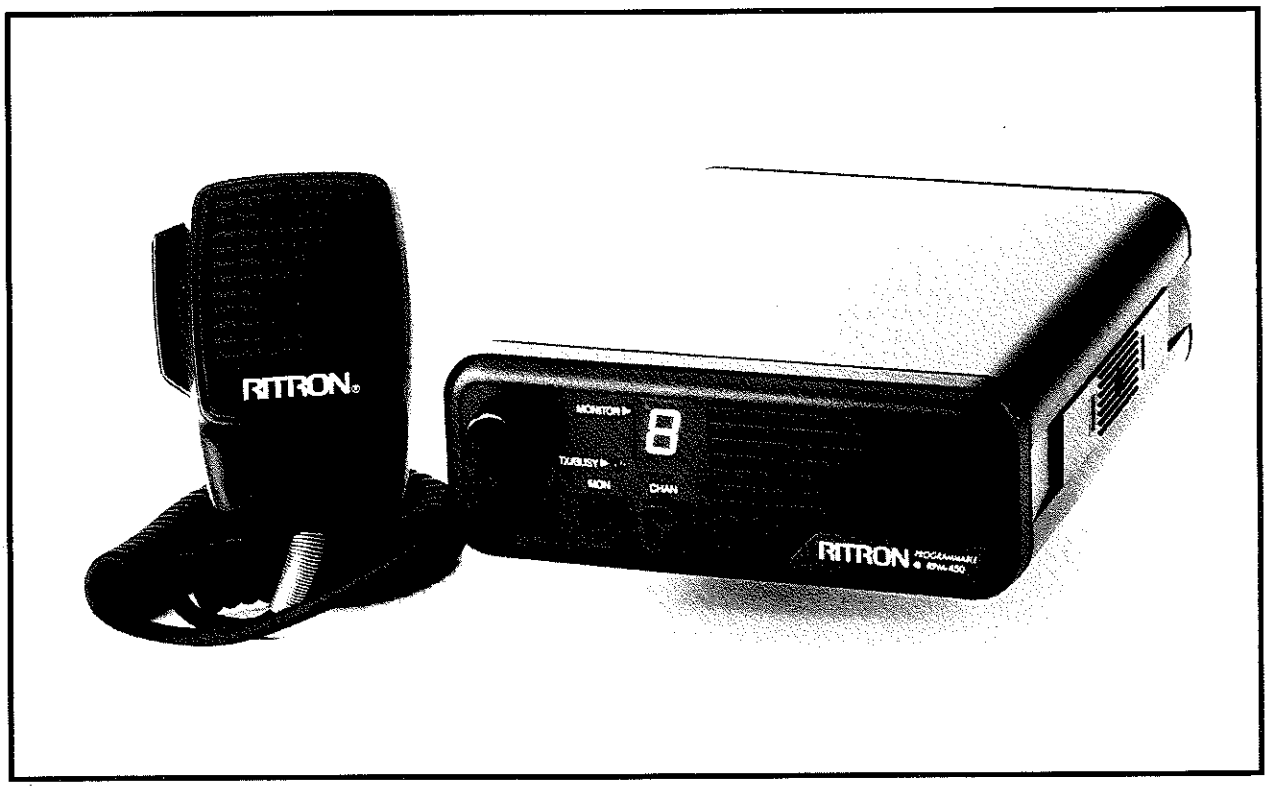
RPM-MRM-A

RITRON, INC.

RITRON MODELS RPM-150 & RPM-450

PROGRAMMABLE

FM MOBILE TRANSCEIVERS



MAINTENANCE/REPAIR/OPERATING MANUAL

FOR USE BY AUTHORIZED SERVICE/MAINTENANCE PERSONNEL ONLY

RITRON, INC.

MOBILE RADIO
ADDENDUM 10

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RPM-450 (PCB #17031002 REV. L)
OPTIONAL UHF SUB-BANDS: 470-490, 490-512 MHZ

The RPM-450 may be ordered from the factory to operate in one of these optional sub-bands: 1) 470 to 490 MHz, or 2) 490 to 512 MHz. (The standard RPM-450 frequency range is 450 to 470 MHz.)

RPM-450 radios manufactured to operate in an optional sub-band come with the following component values, replacing those used in the standard 450 to 470 MHz unit. All components listed below are located on the PC board topside, except C512 and C517 (marked with an asterisk [*]), which are found on the bottomside. Refer to the parts placement diagrams in the RPM-150/450 Maintenance/Repair/Operating Manual.

CAPACITORS, NPO, CERAMIC DISK, UNLESS STATED OTHERWISE.

REF #	450 to 470 MHz Description	450 to 470 MHz RITRON #	470 to 490 MHz Description	470 to 490 MHz RITRON #	490 to 512 MHz Description	490 to 512 MHz RITRON #
C333	3.3 pF CHIP	151203A3	2.7 pF CHIP	151202A7	2.7 pF CHIP	151202A7
C334	1.5 pF CHIP	151201A5	1.5 pF CHIP	151201A5	1.2 pF CHIP	151201A2
C336	4.7 pF CHIP	151204A7	3.9 pF CHIP	151203A9	3.9 pF CHIP	151203A9
C337	3.3 pF CHIP	151203A3	3.3 pF CHIP	151203A3	2.7 pF CHIP	151202A7
C350	15 pF CHIP	15120150	15 pF CHIP	15120150	6.8 pF CHIP	151206A8
C353	5.6 pF CHIP	151205A6	3.3 pF CHIP	151203A3	3.3 pF CHIP	151203A3
C407	6.8 pF CHIP	151206A8	NOT USED	--------	4.7 pF CHIP	151204A7
C410	39 pF CHIP	15120390	33 pF CHIP	15120330	33 pF CHIP	15120330
C411	39 pF CHIP	15120390	33 pF CHIP	15120330	33 pF CHIP	15120330
C412	22 pF CHIP	15120220	22 pF CHIP	15120220	33 pF CHIP	15120330
C418	39 pF MICA	01517420	33 pF MICA	01517419	33 pF MICA	01517419
C419	33 pF MICA	01517419	22 pF MICA	01517417	22 pF MICA	01517417
C501	.82 pF P100	01508002	.82 pF P100	01508002	1.0 pF	01508003
C502	1.2 pF	01510004	1.0 pF	01510003	.68 pF	01508001
C503	2.7 pF	01510008	2.2 pF	01510007	2.2 pF	01510007
C505	.39 pF MOLD	01501108	.33 pF MOLD	01501107	.33 pF MOLD	01501107
C506	2.7 pF	01510008	2.2 pF	01510007	2.2 pF	01510007
C508	1.5 pF	01510005	1.0 pF	01510003	1.0 pF P100	01508003
C511	.33 pF MOLD	01501107	.22 pF MOLD	01501105	.22 pF MOLD	01501105
C512 *	2.2 pF	01510007	1.8 pF	01510006	1.5 pF	01510005
C513	2.7 pF	01510008	2.2 pF	01510007	2.2 pF	01510007
C514	.33 pF MOLD	01501107	.33 pF MOLD	01501107	.22 pF MOLD	01501105
C516	2.7 pF	01510008	2.2 pF	01510007	2.2 pF	01510007
C517 *	.82 pF P100	01508002	.68 pF P100	01508001	.33 pF MLD (1)	01501107
C518	.82 pF P100	01508002	.68 pF P100	01508001	.68 pF P100	01508001
C519	2.7 pF	01510008	2.2 pF	01510007	2.2 pF	01510007
C550	NOT USED	--------	.22 pF MLD (2)	01501105	NOT USED	--------

(Con't. next page)

	450 to 470 MHz		470 to 490 MHz		490 to 512 MHz	
COILS, #20 AWG, UNLESS STATED OTHERWISE.						
REF #	Description	RITRON #	Description	RITRON #	Description	RITRON #
L302	.33 µH CHIP	18110331	.33 µH CHIP	18110331	.1 µH CHIP	18110101
L306	.33 µH CHIP	18110331	.33 µH CHIP	18110331	.1 µH CHIP	18110101
L308	3.5T	01870953	2.5T	01870952	2.5T	01870952
L403	.5T	01802084	#20 WIRE (3)	--------	#20 WIRE (3)	--------
L408	.5T	01802084	.4T	(NA)	.4T	(NA)
L411	1.5T	01802110	1.5T (4)	01802110	1.5T (4)	01802110

NOTES: (1) = Moved from bottomside to topside for 490 to 512 MHz band
(2) = Added to topside, in existing holes, parallel to L502
(3) = Straight wire, as short as possible
(4) = The turns of the coil should be spread
(NA) = Not available

DOCUMENTS TO RECEIVE THIS ADDENDUM:
RPM-150/450 Maintenance/Repair/Operating Manual (Model No. RPM-MRM-A)

TABLE OF CONTENTS

IMPORTANT INFORMATION

OPERATING/PROGRAMMING INSTRUCTIONS FOR RPM RADIOS MANUFACTURED WITH PREVIOUS VERSION OF MICROCONTROLLER SOFTWARE: Units manufactured with a previous version of the microcontroller software do not have some of the features described in this manual. The operating/programming sections in this manual cover radios built with MCU (microcontroller) part #314B0004.

However, the instructions in this manual for basic operation and programming are accurate for all RPM radios. Radios built with MCU #314B0003 work very much like those manufactured with the enchanced software (#314B0004.)

For operating/programming instructions that cover only RPM mobiles built with MCU #314B0002, refer to RITRON publication #01451157.

Service personnel can determine whether any RPM model is a "Rev. 4" radio (contains the "04" MCU), using optional programming kit model RPT-PCPK. Or, the technician can open the radio and check the part number marked on top of the MCU. If the part number is 314B0004, the enhanced features are installed.

PROGRAMMING CAUTION: DO NOT USE VERSIONS OF THE PROGRAMMING SOFTWARE EARLIER THAN 1.6R14 TO PROGRAM A REV. 4 RADIO ("04" MCU INSTALLED). OTHERWISE, DATA IN THE MICROCONTROLLER WILL BE CORRUPTED AND THE RADIO LEFT INOPERATIVE.

SURFACE MOUNT REPAIR: RITRON surface mount products require special equipment and servicing techniques. Improper servicing techniques can cause permanent damage to the printed circuit board and/or components, which is not covered by RITRON's warranty. If you are not completely familiar with surface mount component repair techniques, RITRON recommends that you defer maintenance to qualified service personnel.

PRECAUTIONS FOR HANDLING CMOS DEVICES: This radio contains complementary metal-oxide semiconductor (CMOS) devices, which require special handling techniques. CMOS circuits are susceptible to damage by electrostatic or high voltage charges. Damage can be latent, with no failure appearing until weeks or months later. For this reason, take special precautions any time you disassemble the radio. Follow these precautions, which are even more critical in low humidity environments.

1) Storage/transport - CMOS devices that will be stored or transported must be placed in conductive material so that all exposed leads are shorted together. CMOS devices must not be inserted into conventional plastic "snow" or plastic trays of the type that are used for other semiconductors.
2) Grounding - All CMOS devices must be placed on a grounded bench surface. The technician that will work on the radio/CMOS circuit must be grounded before handling the radio. Normally, the technician wears a conductive wrist strap in series with a 100 KΩ resistor to ground.
3) Clothing - Do not wear nylon clothing while handling CMOS circuits.
4) Power off - Remove power before connecting, removing or soldering a PC board that contains CMOS devices.
5) Power/voltage transients - Do not insert or remove CMOS devices with power applied. Check all power supplies to be used for testing CMOS devices, making sure that no voltage transients are present.
6) Soldering - Use a grounded soldering iron for soldering CMOS circuitry.
7) Lead-straightening tools - When straightening CMOS leads, provide ground straps for the tool used.

WARNING: When "jump starting" another vehicle, first disconnect power from the RPM mobile to avoid blowing the radio's internal reverse protection diode.

1. MODELS RPM-150 & RPM-450 SPECIFICATIONS

1.1 GENERAL

	RPM-150	RPM-450
FCC ID:	AIERPM-150	AIERPM-450
FCC RULE PARTS:	15, 22, 74, 90	15, 22, 74, 90, 95
FREQUENCY RANGE:	146 to 174 MHz standard	450 to 470 MHz standard 470 to 490 MHz optional 490 to 512 MHz optional
MAX. FREQ. SEPARATION:	15 MHz	20 MHz
RF CHANNELS:	16 RX/TX or scan channels	
SCAN RATE:	7 channels per second	
SYNTHESIZER RESOLUTION:	5 KHz (12.5 KHz optional)	12.5 KHz
FREQUENCY STABILITY:	+/-5 PPM (-30° to +50° C)	
TONE/CODE SIGNALING:	CTCSS (Quiet Call) Digital Coded Squelch (Digital Quiet Call) Two Tone Sequential (Paging Quiet Call)	
POWER SUPPLY:	+10.5 to 14.5 VDC external	
CURRENT REQUIREMENTS:	All measurements made @ +13.5 VDC	
Standby:	0.3 A	0.3 A
Receive:	0.8 A	0.8 A
Transmit:	6.0 A	5.6 A
CONTROLS:	Volume/On-Off, Monitor, Channel Select Microphone hang-up - Monitor circuit	
INDICATORS:	Digital Channel Display Transmit Activated/Channel Busy Lamp Monitor Lamp	
ANTENNA CONNECTOR:	SO-239, 50 Ω	
MICROPHONE CONNECTOR:	Modular jack, 6-conductor	
EXT. SPEAKER CONNECTOR:	3.5 mm jack	
ACCESSORY CONNECTOR:	9-pin (optionally installed on rear panel)	
WEIGHT:	2.5 lbs. (40 oz.)	
DIMENSIONS:	2.1" H x 5.8" W x 7.4" D	

1.2 RECEIVER

	RPM-150	RPM-450
RECEIVING SYSTEM:	Track tuned, dual conversion superheterodyne	
I.F. SYSTEM:	10.7 MHz/455 KHz	21.4 MHz/455 KHz
SENSITIVITY:	Better than 0.3 µV @ 12 dB SINAD	
NOISE SQUELCH SENSITIVITY:	Programmable (per channel), factory set for 12 dB SINAD	
SELECTIVITY (EIA):	-70 dB @ 25 KHz	-70 dB @ 25 KHz
SPURIOUS REJECTION:	-70 dB	-70 dB
IMAGE REJECTION (EIA):	-70 dB	-70 dB
INTERMODULATION (EIA):	-70 dB	-70 dB
MODULATION ACCEPTANCE:	+/- 7.5 KHz maximum	
AUDIO OUTPUT:	4 Watts to internal speaker 6 Watts to external speaker jack (2 Ω)	

1.3 TRANSMITTER

RF POWER OUTPUT:	30 Watts minimum Low power programmable (per channel, RPM-150 only)	25 Watts minimum
MODULATION:	Type 16K0F3E	
SPURIOUS AND HARMONICS:	Better than -57 dBc	
AUDIO RESPONSE:	Meets FCC requirements	
MODULATION SENSITIVITY:	10 to 12 mV for 60% maximum deviation @ 1 KHz	
TIME-OUT TIMER:	3 minutes, programmable	

1.4 MICROPHONE

TYPE:	Handheld, omni-directional dynamic (with coiled cord and modular plug)
SENSITIVITY:	-72 +/- 4 dB @ 1 KHz (0 dB = 1V/microbar)
FREQUENCY RESPONSE:	200 Hz to 5 KHz
IMPEDANCE:	500 Ω +/- 30% @ 1KHz
MONITOR CIRCUIT:	No ground required for hang-up clip

2. INTRODUCTION

2.1 GENERAL

RITRON's RPM mobile radio is programmable, track-tuned, and can transmit and receive on any one of up to 16 channels in a FM communications band (UHF or VHF available). This radio includes channel select and monitor push-buttons, and a single digit display. Each channel may be programmed to operate using communications industry standard signaling formats: Quiet Call, Digital Quiet Call and Paging Quiet Call.

2.1.1 INSPECTION

Make sure the RPM package includes a mobile radio and two boxes. One box contains the microphone and attached cord. The other box holds radio and microphone brackets, a DC power cable, an in-line fuse assembly and installation hardware. See the installation instructions in the hardware box for a complete list of parts included. Inspect the equipment immediately after delivery and report any damages to the shipping company.

2.1.2 MODEL IDENTIFICATION

The FCC identification and radio serial numbers appear on a label attached to the mobile's rear panel. The radio model is indicated by the last six characters of the FCC ID number, as shown below. The model number illustrated is "RPM-450." This means that the unit will operate in the UHF FM band, on frequencies from 450 to 470 MHz. A FCC label that says "RPM-150" identifies the radio as VHF, for use on frequencies from 150 to 165 MHz. RPM models that operate in other sub-bands within the UHF and VHF bands are available.

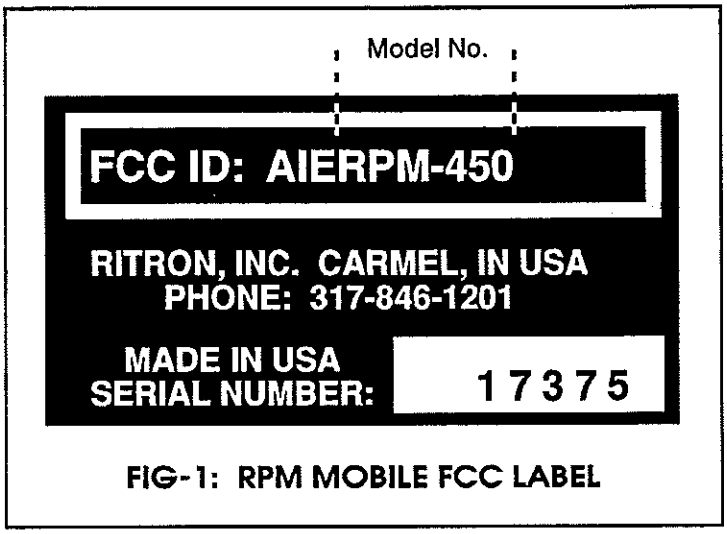


FIG-1: RPM MOBILE FCC LABEL

STANDARD MODEL	BAND	FREQ. RANGE (MHZ)	NO. CHANNELS
RPM-050-M	VHF	30 to 38	16
RPM-050-N	VHF	38 to 50	16
RPM-150	VHF	150 to 165	16
RPM-450	UHF	450 to 470	16
RPM-050-M-OP	VHF	30 to 38	16
RPM-050-N-OP	VHF	38 to 50	16
RPM-150-0P	VHF	150 to 165	16
RPM-450-0P	UHF	450 to 470	16

2.2 FCC REGULATIONS

2.2.1 LICENSING

The FCC requires the radio owner to obtain a station license for his radios before using the equipment to transmit, but does not require an operating license or permit. The station licensee is responsible for proper operation and maintenance of his radio equipment, and for ensuring that transmitter power, frequency and deviation are within the limits specified by the station license. This includes checking the transmitter frequency and deviation periodically, using appropriate methods.

2.2.2 SAFETY STANDARDS

The FCC (with its action in General Docket 79-144, March 13, 1986) has adopted a safety standard for human exposure to radio frequency electromagnetic energy emitted by FCC regulated equipment. RITRON follows these safety standards, and recommends that you observe them also:

- DO NOT operate a mobile radio transmitter when someone outside the vehicle is within two feet of the antenna.
- DO NOT operate the transmitter of a fixed radio (base station, microwave, rural telephone RF equipment) or marine radio when someone is within two feet of the antenna.
- DO NOT operate any radio transmitter unless all RF connectors are secure and any open connectors are properly terminated.
- DO NOT operate radio equipment near electrical blasting caps or in an explosive atmosphere.
- DO NOT press the Push-To-Talk button except when you intend to transmit.
- GROUND ALL RADIO EQUIPMENT according to RITRON's installation instructions.
- Repair of RITRON products should be performed only by RITRON authorized personnel.

3. INSTALLATION

FAILURE TO COMPLY WITH THE WARNING, CAUTION AND IMPORTANT STATEMENTS ON THE FOLLOWING PAGES COULD RESULT IN DAMAGE TO THE RADIO THAT WILL VOID THE WARRANTY!

3.1 SAFETY PRECAUTIONS

3.1.1 RADIO MOUNTING LOCATION

Consider driver and passenger safety when you choose a location for the radio. Do not mount the unit overhead or on a sidewall unless you take special precautions, such as securing the radio with a retaining strap.

Improper installation increases the possibility that a car accident could dislodge the radio and make it a dangerous projectile.

3.1.2 VEHICLE OPERATION

3.1.2.1 ELECTRONIC SYSTEMS

Check the vehicle's service manual for possible warnings about operating a two-way radio in a vehicle equipped with an electronic ignition or anti-skid braking system.

3.1.2.2 LIQUEFIED PETROLEUM (LP) GAS FUEL SYSTEM

Radio installation in a vehicle fueled by liquefied petroleum (LP) gas (with the LP gas container stored in a sealed-off space, such as the trunk) must conform to NFPA (National Fire Protection Association) standard 58:

- Any space that contains radio equipment must be isolated by a seal from the space in which the LP gas container and its fittings are located.
- Remote (outside) fitting connections must be used.
- The container space must be vented to the outside.

3.1.2.3 BATTERY POWER

Avoid leaving the radio turned on for long periods when the engine is off, which could run down the vehicle's battery.

3.1.3 ANTENNA LOCATION

3.1.3.1 NON-METAL BODY VEHICLES

Do not install any kind of antenna closer than two feet from any vehicle occupant in vehicles whose body is made of a material other than metal (such as fiberglass). Otherwise, occupants can be exposed to radio frequency energy levels higher than recommended by the ANSI (American National Standards Institute).

3.1.3.2 METAL BODY VEHICLES

Be sure to follow the installation instructions for glass mount antennas; it is important to correctly place the antenna along the front or rear window and to route the cable as directed. Installation mistakes can subject vehicle occupants to RF levels higher than judged safe by the ANSI.

3.2 PREPARATION

IMPORTANT: THE RITRON MOBILE CAN BE OPERATED ONLY IN NEGATIVE GROUND ELECTRICAL SYSTEMS! A negative ground system has the negative (-) battery terminal connected to the vehicle motor block. If you cannot find this connection, consult the vehicle owner's manual to determine the ground system type. Most late model U.S. and foreign made cars and small trucks use a negative ground electrical system. However, some older cars and newer large trucks use a positive ground system.

3.2.1 MOBILE RADIO PACKAGE CONTENTS

Make sure that all of the items listed below are included in the radio package, which holds a mobile transceiver and two boxes of equal size. One box contains the microphone and attached cord. The other includes hardware for installing: 1) the DC power cable, 2) the mobile radio and 3) the microphone hang-up clip.

3.2.1.1 DC POWER CABLE

Parts for power cable installation - ten foot DC cable with attached fuse holder assembly (1), 10 A fuse (1), 20 A fuse (1), ring lug (2), plastic tie (2). RPM-150 and 450 installations use the 10 A fuse. RPM-050 installations require the 20 A fuse.

3.2.1.2 MOBILE RADIO

Parts for radio installation - radio mounting bracket (1), Phillips head sheet metal screw #10 x 3/4" (4), lock washer (4), flat washer (4), slotted head washer hex nut screw #10-32 x 5/8" (2), rubber washer 11/8" DIA. (2).

3.2.1.3 MICROPHONE HANG-UP CLIP

Parts for hang-up clip installation - hang-up clip (1), Phillips head self-tapping screw #6 x 3/8" (2).

3.2.2 RECOMMENDED TOOLS

- PHILLIPS #2 SCREWDRIVER
- TORX SCREWDRIVER, T25
- 5/16" HEX NUT DRIVER
- ELECTRIC DRILL
- 19/32" DIAMETER DRILL BIT
- 9/64" DIAMETER DRILL BIT
- 7/64" DIAMETER DRILL BIT
- HAMMER
- CRIMPING TOOL
- WIRE CUTS

3.2.3 MOUNTING LOCATIONS

Before you begin installation, inspect the vehicle and decide how and where to mount the antenna, radio and microphone. Plan wire and cable runs to provide maximum protection from pinching and crushing.

3.2.3.1 ANTENNA

3.2.3.1.1 Permanent Mount

The best place to mount the antenna is in the center of a large, flat conductive surface, such as the vehicle's roof. A large trunk lid also provides a good antenna location. If you use the trunk lid, connect grounding straps between the lid and vehicle chassis! See the antenna installation instructions for directions.

3.2.3.1.2 Glass Mount

Position a glass mounted antenna as high as possible in the center of the rear window or windshield. Consult the antenna installation guide for further instructions.

3.2.3.1.3 Magnet Mount

The magnet mounted antenna should be attached to the center of the vehicle's roof or trunk lid. If you use the trunk lid, connect grounding straps between the lid and vehicle chassis! Refer to the antenna installation sheet for details.

3.2.3.2 RADIO MOUNTING BRACKET

The radio mounting bracket permits attaching the mobile to a variety of surfaces, and requires a flat mounting surface (6" x 2" minimum) with adequate clearance for inserting the radio. Be certain the mounting surface can support the radio's weight. Leave enough space around the radio for air flow cooling, and make sure the user can easily reach and view the mobile's operating controls and access rear panel connections. The mounting bracket and radio must not impair vehicle operation. Although the bracket can be fixed to a plastic dashboard, the mounting screws should penetrate into the dashboard's supporting metal frame.

3.2.3.3 MICROPHONE HANG-UP CLIP

The microphone clip may be attached to any metal or plastic surface strong enough to withstand continued microphone use; a hang-up clip to ground connection is not required. Mount the clip within easy reach of the driver, mindful that using the microphone must not impair vehicle operation. Although the hang-up clip can be mounted to a plastic dash board, the mounting screws should penetrate into the dash board's supporting metal frame.

3.3 PROCEDURE

FAILURE TO COMPLY WITH THE WARNING, CAUTION AND IMPORTANT STATEMENTS ON THE FOLLOWING PAGES COULD RESULT IN DAMAGE TO THE RADIO THAT WILL VOID THE WARRANTY!

3.3.1 DC POWER CABLE

WARNING: THE RITRON MOBILE CAN BE OPERATED ONLY IN NEGATIVE GROUND ELECTRICAL SYSTEMS! DO NOT CONNECT THE RADIO TO THE POWER CABLE UNTIL INSTALLATION IS COMPLETE.

TO INSTALL THE POWER CABLE, FOLLOW THE STEPS BELOW:

1) Inspect the vehicle and determine how and where to run the power cable to provide maximum protection from pinching, crushing and excessive heat.

2) Drill a 19/32" hole (or use an existing, empty hole) in the driver's side of the firewall for passing the power cable into the engine compartment. Be careful not to damage existing vehicle wires. A rubber grommet (not provided) may be installed in the access hole to help protect the cable.

3) From inside the vehicle, feed the cable leads and fuse assembly through the access hole and into the engine compartment. Refer to FIG-2 on the next page. Leave as much space as possible between the power cable and the vehicle's wiring (the power cable red and black wires may be twisted together).

4) Route the power cable through the engine compartment to the battery. If the battery is located on the passenger's side, the cable should cross the compartment in front of the engine as shown in FIG-2. If the battery is located on the driver's side, run the cable straight to the battery. Install the cable as far as possible from the vehicle's electronic modules and wiring.

5) Install one ring lug onto the fuse assembly lead, the other lug onto the power cable black lead (stripped end).

6) Place the fuse assembly close to the battery, away from heat-generating engine components. Mount the fuse assembly using the plastic ties provided.

7) Connect the power cable black lead (with ring lug attached) to the vehicle's negative (-) battery terminal, or to the jump start block on vehicles so equipped.

   CAUTION: Avoid disconnecting the battery-to-engine block ground, which might damage the vehicle and/or radio. An in-line fuse (not included) may be installed near the battery in the black lead.

8) Connect the fuse assembly lead (ring lug attached) to the positive (+) battery terminal. Check that the fuse assembly contains a 10 Ampere fuse. (RPM-050 installations require a 20 A fuse.)

   IMPORTANT: Failure to connect the power cable leads directly to the battery (via the fuse) can produce severe alternator noise in the radio.

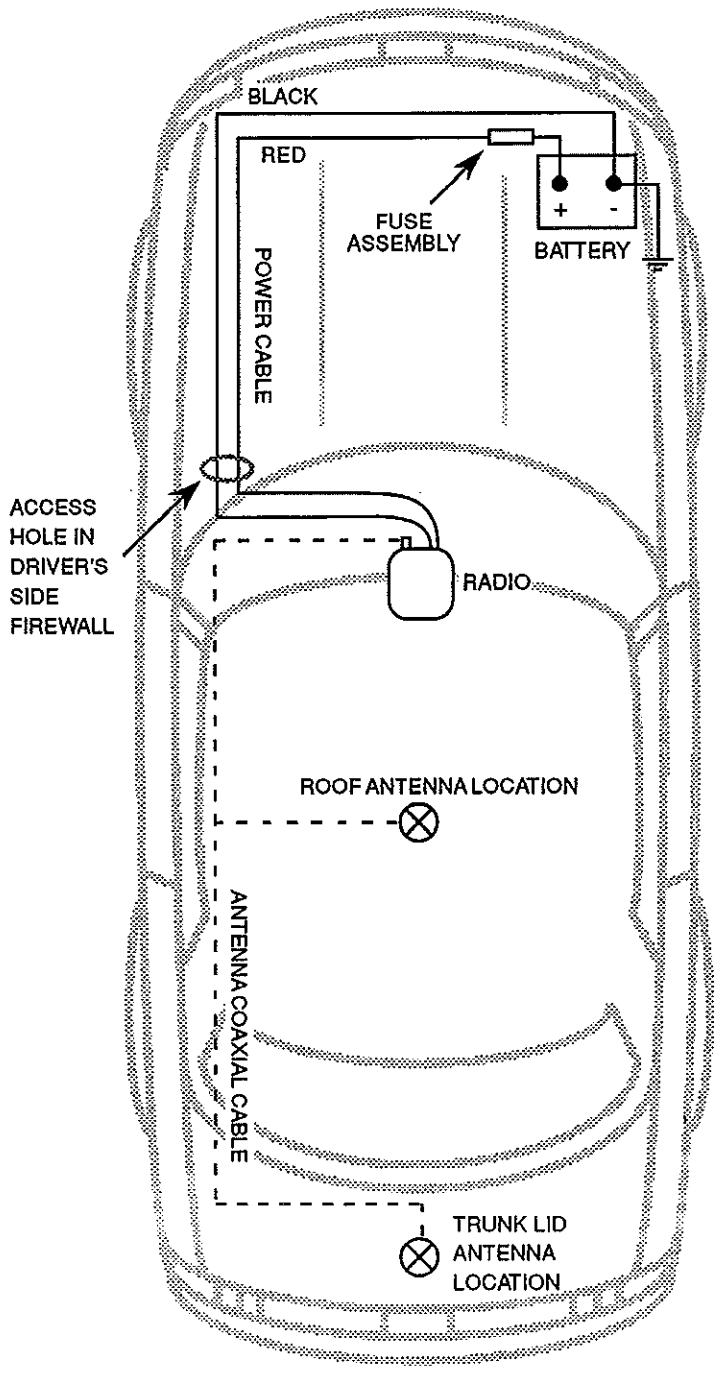


FIG-2: RADIO INSTALLATION OVERVIEW

3.3.2 OPTIONAL IGNITION SWITCH CONTROL

An ignition switch control may be installed (not included with the radio), which automatically applies power to the mobile when the car is started. Power is removed when the ignition is shut off.

