8 W
R3	6-10401C17	47 ±10%; 1/4 W

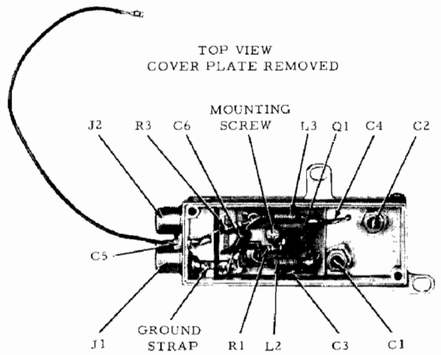
NOTES:

I. For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola Part numbers.

II. When replacing capacitor C1 or C2 for the 450-512 MHz range, order the two items (capacitor and special tuning "piston") shown in the parts list. Remove the standard tuning piston from the capacitor and replace it with the special piston.

TLE8191A-SP1 Preamplifier (450-512 MHz) PL-4029-0

1	15B84322B01	COVER, top
2	15B84323B01	COVER, side: 2 required
3	IV80708B85	CIRCUIT BOARD ASSEMBLY
4	11-10184A24	PIN
5	15B84501G01	HOUSING, preamplifier
6	42B83660C01	CLIP, transistor mounting
7	4K844123	SPACER, insulator (under board)
	NON-REFERENCED PARTS	
	3S490352	SCREW, machine: No. 2-56 x 5/32: cover mounting screws, 6 required
	3S1234212	SCREW, tapping #4 x 5/16: "Phillips" hex nut (3 req'd)



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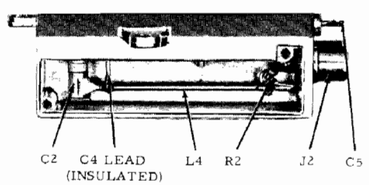

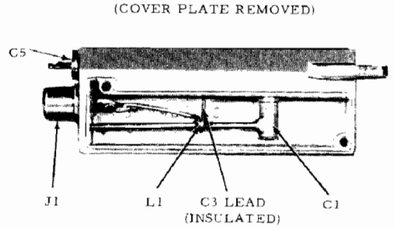

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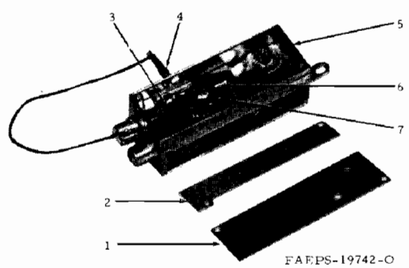

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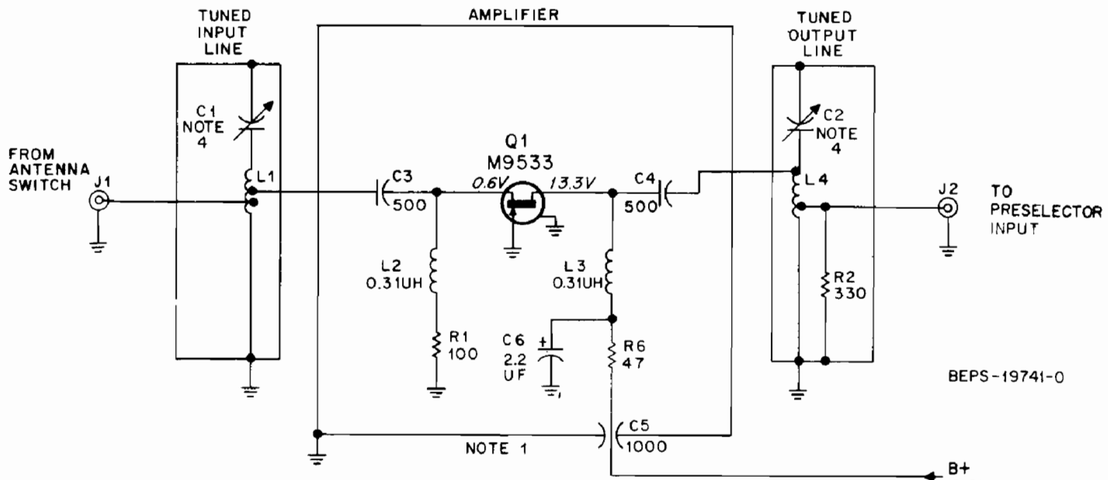
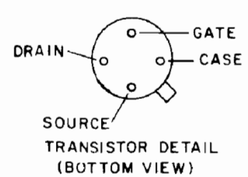
FUNCTION

The received signal from the duplexer receiver terminal is coupled directly into the input tuned-line of the preamplifier through the INPUT jack. This tuned-line passes the desired signal and matches the relatively low FET input impedance to the 50-ohm input line. The signal is capacitively coupled to the source terminal of the FET where it is amplified and then capacitively coupled to the output tuned-line. The output tuned-line is a high Q tank circuit. It passes the desired signal and matches the relatively high FET output impedance to the 50-ohm output line.





TRANSISTOR DETAIL (BOTTOM VIEW)

NOTES:

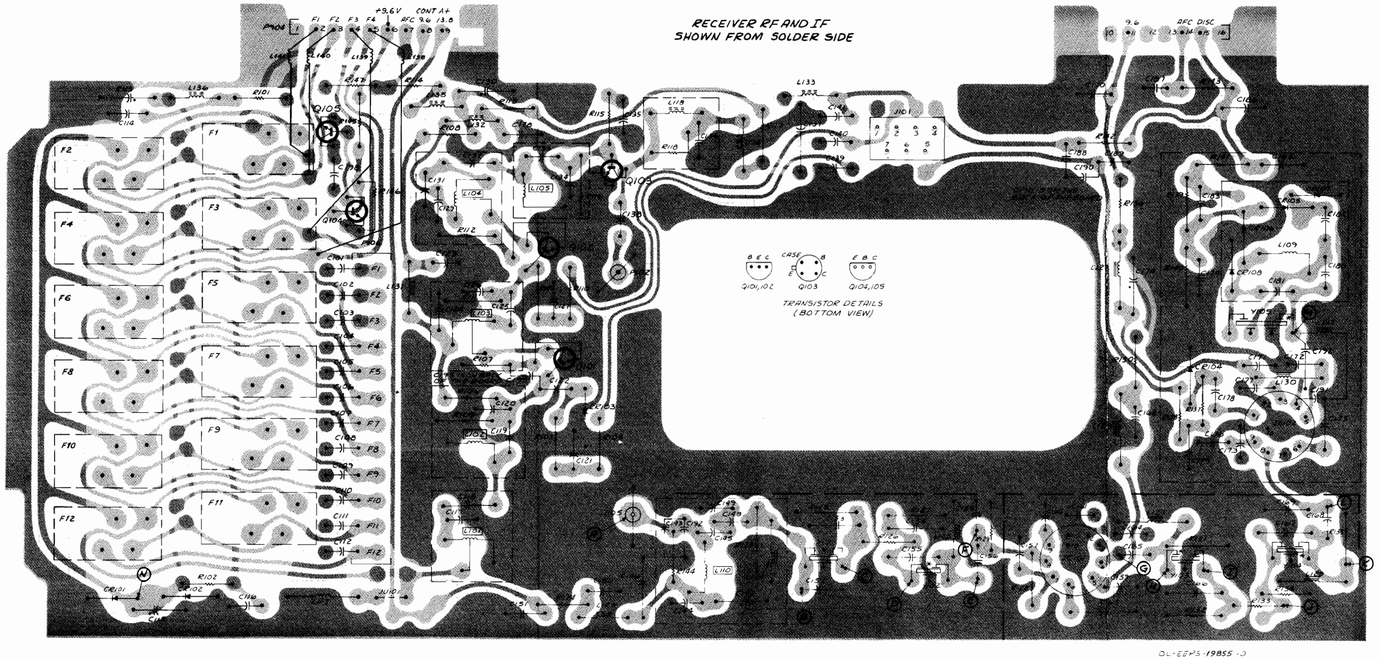
1. ALL COMPONENTS WITHIN THIS BOX ARE PHYSICALLY MOUNTED ON PRINTED CIRCUIT BOARD.
2. ALL CAPACITOR VALUES ARE IN pF UNLESS OTHERWISE STATED.
3. ALL VOLTAGE READINGS MEASURED WITH A 20,000 OHM-PER-VOLT MULTIMETER.
4. SEE PARTS LIST.

RF PREAMPLIFIER/RECEIVER RF & I-F BOARD

68P81042E62-O
3/28/79-PHI

RECEIVER RF & I-F BOARD

MODEL TRE1203BA-SP5



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(Sheet 1 of 2)
3/28/79-PHI

PARTS LIST

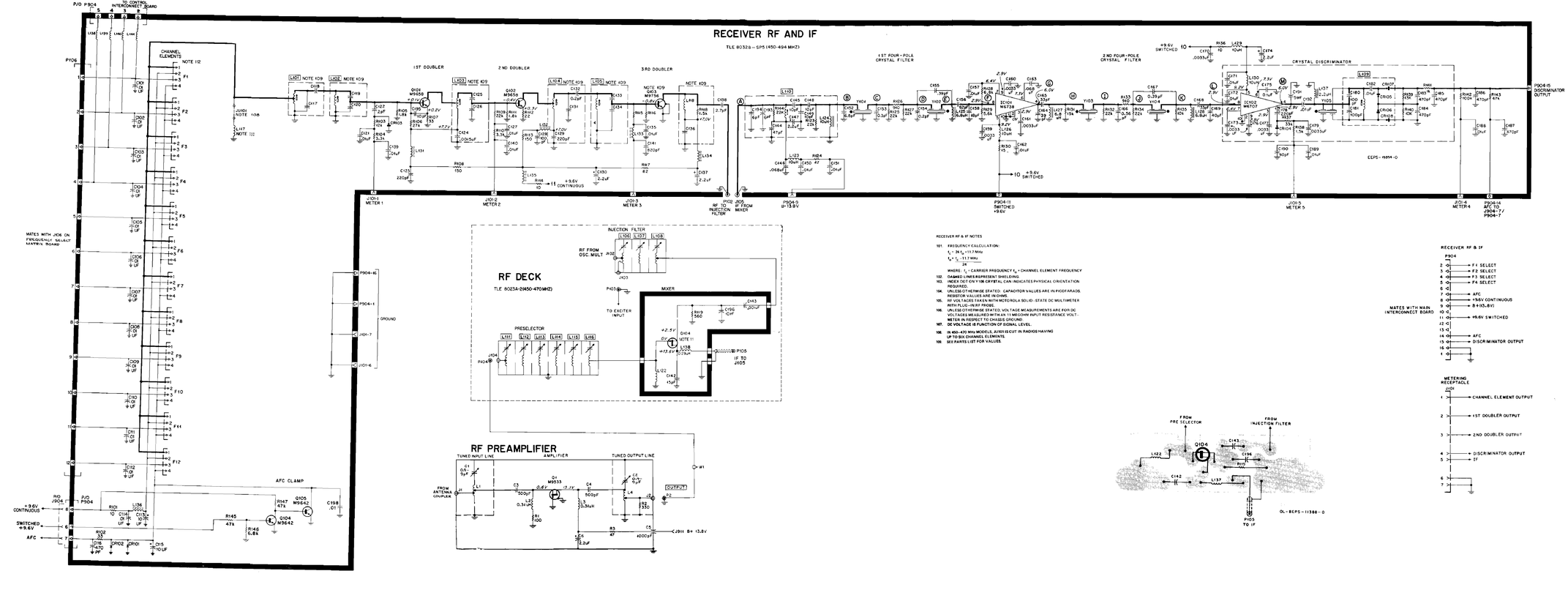
TLE8032B-SP5 (450-494 MHz)
Receiver RF & IF Board PL-4080-C

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: pF; ±5% 500 V; unless otherwise stated
C101 thru 112	21-82428B59	.01 uF +80-20%; 200 V
C113	23-84762H03	10 uF ±10%; 20 V
C114	21-82428B59	.01 uF +80-20%; 200 V
C115	23-84762H03	10 uF ±10%; 20 V
C116	21-82187B39	470 ±10%
C117	21-82133C44	18; N330
C118	21-82450B29	0.5;coded GRN-BRN-GRY-GOLD
C119	21-84493B44	33; 250 V; N150
C120	21-82610C44	100; 100 V; N220
C121	21-82428B59	.01 uF +80-20%; 200 V
C122	21-857336	2 ±0.25 pF; NP0
C123	21-82187B08	220 ±10%
C124	21-82187B11	.0015 uF ±10%; 100 V
C125	21-838912	8 +0.25 pF; N150
C126	21-82610C14	30; 200 V; N150
C127	21-82428B59	.01 uF +80-20%; 200 V
C128	21-831125	100 ±10%; 300 V; N750
C129	21-82187B08	220 ±10%
C130	23-84762H04	2.2 uF ±20%; 25 V
C131	21-857336	2.0 +.25 pF; NP0
C132	21-82450B35	0.2 ±10%; coded RED-BLK-GRAY-SILVER
C133	21-849320	4 +0.25 pF; N470
C134	21-82204B33	5 ±0.25 pF; N470
C135	21-82428B59	.01 uF +80-20%; 200 V
C136	21-82610C03	47; 200 V; N220
C137	23-84762H04	2.2 uF +20%; 25 V
C138	21-82355B30	2.7 +0.1 pF; NP0
C139, 140	21-82428B59	.01 uF +80-20%; 200 V
C141	21-82187B17	820 ±10%
C144	21-82610C03	47; 200 V N220
C145	21-82133G01	10; NP0
C146	8-82905G04	.068 uF ±10%; 50 V
C147	23-84762H04	2.2 uF ±20%; 25 V
C148, 149	21-82133G01	10; NP0
C150, 151	21-82428B59	.01 uF +80-20%; 200 V
C152	21-82133G33	6.8 +0.5 pF; NP0
C153	21-82450B04	0.3 ±10%; coded ORG-BLK-GRAY-SILVER
C154	21-82450B35	0.2 ±10%; coded RED-BLK-GRAY-SILVER
C155	21-82450B07	0.39; coded ORG-WHT-GRAY-GOLD
C156	21-82610C43	62; 100 V; NP0
C157	21-82428B59	.01 uF +80-20%; 200 V
C158	21-82133G29	18; NP0
C159,160,161	21-82428B57	.0033 uF ±10%; 200 V
C162	21-82428B59	.01 uF +80-20%; 200 V
C163	8-83813H05	.068 uF ±10%, 100 V
C164	21-82610C84	39; 450 V; NP0
	21-82355B09	33; NP0
C166	21-82450B33	0.56; coded GRN-BLU-GRAY GOLD
C167	21-82450B07	0.39; coded ORG-WHT-GRAY-GOLD
C168	21-82355B09	33; NP0
C169	21-82610C45	40; 100 V; NP0
C170	21-82428B57	.0033 uF ±10%; 200 V
C171, 172	21-82428B59	.01 uF +80-20%; 200 V
C173	21-82428B57	.0033 uF ±10%; 200 V
C174	23-84762H04	2.2 uF ±20%; 25 V
C175	8-83813H06	0.1 uF ±10%; 100 V
C176, 177	21-82428B57	.0033 uF ±10%; 200 V
C178	21-82187B08	220 ±10%
C179	21-82428B57	.0033 uF ±10%; 200 V
C180, 181	21-83798B01	100; 200 V; NP0
C182	21-82428B59	.01 uF +80-20%; 200 V
C183, 184	21-82187B07	470 ±10%
C185,186,187	21-82187B39	470 ±10%
C188	21-82428B59	.01 uF +80-20%; 200 V
C189	21-82428B57	.0033 uF ±10%; 200 V
C190	21-84493B24	40; N150
C191	21-82610C07	51; N150
C192	21-861443	.01 uF +100-20%; 75 V
C193, 194	21-840848	6 ±.5 pF; NP0
C195	21-82355B26	10 +0.25 pF; NP0
C197	21-82355B26	10 ±0.25 pF; NP0
C198	21-82428B59	0.01 uF +80-20%; 200 V

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		SEMICONDUCTOR DEVICE, diode:
CR101, 102	48-82392B13	silicon
CR103, 104	48-82139G01	germanium
CR105 thru 108	48-84616A01	silicon; hot carrier type
		INTEGRATED CIRCUIT:
IC101	51-84267A38	type M6738
IC102	51-84267A07	type M6707
		CONNECTOR, receptacle:
J105	9-84231B02	female; coaxial; miniature type
		COIL, RF:
L101	24-84972A15	BRN: 8-1/2 turns, tapped at 2-1/8 turns; includes tuning core
L102	24-84972A16	RED; 8-1/2 turns; includes tuning core
L103	24-84972A17	ORG; 6-1/2 turns, tapped at 1-7/8 turns; includes tuning core
L104	24-83857G07	YEL; 3-1/2 turns, tapped at 1-5/8 turns; includes tuning core
L105	24-83856G05	GRN; 3-1/2 turns; includes tuning core
L109	24-83879G04	YEL; 20 turns; includes tuning core
L110	24-84258B06	BLU; 16-2/3 turns; includes tuning core
L117	24-82542E01	.31 uH; choke
L118	24-82723H03	3 turns
L123	24-82723H07	choke; 10 uH; coded VIO
L124	24-82549D25	choke; 10 uH; shielded; coded (SILVER)-BRN-BLK-BLK-GOLD
L125	24-84250D02	choke; 6.8 uH; shielded; coded WHT-BLU-GOLD-GRAY-GOLD
L126	24-82723H07	choke; 10 uH; coded VIO
L127, 128	24-84250D02	choke; 6.8 uH; shielded; coded WHT-BLU-GOLD-GRAY-GOLD
L129, 130	24-82723H07	choke; 10 uH; coded VIO
L131 thru 136	24-83961B01	3 turns over ferrite bead; coded BRN
L137	24-84250D03	choke; 2.2 uH (shld.) coded WHT-RED-GOLD-RED-GOLD
		CONNECTOR, plug:
P102	28-84227B01	male; coaxial; miniature type
		TRANSISTOR:
Q101, 102	48-869658	NPN; type M9658
Q103	48-869756	NPN; type M9756
Q104, 105	48-869642	NPN; type M9642
P106		CONNECTOR, plug: (for reference only)
		RESISTOR, fixed: ±10%, 1/4 W unless otherwise stated
R101	6-129755	10
R102	6-127807	33k
R103	6-129230	12k
R104	6-129231	3.3k
R105	6-129269	1.8k
R106	6-127806	27k
R107	6-10401A13	33 ±5%
R108	6-129862	150
R109	6-128685	22k
R110	6-129231	3.3k
R111	6-129269	1.8k
R112	6-124A09	22 ±5%
R113	6-129862	150
R114	6-129755	10
R115	6-127807	33k
R116	6-127803	1.5k
R117	6-129224	82
R118	6-127803	1.5k
R123	6-129667	22k ±5%
R124	6-129233	47
R125	6-129667	22k ±5%
R126	6-131289	910 ±5%

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
R127	6-129867	22k ±5%
R128	6-129237	6.8k ±5%
R129	6-129982	5.6k ±5%
R130	6-131377	15
R131	6-129236	15k ±5%
R132	6-129667	22k ±5%
R133	6-131289	910 ±5%
R134	6-129667	22k ±5%
R135	6-129668	10k ±5%
R136	6-129755	10
R137	6-124C86	36k
R138	6-127803	1.5k
R139	6-10401A76	13k ±5%
R140	6S124A76	13k ±5%
R141	6-127802	1k
R142	6-129226	100k
R143	6-128902	47k
R144	6-10401C81	22k
R145	6-124C89	47k
R146	6-124G69	6.8k
R147	6-124C89	47k
		CRYSTAL UNIT, quartz 11.7 MHz
Y101	48-84755E01	i-f filter
*Y102	48-84755E01 or 48-84755E02	i-f filter
*Y103, 104	48-84755E01 or 48-84755E03	i-f filter
Y105	48-84754E01	discriminator

*When replacing Y102, Y103 or Y104, order Part No. 48-84755E01 only.



RECEIVER RF AND I-F BOARD

MODEL TRE1203BA-SP5

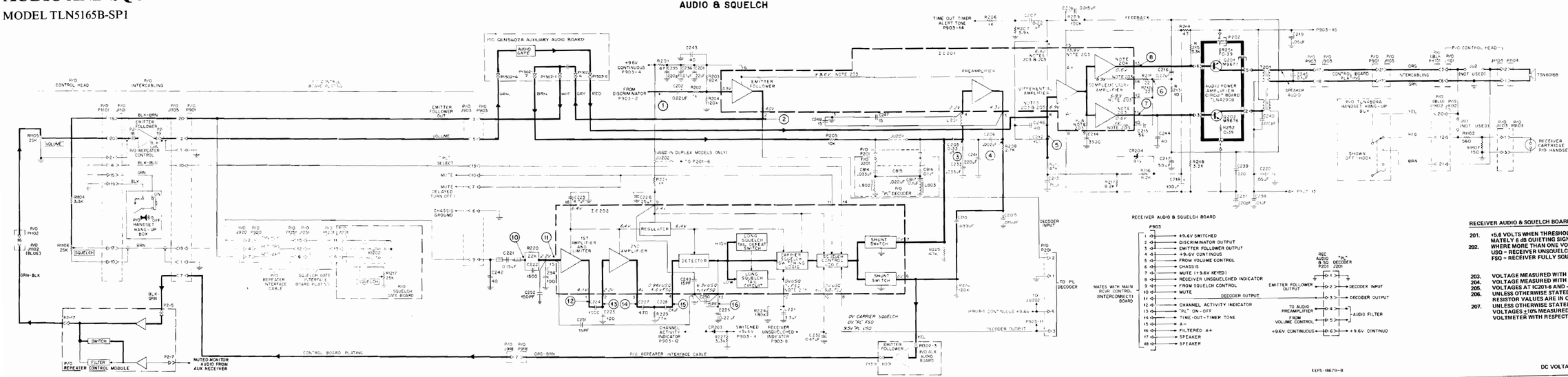
FUNCTION

In general the receiver rf and i-f board operates in the same manner and performs the same functions as the receiver rf and i-f board described in the basic radio set instruction manual. The only exception is the addition of four rf chokes (L138 thru L141) to the F1 thru F4 frequency select lines to the control (interconnect) board.

AUDIO AND SQUELCH BOARD

MODEL TLN5165B-SP1

AUDIO & SQUELCH



RECEIVER AUDIO & SQUELCH BOARD

201. +5.6 VOLTS WHEN THRESHOLD SIGNAL JUST OPENS SQUELCH (I.E., APPROXIMATELY 6 dB QUIETING SIGNAL WITH SQUELCH CONTROL AT THRESHOLD).
202. WHERE MORE THAN ONE VOLTAGE READING APPEARS:
USQ = RECEIVER UNSQUELCHED
FSQ = RECEIVER FULLY SQUELCHED
203. VOLTAGE MEASURED WITH RESPECT TO A–.
204. VOLTAGE MEASURED WITH RESPECT TO A+.
205. VOLTAGES AT IC201-6 AND -7 MUST BE THE SAME VALUE.
206. UNLESS OTHERWISE STATED: CAPACITOR VALUES ARE IN PICOFARADS. RESISTOR VALUES ARE IN OHMS.
207. UNLESS OTHERWISE STATED, VOLTAGE MEASUREMENTS ARE FOR DC VOLTAGES ±10% MEASURED WITH AN 11 MEGOHM INPUT RESISTANCE VOLTMETER WITH RESPECT TO CHASSIS GROUND.

EPS-6229-C

DC VOLTAGE TABLE FOR IC'S

IC201				IC202			
PIN	VOLTAGE	PIN	VOLTAGE	PIN	VOLTAGE	PIN	VOLTAGE
1	5.5 V	9	6.3 V NOTE 203	1	4.1 V	9	9.4 V
2	4.0 V	10	1.0 V NOTE 203	2	2.2 V	10	0 V USQ 8.0–9.0 V FSQ
3	0 V	11	0.6 V NOTE 203	3	4.0 V	11	– –
4	2.2 V	12	6.9 V NOTE 203	4	0.94 V USQ 1.6 V FSQ	12	0 V USQ 0 V FSQ NOTE 201
5	4.3 V	13	0.6 V NOTE 204	5	0 V	13	6.3 V USQ 1.1 V FSQ
6	6.9 V NOTES 203 & 205	14	6.9 V NOTE 203	6	0 V	14	– –
7	6.9 V NOTES 203 & 205	15	13.8 V NOTE 203	7	0 V	15	2.2 V
8	A–	16	9.8 V NOTE 203	8	0 V CARRIER SQ. 9.5 V "PL" USQ 0 V "PL" FSQ	16	6.4 V

EPS–16507–O

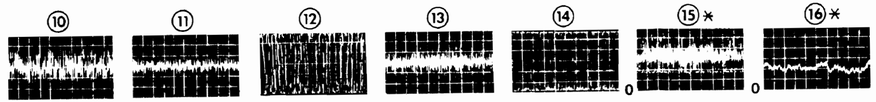
SQUELCH CIRCUIT WAVEFORMS

ALL SQUELCH CIRCUIT OSCILLOSCOPE WAVEFORMS TAKEN UNDER FOLLOWING CONDITIONS:

1. VERTICAL SENSITIVITY = 0.5 V/DIV.
2. HORIZONTAL DEFLECTION = 2 msec/DIV.
3. SQUELCH CONTROL FULLY CLOCKWISE (ON). NO EXTERNAL SIGNAL APPLIED.