TO INSTALL THE IGNITION CONTROL, READ THE INSTRUCTIONS BELOW:

Connect a 12 volt contactor to the power cable red lead, at the vehicle's battery. Refer to FIG-3. The contactor coil (Radio Shack # 275-218) should be driven through an in-line fuse from an accessory circuit or ignition circuit that is not powered during cranking (the fuse Ampere rating should be approximately twice the nominal current of the contactor - see the manufacturer's specifications). The contactor coil must return to the negative (-) battery terminal.

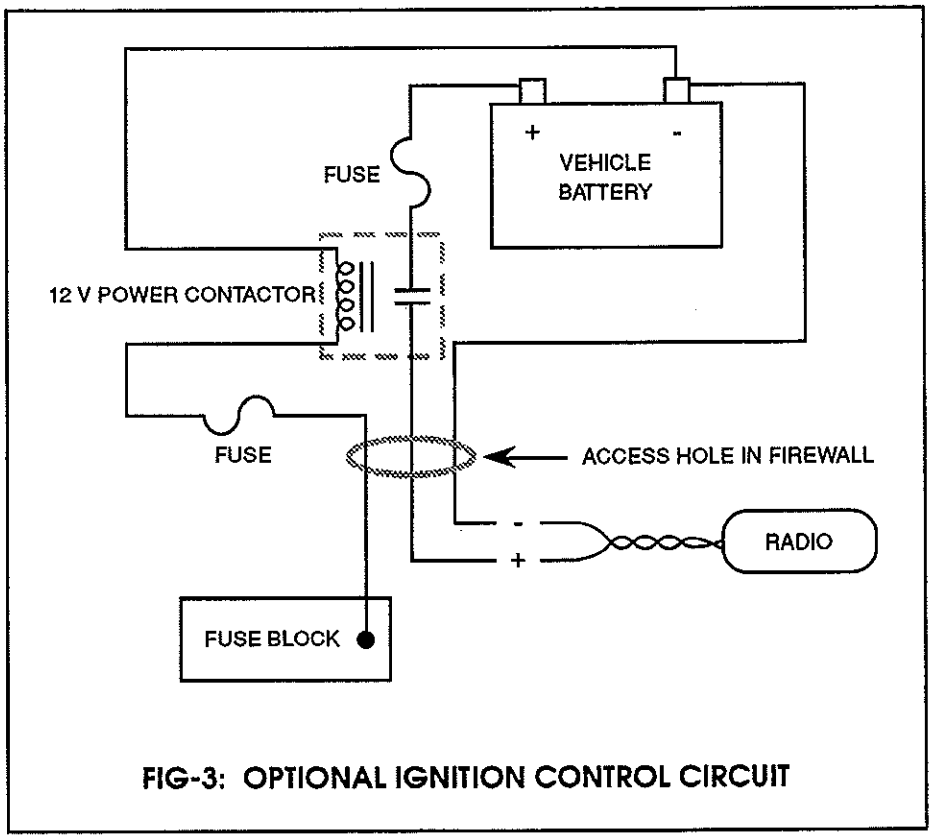


FIG-3: OPTIONAL IGNITION CONTROL CIRCUIT

3.3.3 ANTENNA

Mount the antenna according to the instructions included with the antenna kit. Avoid routing the antenna coaxial cable near vehicle wiring.

3.3.4 RADIO MOUNTING BRACKET

TO INSTALL THE RADIO BRACKET, FOLLOW THE PROCEDURE BELOW:

1) Select a mounting location for the unit, either on the transmission hump or under the dash. See FIG-4.

2) Using the bracket as a template, mark drilling points on the mounting surface.

3) Centerpunch the marks you have made and drill a 9/64" hole at each.

4) Secure the bracket to the mounting surface with the #10 Phillips head sheet metal screws (4), lock washers (4) and flat washers (4) supplied.

   NOTE: Securing the radio mounting bracket with only two screws may be sufficient for some applications.

5) Place the radio in the mounting bracket and attach it with the rubber washers (2) and #10 hex nut screws (2) provided (refer to FIG-4).

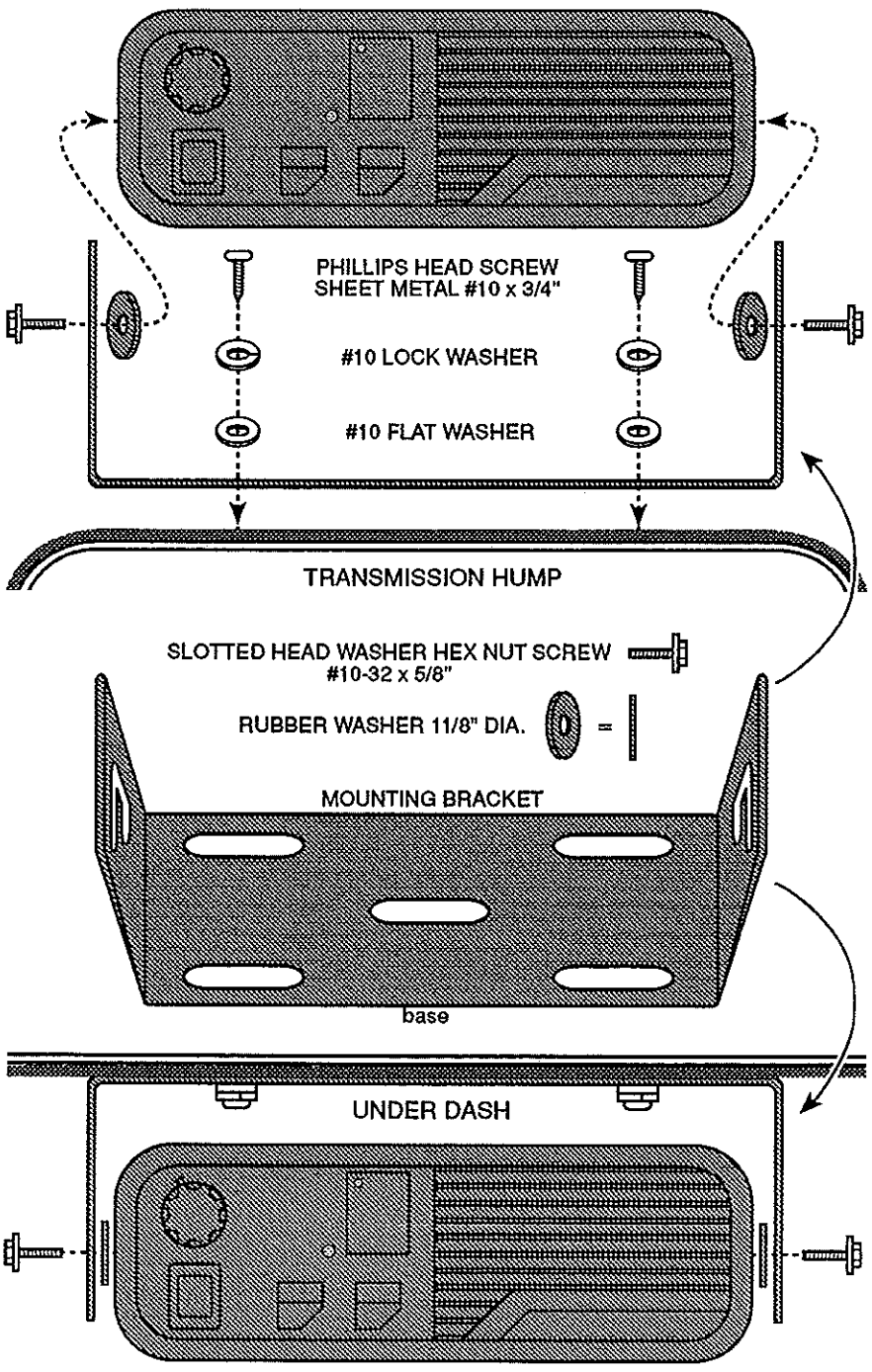


FIG-4: RADIO MOUNTING LOCATIONS

3.3.5 MICROPHONE HANG-UP CLIP

TO INSTALL THE HANG-UP CLIP, SEE THE STEPS BELOW:

1) Select a mounting location for the microphone hang-up clip, within easy reach of the mobile radio user.

2) Using the clip as a template, mark drilling hole positions on the mounting surface.

3) Centerpunch the marks you have made and drill a 7/64" hole at each.

4) Secure the clip with the #6 Phillips head self-tapping screws (2) provided.

5) Hang-up the radio microphone in its clip as shown in FIG-5.

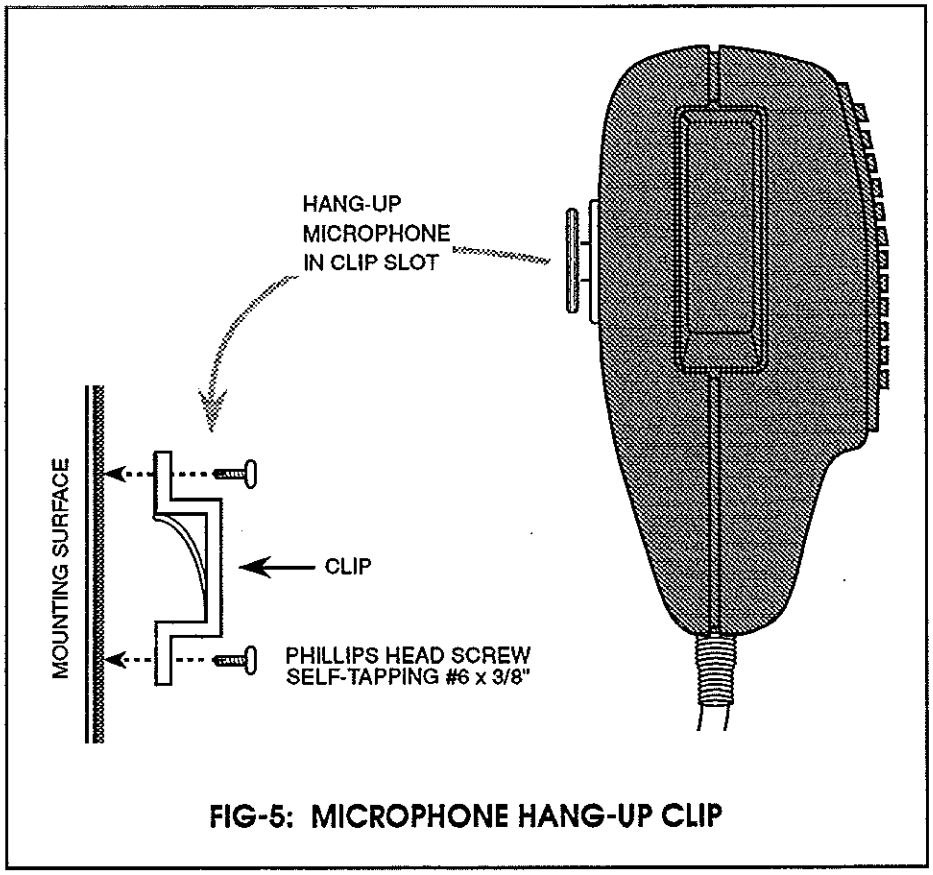


FIG-5: MICROPHONE HANG-UP CLIP

3.3.6 FINAL CONNECTIONS

1) Fasten the antenna cable connector to the mobile rear panel antenna connector. See FIG-6 below.

2) Plug the microphone cord into the radio front panel connector.

3) Plug the DC cable into the radio back panel power connector.

THE MOBILE IS NOW READY FOR OPERATION!

WARNING: When "jump starting" another vehicle, first disconnect power from the RPM mobile to avoid blowing the radio's internal reverse protection diode.

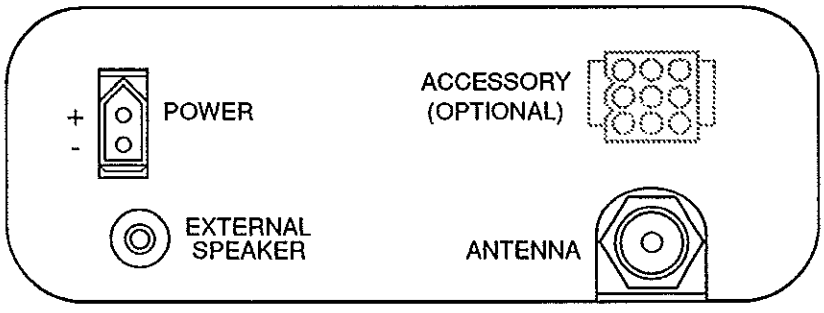


FIG-6: REAR PANEL

4. STANDARD FEATURES

- 16 RECEIVE/TRANSMIT CHANNELS
- THE FOLLOWING ARE PROGRAMMABLE ON A PER CHANNEL BASIS:

  RECEIVE FREQUENCY

  TRANSMIT FREQUENCY

  CHANNEL SCANNING (NORMAL/PRIORITY)

  TONE CODED SQUELCH (QUIET CALL)

  DIGITAL CODED SQUELCH (DIGITAL QUIET CALL)

  PAGING DECODE (PAGING QUIET CALL)

  SPECIAL FEATURES (INCLUDING TX BUSY AND MONITOR LOCK OUT)
- HIGH PERFORMANCE TRACK-TUNED RECEIVER
- ROTARY ON-OFF/VOLUME CONTROL
- AUTOMATIC TRANSMITTER TIME-OUT
- EASY-TO-READ DIGITAL DISPLAY
- PUSH-BUTTON CHANNEL SELECTOR
- ON-HOOK PUSH-BUTTON MONITORING
- TRANSMIT/CHANNEL BUSY INDICATOR
- LONG-RANGE TRANSMITTER (30 WATT VHF, 25 WATT UHF)
- COMPACT SIZE
- RUGGED "UNI-BODY" ALUMINUM CASE
- MILITARY GRADE PRINTED CIRCUIT BOARD
- LOW DISTORTION MICROPHONE WITH COIL CORD
- MICROPHONE INDEPENDENT HOOK-SWITCH CIRCUIT
- HIGH VOLUME FRONT-FACING SPEAKER
- EXTERNAL SPEAKER JACK
- RADIO MOUNTING BRACKET AND HARDWARE
- MICROPHONE HANG-UP CLIP AND HARDWARE
- +12 VDC POWER CABLE WITH IN-LINE FUSE
- LIMITED ONE YEAR FACTORY WARRANTY
- RPM USER MANUAL

5. ACCESSORIES

5.1 ITEMS LIST

Programming kits are for use by authorized service/maintenance personnel only.

DESCRIPTION	ITEM NO.
Programming Kit for RPM and RTX radios (via PTT button)	RPT-PK
Includes: 1) 1 - RPM/RTX Programming and Operating Manual 2) 2 - Programming plugs (one for RPM, one for RTX) 3) 1 - Cloning cable (6-pin modular to 6-pin modular connector) 4) 2 - Cloning cable adaptors (6-pin modular connector to 3.5 mm plug)	
Programming Kit for RPM and RTX radios (via PC compatible computer)	RPT-PCPK
Includes: 1) 1 - Software installation instructions 2) 2 - Programming software diskettes, 3.5" and 5.25" (1 each) 3) 1 - PC/radio adapter cable (DB-25F connector to 6-pin modular connector) 4) 1 - PC cable adapter (6-pin modular connector to 3.5 mm plug)	
Factory programming of channels, codes and features is also optional.	
Hand Microphone (replacement)	RM-4
Desktop Microphone	RM-6
Hand Microphone with 12-button Touch Tone Keypad	RM-5TT
Power Supply (+12 VDC, desktop, with adaptor cable)	RPS-12
External Speaker with 10 ft. cord	RSP-5
Installation Kit for RPM radio (replacement)	RPMK-12
Includes: 1) 1 - Mobile radio mounting bracket 2) 1 - 12 VDC power cable with in-line fuse 3) 1 - Microphone hang-up clip 4) Hardware and installation instructions	
Trunking Interface Ready Option	OPT-TIR
Maintenance/Repair/Operating Manual	RPM-MRM
User Manual	RPM-UM

5.2 RM-5TT HAND MICROPHONE WITH TOUCH TONE KEYPAD

The optional RM-5TT is a combination hand microphone and Touch Tone keypad. Using the keypad, you can send Touch Tone digits. In conjunction with other equipment in your radio system, Touch Tone can enable you to:

1) Answer or originate telephone calls.

2) Page specific portable or mobile radios.

3) Control remote electrical equipment.

5.2.1 RM-5TT MICROPHONE FEATURES

- Ground-Independent Hook-switch Circuit (works on any surface)

  The microphone hang-up clip does not have to be grounded to enable coded squelch.

- Lighted Key Pad

- Sidetone

  Each key entry (dialing) sounds in the microphone speaker.

- Keypad Activated Transmit

  Pressing a key automatically activates the radio transmitter.

5.2.2 HOW TO USE THE RM-5TT MICROPHONE

When a Touch Tone key is pressed, the attached mobile radio transmitter is automatically activated and Touch Tones are broadcast with the radio signal.

1) When dialing, press the first digit of the number slightly longer - for about one second - to allow for any system delays.

2) As long as more digits are pressed within two seconds, the transmitter will remain on.

3) For best results, do not press the PTT switch on the side of the microphone while dialing.

For more details, refer to the manual provided with your telephone interconnect or other radio system equipment.

5.3 TRUNKING INTERFACE OPTION: OPT-TIR

IMPORTANT: THE PC PROGRAMMING KIT (RITRON MODEL: RPT-PCPK, VERSON 1.2 OR HIGHER) ALLOWS RPM RADIOS TO BE PROGRAMMED WITH A PC COMPATIBLE COMPUTER, AND IS REQUIRED TO PROGRAM TRUNKING CHANNELS. Additionally, the radio must be version 2 or higher. (The radio's microcontroller part number must be 314B0003 or higher.) The PC programmer kit includes cables and software.

This option for the RPM series mobile radio provides a factory-installed wiring harness that is designed to accommodate a trunking radio controller manufactured by a third party. The trunking controller is installed inside of the RPM radio case and connected in series with the RPM microphone PTT, channel selector, receiver audio squelch and other control and signaling points. The RPM mobile equipped with option OPT-TIR and an internal trunking controller is a fully integrated, user-friendly package.

6. RADIO CONTROLS & ACCESSORY CONNECTORS

6.1 ON-OFF/VOLUME CONTROL

The on-off/volume control knob switches power on and off, and adjusts volume. Refer to FIG-7.

6.2 CHANNEL DISPLAY

This digital display indicates the channel number -OR- during a channel contents readout, radio frequency/ Quiet Call data or a scan list.

6.3 CHANNEL SELECT BUTTON

You can move forward or backward through the channels. Pressing the channel button increases the channel number. Pressing and holding the channel button while toggling the monitor button decreases the channel number.

With the radio in operating mode, changing channels moves the digital display to the next programmed channel. With the unit in programming mode, the display goes to the next channel, programmed or empty.

6.4 SPEAKER

An internal speaker is mounted behind the front panel grille. An external speaker may be plugged into the rear panel external speaker jack, which disconnects audio to the front speaker.

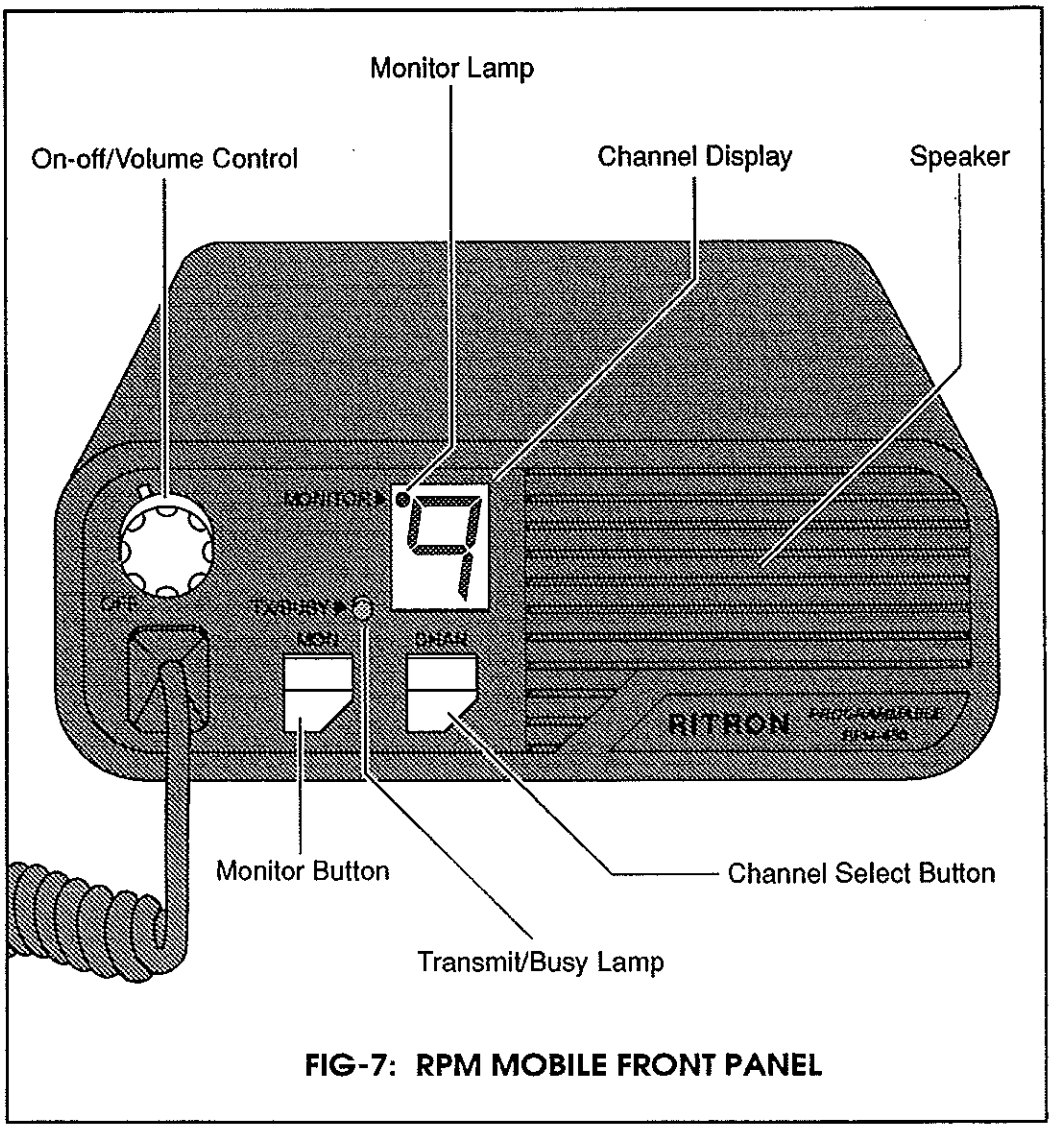


FIG-7: RPM MOBILE FRONT PANEL

6.5 MONITOR BUTTON

Pressing the monitor button lets you hear all radio traffic on the channel. The monitor button can be programmed to operate in different ways, as described on page 18.

6.6 MONITOR LAMP

The monitor lamp (FIG-7) lights when the unit is in monitor mode.

6.7 MICROPHONE HANG-UP

The microphone hang-up controls receiver squelch and monitor functions, through a hook-switch circuit inside of the microphone. The microphone is ON-HOOK when it is in its hang-up clip, as shown below. The microphone is OFF-HOOK when it is out of its hang-up clip.

6.8 PUSH-TO-TALK BUTTON

Pressing the microphone Push-To-Talk (PTT) button activates the radio transmitter (FIG-8). Talk into the microphone while the PTT is held down.

6.9 TX/BUSY LAMP

The transmit/busy lamp flashes red if the channel is in use, and stays lighted while the transmitter is activated.

6.10 MICROPHONE PLUG-IN

The microphone cord is connected to the radio front panel via a modular plug. When inserting the plug, align it with the lock-tab down. The cord may be removed by pressing up on the underside of the rubber cover to unseat the plug's lock-tab. Note that the cover is attached to the plug and should not be peeled off.

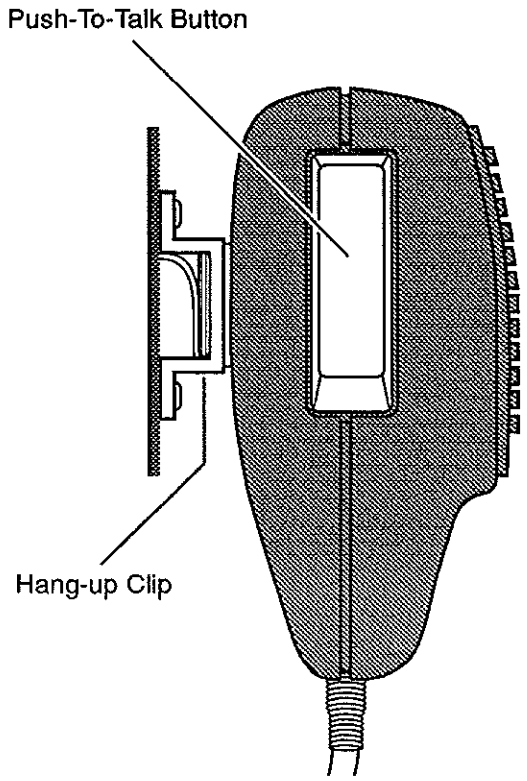


FIG-8: RPM MICROPHONE ON-HOOK

7. OPERATION

7.1 WHAT THE RADIO TONES MEAN

RITRON programmable radios respond to certain instructions by sounding a tone or series of tones. These tones can tell you whether a radio is working as you expect.

7.1.1 POWER ON SELF CHECK "OK"

Switch on the radio by rotating the on-off/volume control knob clockwise out of the "click" position. The unit then runs a quick "self test." When the internal system checks confirm basic functions, the radio sounds a brief "confirmation tone" to indicate that the unit is in *OPERATING MODE* and ready for use.

7.1.2 ERROR TONES

However, if the self test detects a diagnostic error, an error tone sounds. One low-pitched tone means that the radio microcontroller is not working as it should. Alternating tones (the second is lower pitched) indicate that the radio frequency synthesizer is malfunctioning. If you get one of these messages, turn off the radio and try again. If you cannot correct a problem, consult an authorized RITRON service facility or the RITRON Repair Department.

Repeating error tones occur if you press the Push-To-Talk button while a "Receive Only" channel is selected. This is because a "Receive Only" channel does not contain a transmit frequency, which must be present for the radio to broadcast. The error tone repeats until you release the PTT.

One low tone sounds and the transmitter automatically shuts off if you hold the PTT button down continuously for a specified time (normally, three minutes). This transmitter time-out feature may be turned off or adjusted with the optional PC programming kit (model RPT-PCPK).

7.2 ERROR DISPLAYS

In addition to sounding an error tone, the RPM mobile displays a diagnostic message if an error is detected during the power on self check. If an "E" followed by a "2" appears, the channel data is flawed and should be re-programmed. An "E" followed by a "1" signifies a microcontroller malfunction. If any of these messages occur, turn off the radio and try again. If you cannot correct a problem, consult an authorized service facility or the factory.

7.3 CHANNEL SELECTION (IN OPERATING MODE)

Refer to page 15, section 6.3. The radio emits a short tone each time you press the channel button, providing an audible marker. Additionally, when the channel number "rolls-over" from the highest to the lowest programmed channel number, a "double tone" sounds. This allows you to select channels without looking at the radio (useful if the mobile is installed under the driver's seat).

7.4 OPERATING MODES

7.4.1 RECEIVE MODE

The radio can receive broadcasts while the microphone Push-To-Talk button is not being pressed. Whether or not you hear these broadcasts depends upon the volume and squelch settings.

You can adjust the volume as follows. Rotate the on-off/volume control clockwise about one third. Then press and hold the monitor button. After about four seconds, you should hear a rushing sound (noise) and any broadcasts on the channel. Set the volume as desired. Restore squelch by releasing the monitor button.

7.4.1.1 SQUELCH

HOW TO:

Squelch Noise - the mobile automatically squelches noise.

Squelch All Broadcasts On The Channel Except Those Carrying Your Quiet Call Code - hang up the microphone and use the monitor button according to the Monitor section below.

Squelch removes background noise and mutes interference from other licensees. There are two types of squelch used in RITRON programmable radios. First is carrier squelch. This quiets noise and lets you hear all broadcasts on your channel strong enough for the radio to detect.

Second is Quiet Call (coded) squelch. When a radio frequency is shared by several licensees in an area, coded squelch keeps other licensees' broadcasts from disturbing users in your radio network. When you monitor, coded squelch is off and you can hear all traffic on the channel, similar to a telephone "party-line."

7.4.1.2 MONITOR

HOW TO:

Hear All On-channel Broadcasts Within Range - take the microphone off-hook OR leave the microphone on-hook and use the monitor button according to the Monitor section below.

IMPORTANT: In order for the radio to work as described below, the microphone must be on-hook. Taking the microphone off-hook activates monitoring.

The way the monitor button works is dealer-programmable. There are two options available. The first is MOMENTARY operation, which means that you must press and hold the monitor button to hear all broadcasts on the channel. Release to stop monitoring. Then, only messages that carry your Quiet Call code will sound.

The second option is TOGGLE operation. Toggle (press and release) the monitor button to switch between Quiet Call (coded) squelch and monitoring. For channels programmed with Paging Quiet Call, toggling the monitor button advances the radio to another monitor mode (see the PQC section below).

To determine which operating option is programmed for a radio, use the programming kit software, or, perform this test: 1) Select a standard transmit and receive channel that is not programmed with Paging Quiet Call or Channel Monitor Lock Out, 2) Press and release the monitor button, 3) Press and release the monitor button again.

If each time you pressed the monitor button you heard two tones, the unit is programmed for Momentary monitor operation. If you heard one tone and then two tones, or vice versa, the radio is programmed for Toggle monitor operation. This completes the test.

NOTE: Earlier model RPM radios do not sound multiple beeps when you change the monitor mode. Also in earlier models, Quiet Call squelch is automatically turned on when a channel is selected.

7.4.1.2.1 Monitoring A Channel Programmed With Quiet Call

IF THE RADIO IS PROGRAMMED FOR TOGGLE MONITOR OPERATION - To monitor a channel programmed with QC (Quiet Call) squelch, press and release the monitor button until you hear two beeps. Then, you can hear all radio traffic on the channel until you press the monitor button again (one beep sounds) to resume QC squelch.

IF THE RADIO IS PROGRAMMED FOR MOMENTARY MONITOR OPERATION - To monitor a channel programmed with QC squelch, press and hold the monitor button. You will hear two beeps, followed by all radio traffic on the channel. Release this button to restore Quiet Call squelch.

7.4.1.2.2 Monitoring A Channel Programmed With Paging Quiet Call

IF THE RADIO IS PROGRAMMED FOR TOGGLE MONITOR OPERATION - To monitor a channel programmed with QC and PQC (Paging Quiet Call), press and release the monitor button until you hear three beeps. Then, you will be able to hear all broadcasts on the channel.

If you press the monitor button again, one beep sounds. The radio will stay quiet unless paged. Unless programmed to work otherwise, the radio will not detect incoming messages coded with the channel's assigned QC code until you take the microphone off-hook (to transmit) and then replace the microphone. This allows you to answer a page and then have a two-way conversation with the caller who transmits your QC code.

After being paged, the radio must be reset to mute the receiver. To do this, return the microphone to its clip. Then press and release the monitor button until one beep sounds.

Pressing the monitor button again causes the radio to sound two beeps. Then, QC coded calls meant for you will be heard. If the radio receives a page, it will sound an alert tone. You will be able to hear and reply to QC messages without missing a page.

IF THE RADIO IS PROGRAMMED FOR MOMENTARY MONITOR OPERATION - To monitor a channel programmed with PQC, press and hold the monitor button. Three beeps will sound. You will hear any broadcasts on the channel until you release the monitor button. After that, you will hear only calls that carry your QC code.

The radio will ring if paged, regardless of the squelch status. However, anytime you press the monitor button, receive a page or take the microphone off-hook, PQC squelch is disabled. In order to quiet the radio until it is paged, switch to another channel and then back, or turn the radio off and then on.

When you press the monitor button and two beeps sound, you will hear pages and calls that carry your QC code.

7.4.2 TRANSMIT MODE

Before transmitting, make sure the channel is not in use. Check the transmit/busy lamp, which flashes if the channel is busy. This occurs regardless of any code signaling programmed.

To transmit, take the microphone off-hook. Press and hold the microphone Push-To-Talk button while you talk, with the microphone two or three inches away. Speak in a normal tone, since talking louder will not improve the listener's reception. Pressing the microphone PTT button activates the transmitter only if the channel was programmed with a transmit frequency.

RITRON programmable radios feature a transmitter time-out function, which automatically stops a continuous transmission that lasts for a specified time. (This time may be adjusted by authorized service personnel, using the RPT-PCPK programming kit.) The unit sounds a tone when the transmitter shuts off.

7.5 PROGRAMMABLE OPTIONS

RPM mobile radios may be operated with options that are programmed on a per channel basis, including Quiet Call code signaling, scanning and special features.

7.5.1 QUIET CALL CODE SIGNALING

HOW TO:

Turn On Quiet Call Squelch - hang up the microphone and use the monitor button according to the Monitor section.

Turn Off Quiet Call squelch - take the microphone off-hook or, use the monitor button according to the Monitor section.

Turn Off Quiet Call For Receive Mode - program the channel accordingly.

Code signaling lets you screen out broadcasts from other systems on the channel. RITRON pro-grammable radios come from the factory ready to operate with three communications industry standard signaling formats, including Quiet Call (QC), Digital Quiet Call (DQC) and Paging Quiet Call (PQC). Generally, "Quiet Call" refers to the entire family of RITRON signaling formats (QC, DQC and PQC), unless specified otherwise.

7.5.1.1 QUIET CALL (QC)

Quiet Call is RITRON's tradename for what the communications industry calls sub-audible tone, tone squelch or CTCSS (Continuous Tone Coded Squelch System). A group can use a unique Quiet Call code to avoid the bother of "radio traffic" from other licensees. Units with Quiet Call squelch turned on stay quiet unless they detect the appropriate code on a broadcast.

Channels programmed with Quiet Call automatically transmit a code with your voice when you press the PTT button. This allows your message to be heard. Note that other nearby licensees on your channel can hear your transmissions unless they have another code enabled.

7.5.1.2 DIGITAL QUIET CALL

Digital Quiet Call is RITRON's tradename for digital coded squelch. DQC works the same as QC, except that a digital code is broadcast with your call. Units programmed with the correct code "recognize" the call and allow the message to be heard.

7.5.1.3 PAGING QUIET CALL

7.5.1.3.1 General

Paging Quiet Call (PQC) is RITRON's tradename for its selective paging system. Each radio or group of radios may have a unique PQC code. Any channel that contains an operating frequency can be programmed with one of these codes. (A channel programmed with PQC may also contain a QC code.) With a PQC channel selected and the radio set to receive a page, the radio speaker stays quiet until the programmed PQC code is received. A ringing tone announces an incoming call. (If the radio is programmed for momentary monitor operation, the channel's assigned QC code will also open squelch.)

Each Paging Quiet Call code is broadcast as a unique pair of audible tones, with the first tone sent for one second, and the second tone for two seconds. PQC codes can be originated by a base station paging encoder, a telephone (via a RITRON RR-454 Repeater Plus/RP-200 system), or a RITRON programmable radio equipped with a Touch Tone encoder keypad.

7.5.1.3.2 The All-Call Code

Radios operated with PQC respond to a special All-Call code, as well as to their individual codes. This allows one page to be heard by all "PQC units" on the channel. The RPM mobile can transmit an All-Call page.

HOW TO:

Send An All-Call Page -

1) Select a channel programmed with Paging Quiet Call.

2) Turn off the radio.

3) Press and hold the PTT button while switching on the radio. Continue to hold down the PTT for six seconds.

4) Release the PTT.

5) Hold down the PTT and deliver your message.

NOTE: An All-Call page can be sent through a repeater, to call all radios on the channel that are set to receive a page. This is possible because the radio can now transmit All-Call paging and Quiet Call tones together. (Quiet Call activates the repeater.) An All-Call page can also be transmitted directly to other nearby units when the RPM mobile is switched to the "talk-around" frequency, which bypasses the repeater.

7.5.1.3.3 Call Indicator Reset

If the mobile radio has been selectively signaled by Paging Quiet Call or an accessory connected to the selective signaling input, the "C" that appears on the display may be cleared by pressing the monitor button or, by taking the microphone off-hook.

7.5.2 SCANNING (NORMAL/PRIORITY)

HOW TO:

Scan -

1) Hang up the microphone.

2) Select the channel that contains a scan list.

Stop Scanning - take the microphone off-hook or, press and release the channel or monitor button.

7.5.2.1 GENERAL

Scanning automatically lets you listen to broadcasts on different radio channels (frequencies). You may choose the channels to be scanned by creating a "scan list." This list of channel numbers is stored in a radio channel. **A channel cannot hold both a scan list and a radio frequency.**

7.5.2.2 HOW SCANNING WORKS

When you select a channel that contains a scan list, the radio pauses, sounds a tone, and then repeatedly checks each channel of the scan list in turn. Channels are scanned in the order that they were programmed into the list. When a broadcast is received on a channel being scanned, scanning stops to let you hear communications on that channel. Scanning resumes when the transmission ends.

Using the monitor button does not interrupt scanning. Additionally, scanning automatically continues after you make a call and hang-up the microphone.

NOTE: When you call another unit, say which channel you are using. Then other users can determine on which channel to reply.

7.5.2.3 PRIORITY SCANNING

Priority scanning lets you monitor other channels without missing a call on your priority channel, which the radio periodically checks for activity even while scanning has stopped on another channel. Priority scanning works only if the scan list programmed is a Priority Scan List, not a Normal Scan List. (You can find out which kind of scan list is programmed for a channel by doing a "Channel Contents Readout.")

NOTE: The radio must be in programming mode in order to readout channel data.

7.5.2.4 BUSY CHANNEL DELETE

If a channel in the scan list is so busy that you want to temporarily delete that channel from the list, press the monitor button while scanning is stopped on the channel to be deleted. (The priority channel in a Priority Scan List is an exception, and cannot be removed.) The monitor status will not change. The deleted channel will be skipped in the scan list until you switch channels. You may delete more than one channel in the list.

The microphone must be in its hang-up clip for scan to function. If the microphone is off-hook, any channel selected that holds a scan list is skipped.

BUSY CHANNEL DELETE (CON'T.)

While the mobile scans, each channel number of the scan list is displayed in turn. If you take the microphone off-hook OR press the channel or monitor button, scanning stops - on the last active channel for Normal Scan Lists, or on the priority channel for Priority Scan Lists. (However, whether the radio stops on the last active or priority channel is programmable using the optional programming kit.) To continue scanning, hang up the microphone.

7.5.3 SPECIAL FEATURES

Each radio channel can be "dealer or factory" programmed to operate with any combination of special features. The features listed below are "PTT programmable." Other features are available, but require a PC to set. (For a list, see section 8.10.)

7.5.3.1 RECEIVER SQUELCH TIGHTNER FACTOR

This feature reduces distant "co-channel" and other interference for channels that are not programmed with Quiet Call.

Carrier squelch is set for maximum sensitivity at the factory, but may be adjusted (by authorized service personnel) to mute weak signals.

7.5.3.2 CHANNEL MONITOR LOCK OUT

This function may be programmed to keep the radio user from listening to other licensees on a shared channel. The transmit/busy lamp indicates whether the channel is busy. QC or DQC must be used with this option.

7.5.3.3 BUSY CHANNEL TRANSMIT INHIBIT

Busy Channel Transmit Inhibit keeps the radio from broadcasting if the channel is busy, and is often used in conjunction with Channel Monitoring Lock Out. If you press the PTT when the channel is busy with a signal not intended for your radio (not carrying your Quiet Call code), this feature sounds a "busy" tone in the speaker and keeps the transmitter turned off.

7.5.3.4 REDUCED TRANSMIT POWER

This feature allows for reduced transmitter power on individual channels, which might be required by the radio owner's FCC license.

7.5.3.5 PAGING QUIET CALL TRANSPOND

If you receive a page and do not answer within three seconds, this feature automatically keys your radio's transmitter and sends an "acknowledgement" tone to the calling party.

7.6 TROUBLESHOOTING

If you have trouble operating the radio, review the radio controls and operation sections. If you think the radio is malfunctioning, check the table below.

	PROBLEM	POSSIBLE SOLUTIONS
7.6.1	**GENERAL**	
	Front panel lamps do not light.	Replace the DC power cable fuse.
		The DC cable is not properly connected. (Refer to the installation section of this manual.
	Reception is poor.	The antenna is installed incorrectly - see the antenna installation guide.
		The antenna is damaged.
		Move to a different location. (See note 1 on page 25.)
	"Noise" sounds in the radio speaker.	Press and release the monitor button. (Note 2.)
	You cannot hear calls from other radios.	Press and release the monitor button. (Note 2.)
		Be certain that your radio receives on the same frequency as the caller transmits. (Note 3.)
	Your calls cannot be heard in other radios.	Make sure that your radio transmits on the receive frequency of the radio(s) you want to call. (Note 3.)
7.6.2	**ERROR TONES**	
	An error tone sounds when the radio is first switched on.	See page 17, "Error Tones."
	Repeating tones occur when you press the PTT button.	The channel is "Receive Only," or the TX Inhibit feature is on. (Note 4.)
	An error tone sounds while you are talking (and the transmitter shuts off).	The Transmit Time Out Timer has ended your broadcast. See page 17, "Error Tones."
7.6.3	**QUIET CALL (QC, DQC AND PQC)**	
	You cannot screen out calls from users outside of your Quiet Call group.	Make sure that the channel is programmed with Quiet Call.
		Toggle the monitor button to select Quiet Call (coded) squelch. (Note 2.)

TROUBLESHOOTING

PROBLEM	POSSIBLE SOLUTIONS
QUIET CALL (CON'T.)	
You cannot hear Quiet Call messages while in Quiet Call (coded) squelch.	Confirm that the channel is programmed to detect the same code as the calling radio(s) transmits. (Note 5.)
Others in your Quiet Call group cannot hear your Quiet Call messages.	Verify that you transmit the same code as the radio(s) you call are programmed to detect. (Note 5.)

7.6.4 NOTES

1) Reception can often be improved by traveling a short distance. The strength of a radio broadcast and therefore its coverage is decreased by distance and obstructions (natural and man-made). This includes hills, valleys, foliage, buildings, basements and other metal or concrete structures. The best range and coverage is obtained across flat terrain, with line-of-sight visibility and no obstructions.

2) If noise sounds in the radio speaker, press and release the monitor button to activate carrier squelch. Otherwise, this button toggles Quiet Call (coded) squelch on and off.

3) If you want to hear a call, you must select a channel that is programmed to receive the caller's transmit frequency. If you want to call another unit, you must select a channel that is programmed to transmit the other radio's receive frequency. However, if you use a repeater, your channel must be programmed to work with the repeater's transmit and receive frequencies. (A channel can hold two separate radio frequencies, one for receive, the other for transmit.)

4) If you get repeating error tones when you press the PTT, the channel might be programmed for "Receive Only." If so, the channel does not contain a transmit frequency, and cannot be used to transmit. Repeating tones also sound if the Busy Channel Transmit Inhibit feature is activated and another user's radio signal is present on the channel.

5) In order for radios to communicate using Quiet Call, they must be programmed with the same Quiet Call code. Each code is unique, and your radio will respond only to the code programmed for the channel selected. Note that a channel may have been programmed to transmit one code, and detect another code.

RITRON, INC.
Repair Department
505 West Carmel Drive
Carmel, IN 46032
Phone: 317/846-1201
FAX: 317/846-4978

8. PROGRAMMING THE RADIO

8.1 SETUP FOR PROGRAMMING WITH THE PUSH-TO-TALK

1) Switch off the radio.

2) Remove the mobile's front panel.

   A) Using your thumb and index finger, pull off the volume control knob.

   B) Remove the front panel by carefully lifting the plastic hold-down flaps at the sides of the unit with a dime or similar object.

3) Insert the SERVICE PROGRAMMING KEY into its socket as shown on the next page, in the programming position.

4) Replace the unit's front panel and on-off/volume control knob.

5) Connect the mobile to a +12 VDC source and turn on the radio.

   The speaker will sound a "triple tone" (three short ascending tones) to indicate that the mobile is in *PROGRAMMING MODE.*

8.2 RETURNING TO NORMAL OPERATION

AFTER YOU FINISH PROGRAMMING, follow the steps below:

1) Switch off the mobile.

2) Remove the radio's front panel.

3) Remove the programming key.

4) Replace the unit's front panel and on-off/volume control knob.

5) Turn on the radio to resume normal operation.

   The speaker will emit a short tone to indicate that the unit has successfully completed a self-test and is in *OPERATING MODE.*

8.3 CHANNEL SELECTION (IN PROGRAMMING MODE)

Pressing and releasing the channel select button advances the digital display to the next channel. The speaker emits a confirmation tone each time you press the channel button, providing an audible marker. Additionally, when the channel select "rolls-over" from the highest channel number to channel 0, a "double tone" sounds.

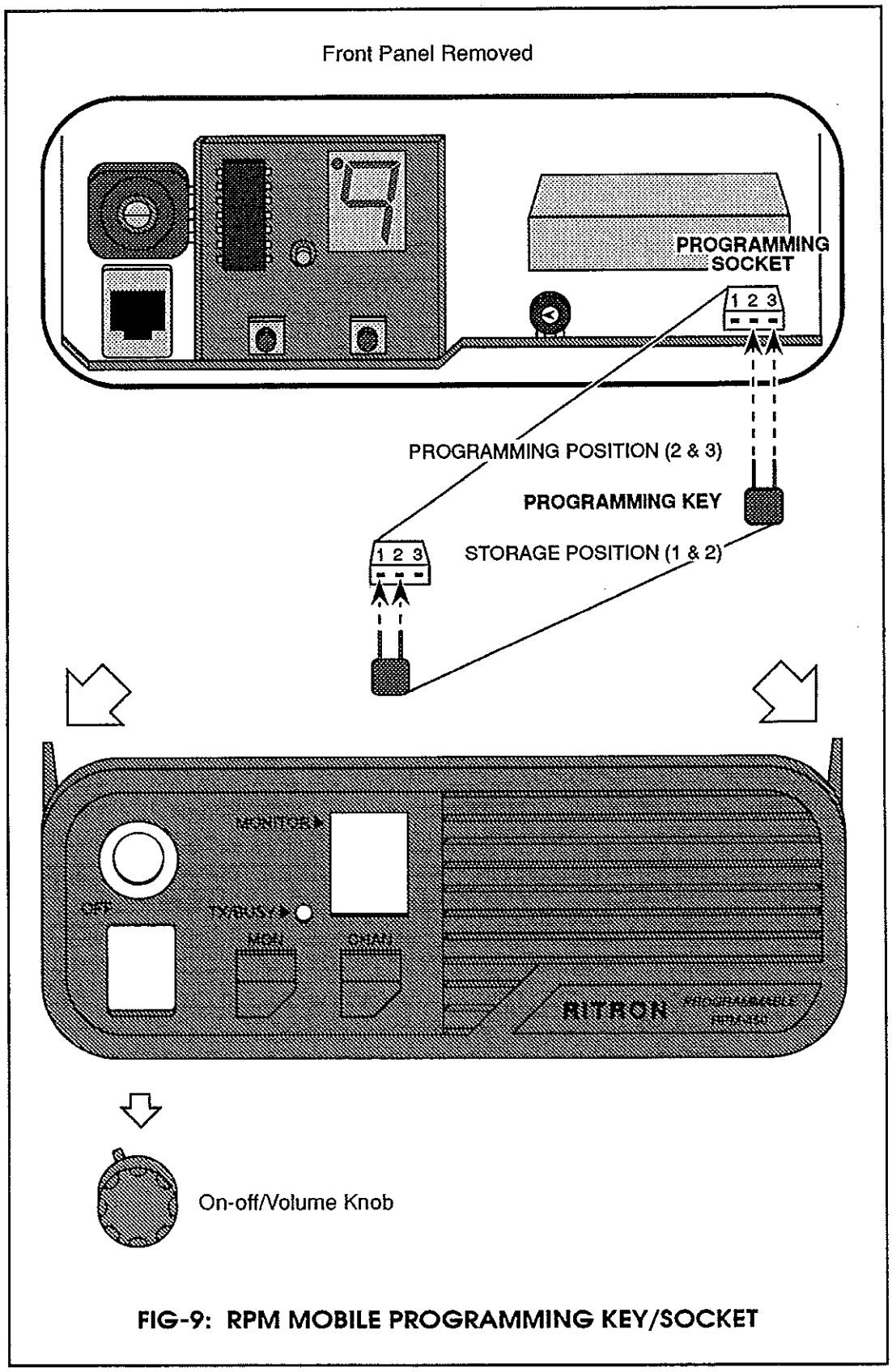


FIG-9: RPM MOBILE PROGRAMMING KEY/SOCKET

8.4 CHANNEL CONTENTS READOUT (IN PROGRAMMING MODE)

8.4.1 TO DETERMINE DATA ALREADY PROGRAMMED

1) Select the channel you want to readout.

2) Press and release the monitor button.

The radio then responds in one of two ways:

Case #1 - When the monitor button is pressed and released and the channel is EMPTY, the unit signals with a triple tone. The channel is ready to be programmed.

Case #2 - When the monitor button is pressed and released and the CHANNEL IS ALREADY PROGRAMMED, the readout begins. A channel may contain radio frequency/Quiet Call data. Or, it may hold a scan list. However, a channel may not contain both.

8.4.1.1 RADIO FREQUENCIES AND QUIET CALL CODES

The unit presents frequency/code data in this order: 1) The RX (receive) frequency, 2) The TX (transmit) frequency and, 3) any Quiet Call code. The channel number then returns.

RX and TX frequencies are six digits each. Quiet Call (QC) codes are two digits, and Digital Quiet Call codes three digits. Paging Quiet Call codes, also three digits, appear with a QC prefix (for a total of five digits).

Each frequency or code is displayed one digit at a time, while the speaker emits a number of tones equal to the digit shown. A pause in the tones separates digits. A dash (-) on the channel display and a longer pause between tones separates the RX frequency from the TX frequency, and the TX frequency from the code.

EXAMPLE: A channel is already programmed with 151.775 MHz for both the RX and TX frequencies, and with "07" for the QC code. When the monitor button is pressed and released:

1) The channel display shows a "1," while the unit sounds a brief tone.

2) After a pause of about one second, a "5" appears, while the unit emits five more tones.

3) This process continues, one digit of the frequency at a time, until the last digit of 151.775, "5," is indicated.

4) Following the last digit of the RX frequency displayed, a dash appears.

5) The TX frequency is then indicated in the same manner as the RX frequency.

6) Following the last digit of the TX frequency displayed, a dash appears.

7) Next, the QC code is represented like the RX and TX frequencies. A "0" appears first, accompanied by ten short tones. A "7" is displayed next while seven tones sound.

8) After the frequencies and code programmed for the channel have been indicated, the front panel displays a dash (-), followed by the channel number. The unit sounds a triple tone.

8.4.1.2 SCAN LISTS

A scan list readout starts with an "8," followed by a "1" OR a "2," and then each channel to be scanned. The first digit ("8") means that the channel holds a scan list; the second digit (a "1" or a "2") identifies the list as a Priority ("1") or Normal ("2") Scan List. The first two digits and the channels of the scan list are presented one at a time - the speaker issues a number of tones equal to the digit/channel.

NOTE: Readouts for scan lists that contain an odd number of channels indicate an extra alphanumeric character at the end of the list. A "F" follows the last channel, although the radio does not actually scan channel F (16).

Channel F (16) cannot be included in a scan list. However, F can hold a scan list.

8.4.1.3 SPECIAL CASES

8.4.1.3.1 "Receive Only" Channels

If the channel is "Receive Only," the channel display shows the transmit frequency as six ones ("1"), each "1" accompanied by a tone.

8.4.1.3.2 Quiet Call Codes

- If no Quiet Call code is programmed, only a dash (-) and the channel number follows the RX and TX frequencies.
- Quiet Call codes may include an optional extra digit that conveys a special instruction to the radio's microcontroller:

  A "9" added to the end of a QC or DQC entry turns off Quiet Call squelch during receive (and makes the channel "encode only").

  A "1" added to the end of a DQC entry "inverts" the code when the radio receives. A "2" inverts the DQC code when the radio transmits.

  Two separate Quiet Call codes can be stored on one channel. One QC code is for receive mode, the other for transmit.

  During a channel readout, the two Quiet Call codes follow the receive and transmit frequencies. The first two-digit QC code is for decode, the second for encode. An "8" comes after the second code to identify the entry for the radio's microcontroller.

8.4.1.4 SPECIAL FEATURES

A channel contents readout does not indicate any special features programmed, such as the receiver squelch tightner factor.

NOTE: Special features may be read using RITRON's optional PC programming kit (model RPT-PCPK) and a PC compatible computer. The programming software included in the kit allows you to print out a complete list of each channel's data.

8.4.2 TO STOP A CONTENTS READOUT

Press and release the monitor button during the readout. Or, change channels.

The channel contents readout sequence then halts and the speaker sounds a triple tone. The radio is ready for any further instructions.

8.5 ERASING CHANNEL CONTENTS

It is not necessary to erase the channel contents before programming new data. Entering a new radio frequency or scan list automatically clears the channel of all data.

IMPORTANT: Do not erase all radio channels - leave at least one channel programmed.

8.5.1 TO ERASE ALL CONTENTS

1) Select the channel you want to erase.

2) Press and hold the PTT (Push-To-Talk) button.

3) Press and release the monitor button.

4) Release the PTT. A triple tone signals that all data for the channel has been erased.

8.5.2 TO ERASE ONLY QUIET CALL CODE DATA

HOW TO:

Erase A Quiet Call Code-

1) Enter "00" (or "44," which is No Tone).

2) Press and release the monitor button.

---

1) Select the channel you want to clear of Quiet Call data.

2) Program "00."

   A) Enter a "0," by pressing and releasing the PTT button ten times WITHOUT PAUSING.

      The radio emits a tone to indicate that it is ready for the next digit.

   B) Enter another "0."

   C) Press and release the monitor button.

      The radio sounds a triple tone when Quiet Call data has been erased.

8.6 PROGRAMMING NEW CHANNEL CONTENTS WITH THE PUSH-TO-TALK

CHANNEL CONTENTS ARE PROGRAMMED ONE DIGIT AT A TIME, by pressing and releasing the microphone's PTT (Push-To-Talk) button a number of times equal to the digit's value. A pause of more than about one second causes the radio's microcontroller to immediately accept the digit as complete. The speaker then sounds a "ready" tone prompt.

CHANNEL CONTENTS ARE STORED BY PRESSING AND RELEASING THE MONITOR BUTTON. When the monitor button is pressed to store valid data, the speaker emits a "triple tone."

8.6.1 GUIDELINES

- Follow the setup and RETURNING TO NORMAL OPERATION instructions on page 26.
- THE RADIO'S OPERATING BAND is determined by model, as explained on page 3. The radio will not operate on frequencies outside of the limits specified (although the radio will allow you to program frequencies in the wrong band).
- While entering a digit, DO NOT pause after releasing the PTT. A pause tells the radio that you are finished entering the digit.
- To enter the digit "0," press the PTT ten times.
- To enter the following channels into a scan list, press the PTT this number of times:
  A = 11 b = 12 c = 13 d = 14 E = 15 F = 16
- YOU MUST ENTER ALL RADIO FREQUENCIES AS SIX DIGITS. You cannot skip zero ("0") digits. For instance, you must enter a zero for each of the last two digits in 464.500 MHz.

  For 12.5 KHz offset channels (7-digit frequencies), enter only the first six digits. Offset channels cannot be programmed for standard VHF models.
- You may add or change a Quiet Call code for a channel without erasing the radio frequencies, simply by programming the new code.
- Programming a radio frequency: 1) erases any Quiet Call codes saved on the channel and, 2) causes any special features stored on the channel to default to their standard settings (defaults for PTT programmable special features are called out on page 39).

8.6.2 ENTRY MISTAKES

8.6.2.1 INVALID ENTRIES

AN ERROR TONE MEANS THAT YOU HAVE TRIED TO SAVE AN INVALID ENTRY. No programming changes are made. The triple tone follows to indicate that the radio is ready for another entry. Attempting to save seven digits for a radio frequency, for instance, provokes an error tone (remember that all radio frequencies are entered as six digits). THE TABLE ON THE NEXT PAGE GIVES VALID ENTRIES.

8.6.2.2 PRESSING THE PTT

If you press the PTT seven times when you intended six, for example, or just lose count, DO NOT press the monitor button to store channel data. To start over without saving any data, move to another channel and then back again.

8.6.3 VALID PROGRAMMING ENTRIES

THE TABLE BELOW LISTS VALID PROGRAMMING ENTRIES. If you get an error tone while programming, you probably tried to save an INVALID entry. Check the table. The example column reflects only a few of the radio frequencies and codes available.

The radio's microcontroller counts the number of digits in an entry to determine what you are programming (for exceptions, see note 3). This table shows how the radio interprets the number of digits in an entry.

NUMBER OF DIGITS	INTERPRETATION	EXAMPLE
1	Carrier Squelch Tightner Factor 0-7	3
2	QC (Quiet Call)	12
3	QC Encode Only	129
3	DQC (Digital Quiet Call)	071
4	DQC Encode Only	0719
4	DQC with Inversion	0711
5	QC decode and QC encode (see note 6)	12208
5	QC and PQC (Paging Quiet Call)	12323
5	Special Features	92212
6	RX/TX Frequency	151775
7	No Interpretation	-------
8	RX/TX Frequency and QC	15177512
9	RX/TX Frequency and QC Encode Only	151775129
9	RX/TX Frequency and DQC	151775071
10	RX/TX Frequency and DQC Encode Only	1517750719
10	RX/TX Frequency and DQC with Inversion	1517750711
11	RX/TX Frequency, QC and PQC	15177512323
12	RX Frequency and TX Frequency	152030158490
13	No Interpretation	----------
14	RX Frequency, TX Frequency and QC	46450046950012
15	RX Frequency, TX Frequency and QC Encode Only	464500469500129
15	RX Frequency, TX Frequency and DQC	464500469500071
16	RX Frequency, TX Frequency and DQC Encode Only	4645004695000719
16	RX Frequency, TX Frequency and DQC with Inversion	4645004695000711
17	RX Frequency, TX Frequency, QC and PQC	46450046950012323
18	RX Frequency, TX Frequency, QC and PQC, Encode Only	464500469500123239

NOTES

1) Where "RX/TX Frequency" appears in the interpretation column, the same radio frequency is used for both receive and transmit.

2) For "Receive Only" channels, the transmit frequency is entered as six ones ("111111").

3) An entry that begins with an "8" is interpreted as a scan list. A "9" introduces special features.

4) A channel must already contain a radio frequency before special features can be programmed for that channel.

5) A "9" added to the end of a QC or DQC entry turns off Quiet Call coded squelch. Quiet Call then operates in transmit mode only ("encode only").

NOTES (CON'T.)

6) An "8" suffix means that two separate QC codes are used. The first QC code entered is for decode, the second for encode.

7) A "1" added to the end of a DQC entry inverts the code for receive (RX). A "2" inverts the code for transmit (TX). The examples in the table use the RX inversion.

8) PQC codes that include six digits total (a 2-digit QC code, 3-digit PQC code, plus the encode only "9") may be entered only as shown in the table. Otherwise, the radio will interpret the 6-digit PQC entry as a radio frequency.