*4. WAVEFORMS (15) AND (16) ARE DC COUPLED WITH ZERO AT BOTTOM, OTHERS AC COUPLED.

EPS-6534-O



AUDIO CIRCUIT WAVEFORMS

ALL AUDIO CIRCUIT OSCILLOSCOPE WAVEFORMS TAKEN UNDER FOLLOWING CONDITIONS:

1. VERTICAL SENSITIVITY SHOWN UNDER EACH WAVEFORM.
2. HORIZONTAL DEFLECTION = .25 msec/DIV.
3. SQUELCH CONTROL FULLY COUNTERCLOCKWISE (OFF). 1000 uV RF SIGNAL INPUT MODULATED WITH 1000 Hz TONE WITH ±3.3 kHz DEVIATION.
4. VOLUME CONTROL SET FOR 9.0 V rms AT LOAD.
5. OUTPUT TERMINATED IN 8-OHM LOAD.

EPS-7656-O

AUDIO AND SQUELCH BOARD

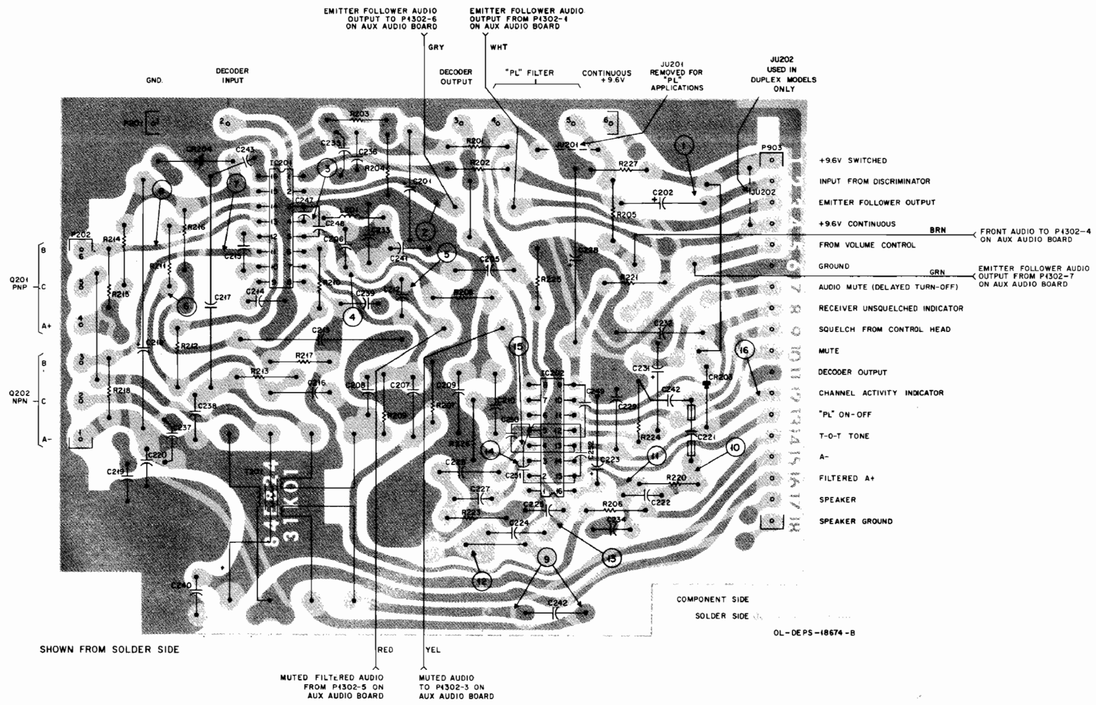
MODEL TLN5165B-SP1

PARTS LIST

TLN5165B-SP1 Audio & Squelch Board PL-3654-B

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: uF; ±10%; 100 V; unless otherwise stated
C201	23-83210A01	22 ±10%; 15 V
C202	8-83813H11	0.22; 75 V
C205	8-83813H29	0.33; 50 V
C206	21-82187B27	.002
C207	8-83813H11	0.22; 75 V
C208	21-82187B31	1500 pF
C209	8-83813H32	.015
C210	8-83813H09	.033
C212	21-84426B06	100 pF ±5%; 500 V
C213	23-84081B03	75 +150-10%; 15 V; NP0
C214	21-82187B43	.0039
C215	21-82133G35	56 pF ±5%; NP0
C216	8-83813H11	0.22; 75 V
C217	23-84081B01	50 +100-10%; 25 V; NP0
C218	23-83210A08	100 ±20%; 25 V
C219, 220	21-82372C04	.05 ±20%; 25 V
C221	8-82905629	0.15; 50 V
C222	21-84426B63	1500 pF; ±5%
C223	23-84762H07	4.7 ±20%; 25 V
C224	21-84493B05	1000 pF; N2200
C225	21-84426B06	100 pF ±5%; 500 V
C226	23-83210A01	25 +150-10%; 25 V
C227	21-84426B11	470 pF ±5%; 500 V
C228	8-83813H31	.01; 50 V
C229	8-83813H11	0.22; 75 V
C230		NOT USED
C231	23-84762H17	3.3 ±20%; 15 V
C232	23-84762H14	0.47 ±20%; 50 V
C233	8-83813H09	.033
C234	21-82610C58	100 pF; N750
C235	21-82428B60	220 pF
C236	21-82428B59	.01 uF
C237	21-82428B60	220 pF
C238	21-82428B59	.01 uF
C239, 240, 241	21-82428B60	220 pF
C242, 243, 244	21-82610C01	40 pF ±5%; 200 V
C245	8-82905C30	0.1 uF; 50 V
C246	21-82610C01	40 pF; ±5%; 200 V
C247 thru 251	21-861462	15 pF ±10%; N150
C252	21-863147	150 pF
		SEMICONDUCTOR DEVICE, diode:
CR201, 202		NOT USED
CR203	48-83654H01	silicon
CR204	48-82256C38	silicon; Zener type; 9.1 V ±0.45 V
		INTEGRATED CIRCUIT:
IC201	51-84267A08	type M6708
IC202	51-84267A09	type M6709
		COIL:
L201	24-82723H01	rf choke
		RESISTOR, fixed: ±5%; 1/4 W; unless otherwise stated
R201	6-129233	47 ±10%
R202	6-127802	1k ±10%
R203	6-124A95	82k
R204	6-131446	120k
R205	6-129668	10k
R206	6-127802	1k ±10%
R207	6-129819	3.9k
R208	6-129707	2.7k
R209	6-129226	100k ±10%
R210	6-131527	47k
R211, 212	6-124A09	22
R213	6-129755	10 ±10%
R214	6-129233	47 ±10%
R215	6-129981	3.3k
R216, 217	6-129983	8.2k
R218	6-129981	3.3k
R219		NOT USED
R220	6-129667	22k
R221	6-131377	15 ±10%
R222		NOT USED
R223	6-129886	27k
R224	6-129229	180k ±10%
R225	6-128902	47k ±10%
R226	6-128987	120k ±10%
R227	6-129231	3.3k ±10%

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
T201	25-84083B02	TRANSFORMER, AF: audio output
	NON-REFERENCED ITEMS	
	76-84069B01	Ferrite bead
	55-84300B02	HANDLE (short)
	3-136905	LOCKSCREW, tapping: #4 x 5/16" (4 req'd)
	42-84284B01	RETAINER, screw (4 req'd)
	55-84300B01	HANDLE (long)
	29-84028H02	PIN (short)
	29-84028H01	PIN (long)

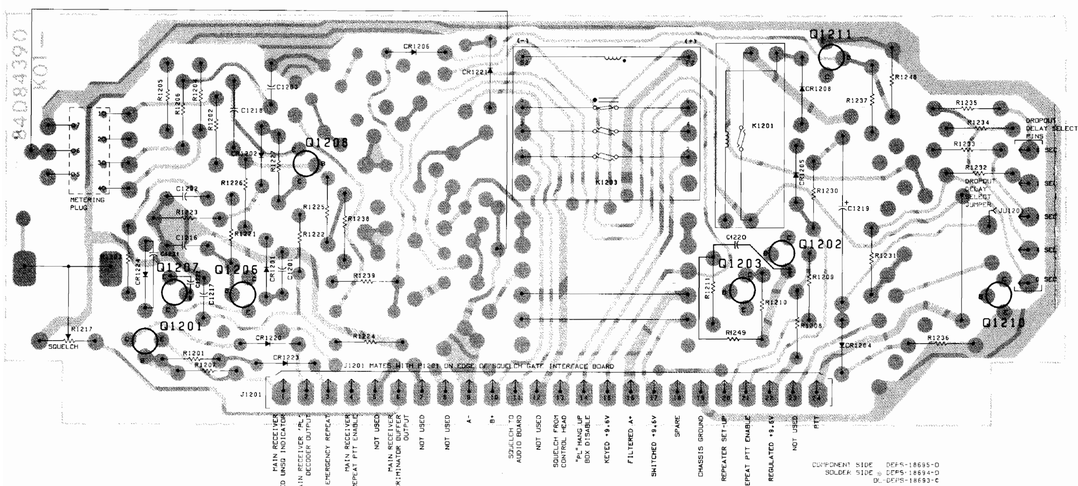


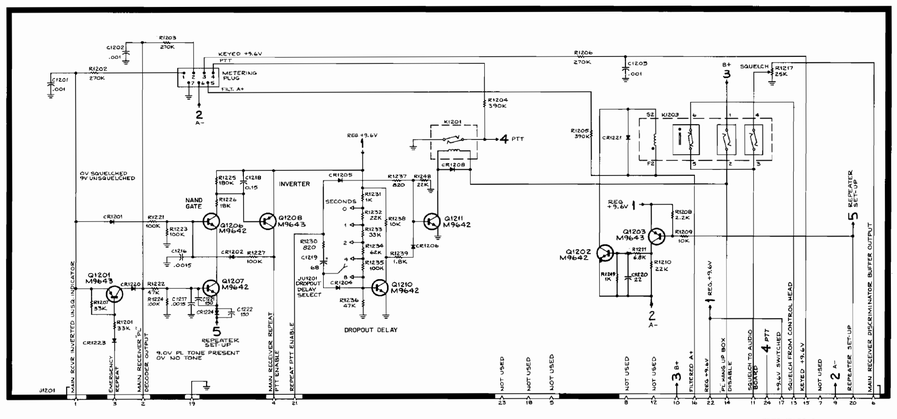
FUNCTION

Although the circuit operation is essentially the same as for the standard TRN6540A Audio and Squelch boards described in the attached UHF "Micor" radio set instruction manual, the main receiver audio signal path has been revised to permit additional processing of the repeat and moonitor audio signals. For details refer to the attached TLN5165B-SP1 Audio and Squelch Board schematic diagram. Note that the emitter follower output of IC201 is fed to the auxilliary audio board to provide the repeat audio signal. The audio signal is then returned to the audio and squelch board, and amplified in the preamplifier section of IC201. It then passes through the auxiliary audio board to the repeater control module where it is combined with the monitor audio from the auxiliary receiver. The resulting processed monitor audio is then applied to the differential amplifier input of IC201 by way of the volume control and the auxiliary audio board. Refer to the appropriate board descriptions and schematics for detailed circuit operation.

SQUELCH GATE AND SQUELCH GATE INTERFACE BOARD

MODELS QLN5603A AND QLN5604A





REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
PARTS LIST		
QLN5603A Squelch Gate Board		PL-3692-C
C1201, 1202, 1203	21-83596E13	CAPACITOR, fixed: .001 uF ±10%; 500 V
C1216, 1217	21-82428B38	.0015 uF +100-0%; 500 V
C1218	8-82905G05	0.15 uF ±10%; 50 V
C1219	23-865594	68 uF ±10%; 15 V
C1220	23-82397D16	22 uF ±20%; 15 V
C1221, 1222	21-863147	150 pF
CR1201 thru 1206	48-83654H01	DIODE: silicon
CR1208	48-82392B03	silicon
CR1220	48-83654H01	silicon
CR1221	48-82392B03	silicon
CR1223, 1224	48-83654H01	silicon
K1201	80-84157B01	RELAY: 1 form "A" coil res. 820 ohms
K1203	80-84157B02	2 form "A" 1 form "B"; coil res. 285 ohms
Q1201	48-869643	TRANSISTOR: PNP; type M9643
Q1202	48-869642	NPN; type M9642
Q1203	48-869643	PNP; type M9643
Q1206, 1207	48-869642	NPN; type M9642
Q1208	48-869643	PNP; type M9643
Q1210, 1211	48-869642	NPN; type M9642
R1201	6-124C85	RESISTOR, fixed: ±10%; 1/4 W; unless otherwise stated 33k
R1202, 1203	6-124D08	270k
R1204, 1205	6-124D12	390k
R1206	6-124D08	270k
R1207	6-124C85	33k
R1208	6-124C57	2.2k
R1209	6-124C73	10k
R1210	6-124C81	22k
R1211	6-124C69	6.8k
R1217	18-83083G24	var: 25k ±30%
R1221	6-124C97	100k
R1222	6-124C69	47k
R1223, 1224	6-124C97	100k
R1225	6-124D04	180k
R1226	6-124C79	18k
R1227	6-124C97	100k
R1228	6-124C71	8.2k
R1230	6-124C47	820
R1231	6-124C49	1k
R1232	6-124C81	22k
R1233	6-124C85	33k
R1234	6-124A92	62k ±5%
R1235	6-124C97	100k
R1236	6-124C89	47k
R1237	6-124C47	820
R1238	6-124C73	10k
R1239	6-124C55	1.8k
R1248	6-124C81	22k
R1249	6-124C49	1k

THEORY OF OPERATION

INTRODUCTION

When the radio set is in the duplex mode the squelch gate board has little effect on the radio operation except to connect continuous regulated +9.6 volts to the switched +9.6 volt inputs of the main receiver rf and i-f and audio and squelch boards. This keeps the receiver active while the transmitter is keyed.

REPEAT MODE SELECTION

When the repeat mode is selected, the repeater set-up line (pin 20) is low, energizing K1203 and enabling NAND gate Q1206-Q1207.

When K1203 is energized the following conditions exist:

- The control head squelch control is disabled.
- Squelch gate squelch control R1217 is connected to the main receiver audio and squelch board squelch input.
- B+ is applied to K1201 coil activating the repeater keying circuitry and permitting K1201 to energize with the correct repeat enable inputs. The contacts of K1201 are connected in parallel with the handset PTT switch and key the transmitter for repeat message transmissions.
- B+ is applied to the receiver PL "hang-up" box disable line. This switches the main receiver to carrier squelch operation to permit the local vehicle operator to monitor the repeater channel.

Enabling NAND gate Q1206-Q1207 allows the squelch gate board to assume control of the transmitter for repeater operation.

REPEATER OPERATION

If the radio set is in the repeat mode and the main receiver unsquelches, the following sequence of events occurs:

- If the receiver signal is strong enough to break squelch *and* contains the proper PL tone squelch, both inputs of NAND gate Q1206-Q1207 go high. The repeat PTT enable line (circuit board pin 4) then goes high.
- The high on the main receiver repeat PTT enable line is applied to the repeat priority switch on the auxiliary audio board. Depending on the repeat priority jumper option used, and whether the auxiliary receiver repeat PTT enable is present, the high level signal enables the repeat audio gate. The high is also OR'd with the auxiliary signal bufferred by repeat PTT buffer Q1307 and applied back to pin 21 of the squelch gate board.
- The repeat PTT enable high at pin 21 turns on Q1210 and Q1211, which energizes K1301, keying the transmitter.

ROAM OPERATION

If the ROAM pushbutton on the QLN1917B "Systems 90" Repeater Control Module has been pressed, pin 3 of the squelch gate board goes low. This low turns on Q1201 so the main receiver unsquelched indicator signal is applied at both inputs of NAND gate Q1206-Q1207. The transmitter then keys whenever the main receiver unsquelches, whether or not a proper PL tone is present.

TRANSMITTER DE-KEYING

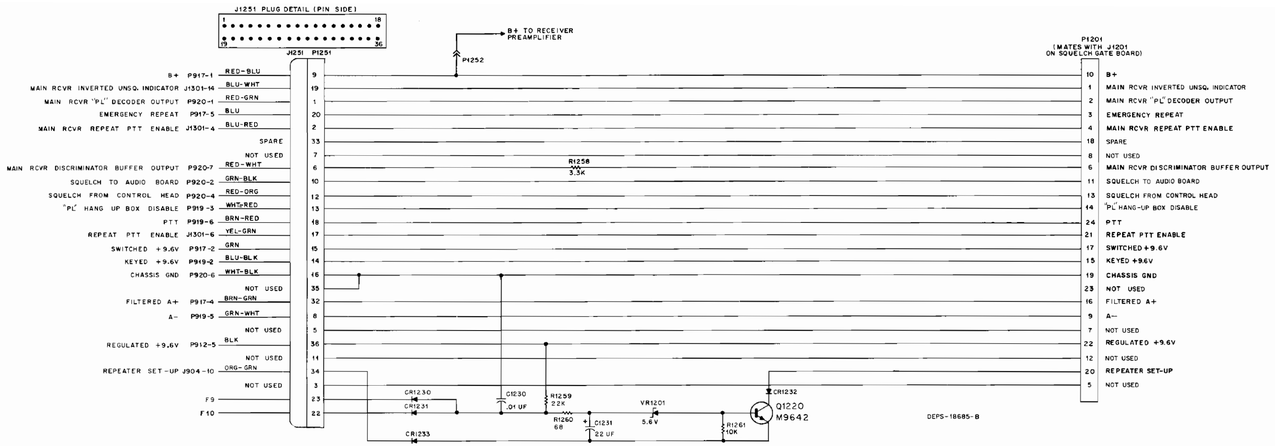
As soon as the main receiver squelches, NAND gate Q1206-Q1207 causes the repeat PTT enable out of inverter Q1208 to go low. This low turns off main receiver audio gate Q1301 on the auxiliary audio board to mute the main receiver audio input to the exciter. The low repeat PTT enable from the auxiliary audio board then turns Q1210 off and allows C1219 to begin charging through dropout delay resistors, keeping Q1211 on. When C1219 charges sufficiently, Q1210 turns on, turning Q1211 off. PTT relay K1201 de-energizes and the transmitter drops out. The transmitter dropout delay may be 0, 1, 2, 4, or 8 seconds, depending on the push-pin connection of J1202.

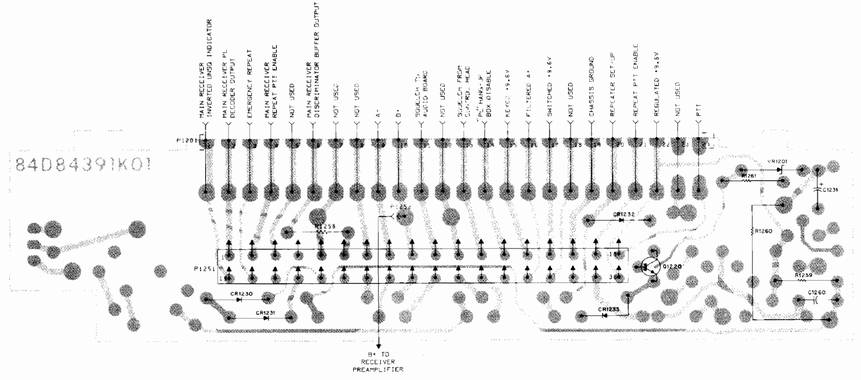
F9-F10 ROAM AND REPEAT INHIBIT

The two operational dispatch channels, F9 and F10, do not cause selection of channel elements on the auxiliary receiver and thus the auxiliary receiver is disabled when either of these frequencies is selected. To prevent repeat and roam operation if either of these frequencies is selected, gate Q1220 on the squelch gate interface board removes the ground from the repeater set-up line J1201-20. This disables NAND gate Q1206-Q1207 and de-energizes repeat mode relay K1203 via Q1202-Q1203 whenever F9 or F10 are selected.

CAUTION

Improper operation will occur, if both REPEAT and ROAM are selected while operating on F9 or F10.





SQUELCH GATE AND SQUELCH GATE INTERFACE BOARD

MODELS QLN5603A AND QLN5604A

FUNCTION

The QLN5603A Squelch Gate Board provides the following functions: (1) keeps receiver operational when the transmitter is keyed, (2) disables the audio mute function in the radio, (3) controls repeater squelch in the repeat mode, and (4) disables the handset hangup box PL switch input to the radio in the repeat mode. The QLN5604A Squelch Gate Interface Board provides interconnection to the radio via the QKN8134A Repeater Interface Cable.

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

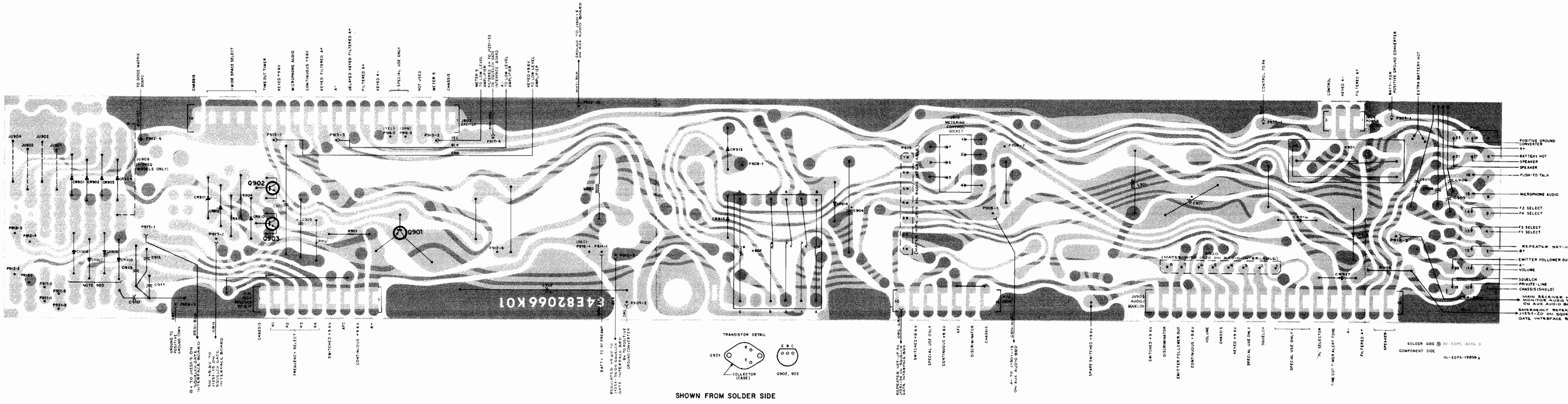
PARTS LIST

QLN5604A Squelch Gate Interface Board PL-3671-B

		CAPACITOR: (Axial)
C1230	21-82428B59	.01 uF ±10%; 100 V
C1231	23-84538C13	22 uF ±20%; 20 V
		DIODE:
CR1230, 1231, 1232, 1233	48-83654H01	Silicon
		RESISTOR:
R1258	6-124C61	3.3k ±10%; 1/4 W
R1259	6-124C81	22k ±10%; 1/4 W
R1260	6-124C21	68 ±10%; 1/4 W
R1261	6-124C73	10k ±10%; 1/4 W
		VOLTAGE REGULATOR:
VR1201	48-82256C12	Zener; 5.6 V

CONTROL (INTERCONNECT) BOARD

MODEL TLN4930C-SP16



68P81042E74-O
(Sheet 1 of 2)
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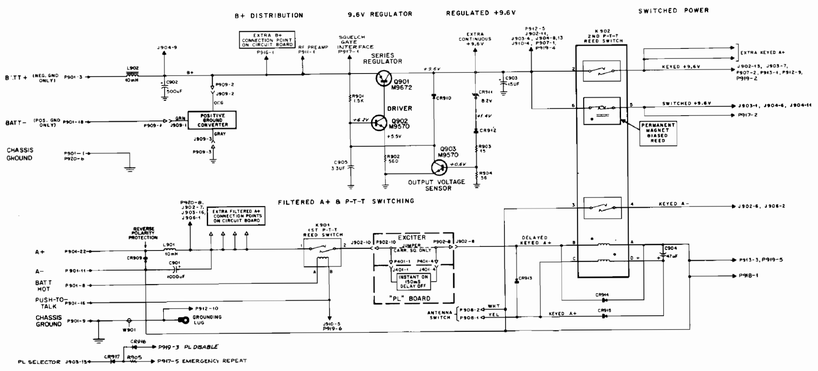
PARTS LIST