8.6.4 BASIC PROGRAMMING INSTRUCTIONS

TO PROGRAM:

8.6.4.1 The Same Frequency For RX and TX

1) Select the channel you want to program.

2) Enter the 6-digit radio frequency, one digit at a time. Remember to pause between digits.

3) Press and release the monitor button.

8.6.4.2 Different Frequencies For RX and TX

1) Select the channel you want to program.

2) Enter the 6-digit RX frequency, one digit at a time. Pause between digits.

3) Enter the 6-digit TX frequency, one digit at a time.

4) Press and release the monitor button.

8.6.4.3 For "Receive Only"

IMPORTANT: For a "Receive Only" channel, six ones ("111111") are programmed as the transmit frequency. This disables the transmitter for that channel.

1) Select the channel you want to program.

2) Enter the 6-digit RX frequency, one digit at a time. Pause between digits.

3) Enter the "No Transmit" sequence ("111111"), one digit at a time.

4) Press and release the monitor button.

8.6.4.4 A Quiet Call Code

1) Select the channel you want to program.

2) Refer to the Quiet Call code chart on the next page and find the QC code for the tone desired.

   For example, to program a tone of 203.5 Hz, locate "203.5 Hz" under the "Frequency (Hz)" column. The corresponding QC code for 203.5 Hz ("32") appears on the same line under the QC code column.

3) Enter the 2-digit QC code, one digit at a time. Remember to pause between digits.

4) Skip this step unless you want QC to operate in transmit mode only (encode only).

   IF SO, enter a "9."

   The radio will transmit the QC code, but will "receive" any on-frequency signal, regardless of Quiet Call squelch.

5) Press and release the monitor button.

QUIET-CALL CODES AND FREQUENCIES
(CODES 39 - 51 AVAILABLE FOR REV. 4 RADIOS ONLY)

QC Code	Tone Code	Freq. (Hz)	QC Code	Tone Code	Freq. (Hz)	QC Code	Tone Code	Freq. (Hz)
01	XZ	67.0	18	3Z	123.0	36	–	233.6
02	XA	71.9	19	3A	127.3	37	–	241.8
03	WA	74.4	20	3B	131.8	38	–	250.3
04	XB	77.0	21	4Z	136.5	39	–	69.4
05	SP	79.7	22	4A	141.3	40	–	159.8
06	YZ	82.5	23	4B	146.2	41	–	165.5
07	YA	85.4	24	5Z	151.4	42	–	171.3
08	YB	88.5	25	5A	156.7	43	–	177.3
09	ZZ	91.5	26	5B	162.2	44	–	No Tone
10	ZA	94.8	27	6Z	167.9	45	–	183.5
11	ZB	97.4	28	6A	173.8	46	–	189.9
12	1Z	100.0	29	6B	179.9	47	–	196.6
13	1A	103.5	30	7Z	186.2	48	–	199.5
14	1B	107.2	31	7A	192.8	49	–	206.5
15	2Z	110.9	32	M1	203.5	50	–	229.1
16	2A	114.8	33	–	210.7	51	–	254.1
17	2B	118.8	34	–	218.1	52	Do Not Use	
			35	–	225.7	53	Programmable	

DIGITAL QUIET-CALL CODES

Normal	Invert	Normal	Invert	Normal	Invert	Normal	Invert
023	047	143	412	315	423	532	343
025	244	152	115	331	465	546	132
026	464	155	731	343	532	565	703
031	627	156	265	346	612	606	631
032	051	162	503	351	243	612	346
043	445	165	251	364	131	624	632
047	023	172	—	365	125	627	031
051	032	174	074	371	734	631	606
054	413	205	263	411	226	632	624
065	271	223	134	412	143	654	743
071	306	226	411	413	054	662	466
072	245	243	351	423	315	664	311
073	506	244	025	431	723	703	565
074	174	245	072	432	516	712	114
114	712	251	165	445	043	723	431
115	152	261	732	464	026	731	155
116	754	263	205	465	331	732	261
125	365	265	156	466	662	734	371
131	364	271	065	503	162	743	654
132	546	306	071	506	073	754	116
134	223	311	664	516	432		

TO PROGRAM:

8.6.4.5 A Digital Quiet Call Code

IMPORTANT: Digital Quiet Call cannot be used on the same channel with Quiet Call or Paging Quiet Call.

1) Select the channel you want to program.

2) Refer to the Digital Quiet Call code chart on the previous page and select a code ("Normal" or the "Invert" of normal).

3) Enter the 3-digit DQC code, one digit at a time. Pause between digits.

4) Skip this step unless you want DQC to operate in transmit mode only (encode only).

   IF SO, enter a "9."

5) Skip this step unless you want to invert the code in either receive or transmit mode.

   If you HAVE NOT programmed DQC to operate in transmit mode only (step 4), you may enter a digit that instructs the radio to invert the DQC code.

   A) TO RECEIVE the invert of the DQC code, enter a "1."

      The radio will "receive" on-frequency signals that carry the DQC code invert, and transmit the DQC code entered in step 3.

   B) TO TRANSMIT the invert of the DQC code, enter a "2."

      The radio will transmit the DQC code invert, and "receive" on-frequency signals that carry the DQC code entered in step 3.

6) Press and release the monitor button.

8.6.4.6 A Paging Quiet Call Code

IMPORTANT: The PQC code cannot be programmed without entering a QC code prefix at the same time. To use PQC without QC, program "44" for the 2-digit QC prefix.

1) Select the channel you want to program.

2) Enter a 2-digit QC code, one digit at a time. Pause between digits.

3) Refer to the Paging Quiet Call code chart on the next page and select a PQC code.

   NOTE: Code 444 is the All-Call code.

4) Enter the 3-digit PQC code, one digit at a time.

5) Skip this step unless you want QC to operate in transmit mode only (encode only).

   IF SO, enter a "9."

6) Press and release the monitor button.

PAGING QUIET CALL CODES AND FREQUENCIES

PQC Code	Std. Code	Lo Freq. (Hz)	Hi Freq. (Hz)	PQC Code	Std. Code	Lo Freq. (Hz)	Hi Freq. (Hz)
111	300	330.5	569.1	311	340	410.8	569.1
112	301	330.5	600.9	312	341	410.8	600.9
113	302	330.5	634.5	313	342	410.8	634.5
114	303	330.5	669.9	314	343	410.8	669.9
121	304	330.5	707.3	321	344	410.8	707.3
122	305	330.5	746.8	322	345	410.8	746.8
123	306	330.5	788.5	323	346	410.8	788.5
124	307	330.5	832.5	324	347	410.8	832.5
131	310	349.0	569.1	331	350	433.7	569.1
132	311	349.0	600.9	332	351	433.7	600.9
133	312	349.0	634.5	333	352	433.7	634.5
134	313	349.0	669.9	334	353	433.7	669.9
141	314	349.0	707.3	341	354	433.7	707.3
142	315	349.0	746.8	342	355	433.7	746.8
143	316	349.0	788.5	343	356	433.7	788.5
144	317	349.0	832.5	344	357	433.7	832.5
211	320	368.5	569.1	411	360	457.9	569.1
212	321	368.5	600.9	412	361	457.9	600.9
213	322	368.5	634.5	413	362	457.9	634.5
214	323	368.5	669.9	414	363	457.9	669.9
221	324	368.5	707.3	421	364	457.9	707.3
222	325	368.5	746.8	422	365	457.9	746.8
223	326	368.5	788.5	423	366	457.9	788.5
224	327	368.5	832.5	424	367	457.9	832.5
231	330	389.0	569.1	431	370	483.5	569.1
232	331	389.0	600.9	432	371	483.5	600.9
233	332	389.0	634.5	433	372	483.5	634.5
234	333	389.0	669.9	434	373	483.5	669.9
241	334	389.0	707.3	441	374	483.5	707.3
242	335	389.0	746.8	442	375	483.5	746.8
243	336	389.0	788.5	443	376	483.5	788.5*
244	337	389.0	832.5	444	377	483.5	832.5

* May be programmed to any 300 - 1200 Hz tone pair using the PC Programmer software.

NOTE: Each PQC code (except All-Call) is transmitted as a pair of audible tones. No two codes use the same pair. The "Lo Frequency" (Tone A) is transmitted first, the "Hi Frequency" (Tone B) second.

The All-Call code is transmitted as a single tone for a duration of four seconds.

TO PROGRAM:

8.6.4.7 A Scan List (Normal/Priority)

IMPORTANT:

1) A channel cannot hold both radio frequency/Quiet Call data AND a scan list. Programming a scan list automatically erases any radio frequency, Quiet Call code OR scan list already on the channel.

2) Each scan list must contain at least two channels (for Priority Scan Lists, this means the priority channel plus one other channel). The radio will scan only channels that are programmed with a radio frequency.

NOTE: Channel "F" cannot be included in a scan list. However, F (16) can hold a scan list.

TO PROGRAM A PRIORITY SCAN LIST, FOLLOW STEPS 1 - 6. FOR A NORMAL SCAN LIST, SKIP STEPS 3 - 6.

1) Select an empty channel.

2) Enter an "8," which tells the radio's microcontroller that the channel will contain a scan list.

For a Priority Scan List

3) If you are programming a Priority Scan List, enter a "1."

4) Enter the priority channel number.

5) Enter the other channels to be scanned, one at a time.

6) Press and release the monitor button.

For a Normal Scan List

7) If you are programming a Normal Scan List, enter a "2."

8) Enter the channels to be scanned, one at a time.

9) Press and release the monitor button to store the list.

TO PROGRAM:

8.6.4.8 Special Features

8.6.4.8.1 *A Receiver Squelch Tightner Factor:*

1) Enter a single digit factor from "0" to "7."

   The squelch threshold tightner may be programmed for any factor from "0" to "7." A "0" = maximum sensitivity; weaker signals will be heard. A "7" = minimum sensitivity; weaker signals will not be heard.

2) Press and release the monitor button.

8.6.4.8.2 *Other Special Features:*

The special features below may be programmed for any channel that already contains radio frequencies. A blank channel will not save any special features programming.

CHANNEL MONITOR LOCK OUT	REDUCED TRANSMITTER POWER
BUSY CHANNEL TRANSMIT INHIBIT	PAGING QUIET CALL TRANSPOND

YOU MUST SET ALL FOUR FEATURES to activate any of these special features. To program, follow the steps below.

1) First, enter a "9," which tells the microcontroller that you are programming special features.

2) Enter a single digit for Channel Monitoring Lock Out (OFF = "1" ON = "2").

3) Enter a single digit for Busy Channel Transmit Inhibit (OFF = "1" ON = "2").

4) Enter a single digit for the Transmitter Power Factor (FULL PWR = "1" REDUCED PWR = "2").

5) Enter a single digit for Paging Quiet Call Transpond (OFF = "1" ON = "2").

6) Press and release the monitor button.

8.6.4.8.3 *Special Features Defaults:*

Programming a RADIO FREQUENCY causes all special features stored on the channel to default to their standard settings.

SPECIAL FEATURE	STANDARD SETTING	EQUIVALENT DIGIT ENTRY
Squelch Tightner Factor	Maximum sensitivity	0
Channel Monitor Lock Out	Off	1
Busy Channel Transmit Inhibit	Off	1
Reduced Transmitter Power	Full power	1
Paging Quiet Call Transpond	Off	1

8.7 CLONING

Cloning allows authorized service personnel to easily copy all channel data from one radio into another, saving time spent entering identical channel contents via the PTT into each unit.

The radio's "personality," however, cannot be cloned. Personality data controls operation for all channels, and includes options such as the transmitter time-out time. A radio's personality may be copied to another radio using a PC compatible computer and optional programming kit model RPT-PCPK. Personality data should not be copied between Rev. 3 and Rev. 4 radios, or between RPM mobiles and RTX handhelds. Doing so will render the "slave" radio inoperable.

TO COPY ALL CHANNEL DATA FROM ONE RADIO TO ANOTHER, FOLLOW THE STEPS BELOW. FIG-10 on the next page illustrates cloning.

WARNING: Using an incorrectly wired substitute for the RITRON cloning cable will damage the radio(s)! DO NOT use a standard telephone cable in place of the cloning cable.

8.7.1 RPM MOBILE TO RPM MOBILE

1) Turn off both mobiles and disconnect the microphones from their front panel jacks.

2) Remove the programming key from each radio. (Or, place the key in its storage position as shown on page 27.)

3) Connect both radios to a common +12 VDC source, such as a battery or power supply. (Refer to FIG-10.)

4) Connect a RITRON RPM cloning cable between the microphone jacks of the two mobiles.

5) The order in which the radios are turned on determines which is the master and which is the slave. Switch on the unit that contains the channel data you wish to copy (the master). The unit sounds a tone. Failure to turn on the master first causes channel data to flow in the wrong direction.

6) Turn on the slave unit. Both radios emit a triple tone. The master displays a "d," and the slave an "L."

7) When the "d" on the master disappears and the units repeatedly sound the "finished" tone, turn off the slave first. Then turn off the master. The slave is now programmed with the same channel contents as the master.

8) Disconnect the cloning cable and plug the microphones into their front panel jacks.

8.7.2 RPM MOBILE TO RTX HANDHELD

NOTE: The RTX portable, unlike the mobile radio, will not sound any tones during cloning.

1) Turn off both radios. Disconnect the microphone from the mobile's front panel jack.

2) Remove the programming key (plug) from each radio.

3) Connect the mobile to a +12 VDC source, such as a battery or power supply.

4) Connect a cloning cable adapter to one end of the cloning cable, by mating the adapter's modular socket to the cable's modular plug. The adapter is a short cable (approx. 9") with a 6-pin modular socket at one end, and a 3.5 mm plug at the other.

RPM MOBILE TO RTX HANDHELD (CON'T.)

5) Insert the cloning cable/adapter 3.5 mm plug into the RTX handheld's audio jack.

6) Insert the cloning cable modular plug into the RPM mobile's microphone jack.

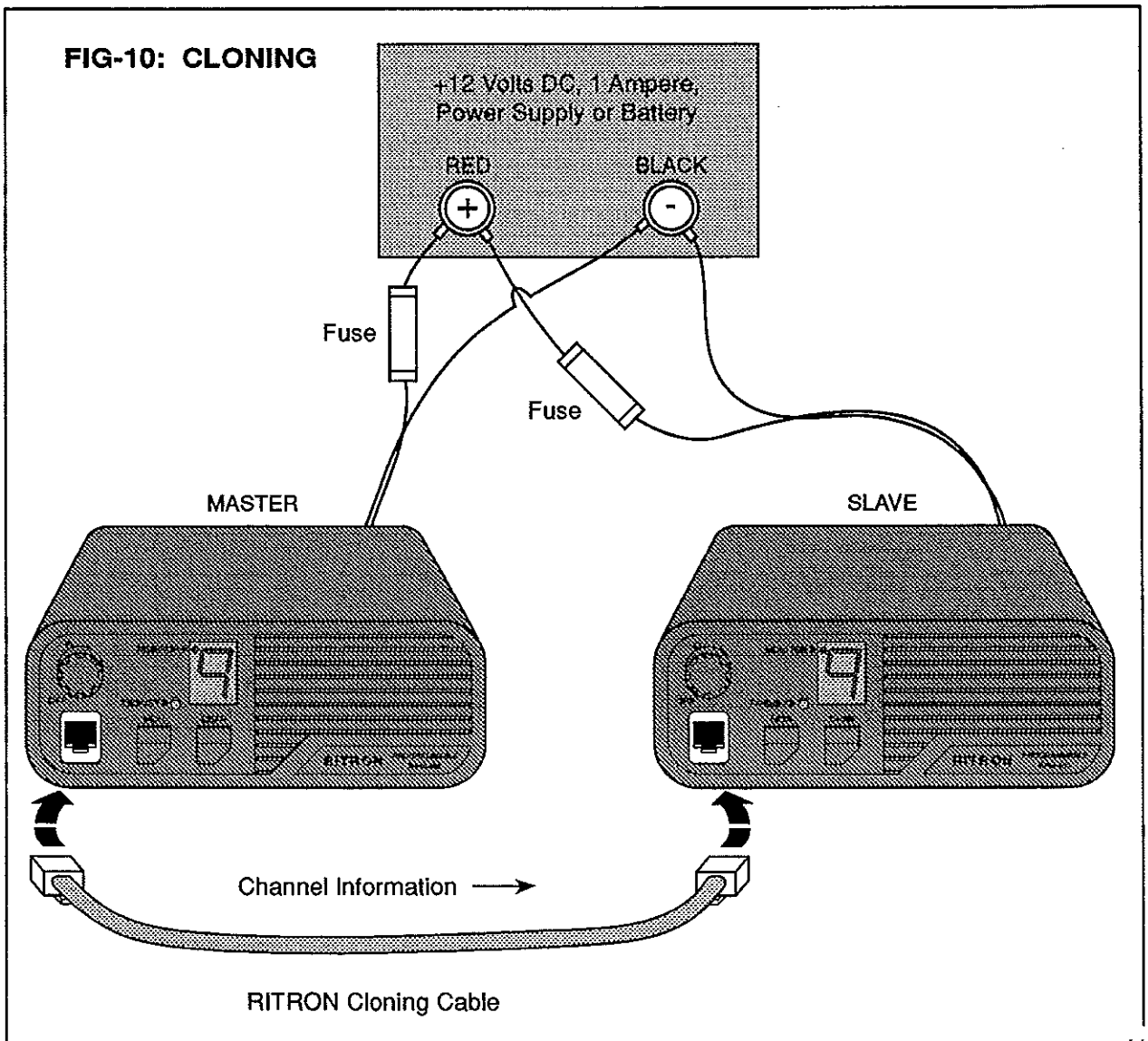
7) The order in which the radios are turned on determines which is the master and which is the slave. Switch on the unit that contains the channel data you wish to copy. This is the master. (If the master is a RPM mobile, it will sound a tone.) Failure to turn on the master first causes channel data to flow in the wrong direction.

8) Turn on the slave. The mobile radio will emit a triple tone, and display a "d" if it is the master, or a "L" if it is the slave.

9) When the RPM mobile repeatedly sounds the "finished" tone, turn off the slave first. Then turn off the master. The slave is now programmed with the same channel contents as the master.

10) Disconnect the cloning cable and plug the microphone into the mobile's front panel jack.

FIG-10: CLONING



8.8 PC COMPUTER PROGRAMMING KIT

RITRON's programming kit (model RPT-PCPK) allows programming of RPM mobile and RTX handheld radios with a PC compatible computer.

RITRON's adapter cable connects the radio to a computer's serial communications port. Once the cable is hooked up, the user inserts the diskette provided into his computer's floppy disk drive and loads a software program. This program transfers data between radio and computer memory, and includes on-screen instructions and help. Radio data may be saved to the computer's hard disk to program other radios.

8.8.1 PRECAUTIONS

Always determine the Rev. of the radio you are programming before you download a file into the radio's memory. This is easily done by following the on-screen instructions and reading the radio's memory (buffer).

Please observe the following precautions while using the PC programming kit. Otherwise, data in the radio microcontroller will be corrupted and the radio left inoperative.

- Do not save Rev. 3 radio personality data files to Rev. 4 radios.
- Do not save RPM mobile personality files to RTX handhelds, and vice versa.
- Do not use versions of the programming software earlier than 1.6R14 to program Rev. 4 radios.

8.8.2 THE RPT-PCPK KIT INCLUDES:

1) RITRON Transceiver Programmer software, which is contained on one 3.5" diskette (the 5.25" format may be ordered).

2) Installation instructions (RITRON #01454947) and a registration form.

3) RITRON PC to radio adapter cable, which is terminated at one end with a DB-25F connector, at the other end with a modular plug. The DB-25 plugs into the computer's serial port, the modular plug into the RPM mobile's microphone jack.

4) An adapter for use with RTX portables. This adapter mates the modular plug to a 3.5 mm plug, for connection to the handheld's audio jack.

8.8.3 THE RPT-PCPK KIT REQUIRES:

A PC compatible computer with DOS 3.2 or later. The computer must have a RS-232 serial port available. A hard disk drive is recommended.

8.9 COMPUTER SOFTWARE COPYRIGHTS

The RITRON, INC. products described in this manual include copyrighted RITRON, INC. computer programs. Laws in the United States and other countries grant to RITRON, INC. certain exclusive rights in its copyrighted computer programs, including the exclusive right to distribute copies of the programs, make reproductions of the programs, and prepare derivative works based on the programs. Accordingly, any computer programs contained in RITRON, INC. products may not be copied or reproduced in any manner without the express written permission of RITRON. The purchase of RITRON, INC. products does not grant any license or rights under the copyrights or other intellectual property of RITRON, INC., except for the non-exclusive, royalty fee license to use that arises in the sale of a product, or as addressed in a written agreement between RITRON, INC. and the purchaser of RITRON, INC. products.

8.10 PROGRAMMABLE FEATURES TABLES

The tables below indicate whether each feature may be programmed with the PTT (Push-To-Talk) button or a PC computer. (If you will use a PC, RITRON programming kit model RPT-PCPK is required.)

Additional PC-programmable features are available for Revision 4 and later radios. If you plan to program these radios using the programming kit, refer to the on-screen instructions built into the RPT-PCPK software for an updated list. (Features are still being added to better provide for a wide variety of customer preferences.)

WARNING: Do not use versions earlier than 1.6R14 of this software to program RPM and other Rev. 4 radio models! Otherwise, the radio data can be corrupted.

8.10.1 FEATURES PROGRAMMABLE PER CHANNEL

These features are programmed for individual channels.

FEATURE	RANGE	STANDARD SETTING	PC	PTT
Transmit (TX) Frequency	-	-	√	√
Receive (RX) Frequency	-	-	√	√
Scan List	-	-	√	√
Carrier Only, No Tones or Codes	-	-	√	√
Quiet Call (CTCSS)	-	-	√	√
Quiet Call Encode Only	-	-	√	√
Digital Quiet Call (DCS)	-	-	√	√
Digital Quiet Call Inverted	-	-	√	√
Digital Quiet Call TX Invert	-	-	√	√
Digital Quiet Call RX Invert	-	-	√	√
Digital Quiet Call Encode Only	-	-	√	√
Quiet Call and Paging Quiet Call	-	-	√	√
Quiet Call Encode Only and Paging Quiet Call	-	-	√	√
Paging Quiet Call Only	-	-	√	√
Quiet Call With Separate Decode/Encode	-	-	√	√
Squelch Tightner Factor	0-7	0	√	√
Busy Channel Transmit Inhibit	Y-N	N	√	√
Channel Monitor Lock Out	Y-N	N	√	√
Scan Resume Delay	Y-N	Y	√	-
Paging Quiet Call Transpond	Y-N	N	√	√
When PTT Is Released	Normal, Reversal	Normal	√	-
Reduced Transmitter Power	Y-N	N	√	√
Transmit Time Out Timer	Y-N	Y	√	-
Special Mode Output	Y-N	N	√	-
Channel Readout Allowed	Y-N	Y	√	-

8.10.2 FEATURES PROGRAMMABLE PER RADIO

These features are programmed for the radio using a PC computer and programming kit model RPT-PCPK. All channels are set together.

FEATURE	RANGE	STANDARD SETTING	PC	PTT
Transmit Time Out Time	0-255 s	180 s	√	-
Transmit Hang Time For Quiet Call	0-983 ms	150 ms	√	-
Transmit Hang Time For Digital Quiet Call	0-983 ms	183 ms	√	-

FEATURES PROGRAMMABLE PER RADIO (CON'T.)

FEATURE	RANGE	STANDARD SETTING	PC	PTT
Quiet Call Tone Reversal Default	Y-N	Y	√	-
Special Quiet Call Encode Code	Any Code	FF	√	-
Paging Quiet Call Alert	Y-N	Y	√	-
Paging Quiet Call Special 1st Tone (443)	300-1200 Hz	483.6 Hz	√	-
Paging Quiet Call Special 2nd Tone (443)	300-1200 Hz	788.6 Hz	√	-
Paging Quiet Call All-Call Enable	Y-N	Y	√	-
Scan Resume Delay Time	0-4 s	2 s	√	-
Priority Scan Look Time	0-4250 ms	1833 ms	√	-
Busy Channel Transmit Inhibit Over-Ride Time	0-127.5 s	4.5 s	√	-
Priority When Off Hook Enable	Y-N	Y	√	-
Number Of Allowable Channels	1-16	16	√	-

8.10.3 DESCRIPTIONS OF FEATURES

Busy Channel Transmit Inhibit - Refer the the Special Features section.

Busy Channel Transmit Inhibit Over-Ride Time - If the Busy Channel TX Inhibit feature is programmed for your channel, and you want to reply to an incoming call that was broadcast via a repeater, you normally would not be able to transmit until the repeater hang time ended. (The hang time is the time that the repeater's transmitter stays on after the receiver ceases to detect an incoming call.) The over-ride option allows you to transmit a reply to a call, regardless of whether the channel is busy (with the repeater's hang time signal).

Carrier Only, No Tones or Codes - One radio frequency is used to transmit and receive. Quiet Call is not programmed for the channel.

Channel Monitor Lock Out - Refer the the Special Features section.

Digital Quiet Call (DQC) - This operates the same as Quiet Call (CTCSS), except that a digital code, instead of a sub-audible tone, is used for coded communications.

Digital Quiet Call Encode Only - The code programmed for the channel is transmitted with your calls. However, Digital Quiet Call is turned off during receive mode. All communications on the channel sound in the speaker.

Digital Quiet Call Inverted - The code programmed for the channel is inverted for receive and transmit modes. The Digital Quiet Call chart lists codes, normal and inverted.

Digital Quiet Call RX Invert - The code is inverted for receive mode only.

Digital Quiet Call TX Invert - The programmed code is inverted for transmit mode.

Number Of Channels - This value should be changed only in order to update older RPM mobiles from 10 to 16 channel capacity.

Paging Quiet Call All-Call Enable - The radio's All-Call decode feature may be enabled or disabled.

Paging Quiet Call Automatic Squelch Reset - The radio may be programmed to automatically reset to paging mode after receiving a page. This mutes all activity on the channel except another page. Normally, QC squelch would be activated after the radio decoded a page, allowing broadcasts coded with the correct sub-audible tone to be heard.

DESCRIPTIONS OF FEATURES (CON'T.)

Paging Quiet Call Channel Default To Monitor - Normally, when a channel programmed with Paging Quiet Call is selected manually or in a scan list, the radio is muted until the proper paging code is received. A Paging Quiet Call channel can be optionally programmed so that when selected the receiver is not muted. This enables the user to select or scan the channel and hear radio traffic coded with his Quiet Call tone, and yet have the radio ring if paged on that channel.

Paging Quiet Call Decode And Carrier Squelch - Once the radio receives a page, Quiet Call squelch is activated to mute unwanted communications on the channel. However, the radio may be programmed to ring and then enter carrier squelch following a page.

Paging Quiet Call Message Alert Ring - Once the radio decodes a Paging Quiet Call signal, it will sound a short ringing tone every minute as a reminder that a call has been received. This reminder is cancelled by pressing the monitor, PTT or changing channels.

Paging Quiet Call Only - If the channel is programmed with PQC, the unit can receive pages, and transmit the All-Call page.

Paging Quiet Call Special 1st Tone (443) - Any 300 - 1200 Hz frequency pair that has 2 second, 2 second signaling timing may be substituted for Paging Quiet Call code 443. This is the first tone of that pair.

Paging Quiet Call Special 2nd Tone (443) - This is the second tone of the frequency pair used to replace PCQ code 443.

Paging Quiet Call Transpond - Refer the the Special Features section.

Power Strobe - Enabling this option allows the radio to go into battery saver mode when the radio remains idle.

Priority Channel Alert Beep In Scan Mode - This feature may be enabled such that when the radio is scanning (a Priority Scan List) and a signal on the priority channel is received, the handheld will emit an alert beep.

Priority Scan Look Time - During priority scanning, the radio's microcontroller regularly checks the priority channel for activity. The look time is the time between these checks. A lower value means that the priority channel is checked more frequently.

Programmable Quiet Call Tone - Quiet Call Code 53 is used to represent a special "tunable" Quiet Call code that may be set using the PC programmer. The range of this tone is 30 to 250 Hz in 0.1 Hz steps. The Quiet Call decoder bandwidth is 1% wide and might false on adjacent tones. Contact Ritron for assistance in programming this code.

Quiet Call (CTCSS) - Programming a Quiet Call code allows you to screen out transmissions that do not carry your code. Your code is broadcast when you press the PTT to make a call.

Quiet Call Encode Only - The Quiet Call code programmed for the channel is transmitted with your calls. However, Quiet Call is turned off during receive mode, allowing all traffic on the channel to be heard.

Quiet Call and Paging Quiet Call (PQC) - If PQC is programmed on a channel with Quiet Call, the radio can receive pages while that channel is selected. In addition, the mobile can transmit the All-Call page.

Quiet Call Encode Only and Paging Quiet Call - This option works exactly the same as the one listed above, except that Quiet Call is deactivated during receive mode.

DESCRIPTIONS OF FEATURES (CON'T.)

When PTT Is Released (PTT Release Options For Quiet Call Encode) - This option enables the radio to match various methods for eliminating the squelch tail (noise burst) at the end of a transmission. You may program the radio to do the following when the PTT is released: 1) reverse the phase of the encode tone and leave the transmitter on for the turn-off time or, 2) turn off the tone and leave the transmitter on for the turn-off time.

Quiet Call Tone Reversal Default - This sets Quiet Call tone phase reversal as the default method of squelch tail elimination for the radio.

Quiet Call With Separate Decode/Encode - One Quiet Call (QC) code is activated during receive mode, a second QC code during transmit mode.

Receive Frequency - The radio frequency that receives broadcasts from other units.

Reduced Transmitter Power - Refer the the Special Features section.

Scan List - A list of channels that the radio automatically monitors when the channel that contains the list is selected.

Scan Resume Delay Time - After the radio has stopped on a busy channel and the broadcast ends, this is the time the radio waits to resume scanning. This delay allows the user to hear the rest of a paused conversation on the channel, or to reply before scanning resumes. The standard delay time is two seconds.

Scan Resume Delay - This is normally enabled, in which case the radio waits the Scan Resume Delay Time before scanning continues. However, this feature may be disabled if required.

Special Mode Output - This output, which terminates inside of the RPM radio, can be used to switch on and off accessories on a per channel basis. Consult the factory for details.

Special Quiet Call Encode Code - A channel can reference this code as its Quiet Call (sub-audible) encode frequency. This enables channels with Paging Quiet Call (two-tone sequential) decode to have separate Quiet Call encode/decode frequencies.

Squelch Tightner Factor - Refer the the Special Features section.

Transmit Channel Revert For Scan Modes - RPM mobiles can be programmed so that if the PTT is pressed while scanning, the radio will transmit on either the last active channel or the priority channel in the scan list. This is determined on a per channel (scan list) basis.

Transmit Frequency - The radio frequency that is transmitted while you press the Push-To-Talk button.

Transmit Hang Time For Digital Quiet Call - This is the time that the Digital Quiet Call turn-off code is transmitted after the PTT is released.

Transmit Hang Time For Quiet Call - This is the time that either no Quiet Call tone or the phase reversed Quiet Call tone is transmitted after the PTT is released.

Transmit Time Out Time - This is the time that you can press the PTT continuously before the Transmit Time Out Timer shuts off the transmitter. (The timer must be turned on.)

Transmit Time Out Timer - This feature automatically shuts off the transmitter (ending your call) if you hold down the PTT button continuously for a specified time. This time can be set to as much as 255 seconds, or the feature turned off. The radio speaker sounds a tone when the transmitter shuts off.

MODEL RPM-150 (VHF) MAINTENANCE/REPAIR

IMPORTANT: The RPM-150 maintenance/repair section of this manual covers two versions of the VHF printed circuit board. (The most recent version is extensively surface mount.) Schematics, parts placement diagrams and parts lists are included for each version of the VHF board. Other RPM-150 information applies to both versions.

To determine which schematics, parts placement diagrams and parts lists to use for a RPM-150 radio, you must know which version of the PC board you have. The radio PC board number (version) is found on the bottom side of the PCB. Match this number, normally eight digits ("17xxxxxx"), to the appropriate set of schematics, diagrams and parts lists.

The two RPM-150 (VHF) PC boards covered in this manual are PCB #17031003 and PCB #1730050A.

⇩ PCB #17031003/SCHEMATIC #17731003 ⇩

SECTION	TOPIC	PAGE

9. RPM-150 THEORY OF OPERATION

Refer to the RPM-150 schematics while reading this section. This manual contains two sets of schematics for the RPM-150 (VHF mobile). The schematics for recently manufactured RPM-150 mobiles reflect minor changes, which are noted below in the theory. To determine which schematic matches a radio, first look at the bottom side of the radio PC board and find the PCB number (normally eight digits, such as "17xxxxxx"). Match this number to the PCB number that appears above the dialog box on schematic 1 of 2.

9.1 POWER SUPPLY

The RPM-150 is powered by an external source (+V BATT) via the battery connector (P402, J402). Zener diode CR403 clamps any high amplitude spikes on the supply line, and causes fuse F401 to blow if the supply rises above +18 Volts. Battery voltage is tied to the on/off volume control (R/SW601), which applies +V SW to the radio circuitry.

C359 and C360 provide filtering for IC304, an +8 Volt regulator that supplies the VCO, reference oscillator, frequency temperature compensation circuit and IC302. Q312, R359, C357 and C358 form a capacitance multiplier power supply filter. Voltage regulator IC302 provides +5 VDC for synthesizer controller IC301, pre-scaler IC303 and, Q301 and Q302 of the charge pump.

Regulator IC103 applies +5 VDC to microcontroller IC102, shift register IC101, the MF6 low-pass filter, bilateral switches IC203 and IC201 of the audio conditioning circuit, and IC202D. Buffer amplifier IC202D provides approximately +2 Volts for audio conditioning circuitry.

A low-voltage reset circuit (Q101, R112 and R120) protects against internal EE memory loss due to battery voltage fluctuations below about +9 Volts, by shutting off the microcomputer. A DC level below +5 Volts at the regulator (IC103) output can cause the CPU to randomly execute instructions that might include an "erase sequence." Q101 turns off when this voltage drops below +5 Volts. R113 then pulls IC102 pin 18 "low" to reset the microcomputer.

9.2 FREQUENCY SYNTHESIZER

9.2.1 VCO/BUFFER AMPLIFIER

Q307, L301, varactor CR304 and associated components form the VCO (Voltage Controlled Oscillator), a resonant circuit that oscillates at approximately 160 MHz. Varying the voltage at the cathode of CR304 changes the varactor's capacitance, which in turn alters the VCO output frequency; for example, when the voltage at CR304 is increased (normally, the charge in C327-329 provides this voltage), CR304's capacitance decreases, which increases the VCO output frequency. +7 VDC is tied to the collector of Q307 through the power supply filter (Q312, R359, C357 and C358). C338 and C339 serve as a feedback network. C340 couples the oscillator signal to buffer amplifier Q308. C336, C337 and C346 function as RF bypass capacitors. The amplified signal at Q308's collector is decoupled by C347 and applied both to pre-scaler divider IC303 pin 1 (via R349, C349 and Q310) and to buffer amplifier Q309. The buffered VCO signal at Q309's collector then feeds through C373 and R354 as local oscillator injection into the source of Q502, the receiver 1st mixer.

9.2.2 PRE-SCALER DIVIDER

IC303 squares and divides the VCO output tied to pin 1 by either 64 or 65, depending upon the synthesizer controller (IC301) logic signal applied to pin 6 of the pre-scaler. A "high" at IC302 pin 6 instructs the pre-scaler to divide the VCO frequency by 64, a "low," 65. The exact number of times the pre-scaler is instructed to change divisors is determined by the channel frequency. The change instruction appears as a series of pulses at pin 6 of IC 303 (Note that not all frequencies cause pulses to appear at pin 6). +5VDC is supplied to IC303 at pin 2. C313 at pin 8 decouples internal divider circuitry. The pre-scaler output (can be observed on an oscilloscope as approximately 2.5 MHz) at pin 4 is coupled by C312 to IC301 pin 10.

9.2.3 SYNTHESIZER CONTROLLER

IC301 contains a digital phase detector that works as follows - when an operating channel is changed or the receive/transmit mode switched, either of which selects a new synthesizer operating frequency, microcomputer IC102 (pin 52) clocks new data into IC301's internal buffer (pin 13) in synchronization with clock pulses that appear at IC301 pin 12 (signals from the microprocessor are usually too fast to observe with an oscilloscope). Until all data is loaded into the buffer, the synthesizer continues to function at the previous operating frequency.

Once all new data is loaded into the buffer, a single pulse from IC102 appears at IC301 pin 14 that instructs the synthesizer controller to latch and execute the new data. IC301 utilizes internal circuitry to determine whether the present VCO output frequency is correct by comparing the phase and frequency of the pre-scaler output and the 16 MHz reference oscillator. IC301 produces a negative-going pulse output signal proportional to the phase difference between the two input signals. If the VCO output frequency is too high, IC301's output appears at pin 19, too low, at pin 20.

The charge pump (Q301, Q302, Q304, Q305 and associated components) and loop filter (C327-330, R327-329 and L307) then transform the negative-going pulse into a DC voltage for application to the VCO. The synthesizer system is "locked" when the phase and frequency of both the reference and the divided VCO signal are the same.

9.2.4 REFERENCE OSCILLATOR

The 16 MHz reference oscillator connected between IC301 pins 2 and 3 is built around crystal Y301, varactor CR301 and tuning capacitor C308. A temperature compensation circuit (R305-307, CR302 and variable thermistor R308) provides the synthesizer controller with a constant 16 MHz reference frequency.

9.2.5 OSCILLATOR MODULATION

When the unit is in transmit, gate IC203B passes modulation to the reference oscillator via C310, and to the VCO via R310. R310 routes modulation through C314 and R331 to the cathode of varactor CR305. Because CR305 is coupled to the VCO through C334, modulation causes the VCO frequency to vary. C310 applies modulation to the reference crystal to provide for the addition of any Quiet Call or Digital Quiet Call signals. If modulation were not applied to the reference, QC and DQC encode tones would be distorted as the synthesizer attempted to track them.

9.2.6 HIGH VOLTAGE SOURCE

Voltage-doubling techniques produce +16 Volts (minimum) to run the charge pump. IC301 generates a 16 MHz 0-4 Volt square wave at pin 18 to drive the high voltage circuit. The 16 MHz signal is applied to the junction of C121 and C123. During the "low" half-cycle of the square wave, this junction is essentially connected to ground; C121 charges through CR105 *(for Schematic 1730051B, through CR105A)* to +12 Volts. During its positive half-cycle the square wave rises to +4 Volts, which appears in series with the +12 Volts stored in C121 (for a total of +16 Volts). Voltage at the anode of CR106 turns on that diode *(for Schematic 1730051B, at the anode of CR105B)*, charging C124. After several cycles, the voltage across C124 reaches +16 Volts or more.

This same process occurs with C123, CR107 and CR108 *(for Schematic 1730051B, CR106A and CR106B)*. During the "low" half-cycle of the square wave C123 charges via CR105 *(for Schematic 1730051B, CR105A)* to +16 Volts. During its positive half-cycle the square wave rises to +5 Volts, which then appears in series with the +16 Volts stored in C121 (for a total of about +21 Volts). Diode voltage drops in the circuit cause the source's output to vary 2-3 Volts, depending upon instantaneous loading. The voltage output present on C125 supplies the charge pump via R317.

9.2.7 CHARGE PUMP/LOOP FILTER

The charge pump, constructed of Q301, Q302, Q304, Q305 and surrounding components, processes the phase detector (IC301) pulses to yield a signal that the loop filter can smooth into a DC voltage. R322 applies the pulses at Q301's collector to Q304. Q304 turns on, applying a voltage "burst" to the loop filter (C327-329, R327-329 and L307) and charging C327-329 one pulse at at time towards +15 Volts. The loop filter provides the DC level at CR304 that governs the VCO frequency.

C316 "sharpens" the negative pulses from IC301 pin 19, and with R313, routes the signal to Q302's base. Q302 turns on and drives Q305. Q305 discharges C327-329 one pulse at a time, the resulting DC voltage applied to CR304.

9.2.8 BANDSWITCH

Because the RPM-150 utilizes a single oscillator for both transmit and receive modes, the oscillator's frequency range must shift approximately 10.7 MHz when the unit is switched between transmit and receive. When the radio is in receive mode, a bandswitch circuit (Q306, R333-335, C335 and CR306) places C332 in parallel with the VCO tank circuit, increasing the tank's capacitance and so shifting the VCO tuning range about 10.7 MHz.

CR306 is forward biased while the RPM-150 is in receive mode, and reverse biased in transmit mode. When receiver B+ is applied to R333 and R334, CR306 switches on and current flows through Q306 to ground. CR306 acts like a short circuit, incorporating C332 into the oscillator circuit. When the RPM-150 is "keyed," the receiver B+ line drops to 0 VDC and CR306 shuts off, turning off Q307. C332 is removed from the oscillator circuit, increasing the VCO output frequency approximately 10.7 MHz.

9.2.9 SOURCE-FOLLOWER BUFFER

The source lead of FET Q303 applies a DC voltage, which "tracks" the VCO (source lead voltage = VCO voltage + approximately 1 Volt), to varactors in the receiver RF amplifier circuit. Q303 isolates the VCO from the receiver amplifier.

9.3 RECEIVER

9.3.1 RF AMPLIFIER

A received signal from the antenna first passes through a low-pass filter (C423-427, L409-411). L405 and C424 then apply the RF signal to a 2-pole track-tuned tank circuit whose center frequency depends upon the VCO tuning voltage applied (via Q303) to varactors CR501-504. C507 matches the output to the emitter of Q501, a low-noise, high-frequency RF amplifier. R503 and R504 set the base bias for Q501, while L504 applies collector voltage to the stage. C511 supplies an RF bypass for L504; R505 restricts the current through Q501. C510 couples the amplified RF signal into a second 2-pole track-tuned tank circuit, whose bandpass shape further sharpens front-end response. C517 applies the output signal to the gate of common-source JFET Q502, the 1st mixer.

9.3.2 1ST MIXER

The RF input signal drives the gate of mixer Q502, while the VCO signal at Q309's collector drives the source. A resonant tank circuit (T501) emphasizes the 10.7 MHz difference frequency component of the mixer output, which C520 couples to a 10.7 MHz four-pole crystal filter (YF501, C521 and YF502). R509 applies the filter output to the base of Q503, a grounded-emitter buffer amplifier that provides stable gain. R511, C522 and C524 then match the signal to IC501 pin 16.

9.3.3 FM RECEIVER SUBSYSTEM

A multi-function integrated circuit, IC501 and associated components, forms the FM-receiver subsystem. This subsystem performs the functions of: 1) 2nd local oscillator (10.245 MHz), 2) 2nd mixer, 3) 2nd IF amplifier, 4) FM detector and 5) noise amplifier.

IC501 pins 1 and 2, 10.245 MHz crystal Y501, and feedback capacitors C525 and C526 comprise the 2nd local oscillator - which provides low-side injection (10.245 MHz). The 10.7 MHz signal at IC501 pin 16 and the 2nd local oscillator output are mixed, with the resulting 455 KHz mixer output appearing at IC501 pin 3. A 455 KHz, 4-pole ceramic filter, YF503, connects the balanced-mixer output to the input of the limiting IF amplifier at IC501 pin 5. IC501 pin 6 is the decoupled input to the IF amplifier, IC501 pin 7 the limited IF output signal. An internal quadrature detector, whose center frequency is determined by T501, detects the FM IF signal. One input of the quadrature detector connects internally to the IF signal at IC501 pin 7, while the other detector input is the phase-shifted signal from quadrature coil T502 at IC501 pin 8. Demodulated audio appears at pin 9, where a low-pass filter (R518 and C533) removes spurious quadrature output. Audio then simultaneously enters both the voice/tone conditioning circuit and a noise filter/amplifier (R521, R523, R520, R519, C534, C535, R522 and the amplifier internal to IC501 at pins 10 and 11) whose bandpass is centered at 8 KHz. *(Note that for Schematic 1730051B, R519 is not present.)*

9.3.4 CARRIER SQUELCH

The noise amplifier output at IC501 pin 11 is rectified and filtered to produce a DC voltage called the RSSI (Received Signal Strength Indication) that is inversely proportional to receive signal strength. CR507 and CR508 *(for Schematic 1730051B, CR507A and CR507B)* form a voltage-doubling detector. C538 integrates the detected signal, while R525 and C539 filter it. R519 and thermistor R520 comprise a temperature compensation network. *(R519 and thermistor R520 are not present for Schematic 1730051B.)* R526, CR509 and CR510 *(for Schematic 1730051B, R526, CR508A and CR508B)* form a threshold bias circuit that keeps CR507 and CR508 *(for Schematic 1730051B, CR507A and CR507B)* slightly biased on, maintaining a constant noise output independent of ambient temperature. The RSSI is applied to IC102 pin 9 for carrier detect. The microcontroller enables carrier detect by comparing the RSSI with a "squelch set" voltage (adjusted with R136) at pin 12.

9.3.5 VOICE/TONE CONDITIONING IN RECEIVE MODE

After R518 and C533 remove 455 KHz elements at the demodulated audio output (IC501 pin 9), C222 couples the signal to a low-pass filter (C236, R245), and to IC201A. The received signal then follows two separate paths: one for sub-audible (QC and DQC) tone detection, the other for voice band (which includes PQC tones) audio conditioning.

9.3.5.1 VOICE BAND

When the transmitter shuts off, IC102 pin 35 goes "low," opening the bilateral gate switch from IC201C pin 3 to ground. *(For Schematic 1730051B, this gate is IC201B.)* Pin 3, which is tied through R235 to +5 Volts, then pulls "high" and toggles gate IC201A, allowing received audio to reach high-pass filter/amplifier circuit, IC202B, IC202C and associated components. The amplified signal, with frequencies below about 250 Hz (sub-audible tones) attenuated, exits IC202C pin 7 *(for Schematic 1730051B, IC202B pin 7)* and travels to: A) IC203C, a bilateral gate and; B) the input of a limiter (IC202A and associated components) via C213 and R229. Audio passes through gate IC203C when squelch is enabled and a "high" at IC102 pin 45 toggles the gate. R213 and C212 provide de-emphasis, and with C211 and potentiometer R601, direct the signal to audio amplifier IC601 and associated circuitry. R229 lowers signal gain and removes pre-emphasis before applying audio to limiter IC202A. The "squared" output then feeds to IC102 pin 22 for PQC (Paging Quiet Call) decode.

9.3.5.2 SUB-AUDIBLE

Audio also passes through IC201B *(for Schematic 1730051B, IC201C)*, which is turned on unless the radio transmitter is keyed, and enters pin 8 of IC204A, a 6-pole low-pass filter that attenuates frequencies above approximately 250 Hz. The output at pin 3 is further conditioned by IC204C, a limiter that squares the signal to drive the QC (Quiet Call) detector resistor/capacitor bridge at IC102 pins 36-39. The microcomputer compares the QC detector bridge outputs at pins 13 and 14 to decode the correct sub-audible (QC) tone. Pin 13 also serves as the DQC (Digital Quiet Call) input.

9.3.6 AUDIO AMPLIFIER

R601, the volume level control, attenuates voice band audio passed through "squelch gate" IC203C to audio amplifier IC601. C601 DC isolates the audio amplifier input, while C602 provides RF bypassing. C606 couples the output at pin 4 to the front panel jack "RX Audio" line through R602, and to the speaker (SP601) via J601. With a load impedance of 4 Ω, the maximum output at pin 4 is about 5 Watts.

9.4 ANTENNA SWITCHING/LOW-PASS FILTER

A low-pass filter comprised of C423-427 and L409-411 removes harmonics from the transmitter output before applying the RF signal to the antenna port. Received signals pass through the low-pass filter before entering the receiver RF input circuitry.

Two high speed PIN diodes (CR401, CR402) and associated components form the antenna switching circuit, which isolates the transmitter output from the antenna when the RPM-150 is in "receive" mode; no voltage is applied to PIN diodes CR401 and CR402 - they do NOT conduct. This reverse biases CR401 to prevent the transmitter amplifier from affecting receiver tuning and removes CR402 from the receiver input. Incoming signals from the antenna pass through the low-pass filter, then L408 and C424 to the receiver RF amplifier.

When the unit is switched into "transmit," Q314 applies +V TX to R404. Current (about 30 mA) flows through R404, L407, CR401, L408 and then CR402 to ground, forward biasing the diodes. CR401 passes transmitter RF power to the antenna port. CR402 shunts the receiver RF input to ground. Now L408 provides sufficient impedance to isolate transmitter power from the receiver RF amplifier, Q501.

9.5 TRANSMITTER KEYING

Q313 and Q314 form a voltage regulator that supplies power amplifier transistor Q401 and the antenna switching circuit. When the user presses the PTT (Push-to-Talk) button, microcontroller IC102 pulls the transmit enable line at pin 35 "high." This "high" is routed to Q313, forward biasing the base-emitter junction and causing current to flow from the +V SW line to ground through R365, Q313 and R366. The resulting voltage (about +6.5 Volts) at Q313's collector switches on Q314, which in turn applies +V TX to to Q401 via R403, Z404 and L402. When the user releases the PTT button, the microcontroller holds the transmitter "high" about 180 ms while sending any tone-related turn-off codes. Then the microcomputer switches pin 35 "low," which turns off the regulator, releases the transmitter and switches off Q315. Q315's collector is no longer pulled to ground, allowing +5 VDC via R361 to forward bias Q316's base-emitter junction. Q317 then turns on and connects +V RX to the receiver circuitry.

9.6 TRANSMITTER POWER AMPLIFIER

Q311 and associated components further amplify the VCO signal at Q309's collector before feeding it via C356 to the 30 Watt, wide-band RF power amplifier. C402 matches the signal to the base of Q401. The output at Q401's collector, which measures about +23 dBm (200 mW), is then coupled into the base of Q402, a 4 Watt power amplifier. The 4 Watt signal is then amplified once again by Q403. The resulting 30 Watt signal is then matched to 50 Ω for application to the switching circuit.

9.7 POWER CONTROL CIRCUIT

"Reduced power channels" may be programmed as described in the PROGRAMMING SPECIAL FEATURES section of this manual. All low power channels have the same power output, which is adjustable for between 0.5 and 30 Watts.

The power control circuit works as follows: current through final transistor Q403 is measured as a voltage across R378. This current is proportional to power output. With the channel programmed for low power, IC102 pin 24 is "low," which turns off Q318 and "removes" the transistor from the circuit. In transmit, Q314 applies +V TX to Q321, which then switches on. This draws current through differential pair Q319 and Q320. Variable resistor R371 adjusts power output. Increasing the power draws more current through R378, lowering voltage at the base of Q320. Q320 then begins to turn off, decreasing current through the base of Q322. As a result, Q322 supplies less current to driver transistor Q402, which reduces RF power to Q403. Power output goes down. The power control circuit works similarly to prevent power from falling below the reduced power setting.

9.8 SPEECH AMPLIFIER

9.8.1 GENERAL

RPM-150 speech amplifier filter circuits are shared with the receiver. The same high-pass filter/amplifier (IC202B, C and associated components) used for "receive" voice band conditioning is used for the "transmit" voice band. Similarly, the low-pass filter (IC204A) used for sub-audible tone decode filtering is also used for sub-audible tone encode. Altering circuit configuration with bilateral gates IC201A, B, C, D and IC203B and C permits utilizing the same audio filtering system for both receive and transmit modes.

9.8.2 VOICE/TONE CONDITIONING IN TRANSMIT MODE

When the user presses the PTT button, IC102 pin 35 goes "high," turning on the transmitter via Q312 and closing bilateral switches IC201C *(for Schematic 1730051B, this gate is IC201B)*, IC201D, IC203B and IC203D. C202 couples microphone audio to pin 9 of IC201D, which passes the signal into filter/amplifier circuitry (via C203-5) that attenuates frequencies below approximately 250 Hz and above 3 KHz.

9.8.2.1 VOICE BAND

Q202 amplifies the audio signal and applies it to a high-pass filter/amplifier (IC202B, IC202C and associated components), which attenuates frequencies below about 250 Hz and further amplifies the signal (about four times). Audio exits IC202C pin 7 *(for Schematic 1730051B, IC202B pin 7)* and passes through bilateral transmission gate IC203D, which is switched on by the TX Enable line. C213 and R216 provide pre-emphasis and apply the audio, which is then summed with any tones generated by microcontroller IC102 at pin 46, to limiting amplifier IC202A. Amplified another 100 times, symmetrically clipped audio (3.5 Vp-p) appears at IC202A pin 1, where it is then fed into a 3-pole, 3 KHz low-pass filter composed of Q201 and associated components. This filter's output signal takes a path through voice deviation potentiometer R224, C220 and R225 to the input of summing amplifier/low-pass filter IC204B. Here, voice modulation is combined with encode sub-audible tone (if QC or DQC is programmed). The conditioned, composite modulation at IC204B's output is then routed through gate IC203B (which is toggled on via the logic "high" at IC102 pin 35) to the VCO.

9.8.2.2 SUB-AUDIBLE

Microcontroller IC102 switches off bilateral gate IC201B *(for Schematic 1730051B, IC201C)* when the unit is in transmit, disconnecting received audio from the low-pass filter, and generates sub-audible/digital encode tones (at pin 33) for application to pin 8 of 250 Hz low-pass filter IC204A. IC201B switches off when the microcomputer applies a "high" to IC201C pin 5 *(for Schematic 1730051B, IC201B pin 5)*, which shorts IC201C pin 3 *(for Schematic 1730051B, IC201B pin 3)* to ground and pulls IC201B pin 12 *(for Schematic 1730051B, IC201C pin 12)* "low."

SUB-AUDIBLE (CON'T.)

The microcontroller sets the low-pass filter's corner frequency to approximately 250 Hz (IC102 pin 43 "floats" in tri-state mode), or to about 150 Hz (pin 43 pulls to ground) by switching C226 into the circuit. The 150 Hz corner frequency operates when a QC tone below 125 Hz or a DQC tone is encoded. Tone deviation potentiometer R228 and R231 tie the filter output at IC204A pin 3 to the incoming voice signal (from R225) at the summing amplifier (IC204B) input. Gate IC203B then passes the output signal at IC204B pin 4 to modulation balance potentiometer R310. C314 couples modulation to the VCO.

Bilateral gates IC203A and IC203B form a compound series-shunt switch. During receive, IC203B is open and IC203A is closed to clamp the synthesizer modulation input voltage to the +Vag reference, preventing frequency modulation of the synthesizer. During transmit, IC203B is closed and IC203A is open to allow speech to modulate the synthesizer.

9.9 SHIFT REGISTER (LED DISPLAY)

IC101 is a serial-in parallel-out shift register that functions as a 7-segment (plus the monitor indicator) display buffer. When the microcomputer detects conditions that require a display change, it clocks a new 8-bit data word into IC101 - data pulses are applied to pin 1 (via IC102 pin 52) in synchronization with clock pulses applied to pin 8 (via IC102 pin 51). Data entering IC102 is quickly clocked into the register and latched. The parallel output appears at IC101 pins 3-6 and 10-13 to drive the 7-segment numeric LED display.

9.10 MICROCONTROLLER (IC102) PIN DESCRIPTIONS

Pins not listed below are not used.

PIN	DESCRIPTION
3	CHANNEL SELECT (A/D). The microcontroller A/D converter reads the input at pin 3 to determine the operating channel. RPM mobile radios require a 10KΩ pull-up resistor and a momentary switch closure to ground to increment channels 0 through 9.
4	PROGRAM SWITCH/RESISTOR (A/D).
5	SYNTHESIZER LOCK DETECT (A/D). The frequency synthesizer is considered locked if IC102 pin 5 is greater than +3.3 VDC (as derived from the synthesizer's lock detect output), and unlocked if less than that value. The microcontoller program checks the lock detect line 180 ms after the synthesizer is programmed, and if the synthesizer is out of lock, sends an error tone. If the synthesizer remains out of lock, the tones continue; if the synthesizer locks, the tones cease and normal operation resumes.
7	GND (A/D).
8	+5 VDC REFERENCE (A/D).
9	RSSI - RECEIVED SIGNAL STRENGTH INDICATION (A/D). The RSSI, a DC voltage derived from rectified demodulated noise, is applied to the microcomputer at pin 9 for carrier detect. The RSSI level should increase with increasing noise on the channel.
10	+V Supply (A/D), +5 VDC.
12	SQUELCH SET (A/D). The microcomputer divides the voltage input here by two and compares it to the voltage applied to the RSSI input. When the RSSI voltage is less than this value, carrier detect is enabled. After detecting a carrier, the the RSSI input must rise to this value plus a threshold voltage to disable carrier detect. The default voltage hysteresis constant is +0.8 VDC, but may be changed by serial programming.

PIN	DESCRIPTION
13-14	QC DETECT INPUT (A/D). Microcomputer software utilizes two A/D inputs, pins 13 and 14, as a differential comparator to measure the output of the QC DETECT bridge.
15	6 K EE PROM PROGRAMMING VOLTAGE +5 VDC (I). Used only in "special software units."
16	4 MHZ OSCILLATOR INPUT (I). Connected to the reference oscillator crystal network.
17	4 MHZ OSCILLATOR OUTPUT (O). Connected to the reference oscillator crystal network.
18	RESET\ (IN). When pin 18 is pulled "low," microcomputer operations stop. A low-voltage reset circuit pulls pin 18 "low" when +V SW is less than 9.5 Volts. This ensures that the microcontroller does not erase internal EE memory due to improper program execution with an "out of spec" supply voltage.
19	INT\(IN). Factory use only.
22	PQC DECODE (I). This input receives Paging Quiet Call signals for decoding (via IC202A).
24	HIGH/LOW POWER OUT (O). This output selects transmitter power. (The previous version of the RPM-450 PC board does not include this circuit - Schematic 17731002/PCB 17031002).
25	SPECIAL MODE OUT (O). This output may be programmed to either a high or low state on a per channel basis for controlling accessories.
26	EXTERNAL SELECTIVE SIGNALING INPUT (I). An external device, such as a Touch Tone decoder, may be used to apply an open collector pull-to-ground (upon decode) to pin 26. The mobile then responds as if it received a valid PQC code, and registers a "C" on the channel display.
28	TX/BUSY INDICATOR (I/O). When the mobile switches into transmit mode, pin 28 is driven "high" to light the TX/BUSY LED. In receive mode, pin 28 pulses at a one second rate to indicate the channel is busy.
29	HANG UP SWITCH (I/O). Pin 29 connects to the microphone hang-up button and a 100 KΩ pull-up resistor tied to +5 VDC. When the hang-up button is removed from ground (e.g. the microphone is lifted from its cradle) pin 29 goes "high," enabling the user to monitor all on-channel transmissions (regardless of any tone signaling in use).
30	SELECTIVE SIGNALING DECODE OUT (O). When the microcontroller receives an external signaling input at pin 26 or decodes the unit's programmed PQC code, pin 30 goes "high" to drive an external device.
31	DISPLAY SHIFT REGISTER ENABLE (I/O). Pin 31 is a "clock clamp." When data from the microcomputer is intended for synthesizer controller IC301 and not shift register IC101, this line is clamped to ground, preventing clock pulses from reaching IC101 pin 8. When data is intended for shift register IC101, pin 31 is tri-stated, which allows clock pulses from IC102 pin 51 to pass. NOTE: Both synthesizer and shift register clock pulses occur rapidly and are difficult to display on a non-storage type oscilloscope.
32	SPEAKER "BEEP" OUTPUT (I/O). Alerting tones exit this pin for application to the audio amplifier.
33	QC ENCODE (I/O). Pin 33 applies either Quiet Call or Digital Quiet Call tones to the low-pass filter (IC204A). The QC encode line is tri-stated when the unit is not encoding one of these formats.