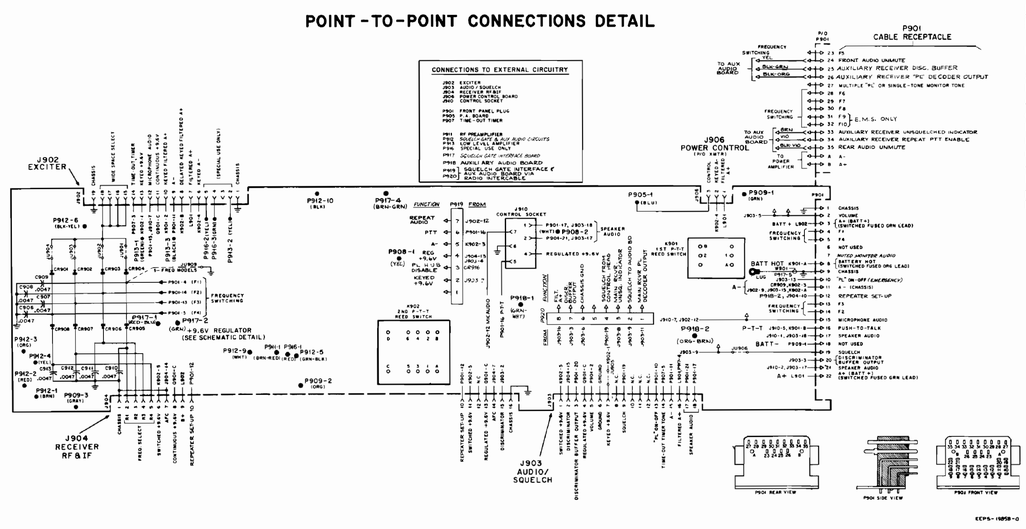
TLN4930C-SP16 Control (Interconnect) Board PL-4079-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed:
C901	23-82394A16	1000 uF +150-10%; 25 V
C902	23-83210A23	500 uF +150-10%; 25 V
C903	23-82601A31	15 uF +33-10%; 25 V
C904	23-82783B31	47 uF ±20%; 20 V
C905	23-83214C17	3.3 uF ±20%; 15 V
C906 thru 913	21-82428B09	0.0047 uF; ±10%; 200 V
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR901 thru 908	48-82392B03	silicon
CR909	48-82525G13	silicon
CR910	48-82392B03	silicon
CR911	48-83461E32	silicon; Zener type; 8.2 V ±3%
CR912 thru 917	48-82392B03	silicon
J910	9-84207B01	CONNECTOR, receptacle: female; 7-contact
K901	80-84157B01	SWITCH, magnetic reed: 13.4 V 1 form "A" (coil res 820 ohms ±10% 2 form "A"; 1 form "B" (biased with permanent magnet) 2 coil; 1st coil res 285 ohms ±10% 2nd coil res 285 ohms ±10%.
K902	80-84157B02	
P901	28-84085B01	CONNECTOR, plug: male; 37-contact
Q901	48-869672	TRANSISTOR: (SEE NOTE B PNP; type M9672
Q902, 903	48-869570	NPN; type M9570
R901	6-127803	RESISTOR, fixed: 1/4 W 1.5k ±10%
R902	6-129620	560 ±10%
R903	6-124A05	15 ±5%
R904	6-124A19	56 ±5%
R905	6-127802	1k ±10%

SCHEMATIC DETAIL



POINT-TO-POINT CONNECTIONS DETAIL



FUNCTION

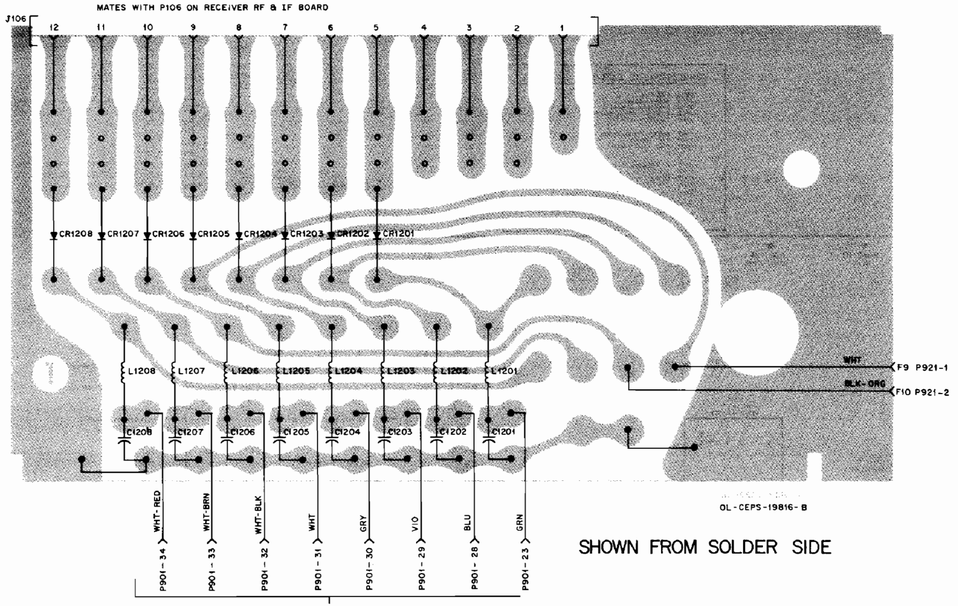
In general, the main receiver control (interconnect) board operates in the same manner and performs the same functions as the control (interconnect) board described in the basic radio set instruction manual. Diodes CR917 and CR918 and resistor R905 are added to allow the squelch gate board to disable PL in repeater modes. Connectors P917, P918, P919, and P920 are added to provide interconnect points for the QKN8134A Repeater Interface Cable. Capacitors C906 thru C913 provide additional decoupling on the frequency select lines.

FREQUENCY SELECT MATRIX BOARD

MODEL QLN5970A

FUNCTION

The frequency select matrix board provides the additional diode matrix for selection of frequencies F5 through F12. The select inputs from the radio front plug P901 connect through intercabling to the matrix board.



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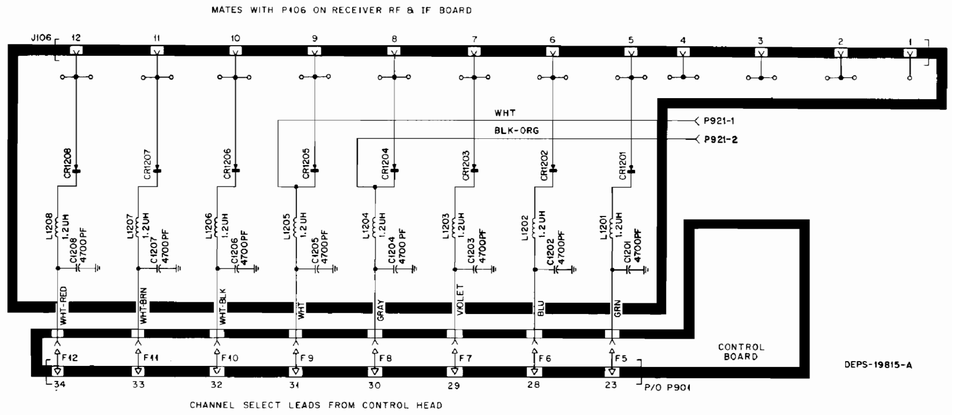

PARTS LIST

QLN5970A Frequency Select Matrix Board PL-4073-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
C1201 thru 1208	21-82213E06	CAPACITOR, fixed: 4700 pF; 20%; 100 V
CR1201 thru 1208	48-82392B03	SEMICONDUCTOR DEVICE, diode: silicon
L1201 thru 1208	24-82723H01	COIL, RF: 1.2 uH
J106		CONNECTOR, receptacle: consists of: 9B83011H01; PIN, female; 12 req'd.

AUXILIARY AUDIO BOARD

MODEL QLN7225A

1. INTRODUCTION

The QLN7225A Auxiliary Audio Board is designed specifically for use in a duplex/multiplex Emergency Medical Service (EMS) mobile repeater system. The board is different from the Motorola Model QLN5855A Auxiliary Audio Board (described in Motorola UHF Duplex/Repeater with Auxiliary Receiver Manual 68P81029E45) used in other EMS repeater systems in that main receiver repeat audio is processed on a separate repeat audio processing module instead of on the auxiliary audio board itself. Gating of main receiver audio, however, is still controlled by this auxiliary audio board. The board physically mounts in the "Micor" FM two-way duplex/repeater radio and performs the following function:

- Auxiliary receiver audio signal processing -- In repeater operation the auxiliary receiver audio signal is applied to the exciter audio input. The auxiliary audio board circuits filter out the "PL" tone, provide de-emphasis, and determine the auxiliary receiver repeat audio level at the exciter audio input.

- Monitor audio muting -- Monitor audio is muted in the receivers under non-intercom and no-signal conditions.

- Unsquelched indicator inversion and buffering (main receiver only) -- The unsquelched indicator signal from the main receiver audio & squelch board is inverted and amplified before application to the repeater control logic circuits on the squelch gate board.

- Repeat priority logic -- establishes priority of repeat audio between the auxiliary receiver and main receiver when the system is in repeat mode.

1. Main receiver has priority -- jumper JU6 used.

2. Auxiliary receiver has priority -- jumper JU5 used.

3. First come—first serve priority -- jumpers JU5 and JU6 used.

4. No priority -- jumpers JU5 and JU6 omitted.

2. CIRCUIT DESCRIPTION

2.1 AUXILIARY RECEIVER REPEAT AUDIO CIRCUIT

2.1.1 In repeat operation receiver audio gate Q1302 passes audio from the emitter follower of the audio and squelch board in the auxiliary receiver to the input of repeat audio preamplifier U1301A. When the radio set is in the duplex mode or is unsquelched, the output of AND gate CR1303—CR1304 is low, keeping Q1302 turned off. If jumper JU1303 is in, the board is connected for the PL repeat mode. Audio gate Q1302 turns on only when repeater PTT enable and the receiver PL decoder output both go high. This makes the output of AND gate CR1303—CR1304 go high. If jumper JU1304 is in (and JU1303 is out) the board is connected for carrier squelch repeat operation. The AND gate output goes high and the respective receiver audio gate passes audio when repeat PTT enable and the inverted unsquelched indicator of the auxiliary receiver are both high. As shipped from the factory, JU1303 is inserted, connecting the unit for PL repeat operation.

CAUTION

Incorrect operation will result if both jumpers (JU1303 and JU1304) are connected.

2.1.2 Repeat audio amplifiers U1301A and U1301B amplify and de-emphasize the signal from the audio gates in repeater operation. Auxiliary receiver

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audio adjust R1309 sets the auxiliary receiver audio level to match the main receiver audio level. Repeat level adjust R1313 establishes the repeat audio audio output level and high-pass filter C1306—L1301—C1307—C1308—L1302 removes low-frequency components, such as PL tones, from the repeat audio signal.

2.2 MAIN RECEIVER REPEAT AUDIO ENABLE

Transistor Q1301 controls the gating of main receiver repeat audio on the repeat audio processing board. When Q1301 is off pulldown resistor R22 on the repeat audio processing board turns off Q3 allowing the gate of Q2 to go high which enables audio to pass through Q2. When Q1301 is conducting it puts a high logic level (≃3.2 volts) on the base of Q3 turning that transistor on to disable Q2 and prevent audio from passing through.

2.3 AUDIO MUTING

Front and rear audio muting circuits are included on the auxiliary audio board for those installations that include optional dual control accessories. In single- control systems front audio gate Q1309 is turned on whenever either receiver is unmuted.

2.4 AUDIO BUFFER

Audio buffer Q1310 matches the monitor audio output from the preamplifier stage of IC201 on the audio and squelch board to the muted monitor audio input of the "Systems 90" Repeater Control Module.

2.5 UNSQUELCHED INDICATOR INVERTER

Unsquelched indicator inverter Q1303—Q1304 inverts the unsquelched indicator from IC202 on the audio and squelch board and buffers the signal for application to the squelch gate board. The unsquelched indicator goes low when either receiver unsquelches.

2.6 REPEAT AUDIO PRIORITY SWITCH

2.6.1 The repeat audio priority switch determines which receiver audio signal will have priority for repeat transmission purposes. Jumpers JU1305 and JU1306 provide four operational repeat priority modes as follows:

REPEAT PRIORITY	JU1305	JU1306
Main Receiver	Out	In
Auxiliary Receiver	In	Out
First receiver enabled	In	In
No priority, either or both	Out	Out

2.6.2 As shipped from the factory, both jumpers are fitted, giving repeat priority to the first receiver to be enabled. If some other priority mode is desired, determine from the table above which jumper(s) should be removed.

2.6.3 In the repeat mode, with both receivers squelched, the repeat PTT enable inputs to the repeat audio priority switch are low, the outputs of NAND gates U1302C and U1302D are high, and the outputs of inverters U1302A and U1302B are low, turning off audio gates Q1301 and Q1302 and making the output of repeater PTT enable buffer Q1307 low.

2.6.4 If the main receiver receives a proper on-channel signal, the corresponding repeat PTT enable input goes high, causing NAND gate U1302D output to go low, driving U1302A inverter output high. If the auxiliary receiver receives a proper on-channel signal, its corresponding repeat PTT enable input also goes high. (1) If JU1306 is connected, NAND gate U1302C inputlow by the low output at U1302D pin 11. This inhibits NAND gate U1302C, its output remains high, and the auxiliary receiver repeat PTT enable input has no effect. (2) If JU1306 is not connected, or the main receiver repeat PTT enable input is not present, then the output of NAND gate U1302C will go low, driving inverter U1302B output high. (3) If JU1305 is connected, and the main receiver repeat PTT enable is present, then the low output of NAND gate U1302C will drive NAND gate U1302D input pin 12 low and output pin 11 high. The main receiver repeat PTT enable input is thus inhibited until the auxiliary receiver input is removed.

2.6.5 A high level output at inverter U1302A or U1302B enables the corresponding diode AND gate CR1301—CR1302 or CR1303—CR1304 at the inputs to repeat audio gates Q1301 and Q1302. Depending on the connections for JU1301, JU1302, JU1303 or JU1304, the enabled repeat audio gate will then turn on with proper PL decoder output or unsquelched indicator.

2.6.6 The high level output at inverter U1302A or U1302B is also fed to repeat PTT buffer Q1307 through diode OR gate CR1311—CR1312, producing a high level repeat PTT enable output to the squelch gate.

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

PARTS LIST

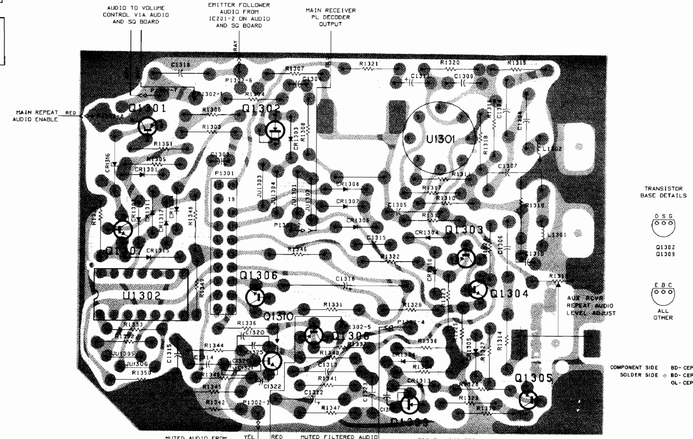
QLN7225A Auxiliary Audio Board (with Dup/Mux) PL-4571-O

		CAPACITOR, fixed: ±F ±10%; 50 V: unless otherwise stated
C1303, 1304	23-84538C01	1.0 +20%, 35 V
C1305	8-82905G26	.0047; 100 V
C1306	8-82905G08	.033
C1307	8-82905G02	.022
C1308	8-82905G30	0, 1
C1309	21-84494B11	200 pF ±5%; 500 V
C1310	23-84538C01	1.0 +20%; 35 V
C1311	23-84538G04	15 +20%; 20 V
C1312, 1313	23-82783B26	1.0; 35 V
C1314	23-84538G04	15 +20%; 20 V
C1315	21-82372C01	0, 1 +80-20%; 25 V
C1316	23-82783B31	47 +20%; 20 V
C1317	21-82372C01	0, 1 +80-20%; 25 V
C1318	8-83813H11	0, 22; 75 V
C1319 thru 1322	21-86146Z	15 pF
C1324	21-82372C01	0, 1; +80-20%; 25 V
C1329	21-86146Z	15 pF
		DIODE: (SEE NOTE)
CR1301 thru 1315	48-83654H01	silicon
		COIL, RF:
L1301, 1302	24-84003A01	choke: 6 H
		TRANSISTOR: (SEE NOTE)
Q1301	48-869643	PNP; type M9643
Q1302	48-869652	field-effect; type M9652
Q1303, 1304	48-869642	NPN; type M9642
Q1305	48-869643	PNP; type M9643
Q1306, 1307	48-869642	NPN; type M9642
Q1308	48-869643	PNP; type M9643
Q1309	48-869652	field-effect; type M9652
Q1310	48-869642	NPN; type M9642
		RESISTOR, fixed: ±5%; 1/4 W; unless otherwise stated
R1303, 1304	6-124B06	220k
R1305, 1306	6-124A97	100k
R1307	6-124A83	27k
R1308	6-124A75	12k
R1309	18-83083G24	var; 25k
R1310, 1311	6-124B18	680k
R1312	6-124A91	56k
R1313	18-83083G24	var; 25k
R1314	6-124A73	10k
R1315	6-124A61	3.3k
R1316, 1317	6-124B18	680k
R1318	6-124A75	10k
R1319	6-124A75	12k
R1320	6-124A99	120k
R1321	6-124A43	560
R1322	6-124A89	47k
R1323	6-124B14	470k
R1324	6-124A73	10k
R1325	6-124A67	5.6k
R1326	6-124A43	560
R1327	6-124A97	100k
R1328	6-124B16	560k
R1329	6-124A83	27k
R1331	6-124A49	1k
R1332, 1333	6-124A97	100k
R1334	6-124A43	560
R1335	6-124A67	5.6k
R1336	6-124A89	47k
R1337, 1338	6-124A73	10k
R1339	6-124A97	100k
R1340, 1341	6-124B06	220k
R1342	6-124A89	47k
R1343	6-124A43	560
R1344	6-124A89	47k
R1345	6-124A65	4.7k
R1346	6-124A21	68
R1347	6-124A45	680
R1348	6-124A77	15k
R1349, 1350	6-124A73	10k
R1351	6-124A83	27k

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
VR1301	48-82256C12	VOLTAGE REGULATOR: (SEE NOTE) zener 5.6 V

NOTE:

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



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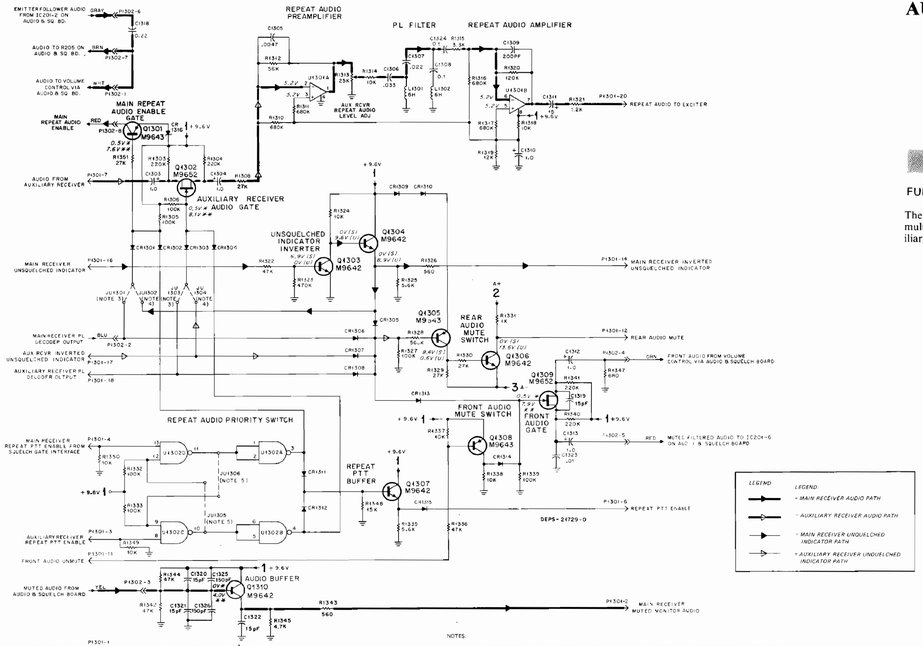

NOTES:

1. UNLESS OTHERWISE NOTED, CAPACITOR VALUES ARE IN MICROFARADS AND RESISTOR VALUES ARE IN OHMS.
2. P1302 CONSISTS OF PUSH PINS ON CIRCUIT BOARD.
3. WHEN J1301 AND J1302 ARE INSERTED, THE REPEAT AUDIO GATE WILL UNMUTE ONLY IF THE CORRECT PL TONE IS RECEIVED.
4. WHEN J1302 AND J1304 ARE INSERTED, THE REPEAT AUDIO GATE WILL UNMUTE WHEN AN ON-CHANNEL SIGNAL IS RECEIVED.
5. JU1305 AND JU1306 ARE REPEAT PTT PRIORITY JUMPERS CONNECT AS FOLLOWS:

REPEAT PTT PRIORITY	JU1305	JU1306
MAIN RECEIVER	OUT	IN
AUXILIARY RECEIVER	IN	OUT
FIRST ENABLED	IN	IN
EITHER OR BOTH	OUT	OUT

6. ON U1302 V_{CC} IS CONNECTED TO PIN 14 AND GROUND IS CONNECTED TO PIN 7.
7. WHEN MORE THAN ONE VOLTAGE IS GIVEN THE FOLLOWING NOTATIONS APPLY:
   - * - MUTED
   - ** - UNMUTED
   - (SQ) - SQUELCHED
   - (US) - UNSQUELCHED

AUXILIARY AUDIO BOARD

MODEL QLN7225A

FUNCTION

The Auxiliary Audio Board is used in EMS duplex multiplex systems to process the audio from the auxiliary receiver in the mobile duplex-repeater radio.

QLN7225A Auxiliary Audio Board
Schematic Diagram
Motorola No. PEPS-21730-A
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AUXILIARY AUDIO BOARD

MODEL QLN5855A

[redacted]

FUNCTION

This board performs the following functions: (1) auxiliary receiver audio signaling processing, (2) monitor audio muting, (3) unsquelched indicator inversion and buffering, (4) repeat priority logic, and (5) main receiver repeat audio processing. It is intended for use in EMS systems without duplex multiplex.