PIN	DESCRIPTION
35	TRANSMIT ENABLE (I/O). Pin 35 pulls "high" to disable the receiver, toggle bilateral transmission gates, switch the VCO operating range, activate the transmitter and, switch-in a pre-emphasis/ gain network connected to the 300 Hz high-pass filter output.
36-39	QC DETECT (I/O). The four lines at pins 36-39 drive a resistor/capacitor bridge used in Quiet-Call decoding.
40	USER EE PROM PROGRAMMING VOLTAGE (I). Pin 40 can aid in troubleshooting; during an EE write cycle this pin toggles "high."
41	SUPPLY RETURN (I), GND.
42	SYNTHESIZER SHIFT REGISTER LATCH (O). Following an operating frequency change (which includes a receive/transmit mode transition), pin 42 sends a single positive pulse to the synthesizer IC, latching the new serial data into IC301.
43	LP FILTER SLEW CONTROL (I/O). The filter slew control decreases the low-pass corner frequency to improve decode and encode waveform purity. Pin 43 appears tri-stated while the mobile decodes or encodes Quiet Call tones above 141.3 Hz, and as an "active low" for QC tones below 141.3 Hz and Digital Quiet Call.
45	RX AUDIO ENABLE (I/O). A "low" at pin 45 opens switch IC203C, preventing receive signals from reaching the audio amplifier. For example: if the microcontroller must generate a "beep," it first pulls pin 45 "low" to open switch IC203C and mute received audio ("beeping" tones follow another route to the audio amplifier). When the monitor button is pressed for two seconds, the microcomputer pulls pin 45 "high" to close IC203C and pass audio.
46	PQC ENCODE (I/O). Pin 46 is tri-stated unless the microcomputer is generating the Paging Quiet Call All-Call tone (483.5 Hz). Turning on the unit while holding the PTT button sends the All-Call page.
47	DQC DECODE INPUT (I/O). The limited sub-audible data is applied here for DQC decode.
48	MONITOR (I/O). A "low" on the monitor line, which is tied to a contact closure to ground (SW102) and to +5 VDC via a pull-up resistor, defeats the tone squelch requirement that only a programmed tone can unsquelch audio. A momentary closure toggles between monitor and tone squelch modes. Pressing and holding the monitor button for more than about two seconds defeats carrier squelch and directs receiver noise to the audio amplifier.
49	PTT SWITCH (I/O). Switching pin 49 "low" instructs the software to pull the transmit enable line "high."
50	SERIAL DATA IN (I). Pin 50 links the microcontroller to communications from an external data terminal, or to a personal computer running a communications program. Pin 50 serves as the DATA IN line for cloning operations.
51	SERIAL DATA CLOCK (O). The line at pin 51 toggles in the center of each bit period sent via the serial data out line, and clocks data to the display and synthesizer shift registers.
52	SERIAL DATA OUT (O). Pin 52 supplies serial data out for: 1) Synthesizer IC301 (125 Kbits/sec, binary, w/clock) 2) Display shift register IC101 (125 Kbits/sec, binary, w/clock) 3) External Communications (1200 bits/sec, ASCII, asynchronous) 4) Cloning operations

10. RPM-150 ALIGNMENT PROCEDURE

10.1 RECOMMENDED TEST EQUIPMENT

1) 0 to 15 VDC, 10 Amp current-limited power supply
2) FM service monitor (to 174 MHz)
3) Oscilloscope (to 20 MHz)
4) FM deviation meter
5) RF Wattmeter, 50 Watts full scale
6) Frequency counter (to 174 MHz)
7) VTVM or DMM
8) Square wave reference generator
9) SINAD measuring device.
10) Service programming key (red plug)

10.2 RADIO PREPARATION

1) Carefully pull the volume knob off of the front panel.
2) Remove the three #6 screws from the bottom of the case.
3) Remove the front and back panels.
4) Remove the nut that holds the on/off volume control to the case.
5) Slide the radio PC board and front panel out of the radio case through the back.
6) Connect the power supply (@ approx. +13.0 VDC) to the 2-pin power connector on the back of the unit.
7) Connect an RF signal generator to the antenna connector on the back of the unit.
8) For operation in the band from 150 to 165 MHz, program the channels below as indicated.

CHANNEL	RX/TX FREQUENCY	QUIET CALL TONE OR SPCL. FEATURE	QUIET CALL CODE OR SPCL. FEATURE
1	150.330 MHz	none	none
2	157.320 MHz	none	none
3	165.330 MHz	none	none
4	157.320 MHz	97.4 Hz	11
5	157.320 MHz	203.5 Hz	32
6	157.320 MHz	071 (DQC)	071
7	157.320 MHz	349 Hz/832.5 Hz (PQC)	44144
8	157.320 MHz	Low Power	91122

If another user's carrier signal causes interference, an alternate frequency within 1 MHz may be used.

NOTE: To program for a different 15 MHz band, substitute frequencies at the low, mid and high ends of the band for the frequencies given above.

RADIO PREPARATION (CON'T.)

9) Turn off the RPM-150. Remove the programming key or place it in the storage position of the programming socket. Switch on the radio to place it in operating mode.

10.3 SYNTHESIZER

The synthesizer control voltage should not need re-adjustment unless you change the 15 MHz operating band or replace a key component in the synthesizer. Key components do not include the synthesizer reference crystal or the synthesizer IC. Synthesizer alignment errors cause poor operation at temperature extremes.

10) Select channel 1.

11) Connect a high impedance voltmeter or oscilloscope to Z501.

12) The voltage at this point should measure +5.0 VDC (+/- 0.2 Volts).

IF SO:

Select channel 2 and measure the same point. The voltage should then read approx. +8 Volts (+/- 0.8 VDC). Next, select channel 3 and check the voltage, which should measure approx. +12 Volts. If these readings are correct, skip steps 13 and 14. If not, continue with step 13.

IF NOT:

Proceed with steps 13 and 14.

13) Turn off the mobile and carefully turn the holddown tabs on the synthesizer box until the lid can be removed. Remove the lid. Switch the unit back on and select channel 1.

14) Note the exact position of VCO coil L301. Adjust L301 until the voltage at Z501 is +5.0 Volts. A small adjustment (a quarter turn) should produce a large change in voltage.

IF THE VOLTAGE ADJUSTS FOR +5.0 VOLTS:

Select channel 2 and measure the same point. The voltage should then read about +8 Volts (+/- 0.8 VDC). Next, select channel 3 and check the voltage, which should measure approx. +12 Volts. If your adjustments produce the correct voltages, replace the synthesizer shield lid and proceed with the next step. Do not secure the holddown tabs, since the lid will be removed in subsequent steps.

IF THE VOLTAGE DOES NOT ADJUST:

Rotate L301 back to its original position before troubleshooting.

10.4 REFERENCE FREQUENCY

15) Select channel 1.

16) Set the service monitor receiver to 139.630 MHz (receiver L.O. frequency = receive frequency - 10.7 MHz). The monitor should be able to receive the L.O. signal with a short antenna.

17) Align C308 to center the frequency. (C308 may be adjusted through a hole in the synthesizer lid.)

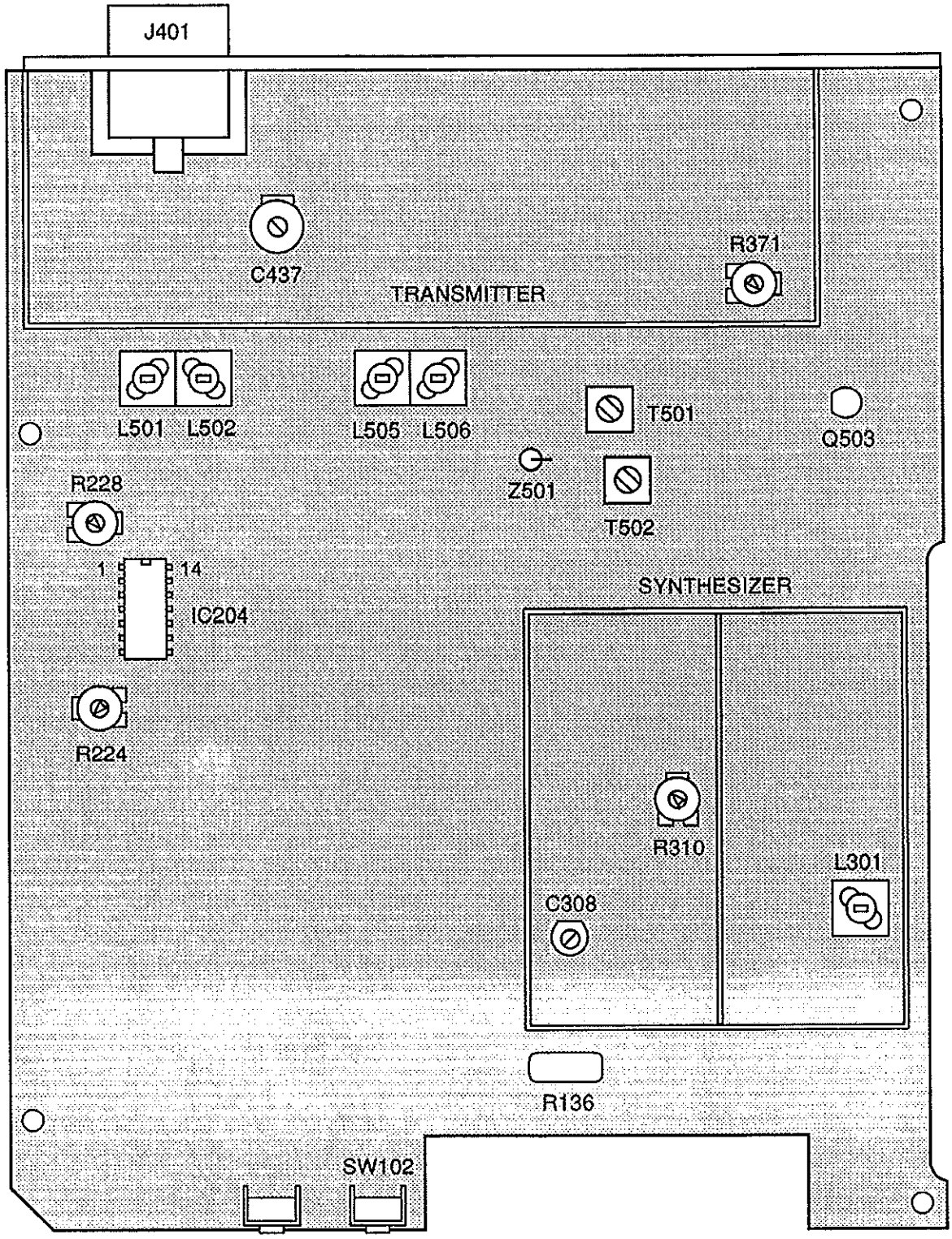
RPM-150

PCB #17031003

TOPSIDE VIEW

L301 = VCO Voltage
C308 = Reference Frequency/ RX L.O. Frequency
R224 = Voice Modulation
R228 = Sub-audible/Digital Modulation

R310 = Modulation Balance Control
C437 = TX Output Power
R371 = TX Reduced Power
L501, L502, L505, L506 = RX Sensitivity
R136 = Squelch Adjust
T501 = 10.7 MHz Bandpass Adjust
T502 = 1 KHz Signal Amplitude Adjust

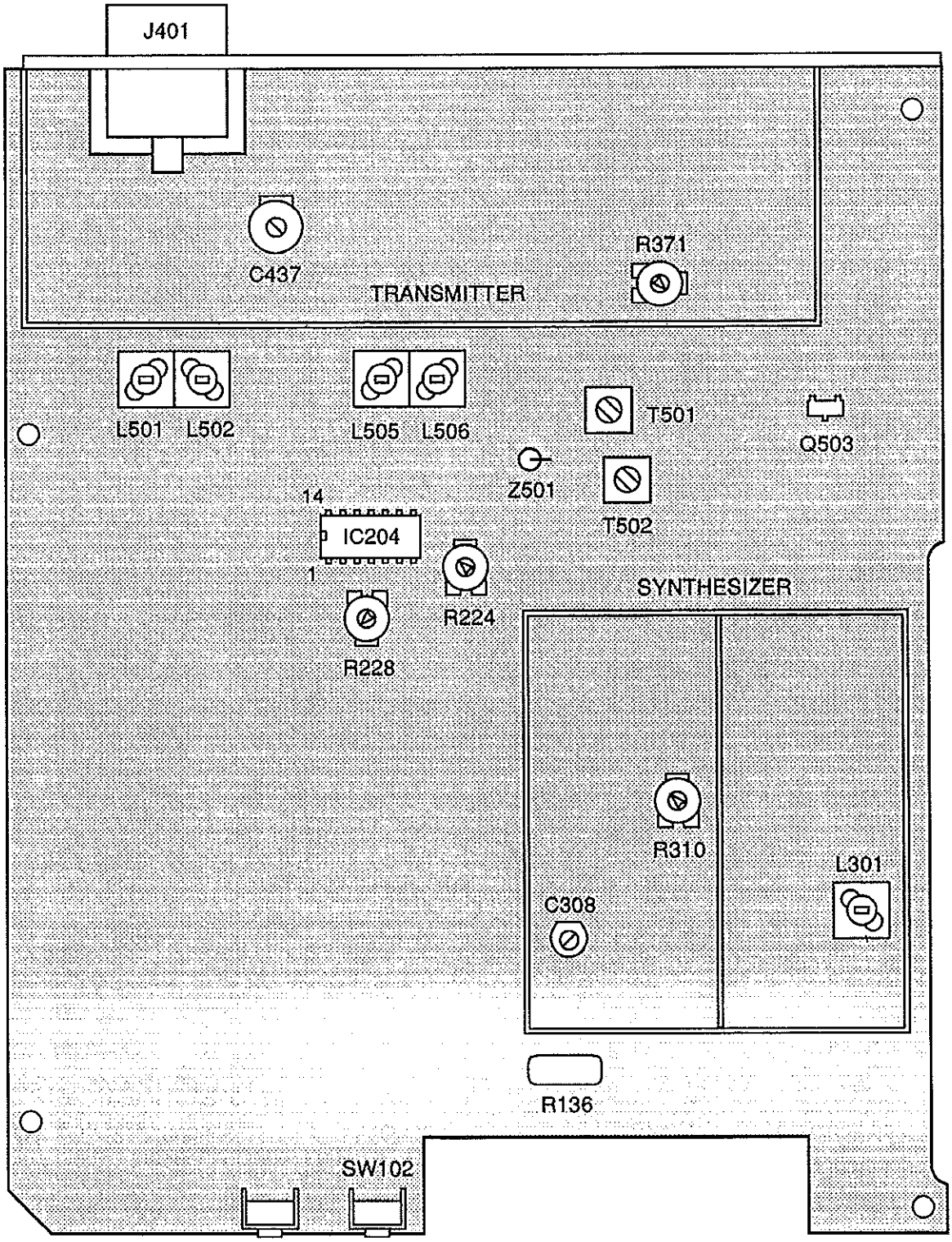


RPM-150

PCB #1730050A

TOPSIDE VIEW

L301 = VCO Voltage
C308 = Reference Frequency/ RX L.O. Frequency
R224 = Voice Modulation
R228 = Sub-audible/Digital Modulation
R310 = Modulation Balance Control
C437 = TX Output Power
R371 = TX Reduced Power
L501, L502, L505, L506 = RX Sensitivity
R136 = Squelch Adjust
T501 = 10.7 MHz Bandpass Adjust
T502 = 1 KHz Signal Amplitude Adjust



10.6 MODULATION BALANCE CONTROL

Normally, the balance control should not require re-alignment. The purpose of the balance adjustment is to prevent sub-audible (Quiet Call) and DQC (Digital Quiet Call) encode signals from being distorted.

18) Rotate both R224 (voice modulation) and R228 (sub-audible/digital modulation) fully counter-clockwise.

19) Switch off the radio and remove the synthesizer shield lid. Turn on the mobile.

20) Set R310 about midway.

21) Connect a 10 KΩ resistor in series with a 22 µF electrolytic capacitor between IC204B pin 13 and a square wave reference generator.

22) Set the square wave generator to 30 Hz, 0.2 Vp-p.

23) Connect an appropriate 50 Ω load to the mobile's antenna port (J401).

24) Set the service monitor receiver to 157.320 MHz.

25) Switch the mobile to channel 2. Press and hold the microphone PTT to transmit. The mobile's TX/ Busy LED should light when the transmitter is activated.

26) Observe the received waveform on the service monitor. Adjust modulation balance control R310 (inside the synthesizer shield) for the "best" square wave.

    NOTE: Many service monitors and oscilloscopes do not have sufficient low-frequency response to reproduce a 30 Hz square wave accurately, and instead display a waveform that has a "ramped" appearance. If your equipment exhibits this limitation, adjust R310 for minimum "overshoot" on the leading edge of the square wave. This will give the correct setting.

27) Replace the synthesizer shield lid, secure the holddown tabs and proceed with the transmitter alignment.

10.7 TRANSMITTER

28) Connect a Wattmeter to the antenna port (J401).

29) Press and hold the microphone PTT to key the transmitter. The TX/Busy LED should light.

30) Switch off power to the mobile and remove the screws that hold the transmitter shield lid to the heat sink. Lift away the lid. Restore power to the radio.

31) Using a non-metallic alignment tool (Sprauge-Goodman #GTT-5 or similar), adjust C437 for maximum output power.

32) Unkey the transmitter.

33) Select channel 4 (remember that channel 4 is programmed with a 97 Hz tone).

34) With the transmitter keyed, apply a loud continuous voice to the microphone while adjusting R224 for +/- 4.6 KHz deviation, as indicated on the deviation meter.

35) With the transmitter keyed and no sound applied to the microphone, adjust R228 for 600 Hz deviation.

TRANSMITTER (CON'T.)

36) Unkey the transmitter.

NOTE: To set power for all "reduced power" channels with one adjustment, select any channel programmed for low power (CH 8). With the transmitter keyed, adjust R371 until the Wattmeter reads the desired value. The output level for "high power" channels will remain unchanged.

37) Switch off the radio and install the transmitter shield lid. Switch on the unit again.

10.8 RECEIVER

NOTE: THE RECEIVER CANNOT BE ALIGNED UNTIL THE SYNTHESIZER CONTROL VOLTAGE (STEPS 10-14) IS CORRECT.

38) Connect a SINAD measuring device to the speaker terminals on the front panel.

39) Select channel 2.

40) Set the service monitor receiver for 146.620 MHz to check the receiver L.O. frequency (receiver L.O. frequency = receive frequency - 10.7 MHz). Adjust C308 (through a hole in the synthesizer lid) for the correct frequency.

41) Adjust L501, L502, L505 and L506 to position the aluminum core of each coil at the top.

42) Set the service monitor RF signal generator to 157.320 MHz.

43) Set the generator to modulate the signal with 1KHz @ 3KHz deviation. Set the generator output to 1000 μV.

44) Adjust R136 fully counter-clockwise to "open" squelch.

45) At this point, a 1 KHz tone should be heard in the speaker.

46) Decrease the generator output and adjust L501, L502, L505 and L506 for best SINAD.

47) Set the generator output to 2000 μV.

48) Frequency modulate the generator with a 15 Hz signal, and set the deviation to +/-15 KHz.

49) Connect the 15 Hz signal directly to the HORIZONTAL input of an oscilloscope, and set the horizontal sweep to EXTERNAL.

50) Connect the VERTICAL input of the oscilloscope to Test Point 43 (collector of Q503).

51) Adjust T501 for a 10.7 MHz bandpass waveform.

52) Set the signal generator for a frequency modulated 1KHz sine wave at +/-7.5 KHz deviation. Set the output for 2000 μV.

53) Connect the oscilloscope to the radio speaker on the front panel.

54) Adjust T502 for a maximum amplitude of the 1 KHz sine wave.

55) Decrease the deviation of the modulated 1 KHz signal to +/-3 KHz.

RECEIVER (CON'T.)

56) Decrease the signal generator output and adjust L501, L502, L505 and L506 for best 12dB SINAD. The 12 dB SINAD should be 0.30 µV worst case.

57) Press and release the monitor button (SW102).

58) Set the generator output for a reading of 12 dB SINAD.

59) Turn R136 clockwise until no signal is heard in the speaker.

60) Slowly rotate R136 counter-clockwise until a signal is heard in the speaker.

61) Check for 12 dB Sinad sensitivity at the low (150.330 MHz - channel 1) and high (165.330 MHz - channel 3) ends of the frequency range. The sensitivity should be at least 0.30 µV for each channel.

CAUTION: RITRON surface mount products require special servicing techniques. Improper servicing techniques can cause permanent damage to the printed circuit board and/or components, which is not covered by RITRON's warranty.

11. RPM-150 VOLTAGE CHARTS

MEASUREMENT CONDITIONS: Supply @ 13.0 VDC, unit in operating mode, volume control @ minimum, microphone connected, readings taken with channel 8 programmed and selected.

KEY: ALL MEASUREMENTS ARE IN VOLTS DC, UNLESS AS INDICATED BELOW.

GND = GROUND	SQ = SQUAREWAVE
SINE = SINEWAVE	TRI = TRI-STATED WAVEFORM
SAW = "SAWTOOTH" WAVEFORM	MOD = MODULUS CONTROL WAVEFORM
--- = NOT RELEVANT	NC = NOT CONNECTED

[ ] = SPECIAL NOTE (SEE THE EXPLANATION BELOW)

A measurement shown as two values separated by a "/" indicates a reading for each of two conditions. All measurements are for both versions of the UHF PC board, unless noted otherwise.

SPECIAL NOTES [ ] EXPLANATION:

[1] The measured value depends upon signal strength. This reading was taken with no signal applied.

[2] This reading was taken with a 100 µV signal and 123 Hz sub-audible tone @ 500 Hz applied.

[3] Paging Quiet Call input- with no signal present, random square waves appear. With a 10 µV signal and 1 KHz modulaton applied, this pin shows a 3.5 Vp-p clipped square wave.

[4] This pin measures "high" in full power transmit, "low" in reduced power transmit.

[5] External signaling input - normally measures a logic "high." When an external device pulls this pin "low," the microcontroller generates a "ring" tone in the speaker and latches a "C" on the display.

[6] "Switch" output used to excite the CTCSS decode circuit. To see the output, connect the pin to +5 VDC through a 10 KΩ resistor. No signal is applied to the receiver. A square wave at the CTCSS frequency should appear.

[7] Measurements at this pin depend upon the CTCSS tone programmed. The pin reads "low" for CTCSS tones below 141.3 Hz. For tones at 141.3 Hz and above, this line is open and the clock oscillation via IC204 pin 9 appears.

[8] The microcomputer pulls this pin "high" to open channel audio. The pin is "low" at all other times.

[9] The All-Call frequency (483.5 Hz) is generated at this pin.

[10] A square wave appears when voice is applied to the microphone.

[11] Measurement taken with the synthesizer "locked."

IMPORTANT: Because the RITRON mobile is constructed with grounding "sub-planes," use a system ground in the same proximity as the circuit being measured. All readings indicated as GND are true system ground.

DEVICE	PIN	MEASUREMENTS			FUNCTION
		RECEIVE	TRANSMIT	STANDBY	
Q101					Low Voltage Detector
	E	5.6	5.6	5.6	
	B	5	5	5	
	C	5.6	5.6	5.6	
Q201					Low-pass Darlington
	E	3.2	3.2	3.2	
	B	2	2	2	
	C	GND	GND	GND	
Q202					Microphone Pre-amplifier
	E	GND	GND	GND	
	B	0.6	0.6	0.6	
	C	0.8	0.8	0.8	
Q301					Charge Pump Level Shifter
	E	5	5	5	
	B	5	5	5	
	C	15	15	15	
Q302					Charge Pump Inverter
	E	5[11]	5[11]	5[11]	
	B	5[11]	5[11]	5[11]	
	C	0[11]	0[11]	0[11]	
Q303					Buffer For Front End Tracking
	D	15	15	15	
	G	2-13	2-13	2-13	
	S	2-13	2-13	2-13	
Q304					Charge Source For VCO
	E	15	15	15	
	B	15	15	15	
	C	2-13	2-13	2-13	
Q305					Charge Drain For VCO
	E	0	0	0	
	B	0	0	0	
	C	2-13	2-13	2-13	
Q306					VCO Scaling Switch
	E	GND	GND	GND	
	B	0.7	0	0.7	
	C	0.2	8	0.2	
Q307					VCO Oscillator Transistor
	E	2.5	2.5	2.5	
	B	3.1	3.1	3.1	
	C	6.5	6.5	6.5	

DEVICE	PIN	MEASUREMENTS			FUNCTION
		RECEIVE	TRANSMIT	STANDBY	
Q308					VCO Buffer/Amplifier
	E	GND	GND	GND	
	B	0.7	0.7	0.7	
	C	5.8	5.8	5.8	
Q309					Synthesizer Output Buffer
	E	GND	GND	GND	(+10 dBM output)
	B	0.7	0.7	0.7	
	C	6	6	6	
Q310					Prescaler Buffer
	E	0.3	0.3	0.3	
	B	1	1	1	
	C	7.4	7.4	7.4	
Q311					1st TX Amplifier
	E	GND	GND	GND	(output = 18 dBM or 75 mV) TX
	B	0	0.7	0	
	C	0	12	0	
Q312					Capacitance Multiplier
	E	7.2	7.2	7.2	
	B	8	8	8	
	C	8	8	8	
Q313					Power Switch Driver
	E	0	1	0	
	B	0	5	0	
	C	13	11.8	13	
Q314					TX Power Switch
	E	13	13	13	
	B	13	12	13	
	C	0	12	0	
Q315					TX Enable Inverter
	E	GND	GND	GND	(logic "low" for TX)
	B	0	0.7	0	
	C	.1	3.2	3.2	
Q316					RX Switch/Regulator
	E	2.6	0	2.6	
	B	3.2	0	3.2	
	C	12.4	13	12.4	
Q317					RX +9 Volt Regulator
	E	13	13	13	
	B	12.5	13	12.5	
	C	10	0	10	

DEVICE	PIN	MEASUREMENTS			FUNCTION
		RECEIVE	TRANSMIT	STANDBY	
Q318					High/Low Power Switching
	E	0	1	1	Circuit (Q318 - Q322)
	B	0	1.7	1.7	(All measurements in high
	C	11.5	1.3	1.3	power)
Q319					
	E	11.5	8.5	11.5	
	B	11.5	1.3	11.5	
	C	13	13	13	
Q320					
	E	11.5	8.5	11.5	
	B	6.3	6.3	6.3	
	C	13	12.3	13	
Q321					
	E	0	1.6	0	
	B	0	2.3	0	
	C	11.5	9.5	11.5	
Q322					
	E	13	13	13	
	B	13	12.1	13	
	C	0	12.8	0	
Q401					2nd TX Amplifier
	E	GND	GND	GND	(output = .25 Watts)
	B	0	0.7	0	
	C	0	12	0	
Q402					3rd TX Amplifier
	E	GND	GND	GND	(output = 4 Watts)
	B	0	—	0	
	C	0	12	0	
Q403					Final TX Amplifier
	E	GND	GND	GND	(output = 30 Watts)
	B	0	—	0	
	C	13	—	13	
Q501					RX RF Amplifier
	E	GND	GND	GND	
	B	0.8	—	0.8	
	C	4.8	—	4.8	
Q502					RX Mixer
	D	9.9	—	9.9	
	G	0	—	0	
	S	0.8	—	0.8	

DEVICE	PIN	MEASUREMENTS			FUNCTION
		RECEIVE	TRANSMIT	STANDBY	
Q503					IF Amplifier
	E	GND	GND	GND	
	B	0.7	—	0.7	
	C	1.2	—	1.2	
IC101					Channel Display Data Latch
	1	5	—	5	Data In
	2	5	—	5	
	3	4.4	—	4.4	Segment Drive Voltage
	4	4.4	—	4.4	(Pins 3 - 6)
	5	4.4	—	4.4	
	6	4.4	—	4.4	
	7	GND	GND	GND	
	8	0	—	0	Clock In
	9	5	—	5	
	10	4.4	—	4.4	Segment Drive Voltage
	11	4.4	—	4.4	(Pins 10 - 14)
	12	4.4	—	4.4	
	13	4.4	—	4.4	
	14	5	—	5	
IC102					Microcontroller
	1	NC	NC	NC	
	2	NC	NC	NC	
	3	5/0	—	—	Channel Selector
	4	5	5	5	
	5	5	5	5	Synthesizer Lock Detect
	6	NC	NC	NC	
	7	GND	GND	GND	
	8	5	5	5	Regulated +5 Volts
	9	0 - 1	—	1.5 [1]	Carrier Squelch RSSI Input
	10	5	5	5	Regulated Supply
	11	NC	NC	NC	
	12	0 - 5	—	0 - 5	Squelch Threshold Set
	13	TRI [2]	—	—	QC/DQC Detect Input
	14	TRI [2]	—	—	(Pins 13 - 14)
	15	5	5	5	
	16	SINE	SINE	SINE	Oscillator In
	17	SINE	SINE	SINE	Oscillator Out
	18	5	5	5	Microcontroller Power Reset
	19	5	5	5	Stop Microcontroller
	20	NC	NC	NC	
	21	NC	NC	NC	
	22	SQ [3]	—	—	PQC Input

DEVICE	PIN	MEASUREMENTS			FUNCTION
		RECEIVE	TRANSMIT	STANDBY	
IC102					Microcontroller (con't.)
	23	5	5	5	
	24	0 [4]	5	0	High/Low Power
	25	—	—	—	Special Mode Output
	26	5 [5]	—	—	Ext Selective Signaling Input
	27	5	5	5	
	28	SQ	4.5	0	Transmit/Busy Lamp Driver
	29	5/0	5	5/0	Microphone Hang-up Switch
	30	5	—	—	Selective Sig. Decode Out
	31	0	0	0	Clock "Clamp" for Chan Display
	32	0	0	0	Speaker "Beep" Output
	33	—	TRI	—	QC Pseudo-Sine Wave or
	34	—	—	—	DQC Output
	35	0	5	0	Transmitter Enable
	36	SQ [6]	—	—	Sub-audible Filter Switch (QC
	37	SQ [6]	—	—	Detect) Pins 36 - 39
	38	SQ [6]	—	—	
	39	SQ [6]	—	—	
	40	NC	NC	NC	
	41	GND	GND	GND	
	42	0	0	0	Synth. Shift Register Latch
	43	0/SAW [7]	0/SAW [7]	0/SAW [7]	Low-pass Filter Slew
	44	—	—	—	
	45	0/5 [8]	—	0	RX Audio Enable (Sq Output)
	46	—	SQ [9]	—	PQC All-Call Tone Output
	47	—	—	—	
	48	5/0	—	5/0	Monitor Switch
	49	5	0	5	PTT Switch
	50	5	0	5	Serial Port Data In
	51	0	—	—	Serial Data Clock Output
	52	5	—	—	Serial Data Output
IC103					Power Reset +5 Volt Regulator
	1	13	13	13	In
	2	GND	GND	GND	
	3	5	5	5	Out
IC201					Configuration Switch
	1	1.7	—	—	RX Audio (Pins 1 and 2)
	2	1.7	0.8 [1]	1.7	
	3	5	0	0	TX Inverter (Pins 3 and 4)
	4	GND	GND	GND	
	5	0	5	0	
	6	0	5	0	