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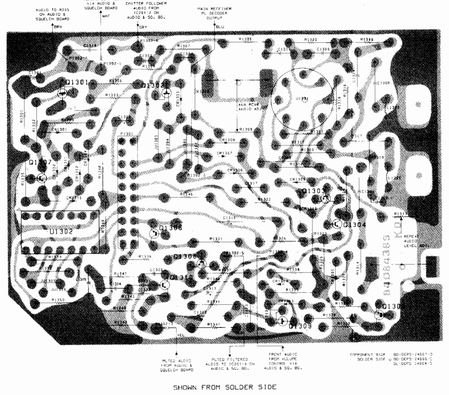
PARTS LIST

QLN5855A Auxiliary Audio Board — PL-4032-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: pF ±10%, 50 V; unless otherwise stated
C1301 thru C1304	23-84538G01	1.0 ±20%: 35 V
C1305	8-82905G26	.0047; 100 V
C1306	8-82905G08	.033
C1307	8-82905G02	.022
C1308	8-82905G30	0.1
C1309	21-84494B11	200 pF ±5%; 500 V
C1310	23-84539G01	1.0 ±20%; 35 V
C1311	23-84538G04	15 ±20%; 20 V
C1312,1313	23-82783B26	1.0; 35 V
C1314	23-84538G04	15 ±20%; 20 V
C1315	21-82372C01	0.1 +80-20%; 25 V
C1316	23-82783B31	47 ±20%; 20 V
C1317	21-82372C01	0.1 +80-20%; 25 V
C1318	8-83813H11	0.22; 75 V
C1319 thru 1322	21-861462	15 pF; N150
C1324	8-82905G30	0.1
CR1301 thru 1315	48-83654H01	DIODE: silicon
L1301, L1302	24-84003A01	COIL, RF: choke; 6 H
Q1301,1302	48-869652	TRANSISTOR: field-effect; type M9652
Q1303,1304	48-869642	NPN; type M9642
Q1305	48-869643	PNP; type M9643
Q1306,1307	48-869642	NPN; type M9642
Q1308	48-869643	PNP; type M9643
Q1309	48-869652	field-effect; type M9652
Q1310	48-869642	NPN; type M9642
R1301 thru R1304	6-124B06	RESISTOR, fixed: ±5%; 1/4 W, unless otherwise stated: 220k
R1305,1306	6-124A97	100k
R1307	6-124A83	27k
R1308	6-124A75	12k
R1309	18-83083G24	var; 25k
R1310, 1311	6-124B18	680k
R1312	6-124A91	56k
R1313	18-83083G24	var; 25k
R1314	6-124A73	10k
R1315	6-124A61	3.3k
R1316, 1317	6-124B18	680k
R1318	6-124A73	10k
R1319	6-124A75	12k
R1320	6-124A99	120k
R1321	6-124A50	1.2k
R1322	6-124A89	47k
R1323	6-124B14	470k
R1324	6-124A73	10k
R1325	6-124A67	5.6k
R1326	6-124A43	560
R1327	6-124A97	100k
R1328	6-124B16	560k
R1329, 1330	6-124A83	27k
R1331	6-124A49	1k
R1332, 1333	6-124A97	100k
R1334	6-124A43	560
R1335	6-124A67	5.6k
R1336	6-124A89	47k
R1337, 1338	6-124A73	10k
R1339	6-124A97	100k
R1340, 1341	6-124B06	270k
R1342	6-124A89	47k
R1343		NOT USED
R1344	6-124A89	47k
R1345	6-124A65	4.7k
R1346	6-124A21	68
R1347	6-124A45	680
R1348	6-124A77	15k
R1349,1350	6-124A73	10k
U1301	51-843720A27	INTEGRATED CIRCUIT: type M2027
U1302	51-82822F08	type M22F08

LATER VERSION



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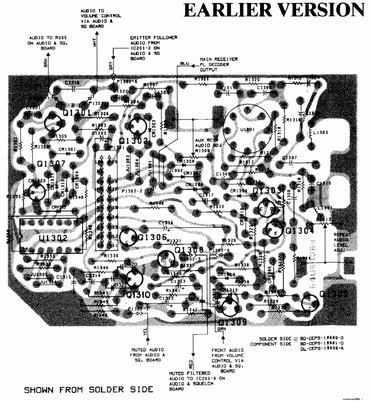
EARLIER VERSION



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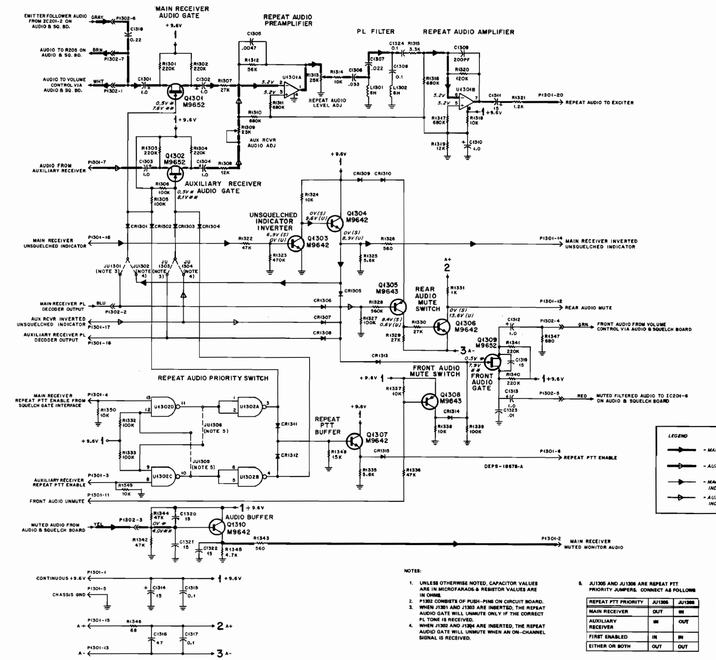


NOTES:
1. UNLESS OTHERWISE NOTED, CAPACITOR VALUES ARE IN MICROFARADS & RESISTOR VALUES ARE IN OHMS.
2. P1302 CONSISTS OF PUSH-PINS ON CIRCUIT BOARD.
3. WHEN P1305-15 IS GROUNDED THROUGH THE REPEAT AUDIO GATE WILL UNMUTE ONLY IF THE CORRECT PL TONE IS RECEIVED.
4. WHEN JUMPERS AND /OR ARE INSERTED, THE REPEAT AUDIO GATE WILL UNMUTE WHEN AN ON-CHANNEL SIGNAL IS RECEIVED.
5. JU1305 AND JU1306 ARE REPEAT PTT PRIORITY JUMPERS. CONNECT AS FOLLOWS:

REPEAT PTT PRIORITY	JU1305	JU1306
MAIN RECEIVER	OUT	IN
AUXILIARY RECEIVER	IN	OUT
FIRST ENABLED	IN	IN
EITHER OR BOTH	OUT	OUT

6. ON U1302 V_{CC} IS CONNECTED TO PIN 14 AND GROUND IS CONNECTED TO PIN 7.
7. WHERE MORE THAN ONE VOLTAGE IS GIVEN THE FOLLOWING NOTATIONS APPLY:
"-" MUTED
"*" — UNMUTED
ISB — BOOSTLAND
IUB — UNBOOSTLAND

THEORY OF OPERATION

REPEAT AUDIO CIRCUITS

In repeat operation receiver audio gates Q1301 and Q1302 pass audio from the emitter follower of the audio and squelch board of the main receiver and/or the emitter follower of the squelch gate board in the auxiliary receiver to the input of repeat audio preamplifier U1301A. When the radio set is in the duplex mode or is unsquelched, the outputs of AND gates CR1301-CR1302 and CR1303-CR1304 are low, keeping Q1301 and Q1302 turned off. If jumpers JU1301 and JU1303 are in, the board is connected for the PL repeat mode. Audio gate Q1301 or Q1302 turns on only when repeater PTT enable and the respective receiver PL decoder output both go high. This makes the output of AND gate CR1301-CR1302 or CR1303-CR1304 go high. If jumpers JU1302 and JU1304 are in (and JU1301 and JU1303 are out) the board is connected for carrier squelch repeat operation. The respective AND gate output goes high and the respective receiver audio gate passes audio when repeat PTT enable and the inverted unsquelched indicator of the main receiver and/or auxiliary receiver are both high. As shipped from the factory, JU1301 and JU1303 are inserted, connecting the unit for PL repeat operation.

CAUTION

Incorrect operation will result if all four jumpers (JU1301, JU1302, JU1303, and JU1304) are connected.

Repeat audio amplifiers U1301A and U1301B amplify and de-emphasize the signal from the audio gates in repeater operation. Auxliary receiver audio adjust R1309 sets the auxiliary receiver audio level to match the main receiver audio level. Repeat level adjust R1313 establishes the repeat audio output level and high-pass filter C1306-L1301-C1307-C1308-L1302 removes low-frequency components, such as PL tones, from the repeat audio signal.

AUDIO MUTING

Front and rear audio muting circuits are included on the auxiliary audio board for those installations that include optional dual control accessories. In single-control systems front audio gate Q1309 is turned on whenever either receiver is unmuted.

AUDIO BUFFER

Audio buffer Q1310 matches the monitor audio output from the preamplifier stage of IC201 on the audio and squelch board to the muted monitor audio input of the "Systems 90" Repeater Control Module.

UNSQUELCHED INDICATOR INVERTER

Unsquelched indicator inverter Q1303-Q1304 inverts the unsquelched indicator from IC202 on the audio and squelch board and buffers the signal for application to the squelch gate board. The unsquelched indicator goes low when either receiver unsquelches.

REPEAT AUDIO PRIORITY SWITCH

The repeat audio priority switch determines which receiver audio signal will have priority for repeat transmission purposes. Jumpers JU1305 and JU1306 provide four operational repeat priority modes as follows:

REPEAT PRIORITY	JU1305	JU1306
Main Receiver	Out	In
Auxiliary Receiver	In	Out
First receiver enabled	In	In
No priority, either or both	Out	Out

As shipped from the factory, both jumpers are fitted, giving repeat priority to the first receiver to be enabled. If some other priority mode is desired, determine from the table above which jumper(s) should be removed.

In the repeat mode, with both receivers squelched, the repeat PTT enable inputs to the repeat audio priority switch are low, the outputs of NAND gates U1302C and U1302D are high, and the outputs of inverters U1302A and U1302B are low, turning off audio gates Q1301 and Q1302 and making the output of repeater PTT enable buffer Q1307 low.

If the main receiver receives a proper on-channel signal, the corresponding repeat PTT enable input goes high, causing NAND gate U1302D output to go low, driving U1302A inverter output high. If the auxiliary receiver receives a proper on-channel signal, its corresponding repeat PTT enable input also goes high. (1) If JU1306 is connected, NAND gate U1302C input pin 9 is held low by the low output at U1302D pin 11. This inhibits NAND gate U1302C, its output remains high, and the auxiliary receiver repeat PTT enable input has no effect. (2) If JU1306 is not connected, or the main receiver repeat PTT enable input is not present, then the output of NAND gate U1302C will go low, driving inverter U1302B output high. (3) If JU1305 is connected, and the main receiver repeat PTT enable is present, then the low output of NAND gate U1302C will drive NAND gate U1302D input pin 12 low and output pin 11 high. The main receiver repeat PTT enable input is thus inhibited until the auxiliary receiver input is removed.

A high level output at inverter U1302A or U1302B enables the corresponding diode AND gate CR1301-CR1302 or CR1303-CR1304 at the inputs to repeat audio gates Q1301 and Q1302. Depending on the connections for JU1301, JU1302, JU1303 or JU1304, the enabled repeat audio gate will then turn on with proper PL decoder output or unsquelched indicator.

The high level output at inverter U1302A or U1302B is also fed to repeat PTT buffer Q1307 through diode OR gate CR1311-CR1312, producing a high level repeat PTT enable output to the squelch gate.

THEORY OF OPERATION

The auxiliary receiver control (interconnect) board provides dc switching, regulation and filtering for the auxiliary receiver. Specifically the functions are:

- Power distribution and filtering.
- A 9.6-volt regulator.
- Reverse polarity protection.
- Interconnection between circuits of the auxiliary receiver.
- Frequency selection routing for eight frequency radios.
- Metering.

Receptacles on the control board mate with pins on the receiver circuit board to distribute desired functions from outside the radio and from board to board inside the radio. The double sided board routes the signals and eliminates the need for most wires. The few wires used, are terminated in removable female pin tip connectors to mate with pins in the circuit board. Additional pins in the board are provided for connecting accessory item such as a positive ground converter. The 37-pin connector mates with the cable to the control head and main receiver. A control socket allows a Motorola portable test set with a TEK-37 Adapter cable to control the radio set for testing. For the following circuit operation, refer to the control board schematic diagram in the DIAGRAMS section of this supplement.

POWER DISTRIBUTION AND FILTERING

Vehicle battery voltage is applied at various pins of the front plug. A+ is applied at J901-22 and filtered by L901 and Q901. The "filtered A+" is routed to the audio and squelch circuit board. A- is supplied to J901-11 as reference voltage to the audio and squelch board.

Reverse polarity protection diode CR909 connects between A+ and A-. The diode is reverse biased when the input power is of the proper polarity and has no effect. If reverse polarity is applied, the diode short circuits and blows the fuse to protect the circuits in the radio set.

In negative ground installations, "battery (+)" is applied to P901-3 and filtered by L902 and C902. For positive ground operation, there is no input at pin 3; instead "battery (-)" is applied at P901-18 and routed to a positive ground converter. The (+) output of the converter is applied to the junction of L902 and C902. With either type of operation, a "filtered B+" voltage is available at this point for distribution to the receiver and the 9.6-volt regulator.

Diodes CR913 and CR914 and resistor R905 are added to allow the squelch gate board to disable PL in repeater modes.

9.6-VOLT REGULATOR CIRCUIT

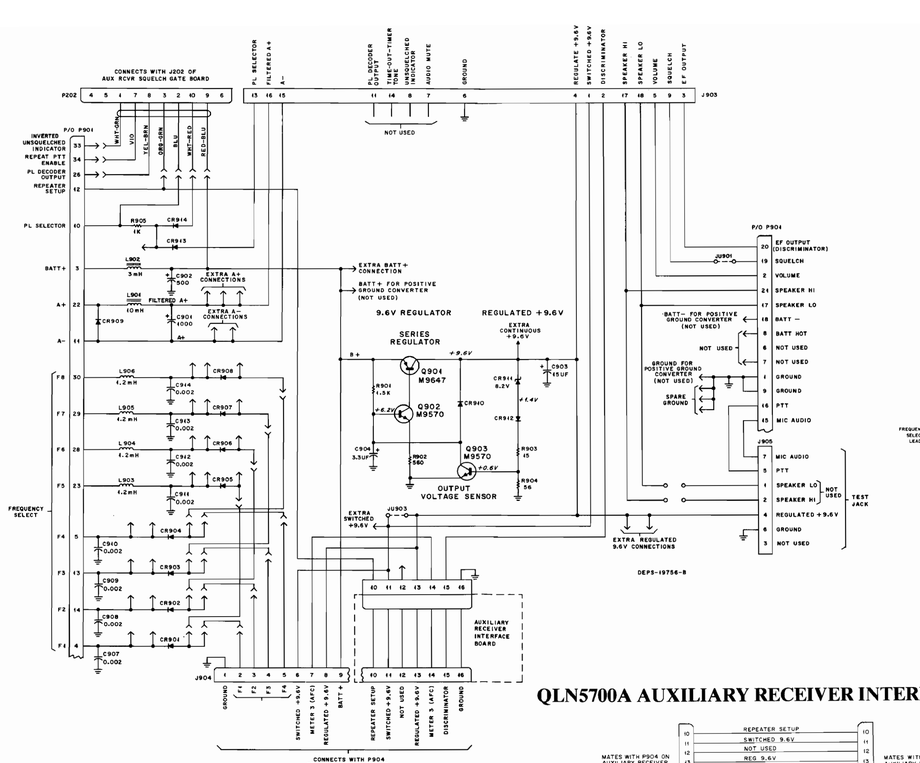
Filtered A+ is applied to a 9.6-volt regulator circuit which provides regulation within ± 100 millivolts for input voltages from 10.5 to over 16 volts. Automatic shutdown occurs if the output becomes overloaded or shorted.

The regulated output voltage is developed across Zener diode CR911, diode CR912 and the resistors, in the base of output voltage sensor Q903. Since the voltage across the Zener diode is constant, almost the entire variation is applied to the base of Q903. It amplifies and inverts the variation, developing a negative feedback which is applied to the base of driver Q902. Driver Q902, in turn, controls the base current drive to series regulator Q901. Total load current flows through Q901 which acts as a controlled series resistance in response to drive from Q902. The complete negative feed-back path causes the resistance of Q901 to counteract output voltage variations.

Drive Q901 is relatively independent of input voltage since drive to Q903 is derived from the regulated output. Therefore, its collector current and the drive to Q902 are also derived from the regulated output.

Diode CR910 protects the circuit from extreme overload such as a short. If the 9.6-volt output is shorted or overloaded, it drops toward zero. Q903 would tend to cut off. However, when the output voltage drops .6 volt below the voltage at the collector of Q903, diode CR910 conducts. This occurs if the output current exceeds 450 milliamps (normal load current is approximately 250 milliamps, plus the current for any optional accessory items operating from 9.6 volts). This action limits the amount of forward bias on Q902, and the emitter resistor limits maximum collector current of Q902. Since collector current of Q902 is the base drive current for Q901, it is limited to this same low value and Q901 shuts down.

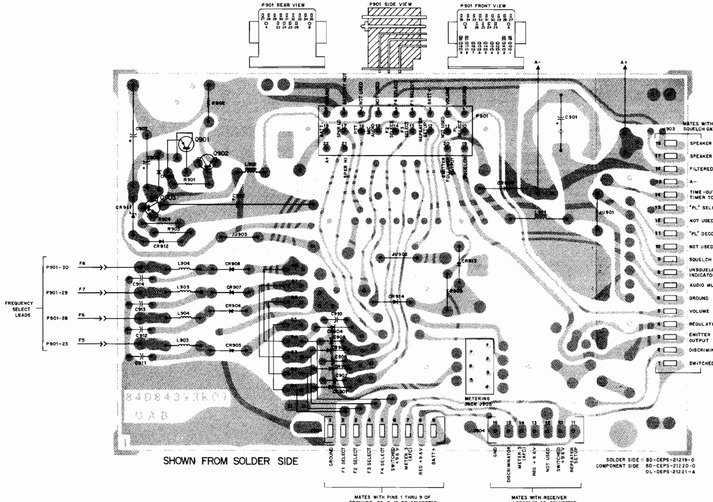
The output voltage of the regulator is a nominal 9.6 volts. Some radios may be as low as 9.1 volts and others may be as high as 9.9 volts. However, the regulation for a given radio is ± 100 millivolts from the regulated value over the entire range of input voltage, load, and temperature.



QLN5700A AUXILIARY RECEIVER INTERFACE BOARD

AUXILIARY RECEIVER CONTROL (INTERCONNECT) BOARD

MODELS QLN5699A



FUNCTION

The auxiliary receiver control (interconnect) board provides dc switching, regulation, and filtering for the auxiliary receiver.

PARTS LIST

QLN5699A Auxiliary Receiver Control (Interconnect) Board PL-4067-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed:
C901	23-82394A16	1000 uF +150-10%, 25 V
C902	23-8321DA23	500 uF +150-10%, 25 V
C903	23-8261A31	15 uF +33-10%, 25 V
C904	23-8321AC17	3.3 uF +20%, 15 V
C907 thru 914	21-82187B27	0.002 uF ±10%, ceramic disc
		SEMICONDUCTOR DEVICE:
		diode:
CR901 thru 908	48-82392B03	silicon
CR909	48-82525G13	silicon
CR910	48-82392B03	silicon
CR911	48-8346JE32	silicon; Zener type; 8.2 V ±3%
CR912 thru 914	48-82392B03	silicon
J905	9-84207B01	CONNECTOR, receptacle: female; 7-contact
L901	25-84134D01	COIL, RFI choke; 10 mH, 0.5 ohm
L902	25-84796G01	3 mH, 0.75 ohm
L903 thru 906	24-82723H01	1.2 uH
P901	28-84085B01	CONNECTOR, plug: male; 37-contact
Q901	48-8x9647	TRANSISTOR: PNP; type M9647
Q902, 903	48-8x9570	NPN; type M9570
R901	6-124C53	RESISTOR, fixed: 1/4 W 1.5k ±10%
R902	6-124C43	560 ±10%
R903	6-124A05	15 ±5%
R904	6-124A19	56 ±5%
R905	6-124C49	1k ±10%

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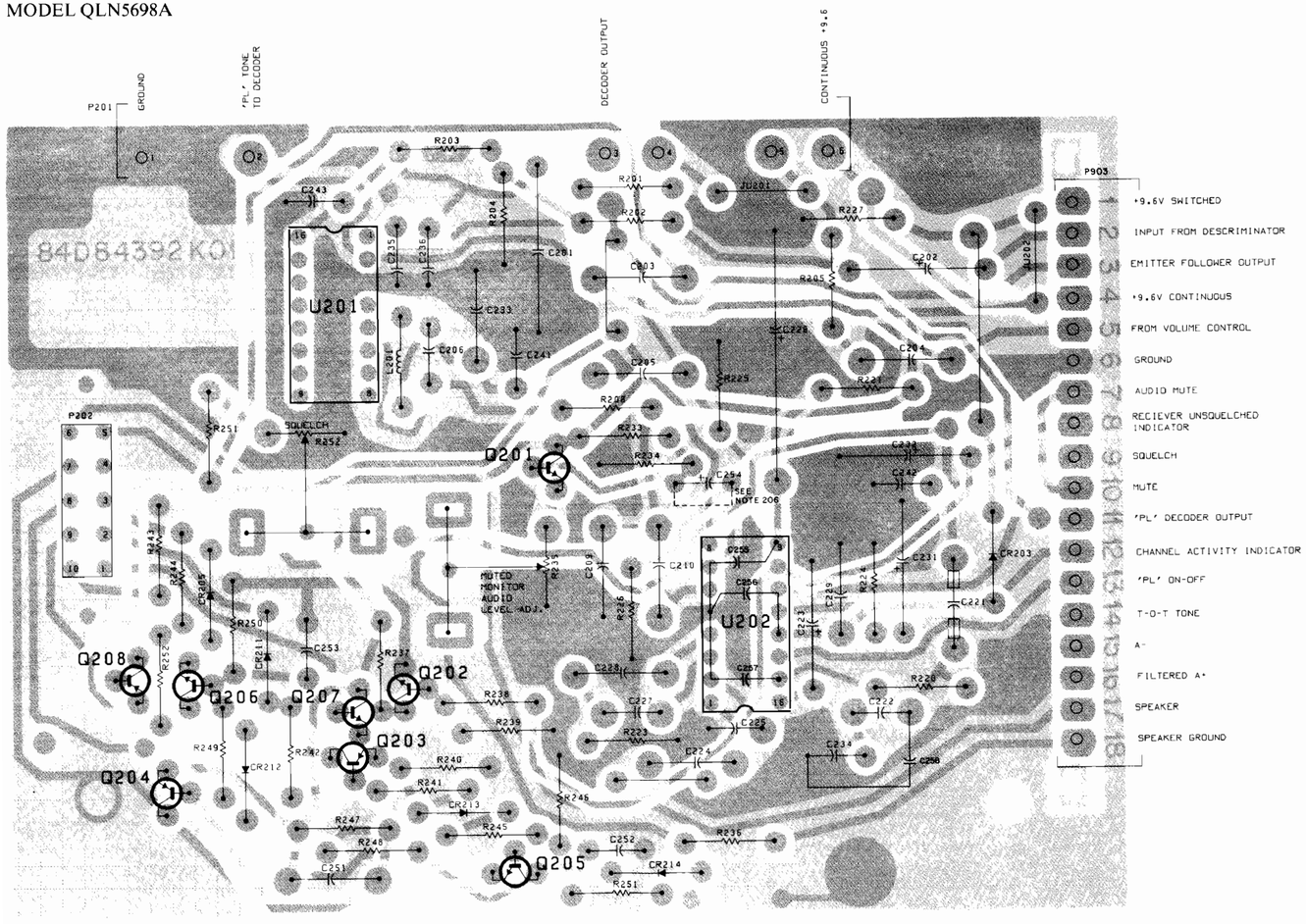
AUXILIARY RECEIVER
SQUELCH GATE BOARD

MODEL QLN5698A



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COMP BD-DEPS-19754-D
SOLD BD-DEPS-19753-A
DL-DEPS-19752-B

TRANSISTOR BASE DETAIL
(LEAD SIDE SHOWN)

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

PARTS LIST

CLN5698A and CLN5698AA Auxiliary Receiver
Squelch Gate Board PL-4035-R

		CAPACITOR, fixed: uF; ±10%; 100 V; uni. stated
C201	23-847o2H01	22 ±20%; 15 V
C202, 203, 204	8-83813H11	0.22; 75 V
C205	8-83813H29	0.33; 50 V
C206	21-82187B27	.002
C209	8-83813H32	.015
C210	8-83813H09	.033
C221	8-82905G29	0.15; 50 V
C222	21-8442oB03	1500 pF; ±5%
C223	23-84762H07	4.7 ±20%; 25 V
C224	21-84493B05	1000 pF; N2200
C225	21-8442oB06	100 pF ±5%; 500 V
C226	23-83210A01	25; 25 V
C227	21-8442oB11	470 pF ±5%; 500 V
C228	8-83813H31	.01
C229	8-83813H11	0.22; 75 V
C231	23-847o2H17	3.3 ±20%; 15 V
C232	23-84762H14	0.47 ±20%; 50 V
C233	8-83813H09	.033
C234	21-82o10C58	100 pF; N750
C235	21-83590E10	220 pF; ±20%; 500 V
C236	21-82428B59	.01 uF; +80-20%; 500 V
C241	21-83590E10	220 pF; ±20%; 500 V
C242, 243	21-82o10C01	40 pF ±5%; 200 V
C251	8-82905G29	.15; 50 V
C252, 253	21-82428B38	.0015
C254	23-84538G01	1 (CLN5698A Only)
C255-258	21-861462	15 pF; N150
		SEMICONDUCTOR DEVICE, diode:
CR203	48-83o54H01	silicon
CR211 thru CR215	48-83o54H01	silicon
		INTEGRATED CIRCUIT:
U201	51-84267A08	type M6708
U202	51-84267A09	type M6709
		COIL:
L201	24-82723H01	rf choke
		TRANSISTOR:
Q201, 202	48-869642	NPN; type M9642
Q203, 204	48-869643	PNP; type M9643
Q205, 206, Q207	48-869642	NPN; type M9642
Q208	48-869643	PNP; type M9643
		RESISTOR, fixed: ±5%; 1/4W; uni. stated
R201	6-124C17	47 ±10%
R202	6-124C49	1k ±10%
R203	6-124A95	82k
R204	6-124A99	120k
R205	6-124A73	10k
R208	6-124A59	2.7k
R220	6-124A81	22k
R221	6-124C05	15 ±10%
R223	6-124A83	27k
R224	6-124D04	180k ±10%
R225	6-124C89	47k ±10%
R226	6-124C99	120k ±10%
R227, 231	6-124C61	3.3k ±10%
R232	18-83083G24	var; 24k
R233, 234	6-124C89	47k; ±10%
R235	18-83083G22	var; 5k
R236	6-124C43	560; 10%
R237	6-124C73	10k; 10%
R238	6-124C89	47k; 10%
R239	6-124D14	470k; 10%
R240	6-124C67	5.6k; 10%
R241, 242	6-124C85	33k; 10%
R243	6-124C65	4.7k; 10%
R244	6-124C89	47k; 10%
R245, 246	6-124C97	100k; 10%
R247	6-124D04	180k; 10%
R248	6-124C79	18k; 10%
R249	6-124C89	47k; 10%
R250, 251	6-124C97	100k; 10%
R252	6-124C89	47k; 10%

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

NON-REFERENCED ITEM		
	76-84069B01	Ferrite bead
	55B84300B02	HANDLE (short)
	3S13o905	LOCKSCREW, tapping: #4 x 5/16" (4 required)
	42C84284B01	RETAINER, screw (4 required)
	55B84300B01	HANDLE (long)
	29C84028H02	PIN (short)
	29C84028H01	PIN (long)

"PRIVATE LINE" DUAL DECODER

MODEL QLN1974A

1. DESCRIPTION

The QLN1974A Dual PL Decoder provides the decoding circuitry for two PL tone-coded squelch tones. The dual PL decoder includes a programmable control gate which allows selection of one of the two tone-codes for each of the eight receiver frequencies. For example, the control gate may be programmed to select tone-code A for use with frequencies R1, R2, and R3, and tone-code B for use with frequencies R4-R8. The dual PL decoder consists of a modified PL decoder board, a dual PL decoder board, and mounting hardware. These items are described in the following paragraphs. The "vibrasponder" resonant reeds used with the dual PL decoder are available as separate items.

2. TLN4294B-SP2 PL DECODER BOARD

This PL decoder board is a modification of the TLN4292B Model described in the attached instruction manual. It is modified for operation with two or more tone-codes. The modification consists of changing the resonant reed interconnections so that externally mounted resonant reeds may be individually selected and switched into the decoder circuitry. Refer to attached diagram PEPS-28440 for circuit details.

3. QLN5936A DUAL PL DECODER BOARD

This dual PL decoder board is added to the radio set to allow PL decoding of incoming messages with either of two tone-codes. The dual PL decoder board contains resonant reed selection circuitry and two "Vibrasponder" resonant reeds. The resonant reed selection circuitry switches the selected "Vibrasponder" resonant reed into the TLN4294B-SP2 PL Decoder where it becomes the PL tone-code reference frequency device. Refer to attached diagram PEPS-28439 for circuit details.

The resonant reed selection circuitry consists of two tone gates (Q1 and Q2), and two tone enable switched (Q3 and Q4), one for each of the two "Vibrasponder" resonant reeds (PLB and PLA). When switched ground is applied to the cathode of a tone enabling diode (CR4-CR70, bias is removed from tone enable switch Q4 and Q4 turns off. A positive voltage is applied to the base of tone gate Q2 thrugh R7 which causes Q2 to turn-on. The secondary winding of reed PLA is completed through the emitter to collector of tone gate Q2. The positive voltage on the base of tone gate Q2 also reverse biases CR2 allowing a current path to be developed through R4, R3, CR1 and R5. A positive voltage is applied to the base of tone enable switch Q3 which turns-on. Its collector goes low turning tone enable gate Q1 off which opens the secondary winding circuit of reed PLB.

Similarly, when none of the tone enabling diodes (CR4-CR7) are grounded, tone gate Q1 turns on. Q1 completes the secondary winding circuit of reed PLB to the PL decoder. Tone gate Q2 turns-off and opens the secondary winding circuit of reed PLA.

4. QLN5937A MOUNTING HARDWARE KIT

The hardware kit is used to mount the dual tone PL decoder board in the radio set and consists of the following items:

Motorola Part No.	Description
42B84816B01	CABLE CLIP
3S138891	SCREW, self-tapping 6-32 x 7/16"
7-06969B01	BRACKET; Dual PL Decoder Mounting
1V06707B45	WIRE & LUG ASSEMBLY

MOTOROLA INC.
Communications Division

service publications
1301 E. Algonquin Road, Schaumburg, IL 60196

AUXILIARY RECEIVER SQUELCH GATE

MODEL QLN5698A

THEORY OF OPERATION

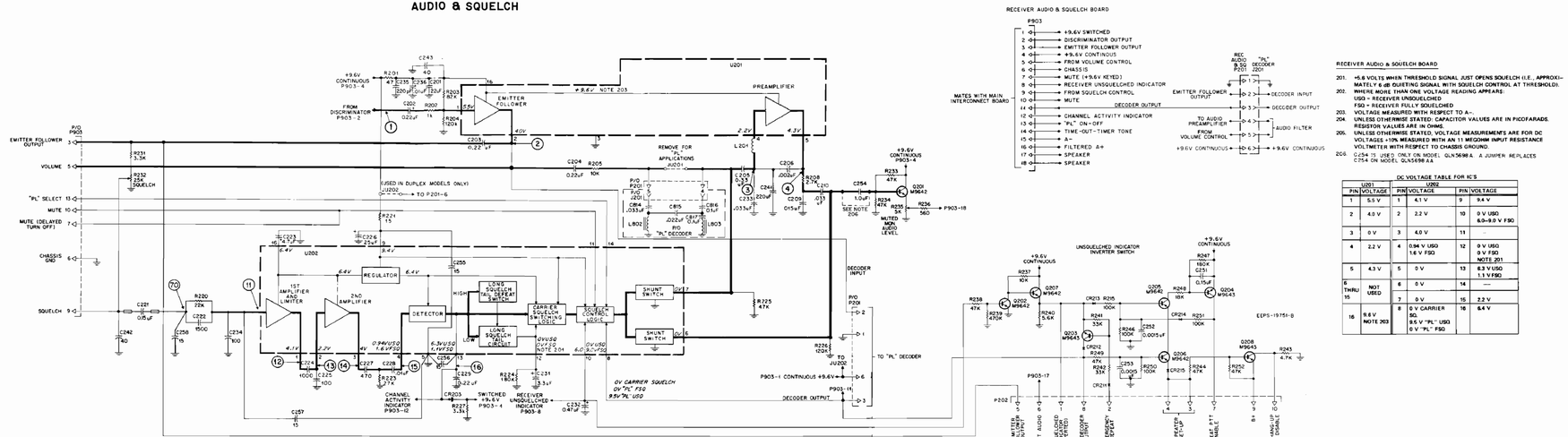
Emitter follower Q201 provides level setting and buffering of muted monitor audio which is passed to the repeater control module via the control (interconnect) board and cable kits. Potentiometer R232 provides the SQUELCH adjustment for the auxiliary receiver while inverter Q202 and emitter follower Q207 invert and buffer the unsquelch indicator signal.

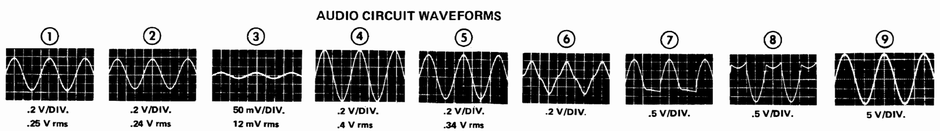
If the radio set is in the repeat mode and the receiver unsquelches due to an input signal with the proper PL tone both inputs of NAND gate Q205 and Q206 go high. Inverter Q204 will now turn on making the Repeat PTT Enable line go high. The Repeat PTT Enable high is routed thru the interconnect cable of the auxiliary receiver and thru the cable kits to the repeater priority switch of the auxiliary audio board in the main radio.

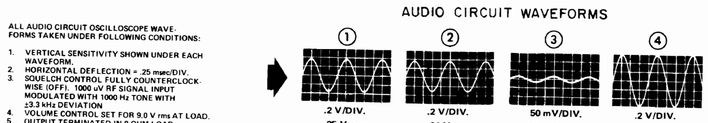
If the ROAM pushbutton on the QLN1917B "Systems 90" Repeater Control Module has been pressed, the cathode of CR211 sees a low which turns on Q203. With Q203 turned on, the receiver unsquelched indicator signal is applied to both inputs of NAND gate Q205 and Q206. The Repeat PTT Enable goes high whenever the receiver unsquelches, whether or not a proper PL tone is present.

NOTE

In some instances, PL repeat operation between the portable and the auxiliary receiver may be preferred when the radio set is selected for emergency repeat operation. In this case, the emergency select input to the auxiliary receiver squelch gate board on the blue wire may be removed from the connector pin on the control (interconnect) board and tied back.







FUNCTION

Circuit operation is essentially the same as for the standard TRN6540A Audio and Squelch Board described in the basic UHF "MICOR" radio set instruction manual except for the deletion of the power amplifier and associate driving circuits and the addition of squelch gate circuitry.

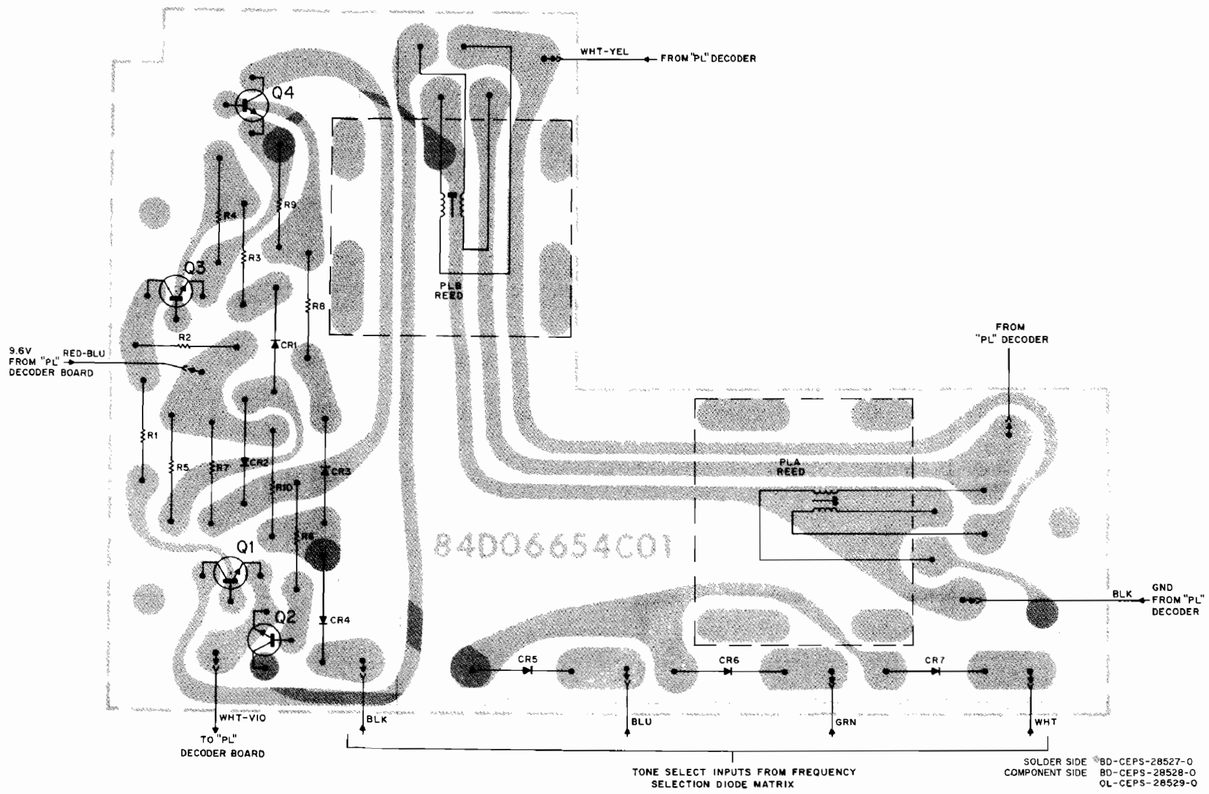
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

parts list

PL-6602-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		diode: (see note)
CR1 thru 7	48-83654H01	silicon
		transistor: (see note)
Q1, 2	48-869567	NPN; type M9567
Q3, 4	48-869642	NPN; type M9642
		resistor, fixed: ± 10%; 1/4 W
R1	6-129242	56k
R2	6-128685	22k
R3	6-128902	47k
R4	6-127805	15k
R5	6-128685	22k
R6	6-129242	56k
R7	6-128685	22k
R8	6-127807	33k
R9	6-129225	10k
R10	6-128904	18k

note: For optimum performance replacement diodes and transistors must be ordered by Motorola part number only.



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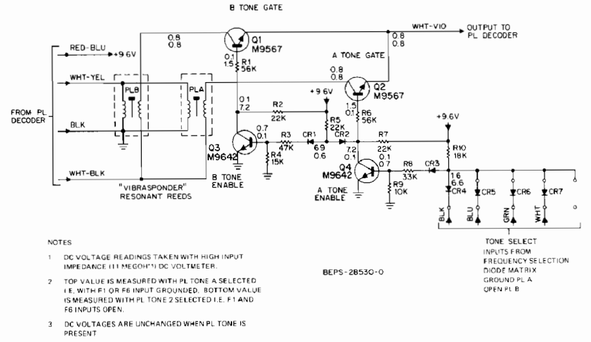
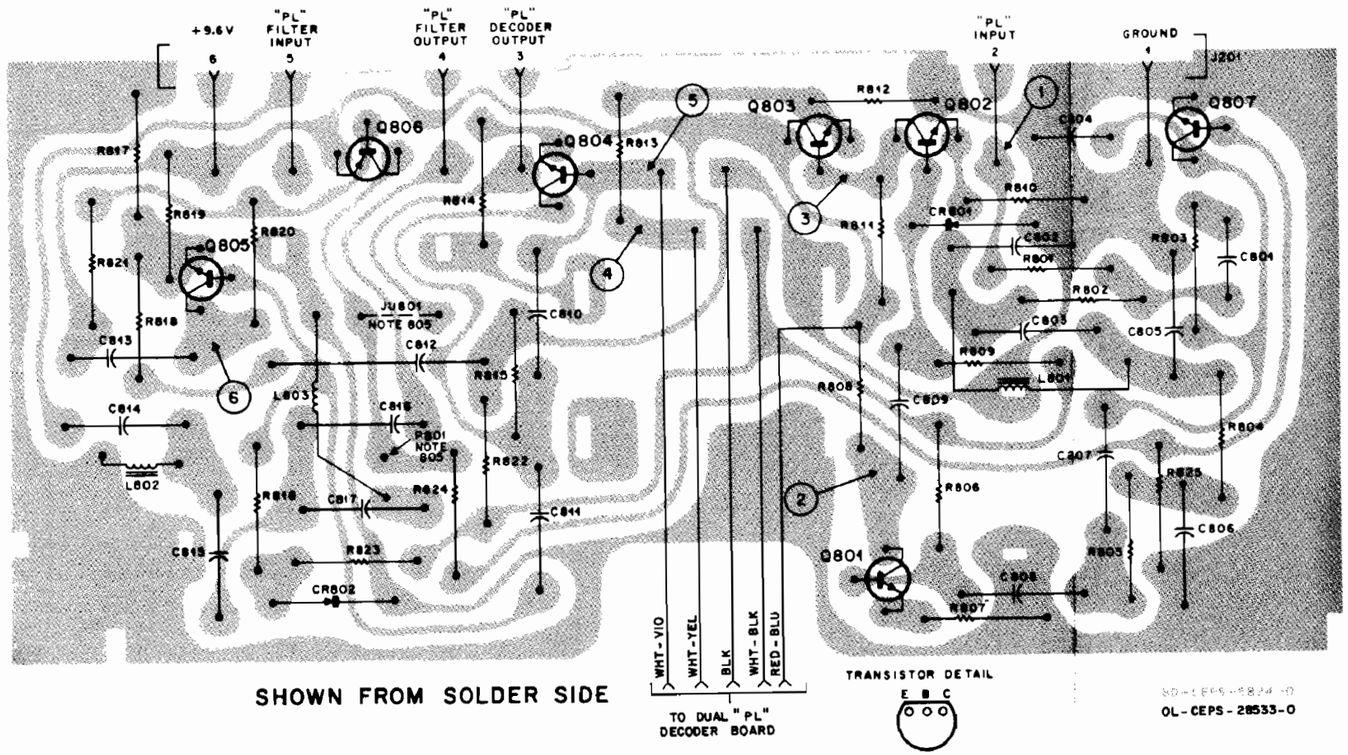
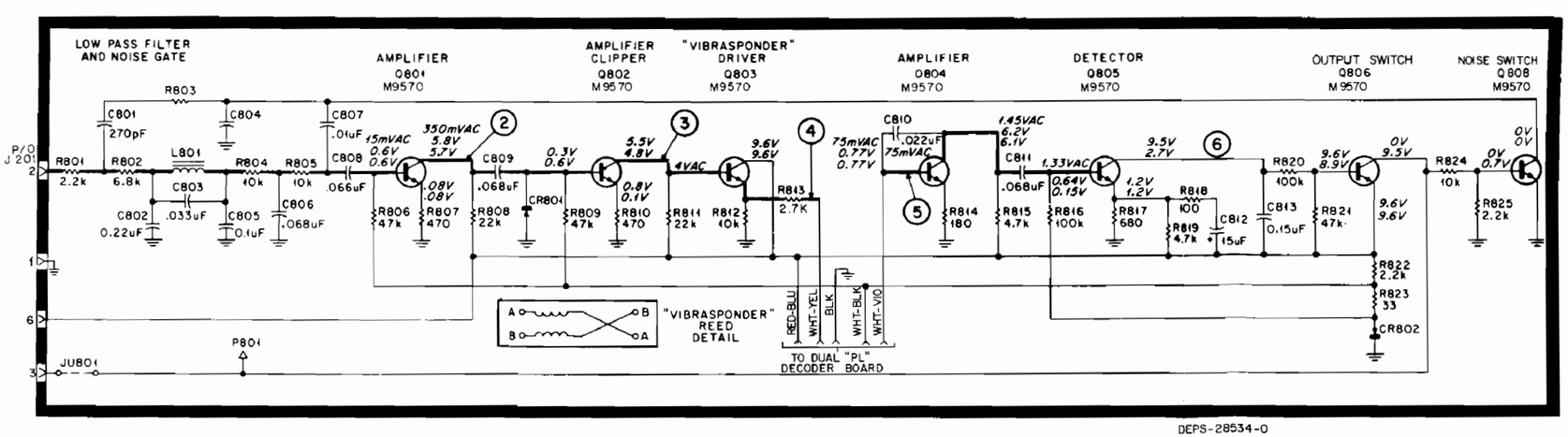


NOTES

1. DC VOLTAGE READINGS TAKEN WITH HIGH INPUT IMPEDANCE (11 MEGOHM) DC VOLTMETER.
2. TOP VALUE IS MEASURED WITH PL TONE A SELECTED I.E. WITH F1 OR F6 INPUT GROUNDED. BOTTOM VALUE IS MEASURED WITH PL TONE 2 SELECTED I.E. F1 AND F6 INPUTS OPEN.
3. DC VOLTAGES ARE UNCHANGED WHEN PL TONE IS PRESENT

Model QLN5936A
Dual "Private-Line" Decoder
Schematic and Circuit Board Detail
Motorola No. PEPS-28439
3/28/79-PHI





Model TLN4294B-SP2
"Private-Line" Decoder
Schematic Diagram and Board Detail
Motorola No. PEPS-28440
3/28/79- **PHI**

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

ELECTRICAL PARTS LIST

IMPORTANT

USE ONLY THE FOLLOWING MOTOROLA PART NUMBERS WHEN ORDERING REPLACEMENT PARTS

TLN4294A and
TLN4294B "Private-Line" Decoder — PL-863-H

		CAPACITOR, fixed: uF ±10%; 50 V; unless otherwise stated
C801	21D82187B38	270 pF
C802	8D82905G32	0.22
C803	8D82905G08	.033; 100 V
C804	21-82187B39	470 pF; 500 V
C805	8D83813H06	0.1; 100 V
C806	8D82905G04	.068; 100 V
C807	8D82905G01	.01
C808	8D82905G04	.068; 100 V
C809	8D82905G04	.068; 100 V
C810	8D82905G02	.022
C811	8D92095G04	.068; 100 V
C812	23D83214C02	15 ±20%; 25 V
C813	8D82905G31	0.15
C814	8D82905G08	.033; 100 V
C815	8D82905G02	.022
C816	8D82905G30	0.1
C817	8D82905G30	0.1
C818	21-83406D51	3 pF ±0.25 pF 500 V
		SEMICONDUCTOR DEVICE, diode (SEE NOTE I)
CR801	48C83654H01	silicon
CR802	48C83654H01	silicon
		COIL, RF; choke
L801	24C84003A01	6 H
L802	24C84003A01	6 H
L803	24C84003A01	6 H
		TRANSISTOR: (SEE NOTE I)
Q801 thru 805	48R869642	NPN; M9642
	or 48R869570	NPN; M9570
Q806	48R869643	PNP; M9643
	or 48R869571	PNP; M9571
Q807	48R869642	NPN; M9642
	or 48R869570	NPN; M9570
		RESISTOR, fixed: ±5%; 1/4 W; unless otherwise stated
R801	6S128689	2.2K ±10%
R802	6S128687	6.8K ±10%
R803	6-124A63	3.9K
R804	6S129225	10K ±10%
R805	6S129225	10K ±10%
R806	6S131527	47K
R807	6S129709	470
R808	6S129667	22K
R809	6S131527	47K
R810	6S129709	470
R811	6S129667	22K
R812	6S129225	10K ±10%
R813	6-124A66	5.1K
R814	6S129431	180
R815	6S129669	4.7K
R816	6S124A97	100K
R817	6S129984	680
R818	6S129753	100 ±10%
R819	6S129669	4.7K
R820	6S124A97	100K
R821	6S131527	47K
R822	6S129804	2.2K
R823	6S124A13	33
R824	6S129225	10K ±10%
R825	6S128689	2.2K ±10%
	NON-REFERENCED ITEMS	
	42-84116B01	CLAMP & SOCKET ASSY. ("Vibrasponder")
	3-139506	SCREW, tapping: 4-40 x 5/16" 2 used
	5-84500B03	EYELET, special: 2 used
	42-84284B01	RETAINER; 2 used

CONTROL HEAD

MODEL TCN1112A-SP12

PARTS LIST

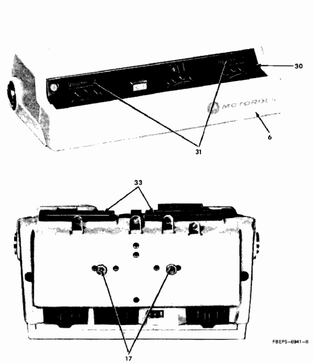
TCN1112A-SP12 Control Head (12-Freq.) PL-3652-O

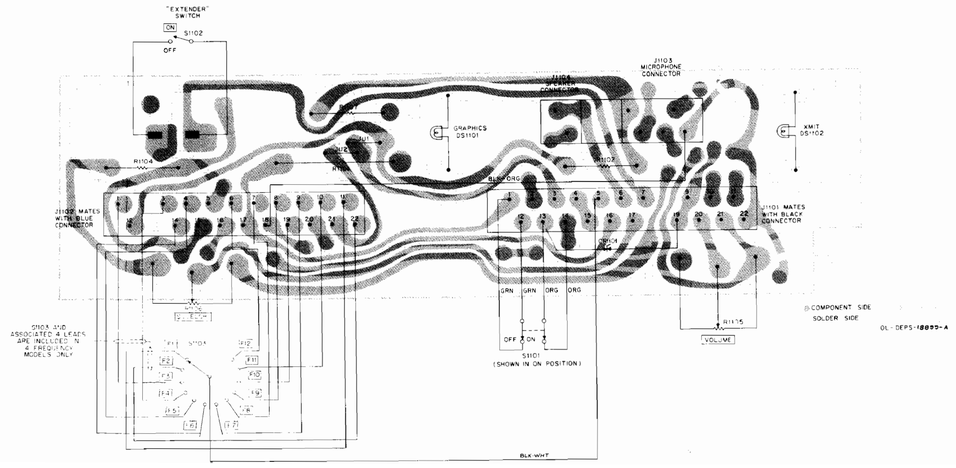
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
CR1101	48-83461E45	DIODE: dual; Zener type; nom. 25 V
		LAMP, incandescent: miniature wedge base:
DS1101	65-83554G01	12 V; 0.19 A; type No. 161
DS1102	65-83554G01	12 V; 0.19 A; type No. 161
		CONNECTOR, receptacle:
J1101		c/o (20) 29-84547B01 TERMINALS, pin; male
J1102		c/o (20) 29-84547B01 TERMINALS, pin; male
J1103		c/o (5) 29-84547B01 TERMINALS, pin; male
J1104		c/o (2) 29-84547B01 TERMINALS, pin; male
		RESISTOR:
R1101	6-488090	fixed; 56 ±10%; 2 W
R1102	6-6291	fixed; 560 ±10%; 1/2 W
R1104	6-5581	fixed; 3.3k ±10%; 1/2 W
R1105	18-84584A02	variable; 25k ±30%; 1/4 W
R1106	18-84584A02	variable; 25k ±30%; 1/4 W
R1107	6-6373	fixed; 150 ±10%; 1/2 W
		SWITCH:
S1101	40-84622B02	slide; dpst; does not include 29-10134A48 LUG, connector; female; 4 required
S1102	40-84301C02	momentary slide; spst
S1103	40-84149C01	rotary; 4-position; non-shorting
	40-84149C03	adjustable limiting stop rotary; 12 position; non-shorting
NON-REFERENCED ITEM		
	TLN4369B	PRINTED CIRCUIT BOARD ASSEMBLY; includes 29-84547B01 TERMINAL, contact; male; 47 req'd, 42-84942C01 RETAINER, connector; 2 req'd.