DEVICE	PIN	MEASUREMENTS			FUNCTION
		RECEIVE	TRANSMIT	STANDBY	
IC201					Configuration Switch (con't.)
	7	GND	GND	GND	
	8	1.7	1	1.7	TX Modulation Switch
	9	—	0.8	—	(Pins 8 and 9)
	10	1.7	—	—	RX to Sub-audible Filter Switch
	11	1.7	—	—	(Pins 10 and 11)
	12	5	0	5	
	13	5	0	5	
	14	5	—	—	Supply
IC202					Audio Conditioning Amplifier
	1	—	SQ [10]	—	Modulation Limiter/PQC
	2	1.7	—	—	
	3	1.7	—	—	Squaring in RX (Pins 1 - 3)
	4	5	—	—	
	5	1.7	—	—	3-Pole High-pass Filter (no. 2)
	6	1.7	—	—	(Pins 5 - 7)
	7	1.7	—	—	
	8	1.7	—	—	3-Pole High-pass Filter (no. 1)
	9	1.7	—	—	(Pins 8 - 10)
	10	1.7	—	—	
	11	GND	GND	GND	
	12	1.7	—	—	+1.75 Volt Buffer
	13	1.7	—	—	(Pins 12 - 14)
	14	1.7	—	—	
IC203					Configuration Switch
	1	1.7	1.7	1.7	RX/TX Volt. Stabilizer
	2	1.7	1.7	1.7	Pins 1 and 2)
	3	1.7	1.7	1.7	Modulation to VCO Enable
	4	1.7	1.7	1.7	Switch (Pins 3 and 4)
	5	0	5	0	
	6	5	0	0	
	7	GND	GND	GND	
	8	1.7	—	—	RX Audio Path Squelch Switch
	9	1.7	—	—	(Pins 8 and 9)
	10	1.7	1.7	1.7	TX Pre-emphasis Enable
	11	1.7	1.7	1.7	(Pins 10 and 11)
	12	0	5	0	
	13	2.5	2.5	2.5	
	14	5	5	5	

DEVICE	PIN	MEASUREMENTS			FUNCTION
		RECEIVE	TRANSMIT	STANDBY	
IC204					Switched Capacitor Filter
	1	1.8	1.8	1.8	Comparator Reference In
	2	2	2	—	Comparator Out
	3	1.7	1.7	1.7	Filter Out
	4	1.7	1.7	1.7	Mixer Amplifier Out
	5	1.7	1.7	1.7	Analog Gnd In
	6	5	5	5	Supply
	7	1.7	1.7	1.7	Reference In
	8	1.7	SINE	1.7	Signal Input
	9	SAW	SAW	SAW	Clock Input
	10	GND	GND	GND	
	11	SQ	SQ	SQ	Clock Onput
	12	GND	GND	GND	
	13	1.7	1.7	1.7	Mixer Input
	14	2[1]	2[1]	2[1]	Comparator In
IC301					Synthesizer Controller
	1	NC	NC	NC	
	2	2.5	2.5	2.5	Oscillator In
	3	2.8	2.8	2.8	Oscillator Out
	4	NC	NC	NC	
	5	5	5	5	Supply
	6	NC	NC	NC	
	7	NC	NC	NC	
	8	GND	GND	GND	
	9	5	5	5	Lock Detect Out
	10	SQ	SQ	SQ	Input
	11	NC	NC	NC	
	12	0	0	0	Programming Pins (12 -14)
	13	5	5	5	
	14	0	0	0	
	15	MOD	MOD	MOD	Modulus Control Out
	16	NC	NC	NC	
	17	NC	NC	NC	
	18	SQ	SQ	SQ	Buffered 16 MHz Output
	19	5	5	5	VCO "High" Detector Output
	20	5	5	5	VCO "Low" Detector Output
IC302					Low Power +5 Volt Regulator
	1	8	8	8	Regulator Input
	2	GND	GND	GND	
	3	5	5	5	+5 Volt Regulated Output

DEVICE	PIN	MEASUREMENTS			FUNCTION
		RECEIVE	TRANSMIT	STANDBY	
IC303					Prescaler
	1	—	—	—	Prescaler Input
	2	5	5	5	+5 Volt Supply
	3	NC	NC	NC	
	4	SQ	SQ	SQ	Prescaler Output
	5	GND	GND	GND	
	6	SQ	SQ	SQ	Modulus Input
	7	NC	NC	NC	
	8	2.5	2.5	2.5	Bypass
IC304					+8 Volt Regulator
	1	13	13	13	Regulator Input
	2	GND	GND	GND	
	3	8	8	8	+8 Volt Regulated Output
IC501					IF Subsystem
	1	5.2	—	5.2	10.245 MHz Osc Trans Base
	2	4.6	—	4.6	10.245 MHz Osc Trans Emitter
	3	5	—	5	10.7 MHz to 455 KHz Mixer Out
	4	5.2	< 0.6	5.2	+5 Volt Supply
	5	1	—	1	455 KHz IF Input
	6	1	—	1	IF Amplifier Bypass
	7	1	—	1	455 KHz IF Output
	8	5.2	—	5.2	Quadrature In
	9	2.7	—	2.7	Recovered Audio
	10	2	—	2	Noise Filter Input
	11	2.1	—	2.1	Noise Filter Output
	12	NC	NC	NC	
	13	NC	NC	NC	
	14	NC	NC	NC	
	15	GND	GND	GND	
	16	2	—	2	IF In
IC601					Audio Amplifier
	1	1.3	1.3	1.3	
	2	0.8	0.8	0.8	
	3	GND	GND	GND	
	4	6.5	6.5	6.5	
	5	13	13	13	

12. SCHEMATIC TEST POINTS (Δ) IDENTIFICATION

SCHEMATIC & COORDINATES		TEST POINT	DESCRIPTION
SCHEM 1	D8	Δ 1-8	CHANNEL INDICATOR DISPLAY SEGMENTS A-G and decimal point. (Not present on RPM-150 Schematic 1730051B or RPM-450 Schematic 1730081D.)
	C8	Δ9	DISPLAY BOARD GND. (Not present on RPM-150 Schematic 1730051B or RPM-450 Schematic 1730081D.)
	D6	Δ10	TX/BUSY INDICATOR LED.
	D6	Δ11	CHANNEL DATA CLOCK INPUT. Although all data is sent to the channel board, clock pulses are delivered only when a display change is required.
	D6	Δ12	PROGRAMMING KEY. This test point is used during factory alignment to load test data.
	C6	Δ13	DISPLAY/SYNTHESIZER/SERIAL PORT DATA. All three types of data are present at Δ13, but data is only latched in IC101 when clock pulses (at Δ11) are sent simultaneously.
	C6	Δ14	CHANNEL SELECT.
	C5	Δ15	MASTER RESET. Pulling this pin to ground causes system reset. Q101 forces this point "low" if the supply falls below +9 Volts.
	C6	Δ16	MICROCONTROLLER/DISPLAY BOARD SUPPLY VOLTAGE. +5 Volts.
	C6	Δ17	MONITOR SWITCH.
	A7	Δ18	SPEAKER AUDIO.
	C7	Δ19	HANG-UP SWITCH. Ground Δ19 to hang-up.
	C6		RPM-450 Schematic 1730081D coordinates for test point described above.
	B6	Δ20	TRANSMITTER CONTROL LINE. Δ20 pulls to Ground for TX.
	B6	Δ21	RELATIVE SIGNAL STRENGTH IN (RSSI). Voltage reflects signal strength.
	B7	Δ22	MODULATION INPUT. Test modulation can be applied through this test point via a series resistor.
	B7	Δ23	OUTPUT AUDIO. This point shows attenuated speaker audio.
	B4	Δ24	SQUELCH OUTPUT. This point is "low" when the unit is squelched, "high" when unsquelched. Δ24 may be forced "high" (+5 Volts) or "low" without damaging the circuit.
	B3	Δ25	AUDIO CONDITIONING AMPLIFIER OUTPUT.
	C4	Δ27	PAGING QUIET CALL OUTPUT. The All-Call encode tone appears at Δ27.

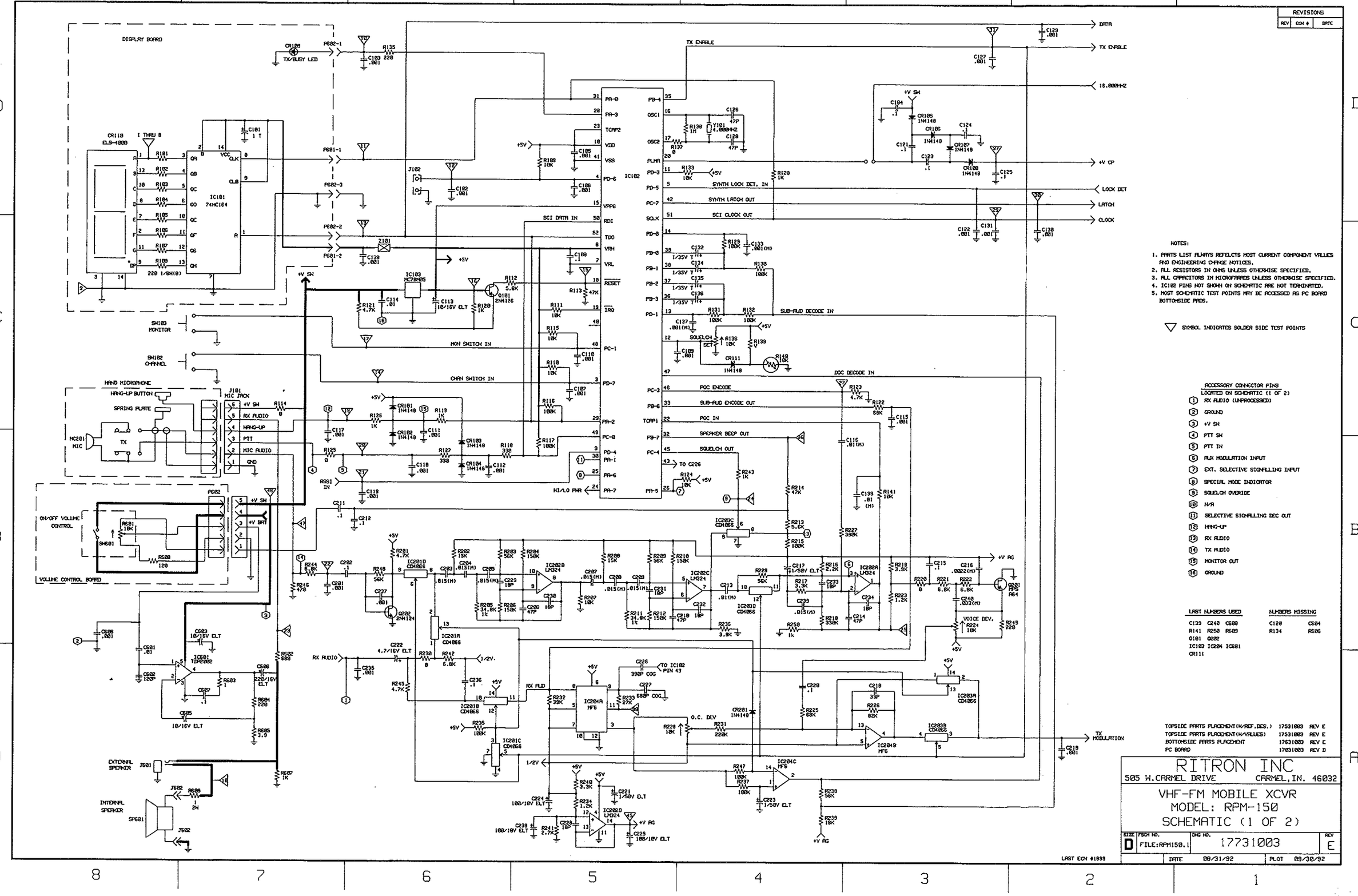
SCHEMATIC & COORDINATES		TEST POINT	DESCRIPTION
SCHEM 1	D3	Δ29	SERIAL COMMUNICATIONS CLOCK OUTPUT. This clock is used for both synthesizer and display board data transfers. Due to the high transfer rate, clock pulses are difficult to measure.
	C3		RPM-450 Schematic 1730081D coordinates for test point described above.
	D2	Δ30	A single pulse on this line signals the transfer of synthesizer data from the input data latch of IC301 into its working registers. Until this pulse occurs, the synthesizer acts as if no new data has been provided. When the pulse at Δ30 appears, the synthesizer loads and executes the new data. When serial data is intended for the display board rather than the synthesizer, the microprocesor does not deliver a pulse to Δ30.
	D3		RPM-450 Schematic 1730081D coordinates for test point described above.
	D3	Δ31	TRANSMITTER ENABLE. When the PTT button is pressed, IC102 raises the voltage at Δ31 to +5 Volts, which turns on the transmitter.
SCHEM 2	D7	Δ33	SUPPLY TO SYNTHESIZER. +0.5 Volts.
	C6		RPM-450 Schematic 1730081D coordinates for test point described above.
	D6	Δ34	COMPOSITE MODULATION before it enters the modulating circuit. The audio level is about 2-3 Vp-p with a 30 mV modulation input signal.
	D5		RPM-450 Schematic 1730081D coordinates for test point described above.
	C5	Δ35	BUFFERED TRACKING VOLTAGE. This control voltage is used to tune the RF amplifier input filter.
	D4	Δ36	SUPPLY TO SYNTHESIZER IC. Buffered, filtered +7.2 Volts. (Not present on RPM-450 Schematic 1730081D.)
	D2	Δ37	SWITCHED TX VOLTAGE. Measures +12 Volts in TX, 0 Volts in RX.
	D1	Δ38	SWITCHED RX VOLTAGE. Reads +10 Volts in RX, 0 Volts in TX.
	D2		RPM-450 Schematic 1730081D coordinates for test point described above.
	C2	Δ39	+V SUPPLY VOLTAGE.
	C2	Δ40	SYSTEM GND.
	A2	Δ41	SUPPLY TO IF. Measures +6.7 Volts in RX, +0.6 Volts or less in TX.
	C7	Δ42	LOCK DETECT OUT. This is an integrated pulse which signals the microprocessor if the synthesizer has locked.
	A4	Δ43	IF OUTPUT.
	D5	Δ44	This voltage is used to source charge current for the VCO control voltage. If this voltage is low (normally +15 Volts), the synthesizer will not lock at higher temperatures and/or frequencies.

SCHEMATIC & COORDINATES		TEST POINT	DESCRIPTION
SCHEM 1	A5	Δ45	$+V_{AG}$ AUDIO CONDITIONING REFERENCE VOLTAGE. Measures approximately +1.7 Volts.
	A6		RPM-450 Schematic 1730081D coordinates for test point described above.
	B7	Δ46	+V SWITCHED.
	B7	Δ47	MICROPHONE AUDIO.
	A6	Δ95	DEMODULATED RECOVERED AUDIO.
SCHEM 2	A3		RPM-150 Schematic 17731003 coordinates for test point described above. Not present on RPM-450 Schematic 17731002.
SCHEM 1	B4	Δ96	SPEAKER BEEP OUT.
	D3	Δ97	$+V_{CP}$. Reads between +16 and +19 VDC. (Not present on RPM-450 Schematic 1730081D.)
	A5	Δ98	FILTER CLOCK OUTPUT. The period of this square wave determines the cut-off frequency of the low-pass filter. This signal's frequency is about 100 times the cut-off frequency.

RPM-150

PCB #17031003

SCHEMATICS
PARTS PLACEMENT DIAGRAMS
PARTS LIST



NOTES:

1. PARTS LIST ALWAYS REFELCTS MOST CURRENT COMPONENT VALUES AND ENGINEERING CHANGE NOTICES.
2. ALL RESISTORS IN OHMS UNLESS OTHERWISE SPECIFIED.
3. ALL CAPACITORS IN MICROFARADS UNLESS OTHERWISE SPECIFIED.
4. IC102 PINS NOT SHOWN ON SCHEMATIC ARE NOT TERMINATED.
5. MOST SCHEMATIC TEST POINTS MAY BE ACCESSED AS PC BOARD BOTTOMSIDE PADS.

▽ SYMBOL INDICATES SOLDER SIDE TEST POINTS

ACCESSORY CONNECTOR PINS
LOCATED ON SCHEMATIC (1 OF 2)

1. RX AUDIO (UNPROCESSED)
2. GROUND
3. +V SW
4. PTT SW
5. PTT IN
6. AUX MODULATION INPUT
7. EXT. SELECTIVE SIGNALLING INPUT
8. SPECIAL MODE INDICATOR
9. SQUELCH OVERIDE
10. N/R
11. SELECTIVE SIGNALLING DEC OUT
12. HANG-UP
13. RX AUDIO
14. TX AUDIO
15. MONITOR OUT
16. GROUND

LAST NUMBERS USED			NUMBERS MISSING	
C139	C248	C808	C120	C804
R141	R250	R803	R134	R806
Q101	Q202			
IC103	IC204	IC801		
CR111				

REVISIONS		
REV	ECN #	DATE

TOPSIDE PARTS PLACEMENT(W/REF.DES.)	17531003 REV E
TOPSIDE PARTS PLACEMENT(W/VALUES)	17531003 REV E
BOTTOMSIDE PARTS PLACEMENT	17531003 REV E
PC BOARD	17531003 REV D

LAST ECN #1899

RITRON INC
505 W.CARMEL DRIVE CARMEL,IN. 46032

VHF-FM MOBILE XCVR
MODEL: RPM-150
SCHEMATIC (1 OF 2)

SIZE	FSCM NO.	DWG NO.	REV
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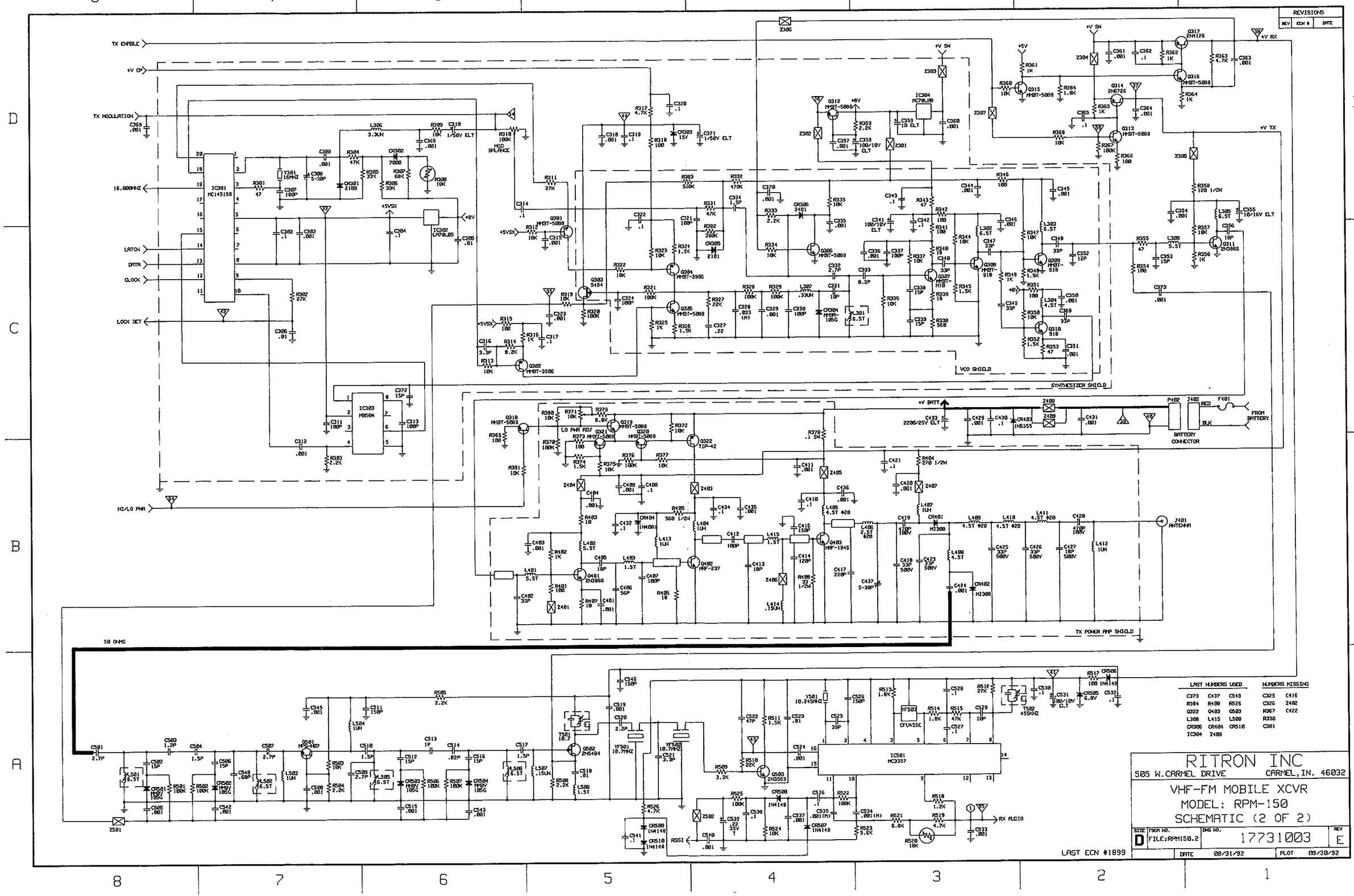
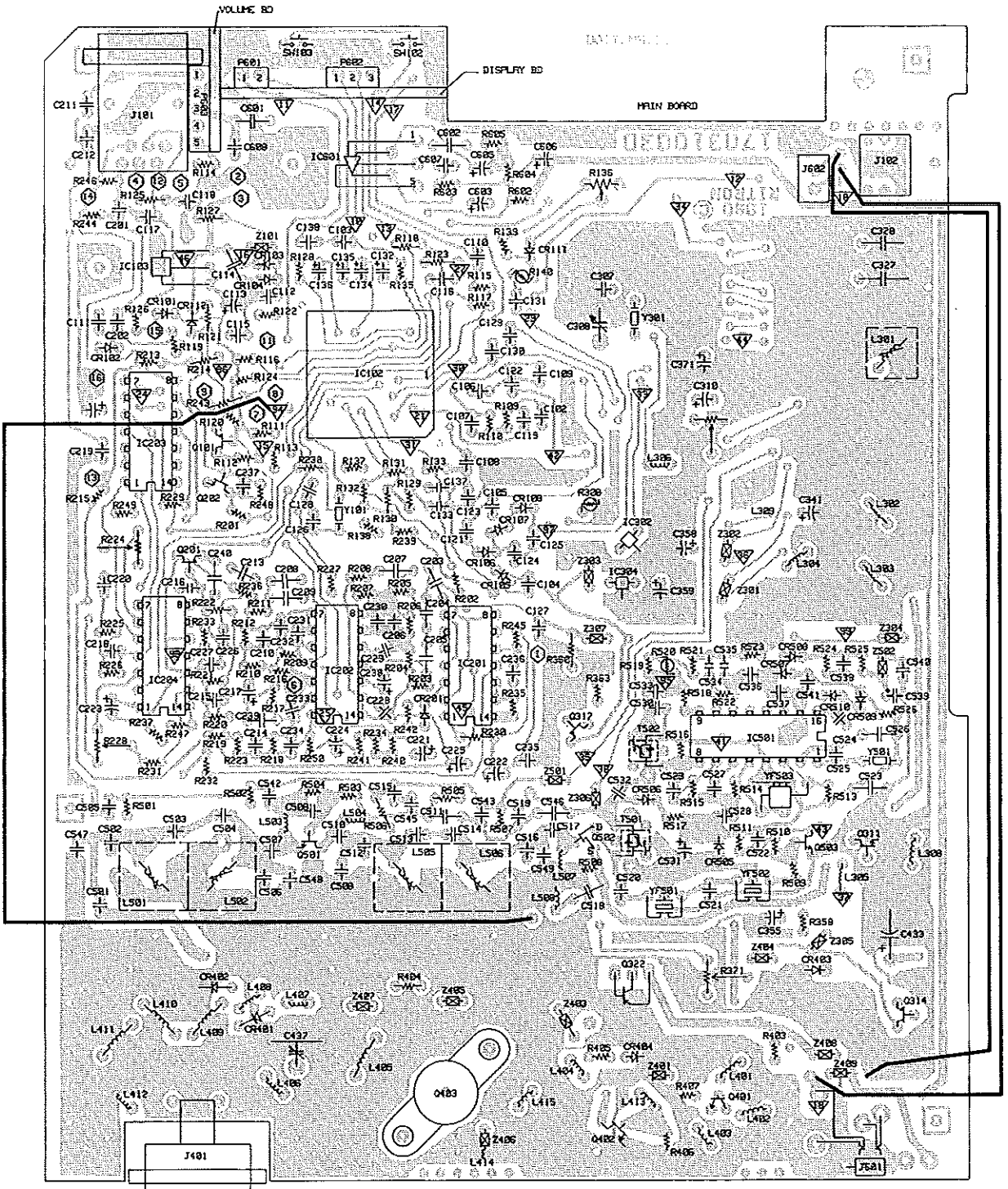
	DATE 08/31/92	PLOT 09/30/92	

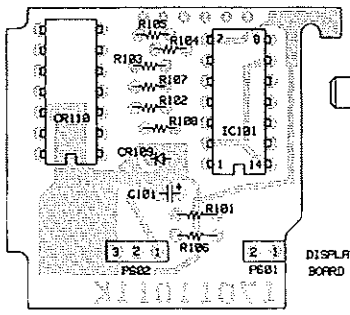

REVISIONS
REV | ECN # | DATE
TX ENABLE
+V CP
TX MODULATION
16.800MHZ
LATCH
DATA
CLOCK
LOCK DET
HI/LO PWR
+V SW
+V RX
+V TX
+V BATT
+5VSX
+8V
VCO SHIELD
SYNTHESIZER SHIELD
TX POWER AMP SHIELD
50 OHMS
FROM BATTERY
BATTERY CONNECTOR
ANTENNA
RX AUDIO
LAST NUMBERS USED
C373 C437 C549
R384 R489 R526
Q222 Q483 Q503
L388 L415 L509
CR306 CR484 CR510
IC304 Z489
NUMBERS MISSING
C325 C416
C326 Z482
R367 C422
R338
C381
RITRON INC
505 W.CARMEL DRIVE CARMEL, IN. 46032
VHF-FM MOBILE XCVR
MODEL: RPM-150
SCHEMATIC (2 OF 2)
SIZE D
FSCM NO. FILE:RPM150.2
DWG NO. 17731003
REV E
DATE 08/31/92
PLOT 09/30/92
LAST ECN #1899

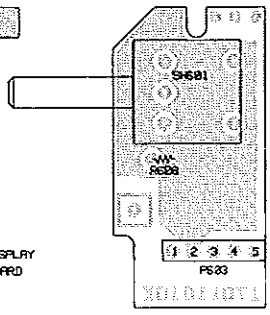
P.C. BOARD	17031003 REV D
TOP SIDE PARTS PLACEMENT(W/VALUES)	17531003 REV E
TOP SIDE PARTS PLACEMENT(W/REF.DES.)	17531003 REV E
SCHEMATIC	17231003 REV E

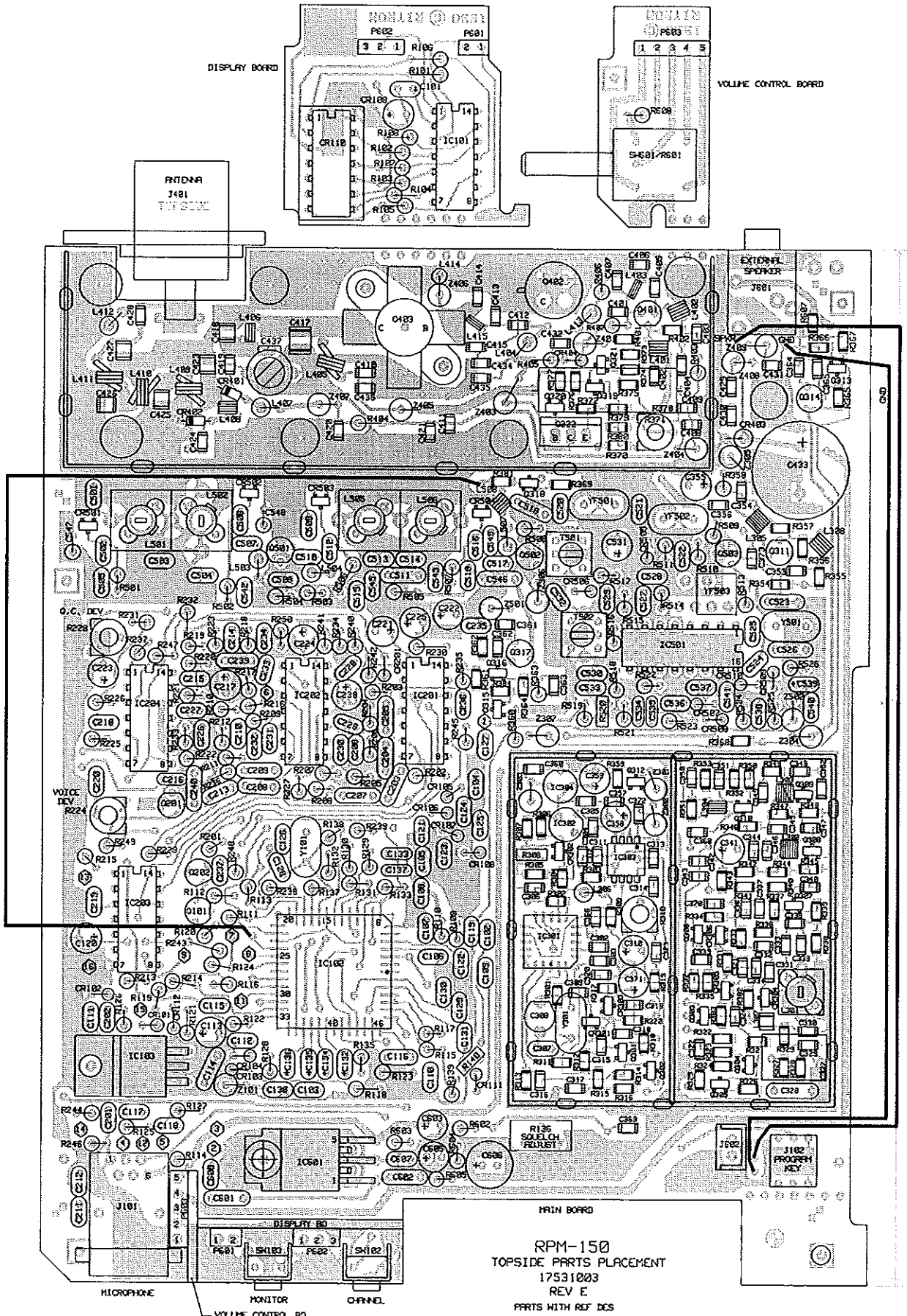


RPM-150
BOTTOMSIDE PARTS PLACEMENT
17631003
REV E
LAST ECN #1899

RITRON, INC.
CARMEL, IN.