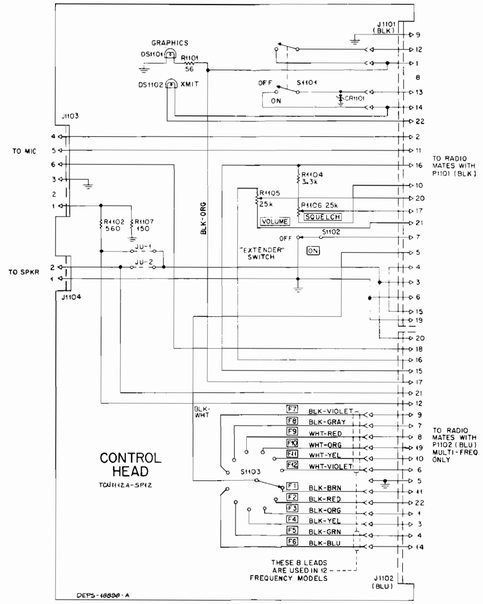
TCN1112A-SP12 Control Head (12-Freq.) PL-3657-A

CODE NUMBER	MOTOROLA PART NO.	DESCRIPTION
1	3-13n75h	SCREW, tapping; 10-16 x 5/8" plain hex flanged head; does not includ 4-2n52 LOCKWASHER; No. 10 external
2	49-849e1C01	DISC, trunnion bracket mounting; "breakaway" type
3	42-849e3C01	COLLAR, trunnion bracket mounting
4	3-115727	LOCKSCREW, machine; 10-32 x 1/2" plain hex head
5	7-84809B01	BRACKET, trunnion, double unit
6	75-84e28B01	FRONT COVER, housing ("bumper")
7	3-13e9e3	SCREW, tapping; n-20 x 5/16" "Phillips" flat head
8	1-80712B88	TOP COVER ASSEMBLY, housing; includes items coded 9, 7, 9, 28, 29, 31 (multi-freq. models)
	or1-80757B65	TOP COVER ASSEMBLY, housing; includes items coded 9, 7, 9, 28, 29 and 31 (single-freq models)
9		PRISM, optical (SEE NOTE)
10	3-129e75	LOCKSCREW, 4-40 x 1/4" "Phillips" binder head with lockwasher
11	TLN4369B	PLATED CIRCUIT BOARD ASSEMBLY; includes contact terminals
12	2-13e272	NUT, machine; 3/8-32 x 1/2" hex
13	4-8210	WASHER, metallic; 0.39" x 0.5e2" x 0.1e"
14	3e-84001C02	KNOB, control (volume & squelch)
15	3-8454eB01	SCREW, machine; shoulder type (trunnion-mount)
16	3-84548B01	SCREW, machine; n-32 x 1/2" "Phillips" round head; "captive" type
17	3-136138	LOCKSCREW, machine; n-32 x 3/8" "Phillips" hex head
18	36-84001C01	KNOB, control; (freq. selector) (requires use of item coded 19)
19	36-84006C01	DISC, switch position indicator (used with item coded 18)
20	45-84004C01	ACTUATOR, switch
21	15-84920B01	HOUSING, (bottom section)
22	7-84005C01	BRACKET (chassis)
23	1-80712B89	SWITCH ASSEMBLY; (slide switch); includes wires, contact terminals and mounting screws
24	3-135084	LOCKSCREW, tapping; 4-40 x 5/16" "Phillips" fillister head
25	42-84067C01	RETAINER, connector
26	9-84627B01	LAMPHOLDER
27, 28		PRISM, optical (SEE NOTE)
29		PRISM, optical; includes RED LENS (SEE NOTE)
30	13-84000C01	BEZEL (Single-frequency)
	or13-84000C02	BEZEL (Multi-frequency)
31	33-84038C01	MARKER STRIP (VOLUME, SQUELCH)
32	38-84357C01	PLUG, SNAP-IN (Single-freq.)
33	42-84962C01	RETAINER, connector
NON-CODED ITEM		
	54-84111D01	MOUNTING TEMPLATE

NOTE: Items coded 9, 27, 28 and 29 are not individually replaceable. For field-replacement, order item No. 8 (TOP COVER ASSEMBLY).







FUNCTION

This control head generally performs the same function as the control head described in the basic radio set instruction manual. It has been modified to bring the XMIT light lead out separately at J1101-22 instead of tying it to the PTT bus. This allows the repeater logic circuits to light the indicator when the radio is keyed in the repeat mode.

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REPEATER CONTROL MODULE

MODEL QLN1917B

FUNCTION

NOISE CANCELLING AMPLIFIER

Noise cancelling amplifiers U1A and U3D reduce the noise level on the auxiliary receiver and main receiver monitor audio signals. The noise on the audio high lead and the audio shield are in phase and are both referenced to chassis ground. The noise signals are cancelled by applying the audio high and audio shield to opposite-polarity inputs of U1A and U3D. Amplification of the monitor audio signal from the main receiver auxiliary audio board and the squelch gate board of the auxiliary receiver is not impaired, since the monitor audio signal is referenced to the audio shield.

1400 Hz RECEIVE NOTCH FILTER

The receive notch filter is a two-section active filter that provides about 35 dB of attenuation at 1400 Hz when FLTR switch S1 on the control panel is depressed. Each section of the filter consists of two operational amplifiers, with appropriate feedback, and a combining operational amplifier that amplifies the filter section output. The receive notch filter is disabled by Q11 through R34, R78 and is bypassed by Q6 when auxiliary receiver monitor audio filtering is not needed.

FILTER BYPASS

Filter bypass Q6 is an audio gate that routes auxiliary receiver monitor audio around the receive notch filter as long as FLTR switch S1 remains undepressed. Filter bypass driver Q7 is kept on by regulated +9.4 volts through R54; regulated +9.4 volts is applied through Q7 to Q6 gate. Audio from the noise-cancelling amplifier output then passes through Q6 to U2B.

When FLTR switch S1 is depressed a low through CR7 turns off Q7 and A- is applied to the gate of Q6. Filter bypass Q6 turns off, and auxiliary receiver monitor audio from the noise-cancelling amplifier output must pass through the 1400 Hz receive notch filter.

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3/28/79- PHI

MICROPHONE AUDIO MUTING

In receive only or in repeat operation PTT switch transistors Q3 and Q4 are normally off. Transistors Q5 is on, reverse biasing CR1. The gate of microphone audio mute transistor is there for at A- and Q1 is off. When the handset PTT button is pressed, Q3 and Q4 turn on, turning off Q5. The gate of Q1 goes high and microphone audio is gated through Q1 to the microphone audio amplifier.

In duplex operation ECG gate Q10 is normally on. When the handset PTT button closes, Q4 turns on and pulls the gate of Q10 low through CR13. ECG gate Q10 therefore shuts off. If the transmitter is keyed by PTT from the optional "Systems 90" ECG Modulator Preamplifier board, CR12 prevents the repeater control module PTT switch circuits from being activated. Therefore, ECG gate Q10 remains on. The ECG telemetry signal passes through Q10, and the microphone audio amplifier to the exciter audio input.

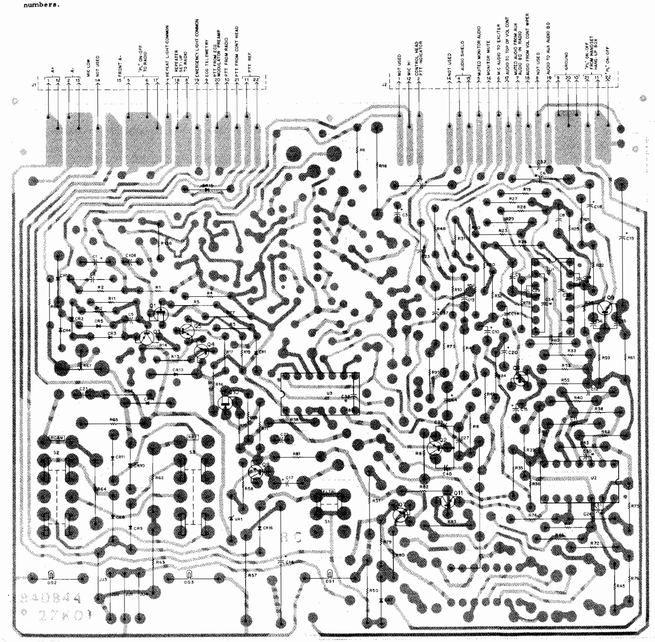
In repeater operation the gate of Q10 is pulled low by the repeater set-up line through CR14. Therefore, Q10 remains off at all times.

PARTS LIST

QLN1917B Repeater Control Module PL-4458-A

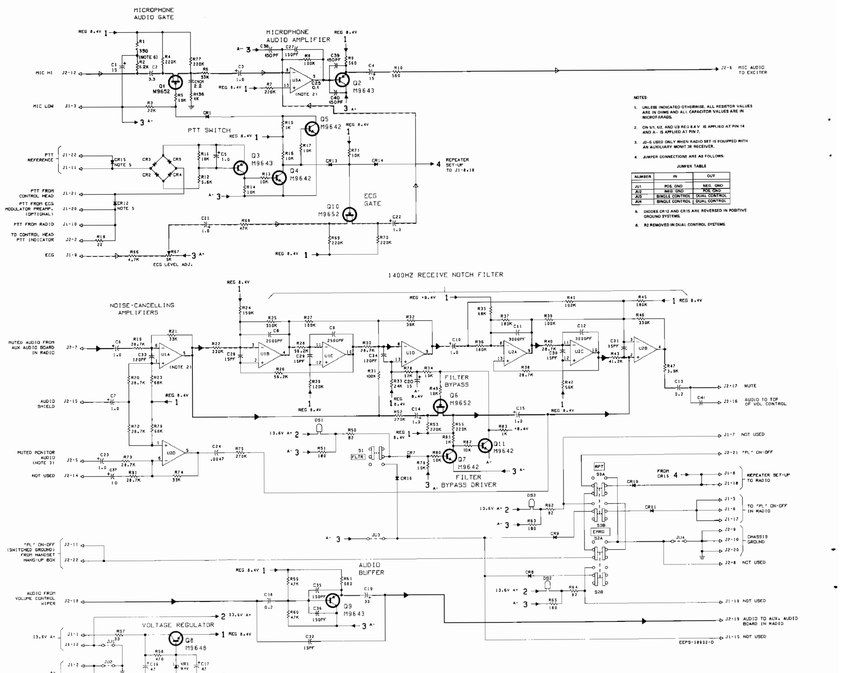
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: uF ±20%; 20 V; unless otherwise stated
C1	23-84538G04	15
C2	23-83214C17	3.3 ±20%; 15 V
C3	23-84538G01	1.0; 35 V
C4	23-84538G04	15
C5	23-84538G01	1.0; 35 V
C6, 7	23-82783B26	1.0 ±10%; 35 V
C8, 9	21-84426B40	2500 pF ±5%; 500 V
C10	23-84538G01	1.0; 35 V
C11, 12	21-850994	3000 pF; 500 V
C13, C41	21-82172C05	0.2 +80-20%; 25 V
C14, 15	23-84538G01	1.0; 35 V
C16	23-82783B31	47
C17	23-84538G06	47
C18	21-82372C05	0.2 +80-20%; 25 V
C19	23-82783B07	33; 25 V
C20	21-861462	15 pF ±10%; N150
C21, 22	23-84538G01	1.0; 25 V
C23	23-82783B26	1.0 ±10%; 35 V
C24	8-82905Q26	.0047 ±10%; 100 V
C27	21-863147	150 pF ±5%; 500 V
C28 thru 32	21-861462	15 pF ±10%; N150
C33, 34	21-82610C09	120 pF ±10%
C35, 36, 38, 39, 40	21-863147	150 pF ±5%; 500 V
C37	23-82783B26	1.0 ±10%; 35 V
C101	23-84538G08	2.2 ±20%; 20 V
CR1	48-83654H01	DIODE: (SEE NOTE) silicon
CR2, 3, 4, 5	48-82420C01	silicon
CR6	48-82466H13	silicon
CR7	48-83654H01	silicon
CR8 thru 12	48-82466H13	silicon
CR13, 14	48-83654H01	silicon
CR15, 16	48-82466H13	silicon
CR17	48-83654H01	silicon
DS1, 2, 3	65-84047E01	LAMP, assembly: 80 mA; 14 V encapsulated
Q1	48-869652	TRANSISTOR: (SEE NOTE) field-effect: type M9652
Q2, 3	48-869643	PNP; type M9643
Q4, 5	48-869642	NPN; type M9642
Q6	48-869652	field-effect: type M9652
Q7	48-869642	NPN; type M9642
Q8	48-869648	NPN; type M9648
Q9	48-869643	PNP; type M9643
Q10	48-869652	field-effect: type M9652
Q11	48-869642	NPN; type M9642
R1	6-124A37	RESISTOR, fixed: ±5%; 1/4 W, unless otherwise stated 330
R2	6-124A51	1.2k
R3	6-124A81	22k
R4, 7	6-124B06	220k
R5	6-124A73	10k
R6	6-124A85	33k
R8	6-124A97	100k
R9, 10	6-124A43	560
R11	6-124A73	10k
R12	6-124A67	5.6k
R13, 14	6-124A73	10k
R15	6-124A49	1k
R16, 17	6-124A73	10k
R18	17-831221009	22 ±10%; 3 W
R19, 20	6-10621D36	28.7k ±1%; 1/8 W
R21	6-124A85	33k
R22	6-124B10	330k
R23	6-124A93	68k
R24	6-124B02	150k
R25	6-124B10	330k
R26	6-10621D64	56.2k ±1%; 1/8 W
R27	6-124A97	100k
R28	6-10621D64	56.2k ±1%; 1/8 W
R29	6-124A99	120k
R30	6-10621D36	28.7k ±1%; 1/8 W
R31	6-10621D89	102k ±1%; 1/8 W
R32	6-124A87	39k
R33	6-124A82	24k
R34	6-124A73	10k
R35	6-124A93	68k
R36, 37	6-124B04	180k
R38	6-10621D36	28.7k ±1%; 1/8 W
R39	6-124A97	100k
R40	6-10621D36	28.7k ±1%; 1/8 W
R41	6-10621D89	102k ±1%; 1/8 W
R42	6-124A99	56k
R43	6-10621D51	41.2k ±1%; 1/8 W
R45	6-124B04	180k
R46	6-124B10	330k
R47	6-124A63	3.9k
R49	6-124A73	10k
R50	6-125C23	82 ±10%; 1/2 W
R51	6-125C31	180 ±10%; 1/2 W
R52	6-124B08	270k
R53	6-124B06	220k
R54	6-124A83	27k
R55	6-124B06	220k
R56	6-124A49	1k
R57	6-125C13	33 ±10%; 1 W
R58	6-124A41	470
R59, 60	6-124A89	47k
R61	6-124A45	680
R62	6-126C23	82 ±10%
R63	6-125C31	180 ±10%
R64	6-126C23	82 ±10%
R65	6-125C31	180 ±10%; 1/2 W
R66	6-124A55	4.7k
R67	18-83083G07	var; 5k
R68	6-124A89	47k
R69, 70	6-124B06	220k
R71	6-124A73	10k
R72, 73	6-10621D36	28.7k ±1%; 1/8 W
R74	6-124A85	33k
R75	6-124B08	270k
R76	6-124A93	68k
R77	6-124B06	220k
R78	6-124A75	12k
R79, 80	6-124A73	10k
R81	6-124A49	1k
R82	6-124A73	10k
R83	6-124A49	10k
R91	6-10621D36	28.7k
R136	6-124A49	1k
S1	40-84324C01	SWITCH: 2 pole slide
S2, 3	40-84324C10	4 pole slide
U1, 2, 3	51-84320A70	INTEGRATED CIRCUIT: (SEE NOTE) type LM3900
VR1	48-82256C38	VOLTAGE REGULATOR: Zener type; 9.1 V

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



SHOWN FROM SOLDER SIDE

NOTE * COMPONENT IS MOUNTED ON SOLDER SIDE OF THE BOARD



AUDIO/TELEMETRY MULTIPLEX MODULE

MODEL QLN1918B

1. DESCRIPTION

1.1 INTRODUCTION

This module mounts in a "Micor" "Systems•90" enclosure replacing the repeater control module and is an integral part of the EMS duplex/repeater mobile radio system. It provides for simultaneous voice audio and medical telemetry transmission (multiplex) by performing the following functions:

- Repeater enabling — closing the RPT switch sets up the radio set to repeat when the proper rf signal and PL tone are received.
- Emergency repeater enabling — closing both the RTP and ROAM switches enables the radio set to repeat any received signal, whether or not it has the proper PL tone.
- Audio Filtering — closing the MUX switch inserts a 1400 Hz, 13 dB transmit notch filter in the mobile mic audio path to eliminate voice audio that falls in the telemetry signal's frequency spectrum. The closing of the MUX switch also inserts a 1400 Hz, 35 dB receive notch filter into the receiver audio signal path to attenuate received telemetry signals. This effectively removes telemetry from the audio signal monitored at the local vehicle receiver(s). The repeated telemetry transmission is unaffected.
- Monitor audio combining (Q1505A systems only) — combines the monitor audio from the auxiliary receiver with the monitor audio from the main receiver.

1.2 MICROPHONE AUDIO MUTING

1.2.1 In receive only or in repeat operation PTT switch transistors Q3 and Q4 are normally off. Transistor Q5 is on, reverse biasing CR1. The gate of microphone audio mute transistor Q1 is therefore at A- and Q1 is off. When the handset PTT button is pressed, Q3 and Q4 turn on, turning off Q5. The gate of Q1 goes high and microphone audio is gated through Q1 to the microphone audio amplifier.

1.2.2 ECG gate Q10 is normally on. If MUX is not selected, when the handset PTT button closes, Q4 turns on and pulls the gate of Q10 low through R304 and CR13. ECG gate Q10 therefore shuts off and prevents passage of ECG telemetry signals. If MUX is selected, Q7 turns off which in turn brings the cathode of CR17 high and prevents handset PTT from muting the ECG signal in the multiplex mode. In either of the above operating conditions, if the transmitter is keyed by some means other than handset PTT (i.e., ECG or REPEAT PTT) CR12 prevents the audio/telemetry multiplex module PTT switch circuits from being activated. The ECG telemetry signal passes thru Q10, the ECG lowpass filter, and transmit audio combining amplifier U3A and is routed via the cable kit to the exciter audio input. The ECG lowpass filter removes annoying second and third harmonic components of the ECG signal.

1.2.3 In repeater operation the gate of Q10 is pulled low by the repeater set-up line through CR14. Therefore, Q10 remains off at all times.

1.3 1400 Hz TRANSMIT NOTCH FILTER

The purpose of the transmit notch filter is to remove voice audio frequency components that would interfere with the telemetry signal while in the multiplex mode. The notch filter is a two-section active filter that provides about 13 dB of attenuation at 1400 Hz (± 250 Hz) when MUX switch S1 on the control panel is depressed.

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When S1 is depressed, the following results — Q7 turns off and Q11 turns on which applies a low to the gate of filter bypass gate Q101 (via CR102). This low turns Q101 off and therefore only mic audio that passes through the 1400 Hz transmit notch filter is transmitted.

Each section of the notch filter consists of three operational amplifiers with appropriate feedback. Either notched audio or bypassed audio is then applied to U3A. The MUX switch also activates the receive notch (described later).

NOTE

With the MUX switch activated, the mobile operator can talk to the base unit and, simultaneously, medical telemetry, signals can be transmitted. If the system is "Duplex Multiplex" the doctor at the hospital can talk back to the paramedic via the mobile repeater without interfering with the repeated ECG signal which the doctor is monitoring.

In some unique situations such as very poor quieting, operation in the MUX mode may result in weakly received audio at the base unit. In such cases, releasing the MUX switch will increase ECG signal deviation to approximately 4 kHz and will allow microphone PTT to interrupt ECG transmission and provide normal 5 kHz deviation for voice messages.

1.4 NOISE CANCELLING AMPLIFIER

Noise cancelling amplifiers U1A and U2D reduce the noise level on the auxiliary receiver (if a Q1505A is used) and main receiver monitor audio signals. The noise on the audio high lead and the audio shield are in phase and are both referenced to chassis ground. The noise signals are cancelled by applying the audio high and audio shield to opposite-polarity inputs of U1A and U3D. Amplification of the monitor audio signal from the main receiver auxiliary audio board and the squelch gate board of the auxiliary receiver is not impaired, since the monitor audio signal is referenced to the audio shield.

1.5 1400 Hz RECEIVE NOTCH FILTER

The receive notch filter is a two-section active filter that provides about 35 dB of attenuation at 1400 Hz when MUX switch S1 on the control panel is depressed. Each section of the filter consists of two operational amplifiers, with appropriate feedback and a combining operational amplifier that amplifies the filter section output. The receive notch filter operates continuously, but is bypassed by Q6 when receiver monitor audio filtering is not needed. When S1 is depressed, the following results — Q7 turns off and Q11 turns on which applies a low to the gate of filter bypass gate Q6 (via R49). This low at gate Q6 turns it off and therefore the receiver monitor audio from the noise-cancelling amplifier output must pass through the 1400 Hz receive notch filter.

2. INSTALLATION

2.1 INTRODUCTION

Installation consists of simply connecting plugs to the two jacks at the module's housing and then making two level set adjustments.

2.2 ECG LEVEL ADJUST

This adjustment is required only when the Motorola Model QLN1919B ECG Mobile Modulator Preamplifier Module is used with the audio/telemetry multiplex module.

Step 1. Connect an rf wattmeter to the radio set antenna terminal. Terminate the wattmeter in a 50-ohm dummy load.

Step 2. Connect a deviation meter to the radio set.

Step 3. Turn on the radio set and also turn on the ECG module. This will automatically key the transmitter.

Step 4. Press the MUX pushbutton in. Do *not* depress the RPT or handset PTT switch.

Step 5. Adjust R67 on the audio/telemetry module to obtain ±2 kHz transmitter modulation deviation.

2.3 MOBILE MICROPHONE ADJUST

Step 1. Connect an rf wattmeter to the radio set antenna terminal. Terminate the wattmeter in a 50-ohm load.

Step 2. Connect a deviation meter to the radio set.

Step 3. Turn on the radio set.

Step 4. Inject a 600 mV, 2 kHz tone at J2-12 on the audio/telemetry module.

Step 5. Press the MUX pushbutton in, and activate handset PTT.

Step 6. Adjust R110 on the audio/telemetry module to obtain ±2 kHz transmitter modulation deviation.

3. OPERATION

3.1 INTRODUCTION

These operating instructions describe operation of the audio/telemetry module in a "Micor" "Systems•90" duplex/repeater radio set. The audio/telemetry module includes the MUX, RPT, and ROAM switches.

3.2 RECEPTION

Step 1. Set the control head ON-OFF switch to the ON position. The receiver operates continuously while the radio is turned on.

Step 2. Select the desired radio channel.

Step 3. Remove the handset from its hang-up box. The receiver now operates with carrier squelch. All signals on the selected channel can be heard.

Step 4. Turn the SQUELCH control fully counterclockwise. Adjust the control head VOLUME control for a comfortable listening level.

Step 5. Turn the control head SQUELCH control clockwise until the speaker noise just stops.

Step 6. Replace the handset on its hang-up box. The receiver now operates with "Private-Line" tone coded squelch. Only signals from your radio system can unsquelch the receiver.

3.3 TRANSMISSION - DUPLEX OPERATION

Step 1. Select the desired radio channel.

Step 2. Remove the handset from its hang-up box. Monitor the channel for activity.

Step 3. If the radio channel is not in use, hold down the PTT button on the handset handle and speak slowly and distinctly into the handset microphone.

NOTE

In duplex operation it is not necessary to release the PTT button to receive a reply. The receiver operates at all times.

3.4 REPEATER OPERATION

Step 1. Set the control head controls as described in the procedure entitled "TO RECEIVE".

Step 2. Depress the RPT button on the control head. The RPT indicator brilliance increases and the radio set is now enabled to re-transmit any received radio signal that contains the proper "Private-Line" tone frequency. All radio signals on the selected channel are monitored in the radio set speaker, but only those signals with the proper "Private-Line" tones are able to activate the repeater transmitter. The control head transmit indicator light runs on whenever the transmitter is "on the air".

NOTE

The radio set handset can be used to transmit message while the radio set is in the repeater mode. If the repeater is activated during your voice transmission, the two messages are transmitted simultaneously.

Step 3. To return to normal duplex (non-repeat) operation, press the control head RPT button and allow it to return to the "out" position. The RPT indicator is then dimly illuminated.

3.5 ROAM EMERGENCY REPEAT OPERATION

Step 1. Set the control head operating controls as described under "TO RECEIVE".

Step 2. Depress the RPT and ROAM control head pushbuttons. The RPT and ROAM indicators are then brightly lit. The radio set operates as described under REPEATER OPERATION, except that all received radio signals are repeated, whether or not they contain a PL tone.

3.6 ECG TELEMETRY FILTERING

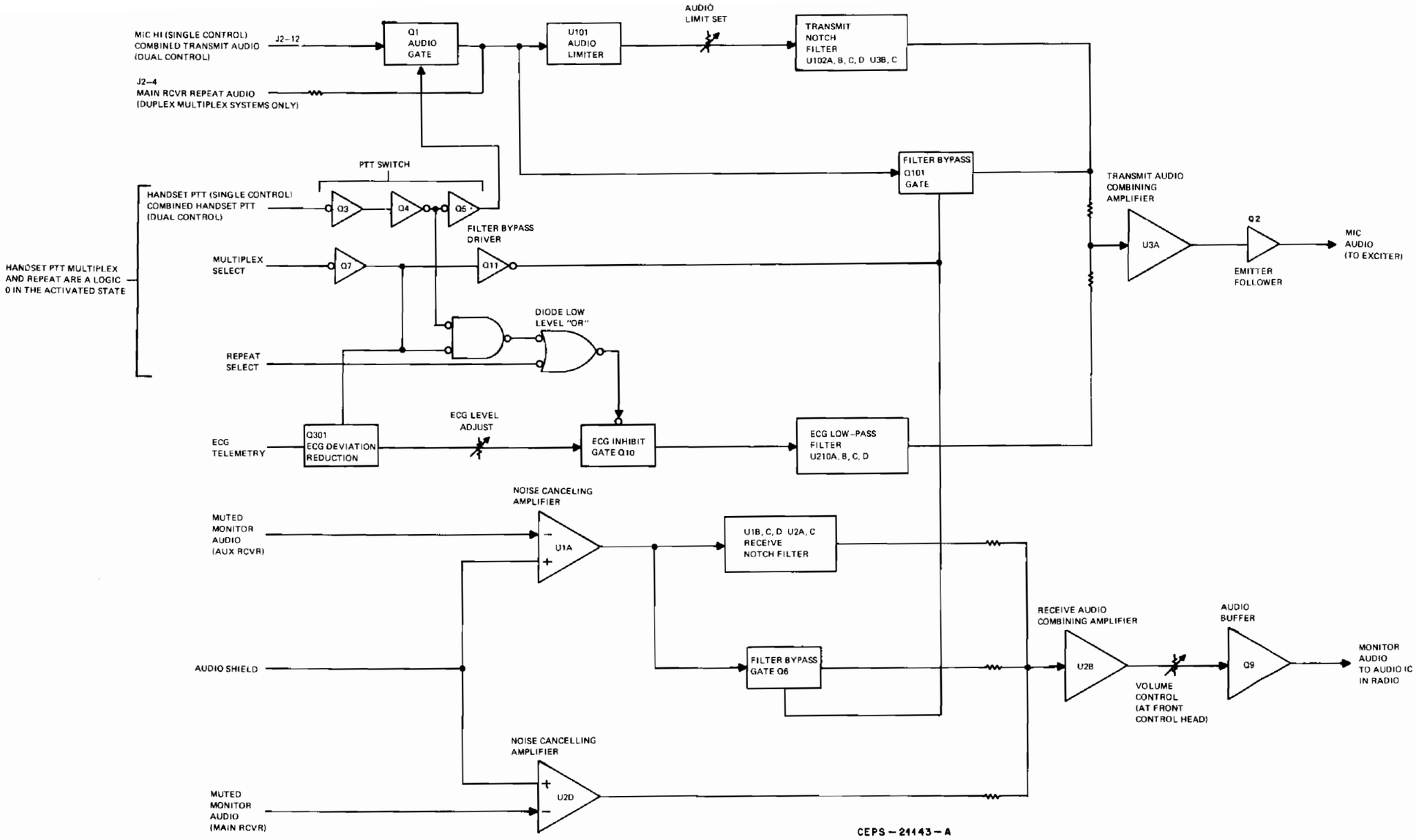
If the repeater is used to repeat ECG telemetry tones from a portable radio, these tones, like all other repeated messages, are monitored at the radio set speaker. To reduce the level of the monitored ECG telemetry tones, depress the control head MUX pushbutton. The MUX indicator is then brightly lit. The repeated ECG telemetry transmission is not impaired in any way and voice messages can still be monitored.

3.7 MULTIPLEX OPERATION

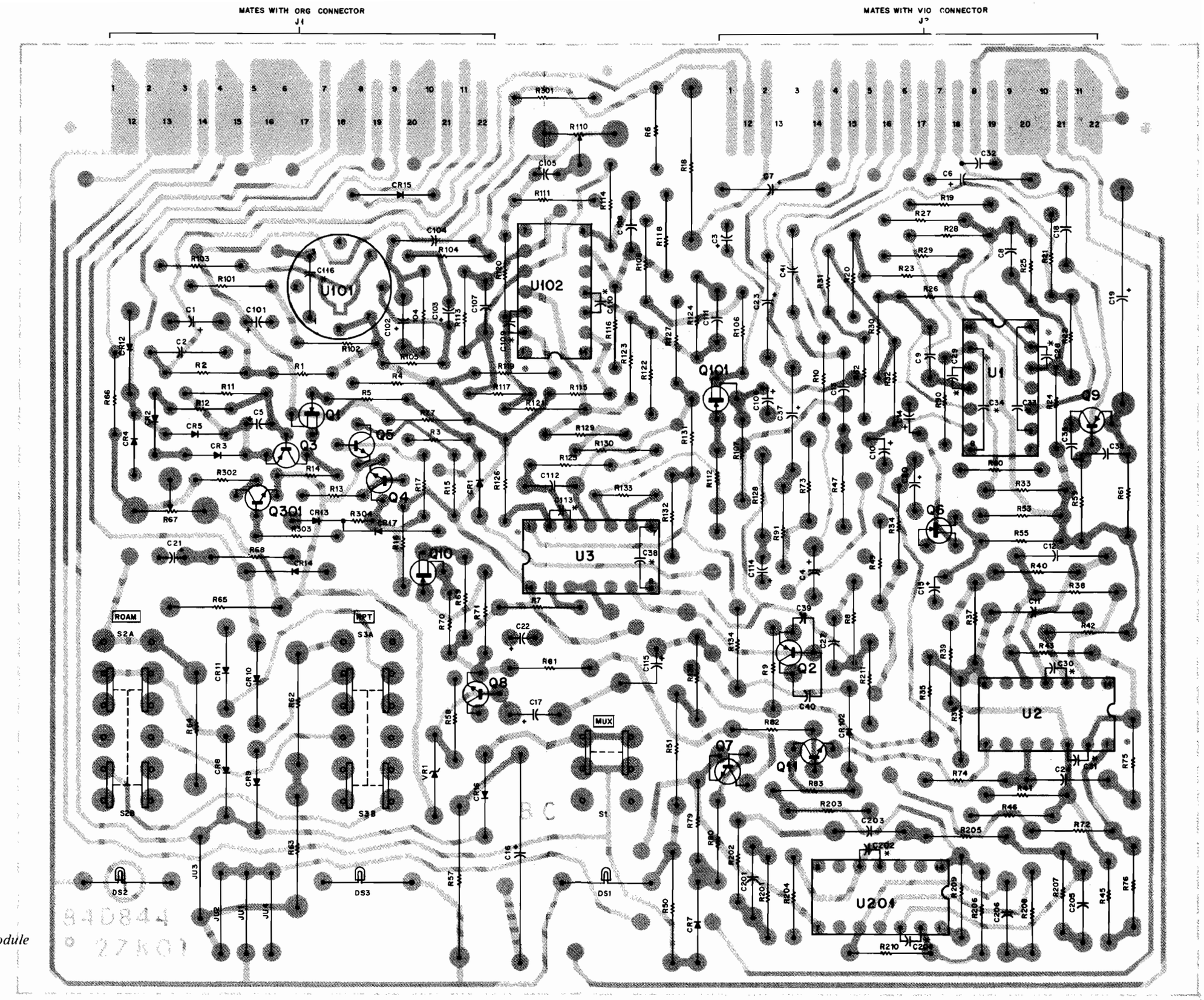
Step 1. Set the control head controls as described in the procedure entitled "TO RECEIVE".

Step 2. Connect the Motorola Model QLN1919B ECG Mobile Modulator Preamplifier Module to the control head and turn it on. This automatically keys the transmitter.

Step 3. Depress the MUX pushbutton in. The MUX indicator brilliance will increase. When the microphone PTT is activated, the 1400 Hz portion of voice audio will be removed which prevents voice audio from interfering with telemetry transmissions.



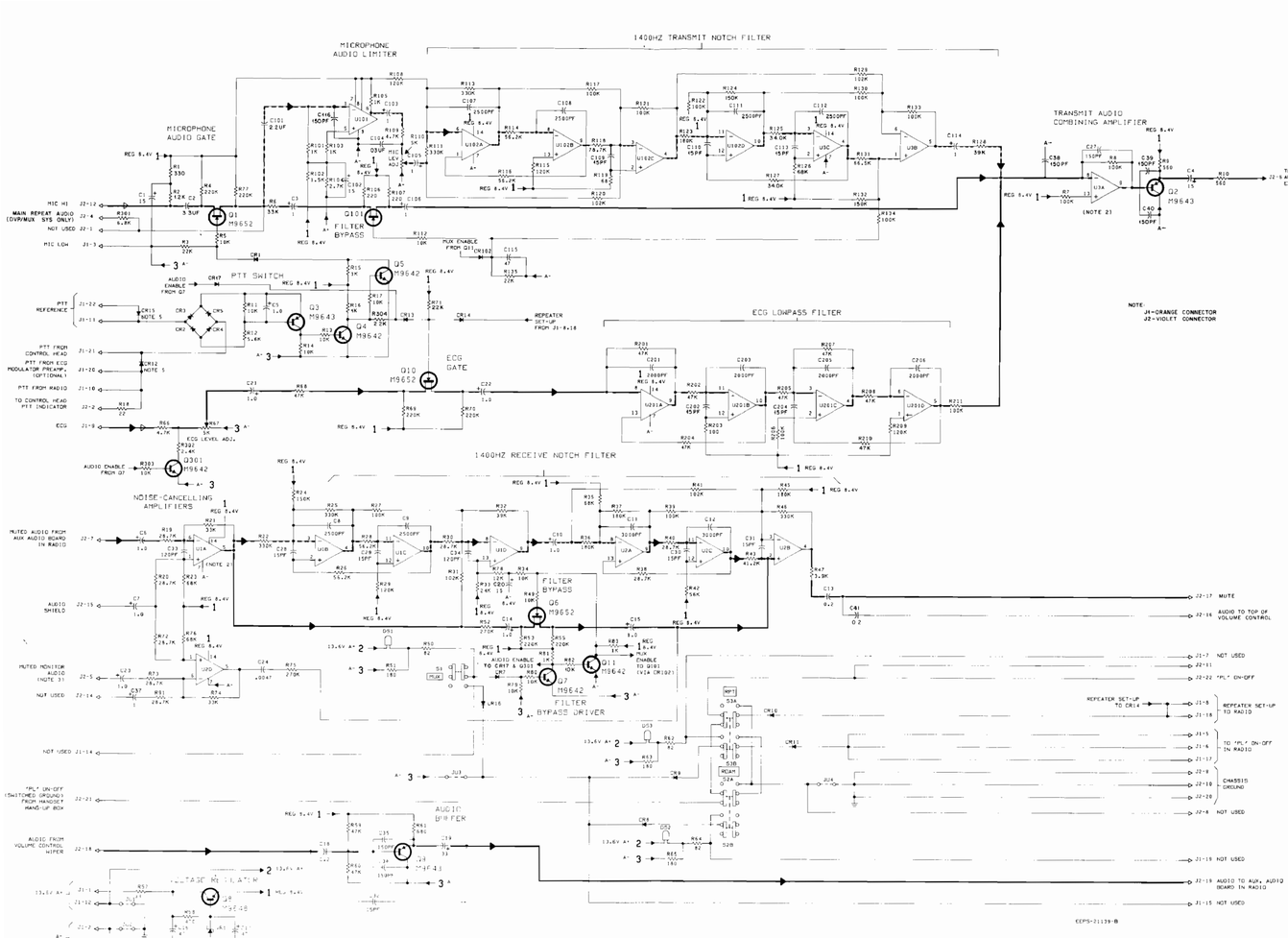
QLN1918B Audio/Telemetry Module
Functional Diagram
Motorola No. CEPS-21143-A
3/28/79- PHI



SHOWN FROM SOLDER SIDE

COMPONENT SIDE BD-EEPS-21140-O
SOLDER SIDE BD-EEPS-21141-O
OL-DEPS-21142-B

QLN1918B Audio/Telemetry Multiplex Module
Circuit Board Detail
Motorola No. PEPS-23770-O
*3/28/79-*PHI



REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

PARTS LIST

QLN1918B Audio/Telemetry Module PL-5399-A

		CAPACITOR, fixed ±20%; unless otherwise stated
C1	23-84538G04	15 uF
C2	23-83214C17	3.3 uF, 20%; 15 V
C3	23-84538G01	1.0 uF; 35 V
C4	23-84538G04	15 uF
C5	23-84538G01	1.0 uF; 35 V
C6, 7	23-82783B26	1.0 uF ±10%; 35 V
C8, 9		2500 pF 2% ; 500 V
C10	23-84538G01	1.0 uF; 35 V
C11, 12	21-850994	3000 pF ±4%; 100 V
C13, C41	21-82372C05	0.2 uF +80-20%; 25 V
C14, 15	23-84538G01	1.0 uF ±20%; 35 V
C16	23-82783B31	47 uF ±10%
C17	23-84538G06	47 uF
C18	21-82372C05	0.2 uF +80-20%; 25 V
C19	23-82793B07	33 uF; 25 V
C21, 22	23-84538G01	1.0 uF; 35 V
C23	23-82783B26	1.0 uF ±10%
C24	8-82905G26	0.0047 uF ±10%; 100 V
C25, 26	21-82372C01	0.1 uF +80-20%; 25 V
C27	21-863147	150 pF ±10%
C28 thru 32	21-861462	15 pF
C37	23-82783B26	1.0 uF ±10%; 35 V
C20	23-84538G04	15 uF ±10%
C101	23-84538G08	2.2 uF ±20%; 20 V
C102	23-84538G04	15 uF
C103	23-84538G08	2.2 uF ±20%; 20 V
C104	8-82905G40	.03 uF; 50 V
C105, 106	23-84538G01	1.0 uF; 35 V
C107, 108		2500 pF 2% 500 V
C109, 110	21-862462	15 pF ±10%
C111, 112		2500 2%; 100 V
C113	21-862462	15 pF ±10%
C114	23-84538G01	1.0 uF; 35 V
C115	23-84538G06	47 uF
C201	21-84426B46	2000 pF ±5%; 500 V
C202	21-861462	15 pF ±10%
C203	21-84426B46	2000 pF ±5%; 500 V
C204	21-861462	15 pF ±10%
C205, 206	21-84426B46	2000 pF ±5%; 500 V
C33, 34	21-82610C09	120 pF ±5%
C35, 36, 38, 39, 40, 116	21-863147	150 pF ±10%
		DIODE: (SEE NOTE)
CR1	48-83654H01	silicon
CR2 thru 5	48-82420C01	silicon
CR7	48-83654H01	silicon
CR8 thru 12	48-82466H13	silicon
CR13, 14	48-83654H01	silicon
CR15, 16	48-82466H13	silicon
CR17	48-83654H01	silicon
CR102	48-83654H01	silicon
		LAMP, assembly:
DS1, 2, 3	65-84047E01	14 V; 80 mA; encased in housing
		TRANSISTOR: (SEE NOTE)
Q1	48-869652	field-effect
Q2, 3	48-869643	PNP; M9643
Q4, 5	48-869642	NPN; M9642
Q6	48-869652	field-effect
Q7	48-869642	NPN; M9642
Q8	48-869648	NPN; M9648
Q9	48-869643	PNP; M9643
Q10	48-869652	field-effect
Q11	48-869642	NPN; M9642
Q101	48-869652	field-effect
Q301	48-869642	NPN; M9642
		RESISTOR, fixed: ±5%; 1/4 W; unless otherwise stated
R1	6-124A37	330
R2	6-124A51	1.2k
R3	6-124A81	22k
R4	6-124B06	220k
R5	6-124A73	10k
R6	6-124A85	33k
R7, 8	6-124A97	100k

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
R9, 10	6-124A43	560
R11	6-124A73	10k
R12	6-124A67	5.6k
R13, 14	6-124A73	10k
R15, 16	6-124A49	1k
R17	6-124A73	10k
R18	17-83122D09	22; 3 W
R19, 20	6-10621D36	28.7k ±1%; 1/8 W
R21	6-124A85	33k
R22	6-124B10	330k
R23	6-124A93	68k
R24	6-124B02	150k
R25	6-124B10	330k
R26	6-10621D64	56.2k ±1%; 1/8 W
R27	6-124A97	100k
R28	6-10621D64	56.2k ±1%; 1/8 W
R29	6-124A99	120k
R30	6-10621D36	28.7k ±1%; 1/8 W
R31	6-10621D89	102k ±1%; 1/8 W
R32	6-124A87	39k
R33	6-124A82	24k
R34	6-124A73	10k
R35	6-124A93	68k
R36, 37	6-124B04	180k
R38	6-10621D36	28.7k ±1%; 1/8 W
R39	6-124A97	100k
R40	6-10621D36	28.7k ±1%; 1/8 W
R41	6-10621D89	102k ±1%; 1/8 W
R42	6-124A91	56k
R43	6-10621D51	41.2k
R45	6-124B04	180k
R46	6-124B10	330k
R47	6-124A63	3.9k
R49	6-124A73	10k
R50	6-125C23	82 ±10%; 1/2 W
R51	6-125C31	180 ±10%; 1/2 W
R52	6-125B08	270k
R53	6-124B06	220k
R55	6-124B06	220k
R57	6-126C13	33 ±10%; 1 W
R58	6-124A41	470
R59, 60	6-124A89	47k
R61	6-124A45	680
R62	6-125C23	82 ±10%; 1/2 W
R63	6-125C31	180 ±10%; 1/2 W
R64	6-125C23	82 ±10%; 1/2 W
R65	6-125C31	180 ±10%; 1/2 W
R66	6-124A65	4.7k
R67	18-83083G07	variable; 5k
R68	6-124A89	47k
R69, 70	6-124B06	220k
R71	6-124A81	22k
R72, 73	6-10621D36	28.7k ±10%; 1/8 W
R74	6-124A85	33k
R75	6-124B08	270k
R76	6-124A93	68k
R77	6-124B06	220k
R78	6-124A75	12k
R79, 80	6-124A73	10k
R81	6-124A49	1k
R82	6-124A73	10k
R83	6-124A49	1k
R91	6-10621D36	28.7k ±1%; 1/8 W
R101	6-124A49	1k
R102	6-124A53	1.5k
R103	6-124A49	1k
R104	6-124A59	2.7k
R105	6-124A49	1k
R106, 107	6-124B06	220k
R108	6-124A99	120k
R109	6-124A65	4.7k
R110	18-83083G07	variable, 5k ±30%; 250 V
R111	6-124B10	330k
R112	6-124A73	10k
R113	6-124B10	330k
R114	6-10621D64	56.2k ±1%; 1/8 W
R115	6-124A99	120k
R116	6-10621D64	56.2k ±1%; 1/8 W
R117	6-124A97	100k
R118	6-10621D78	78.7k ±1%; 1/8 W
R119	6-124A93	68k
R120	6-10621D89	102k ±1%; 1/8 W

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
R121, 122	6-124A97	100k
R123	6-124B04	180k
R125		34.0k ±1%; 1/8 W
R126		68k
R127		34.0k ±1%; 1/8 W
R128	6-124A87	39k
R129	6-10621D89	102k ±1%; 1/8 W
R130	6-124A97	100k
R131	6-10621D71	66.5k ±1%; 1/8 W
R132		150k
R133, 134	6-124A97	100k
R135	6-124A81	22k
R201, 202	6-124A89	47k
R203	6-124A97	100k
R204, 205	6-124A89	47k
R206	6-124A97	100k
R207, 208	6-124A89	47k
R209	6-124A97	100k
R210	6-124A89	47k
R211	6-124A97	100k
R301	6-124A69	6.8k
R302	6-124A58	2.4k
R303	6-124A73	10k
R304	65124A57	2.2k
R124		150k
		INTEGRATED CIRCUIT: (SEE NOTE)
U1, 2, 3	51-84320A70	type M2070
U102	51-84320A70	type M2070
U201	51-84320A70	type M2070
U101	51-84320A02	type M2002
		VOLTAGE, regulator:
VR1	48-82256C38	Zener; 9.1 V

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

QLN1918B Audio/Telemetry Module
Schematic Diagram
Motorola No. PEPS-28535-O
3/28/79-PHI

REPEAT AUDIO PROCESSING (RAP) MODULE

MODEL QLN2042A

1. INTRODUCTION

The RAP module processes main receiver repeat audio. First, it allows audio to pass, only when the main receiver is unsquelched and repeat mode is selected. Second, it amplifies and allows adjustment of main receiver repeat audio to the same level as auxiliary receiver repeat audio. Finally, it removes any PL tone that might accompany main receiver repeat audio so that the PL tone is not retransmitted (repeated).

The QLN2042A RAP Module is made up of a QLN7208A RAP Board, a QLN7209A Escutcheon and Hardware Kit and a QKN8352A Cable Kit.

2. CIRCUIT DESCRIPTION

2.1 Refer to the schematic diagram at the end of this section for the following discussion. Emitter follower audio from the main receiver is applied to the module at J1-16 and routed to noise-cancelling amplifier U1A. This amplifier balances out noise picked up on the cable run between the radio set and the RAP module and provides 6 dB signal gain.

2.2 The audio routed through the module is controlled by audio gate Q2. The gate passes audio (is enabled) when the receiver squelch logic circuitry in the main receiver provides a high (≃9.5 volts) at the base of gate driver Q3 (repeat audio enable).

2.3 Repeat level adjust control R14 balances the level of the main receiver repeat audio to match that of the auxiliary receiver repeat audio. The PL filter network, (which consists of C9, C10, C11, C20, L1, and L2) removes the PL signal from the received audio signal.

2.4 The final stage on the RAP module U1B performs two functions: de-emphasis and amplification. De-emphasis reduces the high frequency components of the audio signal (for correct repeat audio frequency response) and amplification (30 dB) ensures sufficient drive to modulate the repeater transmitter.

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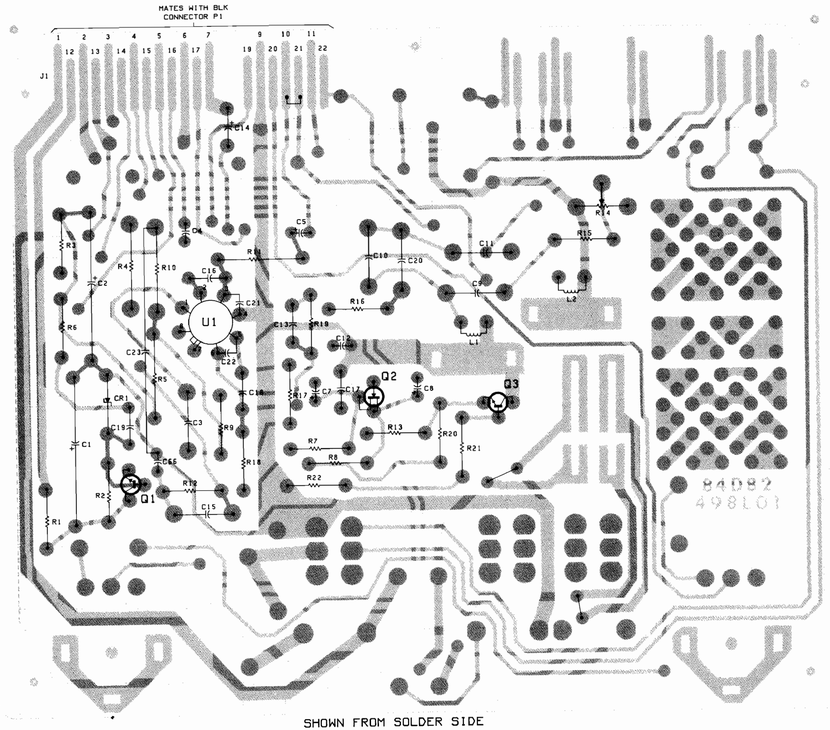
PARTS LIST

QLN2042A Repeat Audio Processing Module PL-4573-O

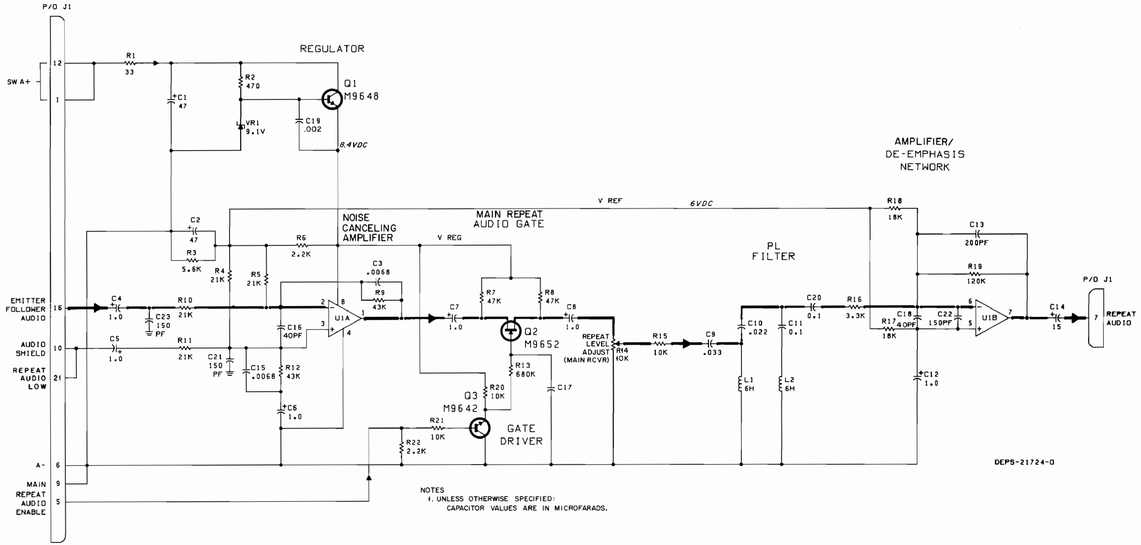
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITORS, fixed, uf: ±10% unless otherwise stated
C1, C2	23-82783B31	47; 20%; 20 V
C3	8-83813H01	.0068; 100 V
C4 thru 8	23-84538G01	1.0; ±20%; 35 V
C9	8-82905G08	.033; 50 V
C10	8-82905G02	.022; 50 V
C11	8-82905G30	0.1; 50 V
C12	23-84538G01	1.0; ±20%; 35 V
C13	21-84494B11	200 pF; ±5%; 500 V
C14	23-84538G04	15; ±20%; 20 V
C15	8-83813H01	.0068; 100 V
C16, 17, 18	21-82610C01	40 pF; ±5%; 200 V
C19	21-82428B28	.002; 200 V
C20	8-82905G30	0.1; 50 V
C21, 22, 23	21-863147	150 pF; 500 V
		DIODE: (SEE NOTE)
CR1	48-82256C38	zener; 9.1 V
		COILS, audio
L1, 2	24-84003A02	choke, 6 H
		TRANSISTORS: (SEE NOTE)
Q1	48-869648	NPN; type M9648
Q2	48-869652	FET; type M9652
Q3	48-869642	NPN; type M9642
		RESISTORS, fixed: ±5%; 1/4 W unless otherwise stated
R1	6-126C13	33; ±10%
R2	6-124A41	470
R3	6-124A67	5.6k
R4, 5	6-1062 1D23	21k; ±1%; 1/8 W
R6	6-124A57	2.2k
R7, 8	6-124A89	47k
R9	6-124A88	43k
R10, 11	6-1062 1D23	21k; ±1%; 1/8 W
R12	6-124A88	43k
R13	6-124B18	680k
R14	18-83083G10	var. 10k
R15	6-124A73	10k
R16	6-124A61	3.3k
R17, 18	6-124A79	18k
R19	6-124A99	120k
R20, 21	6-124A73	10k
		INTEGRATED CIRCUIT: (SEE NOTE)
U1	51-84320A27	type M2027

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



TRANSISTOR BASE DETAIL

COMPONENT SIDE BD-DEPS-21727-D
SOLDER SIDE BD-DEPS-21728-D
DL-DEPS-21726-D



REPEAT AUDIO PROCESSING (RAP) MODULE

Model QLN2042A

FUNCTION

The RAP module is used in EMS duplex multiplex systems to process the audio from the main receiver in the mobile duplex-repeater radio.

QLN2042A Repeat Audio Processing (RAP) Module Schematic Diagram
Motorola No. PEPS-21725-A
3/28/79- PHI

ECG MOBILE PREAMPLIFIER-MODULATOR MODULE

MODEL QLN1919C

1. APPLICATION

1.1 The ECG Preamplifier-Modulator Module is an optional part of the Motorola Emergency Medical Service Radio System. This system is a special adaptation of standard two-way radio and medical monitoring equipment for pre-hospital care of heart patients. Basically, it continuously transmits the in-transit patient's electrocardiogram (ECG) rhythm strip ahead to the hospital coronary monitoring equipment. A cardiologist may then radio appropriate directions back to ambulance technicians and make advance preparations for reception of the patient at the hospital.

1.2 The Model QLN1919C ECG Preamplifier-Modulator adapts a mobile radio for ECG telemetry applications. The ECG unit is supplied with power from the vehicle battery and produces an ECG modulated audio frequency signal which is connected to the microphone input of the radio.

1.3 The QLN1919C includes a ECG Adapter Box which provides an interface to the patient monitor cable. The box mounts near the control group and has a three-wire shielded cable which connects to J102 on the ECG Preamplifier Module. J1 on the adapter box accepts the standard 6-pin patient monitor cable. J2 on the adapter box is a TT jack and accepts the older style patient monitor cable. This jack can also be used as a low level output for connection of a patient monitoring oscilloscope.

1.4 Model QLN7478AA ECG Adapter Box is supplied with earlier model QLN1919C ECG Modules. This adapter is wired for an ECG LEAD I. Model QLN7478B ECG Adapter Box supplied with later model QLN1919C ECG Modules is wired for ECG LEAD II. This makes the modulator compatible with the newer cardioscopes wired for ECG LEAD II and allows the cardiologist to take advantage of the increased diagnostic capability of LEAD II monitoring. The QLN7478B is easily identified by the LEAD II legend screened on the front of the box between the two connectors.

CAUTION

Failure to properly connect the ECG Adapter (i.e. LEAD I to LEAD I or LEAD II to LEAD II) will result in ECG artifact. Also, precaution should be taken to prevent the patient from making contact with the ECG ground.

2. DESCRIPTION

2.1 GENERAL

2.1.1 The QLN1919C Preamplifier-Modulator Module consists of a Model QLN5680B Escuthcheon & Hardware Kit, a Model QLN7113B Modulator-Preamplifier Circuit Board, a Model QKN8128A Cable Kit, and a QLN7478AA ECG Adapter Box. The module mounts in a standard "Systems 90" accessory housing in the upper card position only.

2.1.2 The QLN1919C Module has an ECG input jack, a CALibrate switch button, an LD CHK (lead check) switch button, and an ON switch button. ON and LD CHK buttons have panel lights which indicates the "on" condition. If the ON button is not depressed, the ECG unit is off. The associated radio may then be used for normal two-way communications. With the ON button depressed the ECG circuit is on, and when properly connected, the mobile radio transmitter is keyed for continuous operation. The CALibration control is a push-on/push-off switch. With the ON button depressed and the CAL button on, a calibration signal is present at the output for use in initial adjustment of the

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hospital monitoring equipment. The momentary LD CHK button can then be pressed and held allowing comparison at the hospital of patient contact impedance to the signal previously sent using the standard CALibration resistor.

2.2 ECG MODULATOR-PREAMPLIFIER CIRCUIT BOARD

2.2.1 The ECG modulator-preamplifier circuit board includes a modulator circuit, and ON function switch, and a calibrated on/off switch. In the ON position, patient-attached electrodes may be connected through the ECG input jack to the modulator. The modulator converts the ECG signal to an audio signal which is transmitted directly to the hospital. In the OFF position, the modulator is off and the radio operates independently or as a repeater station to receive and retransmit the ECG signal from a portable ECG transmitter. Each switch position is indicated on the control head panel by a lighted switch button.

2.2.2 The ECG modulator-preamplifier circuit board includes a calibration circuit and a push-on/push- off switch. With the CAL switch on and LD CHK not depressed, the circuit generates a 1-millivolt squarewave signal which may be used at the hospital for adjustment of equipment. With the switch on, and ECG input signal connected at the ECG input jack, and LD CHK pressed, the squarewave signal is superimposed on the ECG audio signal and the squarewave amplitude is an indication of the impedance of patient-connected electrodes.

3. INSTALLATION

The ECG Modulator-Preamplifier Module comes either as a factory equipment option, completely prewired, or as a field installed add on to an existing "Micor" radio set. The ECG Modulator-Preamplifier Module circuit card is installed in the accessory housing, either alone or in combination with other radio accessories. The installation instructions provided here are for the ECG Modulator preamplifier used as the only accessory. For instructions pertaining to multiple installations, refer to the installation instructions supplied with the housing assembly.

3.1 FIELD INSTALLED OPTION

To add the ECG Module in a negative ground system, refer to the schematic diagram and proceed as follows:

Step 1. Slide the circuit card completely in the housing assembly in either position.

Step 2. Install the rear housing cover and secure with two captive screws.

Step 3. Disconnect the black connector (P1101) from the control head.

Step 4. Use the contact removal tool to remove two wires, with pins attached, from P1101 as follows:

a. Yellow wire from position 1.
b. Black-violet wire from position 9.

NOTE

Steps 5 and 6 are not applicable when the wires extend as least five inches beyond the sleeving on the multiconductor cable.

Step 5. Remove the "S" clamp from the end of the multiconductor cable and move the strain relief back about five inches.

Step 6. Cut approximately five inches of sleeving off the cable. Avoid cutting the insulation of any wires.

Step 7. Insert the pins and wires that were removed from P1101 into the green connector P3 as follows:

a. Yellow wire into position 1.
b. Black-violet wire into position 10.

Step 8. Insert the pins and wires connected from P3 into P1101 as follows:

a. Yellow wire into position 1.
b. Black-violet wire into position 9.

Step 9. Reconnect P1101 to the control head and connect P3 to the 22-pin receptacle (P3) on the rear of the circuit card.

Step 10. Disconnect the orange connector (P1) from the Repeater Control Module.

Step 11. Insert the pins and wires connected from P3 into P1 as follows:

a. Black-orange wire into position 20.
b. Brown wire into position 9.

Step 12. Reconnect P1 to the repeater control module 22-pin receptacle (J1) on the rear of the circuit card.

Step 13. Remove the escutcheon backing and attach escutcheon to the housing assembly front panel.

3.2 FACTORY WIRED OPTION

When the ECG Modulator-Preamplifier Module option is purchased as part of a radio system the wiring changes will have been completed. The individual system components are shipped with all interconnecting cables attached, to permit a thorough system check out before unpacking. To install the radio system proceed as follows:

Step 1. Install the radio and cabling as directed in the radio installation instructions.

Step 2. Install the trunnion bracket and housing assembly as instructed.

Step 3. Connect the black and blue connector to the control head.

Step 4. Connect the green connector (P3) to the ECG Modulator-Preamplifier jack (J3).

Step 5. Connect the orange and violet connectors (P1) and (P2) to the Repeater Control Module jacks (J1) and (J2).

Step 6. Insert the handset plug (P1103) into the control head microphone jack (J1103).

Step 7. Connect the speaker plug (P1104) into the control head speaker jack (J1104).

3.3 ECG ADAPTER BOX

The ECG adapter box should be mounted at a convenient location near the ECG control group.

Step 1. Select the desired location and make sure the cable from the adapter is long enough to reach J102 on the pre-amplifier module.

Step 2. Using the adapter box as a template mark the location of the required screw holes.

Step 3. Drill the holes and mount the adapter box using the two screws provided.

Step 4. Connect the cable from the adapter box to J102 at the rear of the preamplifier module.

3.4 INTERNAL SWITCH CONTACTS

If a particular installation requires the use of internal switch contacts in the ECG Modulator Preamplifier Module, contact a Motorola Field Technical Representative or other technically qualified personnel.

4. OPERATION

Step 1. Place the associated radio in operation and check for the desired operating frequency.

Step 2. When a clear channel has been determined, depress the ON and CAL switches (indicators will be brightly illuminated) and allow sufficient time for initial adjustment of the receiver and monitoring equipment at the hospital.

NOTE

Transmitter is "on the air" when the ON button is depressed.

Step 3. Attach the patient electrodes and insert the plug in the ECG input jack. Press and hold the momentary LD CHK button.

NOTE

When the cable is connected at the ECG input jack and the LD CHK button pressed, the signal level at the receiver end will indicate the electrode contact impedance (greater signal indicates poorer contact). If the signal after connection does not increase to more than two times the level before connection at the ECG jack, the electrode and cable connection will be judged adequate.

Step 4. When the reception and electrode contact have been verified, depress the CAL switch a second time (indicator dimly illuminated) to remove the calibration signal.

Step 5. With the ECG cable connected and the ECG indicator illuminated (ECG switch depressed) the ECG signal is connected into the transmitter and the transmitter is keyed for normal continuous operation until disabled by depressing the ON button a second time (indicator dimly illuminated).

5. PREAMPLIFIER MODULATOR CIRCUIT DESCRIPTION

(Refer to schematic diagram)

Circuit connections betwen the ECG input jack J102 and the first differential amplifier Q1 constitute a limiter circuit to by pass any large voltage surge and provide rf filtering. This protection circuit is required because the patient-connected electrodes may pick up shock voltages from defibrillator equipment used for patient treatment. Voltage surges of this magnitude could damage the differential amplifiers.

The dual FET transistor Q1 is connected as a differential amplifier. CR4 is a constant-current diode and is used to allow enough current to low for a stable dynamic bias while maintaining a very low ac impedance. Q1 is ac coupled to Q2. Q2 operates in essentially the same way as Q1 with transistor Q3 and its associated circuitry acting as the constant current source. Each stage provides a gain of 10 for a total gain of 100.

Q4 and Q7 form a free-running multivibrator circuit tuned to 1.4 kHz. Q5 and Q6 serve, as the constant current sources which supply the charging current for the frequency determinging capacitors C19 and C17. Voltage variations at the bases of Q5 and Q6 modulate these current sources for an effective frequency modulation of the oscillator. The FET transistor Q8 is a source follower for output isolation. Q11 is used for matching into the lower impedance of the mobile transmitter.

Q9 and Q10 form a free-running multivibrator with a frequency of approximately 1 Hz. The relay K1 is switched on and off at this rate. When the relay is closed, a signal of 46 millivolts is developed across the 100-ohm resistor R7. When the CAL switch is depressed, one millivolt of this signal appears across the input voltage divider consisting of the two 10,000-ohm resistors (R2 and R4) and the 23,200-ohm resistor (R3). The resulting signal is the 1.4 kHz audio sub-carrier modulated by a 1-millivolt squarewave with a 1 Hz rate. This is the basic calibration signal which may be used for initial adjustment of the ECG monitoring equipment at the hospital.

When an ECG jack is connected at J102 and the LD CHK buttonis pressed, the skin contact and interelectrode resistance replaces resistor R3. If this resistance is close to 23,200-ohms, the signal amplitude will be approximately 1 millivolt. If the signal amplitude remains within a range of 0.5 to 2 times the 1 millivolt standard, it may be assumed that the electrode connections are satisfactory.

6. ECG PREAMPLIFIER-MODULATOR TROUBLESHOOTING PROCEDURE

6.1 TRANSMITTED SIGNAL NOT RECEIVED

Problem in Transmitter or at receiver location. Troubleshoot transmitter.

6.2 RECEIVER TONE IS POOR OR ABSENT

6.2.1 Problem is in preamplifier-modulator. Make the following checks:

Check	Test Point	Correct Indication
(1) Sub-Carrier Freq.	Feedthrough C21	1.4 kHz ± 100 Hz distorted squarewave @ 1-2 Vrms
(2) Supply Voltage	Feedthrough C1	12-14 V dc
(3) Regulated Voltage	Feedthrough C12	8.65-9 V dc

6.2.2 If voltages are proper and signal is present at correct frequency but low level, check Q8, Q11, and associated circuitry.

6.2.3 If subcarrier frequency is not within tolerance or no signal is present, problem is in voltage-controlled oscillator.

Check	Test Point	Correct Indication
DC Voltage	Q2, pins 6 & 2	6.0 ± 0.2 V dc, and within 0.1 volts between pins

6.2.4 If voltages are correct, problem is in Q4, 5, 6, 7, or associated circuitry. If voltages are incorrect, problem is in Q2, 3, or associated circuitry. Add the voltage readings at the two pins. If the sum is within the range of 11.5 to 12.5 V and, two readings differ by more than 0.1 volt, problem is in Q2. If dc voltage at Q2, pins 3 & 7 is not zero, Q2 is bad.

6.3 TONE IS RECEIVED BUT ECG SIGNAL IS POOR

6.3.1 Problem is in Q1 and assoicated circuitry.

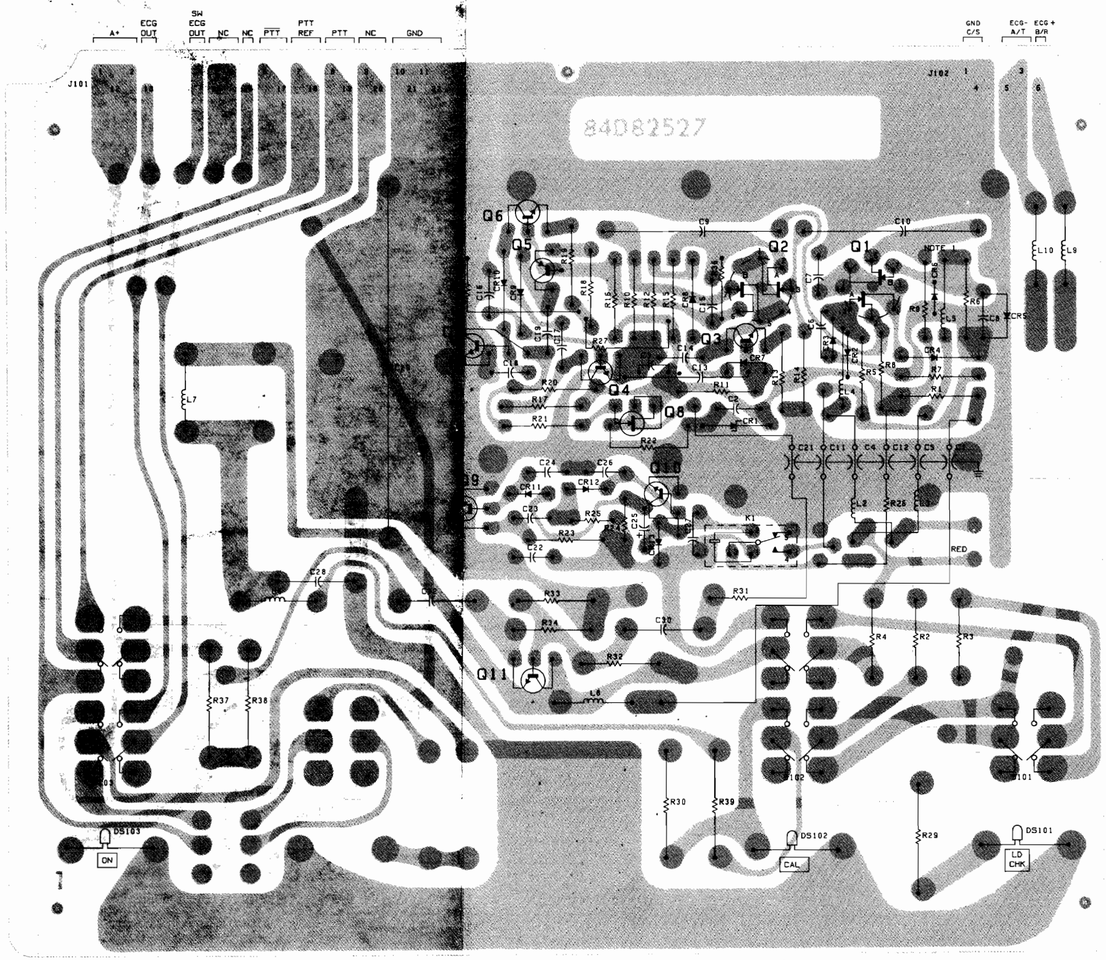
Check	Test Point	Correct Indication
(1) Voltage	Q1, pins 3 & 7	0 V dc
Voltage	Q1, pins 2 & 6	6.0 ± 0.5 V dc and within 0.1 volts between pins
(3) Voltage	Across CR4 (in circuit)	3-4 V dc
(4) Current (If Step 3 does not check)	Through CR4 (Lift one lead)	(With 4 volts across diode)
(5) Introduce 0.2 Vrms from an audio Oscillator at about 50 Hz at either side of J1 with the other side grounded	Q1, pins 2 & 6	0.4-0.6 Vrms (Readings at two points must agree within 0.05 Vrms)
(6) CR2, 3, 5, 6 (Introduce) 0.2 Vrms signal to either J1 input with other input grounded	Q1, pins 2 & 6	Sine wave for 0.2 Vrms input. Waveform should limit symetrically as input voltage is increased to 0.5 volts. Repeat with inputs reversed.
(7) Introduce a 0.2 Vrms signal at both sides of J1.	Q1, pins 2 & 6	Less than 0.02 volt at either pin.

NOTE

Any readings at Q2 are invalid without reducing the level, since Q2 will limit with this large signal. Normal inputs is in the order of 1 millivolt.

6.4 RECEIVE ECG SIGNAL OK BUT CALIBRATION SIGNAL ABSENT OR POOR

Problem is in calibration oscillator Q9, 10. Check relay contacts. The relay switches with an audible click when circuit is operating.



SHOWN FROM SOLDER SIDE

COMPONENT SIDE 80-DEPS-25573-O
SOLDER SIDE 80-DEPS-25574-O
DL-DEPS-25572-O

QLN1919C ECG Mobile Preamplifier-Modulator Module
Schematic Diagram and Circuit Board Detail
Motorola No. PEPS-25575-O
(Sheet 1 of 2)
3/28/79-PHI

PARTS LIST

QLN1919C ECG Mobile Preamplifier-Modulator Module PL-5786-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
C1	21K821474	CAPACITOR, fixed: pF ±10% 50 V unless stated
C1	21K821474	470 ±20%; 500 V ceramic feed-thru
C2	23D82397D19	2.2 uF ±40%-20%; 10 V
C3	21K861436	100; 75 V N750
C4, C5	21K821474	470 ±20%; 500 V ceramic feed-thru
C6-C8	21K861436	100; 75 V N750
C9, C10	8D84326A24	0.0261 ±2%
C11, C12	21K821474	470 ±20%; 500 V ceramic feed-thru
C13, C14	21K861436	100; 75 V N750
C15	21D84008H01	0.01 uF; Y5F
C16	21D82877B31	50
C17	21D82213E08	.001 uF ±5%; 100 V
C18	21D82877B31	50
C19	21D82213E08	.001 uF ±5%; 100 V
C21	21K821474	470 ±20%; 500 V ceramic feed-thru
C22	21K861436	100; 75 V N750
C23	23D82397D17	15 uF ±20%; 20 V
C24	21K861436	100; 75 V N750
C25	23D82397D17	15 uF ±20%; 20 V
C26, C27	21K861436	100; 75 V N750
C28	21C82372C03	0.1 uF ±80%-20%; 25 V
C29	23D82077C18	600-10%-150%; 25 V
C30	8D82905G03	0.047 uF
C32	8D82905G42	0.33 uF
		SEMICONDUCTOR DEVICE: diode (SEE NOTE)
CR1	48D82256C38	Zener 9.1 V
CR2, CR3	48C82363E05	silicon
CR4	48D82685J01	silicon, constant current
CR5-CR13	48C82363E05	silicon
		LAMP
DS101,102,103	65C84047E01	10 V; includes HOUSING
		CONNECTOR:
J101		male; consists of 20 single high & low contacts: 10 high, 28C84269C01 10 low, 28C84269C02
J102		male; consists of 5 single high & low contacts: 2 high
	28C84269C01,	28C84269C01, 3 low
		28C84269C02
		RELAY:
K1	80D84229H01	1 form "C", coil res 940 Ω ±10%
		CHOKE
L2-L6	24D82723H01	choke, RF; 1.2 uH
L7	25C83124C01	Filter, 35 mH; 12 ohms
L8-L10	24D82723H01	choke, RF; 1.2 uH
		TRANSISTOR: (SEE NOTE)
Q1,Q2	48R869708	dual N-Channel FET; type M9708
Q3, Q4	48R869570	NPN; type M9570
Q5, Q6	48R869571	PNP; type M9571
Q7	48R869570	NPN; type M9570
Q8	48R869651	N-Channel FET; type M9651
Q9, Q10	48R869570	NPN; type M9570
Q11	48R869642	NPN; type M9642
		RESISTOR, fixed: ohms ±5% 1/4 W unless stated
R1	6S124A43	560
R2	6S124A73	10k
R3	6D83175C32	23.2k ±1%; 1/8 W metal film
R4	6S124A73	10k
R5, R6	6S185B22	1 Meg; 1/8 W
R7	6D82672B77	100 ±1%; 1/8 W metal film
R8, R9	6D83175C36	25.5k ±1%; metal film
R10	6S185B46	10 Meg. ±10%; 1/8 W
R11	6D83175C57	46.4k ±1%; metal film
R12, R13	6D83175C86	6.04k ±1%; metal film
R14	6S185B46	10 Meg. ±10%; 1/8 W
R15, R16	6D83175C36	25.5k ±1%; metal film
R17	6S185A77	15k; 1/8 W
R18, R19	6D83175C54	41.2k; 1%; 1/4 W
R20	6S185A77	15k; 1/8 W
R21	6S185C18	1.5 Meg. ±10%; 1/8 W
R22	6S124A73	10k
R23	6S124A49	1k
R24	6S185A83	27k; 1/8 W
R25	6S185A91	5ok; 1/8 W
R26		Factory Selected Value
R27	6S10c21C35	3.32k, 1%; 1/8 W
R29	6S125C31	180 ±10%; 1/2 W
R30	6S125C23	82 ±10%; 1/2 W
R31	6S124A65	4.7k ±10%
R32, R33	6S124A73	10k
R34	6S124A49	1k
R35, R36		Factory Selected Value
R37	6S125C31	180 ±10%; 1/2 W
R38, R39	6S125C23	82 ±10%; 1/2 W
		SWITCH:
S101	40D84324C02	dpdt
S102, 103	40D84324C10	4 pdt, locking pushbutton
	NON-REFERENCED ITEMS	
	84D82527L01	BOARD, Circuit
	26C82636J01	SHIELD, Bottom
	26C82637J01	SHIELD, Top
	14-82348C01	INSULATOR, Shield
	38C84321C01	PUSHBUTTON, Grey (2 req d)
	38C84321C02	PUSHBUTTON, Orange
	2S119409	NUT, Hex 0-80 x 5/32(2 req d)
	3S131157	SCREW, Mach 0-80 x 3/16 (2 req d)
	64B05332A01	NUT, Plate (2 req d)
	3S125347	SCREW, Tpg. 2-56 x 3/16 (6 req d)
	32B82639J01	GASKET
	3S7178	SCREW, Mach. 6-32 x 5/16 (2 req d)
	2S7002	NUT, Hex 6-32 (2 req d)
	4S7e66	WASHER, ext. lock (2req d)
	7B82635J01	BRACKET, Cap
	13E84319C59	ESCUTCHEON
	14C84556B03	GRN HOUSING CONNECTOR

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