RPM-150

TOPSIDE PARTS PLACEMENT

17531003

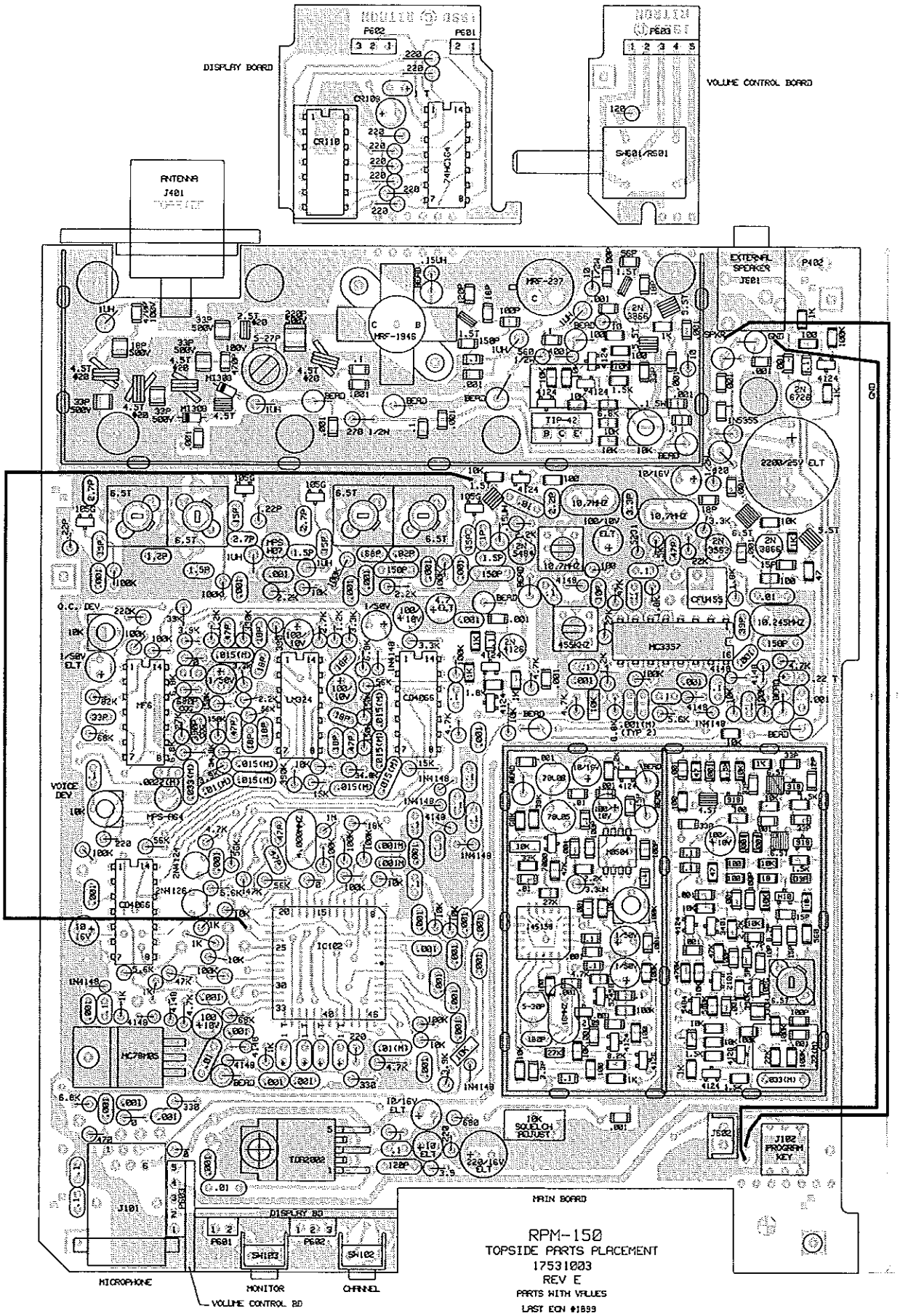
REV E

PARTS WITH REF DES

LAST ECN #1859

RITRON, INC. CARMEL, IN.

SCHEMATIC	17731003 REV E
TOP SIDE PARTS PLACEMENT(W/VALUES)	17531003 REV E
BOTTOM SIDE PARTS PLACEMENT	17631003 REV E
P.C. BOARD	17831003 REV D


DISPLAY BOARD
VOLUME CONTROL BOARD
ANTENNA
J401
EXTERNAL SPEAKER
J102
PROGRAM KEY
MAIN BOARD
MICROPHONE
MONITOR
CHANNEL
VOLUME CONTROL BD
DISPLAY BD
RPM-150
TOPSIDE PARTS PLACEMENT
17531003
REV E
PARTS WITH VALUES
LAST ECN #1899
RITRON, INC. CARMEL, IN.

15. RPM-150 PARTS LIST (SCHEMATIC #17731003)

15.1 RPM-150 SCHEMATIC REFERENCE PARTS LIST (SCHEMATIC #17731003)

NOTE: This parts list reflects the most current component values (through ECN 1899) for schematic number 17731003 (PCB #17031003). If a component value given in the schematic differs from that in the parts list, the parts list should be considered correct.

CAPACITORS, CHIP, FIXED, 50V, UNLESS STATED OTHERWISE

REF #	RITRON #	DESCRIPTION
C 101	01502007	1 µF TANT 35V .1 20%
C 102	01516239	.001 µF Y5P CERDIS
C 103	01516239	.001 µF Y5P CERDIS
C 104	01515463	.1 µF X7R MLCERDIS
C 105	01516239	.001 µF Y5P CERDIS
C 106	01516239	.001 µF Y5P CERDIS
C 107	01516239	.001 µF Y5P CERDIS
C 108	01515463	.1 µF X7R MLCERDIS
C 109	01516239	.001 µF Y5P CERDIS
C 110	01516239	.001 µF Y5P CERDIS
C 111	01516239	.001 µF Y5P CERDIS
C 112	01516239	.001 µF Y5P CERDIS
C 113	01503110	100 µF ELT 10V CERDIS
C 114	01516451	.01 µF Y5V CERDIS 25V
C 115	01516239	.001 µF Y5P CERDIS
C 116	01501050	.01 µF MYLAR 100V10%
C 117	01516239	.001 µF Y5P CERDIS
C 118	01516239	.001 µF Y5P CERDIS
C 119	01516239	.001 µF Y5P CERDIS
C 121	01515463	.1 µF X7R MLCERDIS
C 122	01516239	.001 µF Y5P CERDIS
C 123	01515463	.1 µF X7R MLCERDIS
C 124	01515463	.1 µF X7R MLCERDIS
C 125	01515463	.1 µF X7R MLCERDIS
C 126	01510023	47 pF NPO CERDIS
C 127	01516239	.001 µF Y5P CERDIS
C 128	01510023	47 pF NPO CERDIS
C 129	01516239	.001 µF Y5P CERDIS
C 130	01516239	.001 µF Y5P CERDIS
C 131	01516239	.001 µF Y5P CERDIS
C 132	01502007	1 µF TANT 35V .1 20%
C 133	01501040	.001 µF MYLAR 100V
C 134	01502007	1 µF TANT 35V .1 20%
C 135	01502007	1 µF TANT 35V .1 20%
C 136	01502007	1 µF TANT 35V .1 20%
C 137	01501040	.001 µF MYLAR 100V
C 138	01516239	.001 µF Y5P CERDIS
C 201	01516239	.001 µF Y5P CERDIS
C 202	01515463	.1 µF X7R MLCERDIS
C 203	01501062	.015 µF MYLAR 100V
C 204	01501062	.015 µF MYLAR 100V
C 205	01501062	.015 µF MYLAR 100V
C 206	01510023	47 pF NPO CERDIS
C 207	01501062	.015 µF MYLAR 100V
C 208	01501062	.015 µF MYLAR 100V
C 209	01501062	.015 µF MYLAR 100V
C 210	01510023	47 pF NPO CERDIS
C 211	01515463	.1 µF X7R MLCERDIS
C 212	01515463	.1 µF X7R MLCERDIS
C 213	01501050	.01 µF MYLAR 100V
C 214	01510023	47 pF NPO CERDIS
C 215	01515463	.1 µF X7R MLCERDIS
C 216	01501041	.0022 µF MYLAR 100V
C 217	01503002	1 µF ELT
C 218	01510021	33 pF NP0 CERDIS
C 219	01516239	.001 µF Y5P CERDIS
C 220	01515463	.1 µF X7R MLCERDIS
C 221	01503002	1 µF ELT
C 222	01503005	4.7 µF ELT 16V
C 223	01503002	1 µF ELT
C 224	01503110	100 µF ELT 10V CERDIS
C 225	01503110	100 µF ELT 10V CERDIS
C 226	01515034	390 pF COG MLCERDIS
C 227	01515037	680 pF COG MLCERDIS
C 228	01510018	18 pF NPO CERDIS
C 229	01510018	18 pF NPO CERDIS
C 230	01510018	18 pF NPO CERDIS
C 231	01510018	18 pF NPO CERDIS
C 232	01510018	18 pF NPO CERDIS
C 233	01510018	18 pF NPO CERDIS
C 234	01510018	18 pF NPO CERDIS
C 235	01516239	.001 µF Y5P CERDIS
C 236	01515463	.1 µF X7R MLCERDIS
C 237	01516239	.001 µF Y5P CERDIS
C 238	01503110	100 µF ELT 10V CERDIS
C 239	01501062	.015 µF MYLAR 100V
C 240	01501053	.033 µF MYLAR 100V
C 241	01501062	.015 µF MYLAR 100V
C 302	15121104	.1 µF X7R 1206
C 303	15121102	.001 µF X7R 1206
C 304	15121104	.1 µF X7R 1206
C 305	15121103	.01 µF X7R 1206
C 306	15121103	.01 µF X7R 1206
C 307	01515030	180 pF COG MLCERDIS
C 308	01550006	5-30 pF VARCERDIS
C 309	15121102	.001 µF X7R 1206
C 310	01503002	1 µF ELT
C 311	15120101	100 pF NPO 1206
C 312	15121102	.001 µF X7R 1206
C 313	15120101	100 pF NPO 1206
C 314	15121104	.1 µF X7R 1206
C 315	15121102	.001 µF X7R 1206
C 316	151203A3	3.3 pF NPO 1206
C 317	15121104	.1 µF X7R 1206
C 318	15121102	.001 µF X7R 1206
C 319	15121104	.1 µF X7R 1206
C 320	15121104	.1 µF X7R 1206
C 321	15120101	100 pF NPO 1206
C 322	15121104	.1 µF X7R 1206
C 323	15121102	.001 µF X7R 1206
C 324	15120101	100 pF NPO 1206
C 327	01501071	.22 µF MLPOLY 2 r 5 %
C 328	01501053	.033 µF MYLAR 100V
C 329	15121102	.001 µF X7R 1206
C 330	15120101	100 pF NPO 1206
C 331	15120100	10 pF NPO 1206
C 332	151202A7	2.7 pF NPO 1206
C 333	151208A2	8.2 pF NPO 1206
C 334	151201A5	1.5 pF NPO 1206
C 335	15121102	.001 µF X7R 1206
C 336	15121102	.001 µF X7R 1206

REF #	RITRON #	DESCRIPTION
C 337	15120101	100 pF NPO 1206
C 338	15120150	15 pF NPO 1206
C 339	15120150	15 pF NPO 1206
C 340	15120330	33 pF NPO 1206
C 341	01503110	100 µF ELT 10V CERDIS
C 342	15121104	.1 µF X7R 1206
C 343	15121104	.1 µF X7R 1206
C 344	15121102	.001 µF X7R 1206
C 345	15121102	.001 µF X7R 1206
C 346	15121102	.001 µF X7R 1206
C 347	15120330	33 pF NPO 1206
C 348	15120330	33 pF NPO 1206
C 349	15120330	33 pF NPO 1206
C 350	15121102	.001 µF X7R 1206
C 351	15121102	.001 µF X7R 1206
C 352	15120120	12 pF NPO 1206
C 353	15120150	15 pF NPO 1206
C 354	15121102	.001 µF X7R 1206
C 355	01503006	10 µF ELT 16V
C 356	15120180	18 pF NPO 1206
C 357	15121102	.001 µF X7R 1206
C 358	01503110	100 µF ELT 10V CERDIS
C 359	01503006	10 µF ELT 16V
C 360	15121102	.001 µF X7R 1206
C 361	15121102	.001 µF X7R 1206
C 362	15121104	.1 µF X7R 1206
C 363	15121102	.001 µF X7R 1206
C 364	15121102	.001 µF X7R 1206
C 365	15121104	.1 µF X7R 1206
C 366	15121102	.001 µF X7R 1206
C 368	15120330	33 pF NPO 1206
C 369	15121102	.001 µF X7R 1206
C 370	15121102	.001 µF X7R 1206
C 371	01503002	1 µF ELT
C 372	15120150	15 pF NPO 1206
C 373	15121102	.001 µF X7R 1206
C 401	15121102	.001 µF X7R 1206
C 402	15120330	33 pF NPO 1206
C 403	15121102	.001 µF X7R 1206
C 404	15121102	.001 µF X7R 1206
C 405	15120180	18 pF NPO 1206
C 406	15120560	56 pF NPO 1206
C 407	15120101	100 pF NPO 1206
C 408	15121104	.1 µF X7R 1206
C 409	15121102	.001 µF X7R 1206
C 410	15121104	.1 µF X7R 1206
C 411	15121102	.001 µF X7R 1206
C 412	15120101	100 pF NPO 1206
C 413	15120180	18 pF NPO 1206
C 414	15120121	120 pF NPO 1206
C 415	15120151	150 pF NPO 1206
C 417	15525221	220 µF SURF MNT MICA 500V
C 418	15525330	33 pF MICA 1210
C 419	15120471	470 pF NPO 1206
C 420	15121102	.001 µF X7R 1206
C 421	15121104	.1 µF X7R 1206
C 423	15525330	33 pF MICA 1210
C 424	15121102	.001 µF X7R 1206
C 425	15525330	33 pF MICA 1210
C 426	15525330	33 pF MICA 1210
C 427	15525180	18 pF NPO 1210 500V
C 428	15120471	470 pF NPO 1206
C 429	15121102	.001 µF X7R 1206
C 430	15121104	.1 µF X7R 1206
C 431	15121102	.001 µF X7R 1206
C 432	15121104	.1 µF X7R 1206
C 433	01503208	2200 µF ELT 25V
C 434	15121104	.1 µF X7R 1206
C 435	15121102	.001 µF X7R 1206
C 436	15121102	.001 µF X7R 1206
C 437	01550003	5-27 pF VARPRO
C 501	01510008	2.7 pF NP0 CERDIS
C 502	01510017	15 pF NP0 CERDIS
C 503	01510004	1.2 pF NP0 CERDIS
C 504	01510005	1.5 pF NP0 CERDIS
C 505	01516239	.001 µF Y5P CERDIS
C 506	01510017	15 pF NP0 CERDIS
C 507	01510008	2.7 pF NP0 CERDIS
C 508	01516239	.001 µF Y5P CERDIS
C 509	01510008	2.7 pF NP0 CERDIS
C 510	01510005	1.5 pF NP0 CERDIS
C 511	01510029	150 pF NPO CERDIS
C 512	01510017	15 pF NP0 CERDIS
C 513	01510003	1 pF NPO CERDIS
C 514	01508002	.82 pF P100 CERDIS
C 515	01516239	.001 µF Y5P CERDIS
C 516	01510017	15 pF NP0 CERDIS
C 517	01510005	1.5 pF NP0 CERDIS
C 518	01516451	.01 µF Y5V CERDIS 25V
C 519	01516239	.001 µF Y5P CERDIS
C 520	01510007	2.2 pF NP0 CERDIS
C 521	01510009	3.3 pF NP0 CERDIS
C 522	01510023	47 pF NPO CERDIS
C 523	01516451	.01 µF Y5V CERDIS 25V
C 524	01516239	.001 µF Y5P CERDIS
C 525	01510022	39 pF NP0 CERDIS
C 526	01510029	150 pF NPO CERDIS
C 527	01515463	.1 µF X7R MLCERDIS
C 528	01515463	.1 µF X7R MLCERDIS
C 529	01510015	10 pF NP0 CERDIS
C 530	01515463	.1 µF X7R MLCERDIS
C 531	01503110	100 µF ELT 10V CERDIS
C 532	01515463	.1 µF X7R MLCERDIS
C 533	01516239	.001 µF Y5P CERDIS
C 534	01501040	.001 µF MYLAR 100V
C 535	01501040	.001 µF MYLAR 100V
C 536	01515463	.1 µF X7R MLCERDIS
C 537	01516239	.001 µF Y5P CERDIS
C 538	01515463	.1 µF X7R MLCERDIS
C 539	01502003	.22 µF TANT 35V .1 r 20%
C 540	01516239	.001 µF Y5P CERDIS
C 541	01515463	.1 µF X7R MLCERDIS
C 542	01516239	.001 µF Y5P CERDIS
C 543	01516239	.001 µF Y5P CERDIS
C 545	01516239	.001 µF Y5P CERDIS
C 546	01510029	150 pF NPO CERDIS
C 548	01508001	.68 pF P100 CERDIS
C 601	01516451	.01 µF Y5V CERDIS 25V
C 602	01510028	120 pF NPO CERDIS
C 603	01503006	10 µF ELT 16V
C 605	01503006	10 µF ELT 16V
C 606	01503011	220 µF ELT 16V
C 607	01515463	.1 µF X7R MLCERDIS
C 608	01516239	.001 µF Y5P CERDIS

REF #	RITRON #	DESCRIPTION
DIODES, 1N4148, GENERAL PURPOSE, UNLESS STATED OTHERWISE		
CR101	04810001	
CR102	04810001	
CR103	04810001	
CR104	04810001	
CR105	04810001	
CR106	04810001	
CR107	04810001	
CR108	04810001	
CR109	02450006	MINIATURE RED LED
CR110	02450101	7 SEG GRN LED COM CATH.4
CR111	04810001	
CR201	04810001	
CR301	48C1004J	VVC 26-32PF (4J) MMBV2109
CR302	48A1005C	MMBD7000 DUAL SOT-23 5C
CR303	48B1008W	ZNR SOT-23 (8W) MMBZ5245
CR304	48C1004E	VVC MMBV-105G SOT-23 (4E)
CR305	48C1004G	MMBV-2101L VVC SOT-23
CR306	48A1004D	MMBV3401TI UHF SOT-23
CR401	04810033	PIN 25W GLASS AXIAL MI308
CR402	04810033	PIN 25W GLASS AXIAL MI308
CR403	04820119	1N5355A ZENER 18V 5W
CR404	04810003	1N4001 50 VOLT/1AMP
CR501	48C1004E	VVC MMBV-105G SOT-23 (4E)
CR502	48C1004E	VVC MMBV-105G SOT-23 (4E)
CR503	48C1004E	VVC MMBV-105G SOT-23 (4E)
CR504	48C1004E	VVC MMBV-105G SOT-23 (4E)
CR505	04820009	1N5235 6.8V .5W ZENER
CR506	04810001	
CR507	04810001	
CR508	04810001	
CR509	04810001	
CR510	04810001	
FUSE		
F 401	05110012	10 AMP 32V MED BLO 3AG
INTEGRATED CIRCUITS		
IC101	03144164	8 BIT SHIFT REGISTER
IC102	314B0003	MICRO CMOS MASKED
IC103	03131016	MC78MO5CY 5 V REG
IC201	03134066	CD4066BCP QD ANLG GATE
IC202	03131004	LM324 QUAD OP AMP
IC203	03134066	CD4066BCP QD ANLG GATE
IC204	03132027	MF6 6 POLE FILTER IC
IC301	31137001	FREQ. SYNTH INPUT PLCC-20
IC302	03131012	MC78L05CP 5V REGULATOR
IC303	31131001	PRSCLR 2 MOD MO-1 MB504
IC304	03131013	MC78L08CP 8 VOLT REG
IC501	03131010	MC3357P FM IF SUBSYSTEM
IC601	03131050	8 WATT AUDIO AMP
CONNECTORS		
J 101	02100310	6-PIN MODULAR PHONE JCK
J 401	02100330	UHF RER MT BLKHD RCPTCL
J 601	02100053	3.5MM STEREO JCK PNL MT

REF #	RITRON #	DESCRIPTION
INDUCTORS		
L 301	01850306	6.5T SHIELDED
L 302	01870956	6.5T AIRFCW .12 a L
L 303	01870956	6.5T AIRFCW .12 a L
L 304	01870954	4.5T AIRFCW .09 a L
L 305	01870956	6.5T AIRFCW .12 a L
L 306	01800219	3.3 µH MOL FCW .250 a
L 307	18110331	.33µH CHIP
L 308	01870955	5.5T AIRFCW .1 a L
L 401	01870955	5.5T AIRFCW .1 a L
L 402	01870955	5.5T AIRFCW .1 a L
L 403	01870951	1.5T AIRFCW .03 a L
L 404	01800145	1 µH PHE FCW .250 aR
L 405	01802048	4.5T #20
L 406	01802022	AIRFSW M2.5T #20
L 407	01800213	1 µH MOL FCW .250 a
L 408	01870954	4.5T AIRFCW .09 a L
L 409	01802048	4.5T #20
L 410	01802048	4.5T #20
L 411	01802048	4.5T #20
L 412	01800213	1 µH MOL FCW .250 a
L 413	01800213	1 µH MOL FCW .250 a
L 414	01800101	.15 µH PHE FCW .250 aR
L 415	01870951	1.5T AIRFCW .03 a L
L 501	01850016	6.5T MOLFSW .25 AL CORE
L 502	01850016	6.5T MOLFSW .25 AL CORE
L 503	01800213	1 µH MOL FCW .250 a
L 504	01800213	1 µH MOL FCW .250 a
L 505	01850016	6.5T MOLFSW .25 AL CORE
L 506	01850016	6.5T MOLFSW .25 AL CORE
L 508	01870951	1.5T AIRFCW .03 a L
TRANSISTORS		
Q 101	04800011	2N4126 PNP GP AUDIO TO-92
Q 201	04800008	MPS-A64 PNP DARLINGTON
Q 202	04800006	MPS-4124 NPN LW NSE AUD.
Q 301	4801001Q	MMBT-5088 SOT-23 1Q
Q 302	4801002A	MMBT3906L PNP SOT-23 2A
Q 303	4841006B	MMBF5484 NFET GP SOT-23
Q 304	4801002A	MMBT3906L PNP SOT-23 2A
Q 305	4801001Q	MMBT-5088 SOT-23 1Q
Q 306	4801001Q	MMBT-5088 SOT-23 1Q
Q 307	4821003E	MMBT-H10 VHF, SOT-23 (3E)
Q 308	4821003B	MMBT-918 VHF SOT-23 (3B)
Q 309	4821003B	MMBT-918 VHF SOT-23 (3B)
Q 310	4821003B	MMBT-918 VHF SOT-23 (3B)
Q 311	04800030	MPS-3866 NPN RF MED PWR.
Q 312	4801001Q	MMBT-5088 SOT-23 1Q
Q 313	4801001Q	MMBT-5088 SOT-23 1Q
Q 314	04800018	2N6726 PNP PWR
Q 315	4801001Q	MMBT-5088 SOT-23 1Q
Q 316	4801001Q	MMBT-5088 SOT-23 1Q
Q 317	04800011	2N4126 PNP GP AUDIO TO-92
Q 318	4801001Q	MMBT-5088 SOT-23 1Q
Q 319	4801001Q	MMBT-5088 SOT-23 1Q
Q 320	4801001Q	MMBT-5088 SOT-23 1Q
Q 321	4801001Q	MMBT-5088 SOT-23 1Q
Q 322	04800019	TIP-42 40V 6A PNP PWR
Q 401	04800030	MPS-3866 NPN RF MED PWR
Q 402	04801002	MRF-237 NPN VHF AMP TO-39
Q 403	04801029	MRF-1946 30W RF PWR
Q 501	04800003	MPS-HO7A NPN VHF AMP

REF #	RITRON #	DESCRIPTION
Q 502	04800037	2N5484 FET N-CHANNEL
Q 503	04800002	MPS3563 NPN RF AMP

RESISTORS, FIXED, 1/4W, 5%, CF, UNLESS STATED OTHERWISE

REF #	RITRON #	DESCRIPTION
R 101	04700825	220 Ω 1/8W
R 102	04700825	220 Ω 1/8W
R 103	04700825	220 Ω 1/8W
R 104	04700825	220 Ω 1/8W
R 105	04700825	220 Ω 1/8W
R 106	04700825	220 Ω 1/8W
R 107	04700825	220 Ω 1/8W
R 108	04700825	220 Ω 1/8W
R 109	04700145	10K Ω
R 110	04700145	10K Ω
R 111	04700145	10K Ω
R 112	04700142	5.6K Ω
R 113	04700153	47K Ω
R 114	04720009	ZERO Ω
R 115	04700145	10K Ω
R 116	04700157	100K Ω
R 117	04700157	100K Ω
R 118	04700127	330 Ω
R 119	04700133	1K Ω
R 120	04700133	1K Ω
R 121	04700141	4.7K Ω
R 122	04700155	68K Ω
R 123	04700141	4.7K Ω
R 124	04700145	10K Ω
R 125	04720009	ZERO Ω
R 126	04700133	1K Ω
R 127	04700127	330 Ω
R 128	04700133	1K Ω
R 129	04700157	100K Ω
R 130	04700157	100K Ω
R 131	04700157	100K Ω
R 132	04700157	100K Ω
R 133	04700145	10K Ω
R 135	04700125	220 Ω
R 136	04750004	10K TRIM POT VERT/MINI
R 137	04720009	ZERO Ω
R 138	04700169	1M Ω
R 139	04700140	3.9K Ω
R 140	04750100	THERMISTOR 10K Ω
R 201	04700141	4.7K Ω
R 202	04700147	15K Ω
R 203	04700154	56K Ω 1/4W
R 204	04700159	150K Ω
R 205	04732496	34.8K Ω 1% METAL FILM
R 206	04700159	150K Ω
R 207	04700145	10K Ω
R 208	04700147	15K Ω
R 209	04700154	56K Ω 1/4W
R 210	04700159	150K Ω
R 211	04732496	34.8K Ω 1% METAL FILM
R 212	04700159	150K Ω
R 213	04700142	5.6K Ω
R 214	04700153	47K Ω
R 215	04700157	100K Ω
R 216	04700137	2.2K Ω
R 217	04700139	3.3K Ω
R 218	04700163	330K Ω
R 219	04700140	3.9K Ω
R 220	04720009	ZERO Ω
R 221	04700143	6.8K Ω
R 222	04700143	6.8K Ω
R 223	04700134	1.2K Ω
R 224	04750049	10K PIHER POT (MINI)
R 225	04700155	68K Ω
R 226	04700156	82K Ω
R 227	04700164	390K Ω
R 228	04750049	10K PIHER POT (MINI)
R 229	04700154	56K Ω
R 230	04700139	3.3K Ω
R 231	04700161	220K Ω
R 232	04700152	39K Ω
R 233	04700150	27K Ω
R 234	04700134	1.2K Ω
R 235	04700157	100K Ω
R 236	04700140	3.9K Ω
R 237	04700157	100K Ω
R 238	04700154	56K Ω
R 239	04700148	18K Ω
R 240	04700139	3.3K Ω
R 241	04700138	2.7K Ω
R 242	04700143	6.8K Ω
R 243	04700133	1K Ω
R 244	04700143	6.8K Ω
R 245	04700141	4.7K Ω
R 246	04700129	470 Ω
R 247	04700157	100K Ω
R 248	04700154	56K Ω
R 249	04700125	220 Ω
R 250	04700133	1K Ω
R 301	47110470	47 Ω 1/8W 1206 CHIP
R 302	47110273	27K Ω 1206 1/8W CHIP
R 303	47110222	2.2K Ω 1206 1/8W CHIP
R 304	47110473	47K Ω 1206 1/8W CHIP
R 305	47110333	33K Ω 1206 1/8W CHIP
R 306	47110393	39K Ω 1206 1/8W CHIP
R 307	47110683	68K Ω 1206 1/8W CHIP
R 308	04750100	THERMISTOR 10K Ω
R 309	47110103	10K Ω 1206 1/8W CHIP
R 310	04750050	100K PIHER POT (MINI)
R 311	47110273	27K Ω 1206 1/8W CHIP
R 312	47110103	10K Ω 1206 1/8W CHIP
R 313	47110103	10K Ω 1206 1/8W CHIP
R 314	47110822	8.2K Ω 1/8W 1206 CHIP
R 315	47110101	100 Ω 1206 1/8W CHIP
R 316	47110102	1K Ω 1206 1/8W CHIP
R 317	47110472	4.7K Ω 1206 1.8W CHIP
R 318	47110101	100 Ω 1206 1/8W CHIP
R 319	47110103	10K Ω 1206 1/8W CHIP
R 320	47110104	100K Ω 1206 1/8W CHIP
R 321	47110104	100K Ω 1206 1/8W CHIP
R 322	47110103	10K Ω 1206 1/8W CHIP
R 323	47110103	10K Ω 1206 1/8W CHIP
R 324	47110152	1.5KΩ 1/8W 1206 CHIP
R 325	47110102	1K Ω 1206 1/8W CHIP
R 326	47110152	1.5KΩ 1/8W 1206 CHIP
R 327	47110223	22K Ω 1/8W 1206 CHIP
R 328	47110104	100K Ω 1206 1/8W CHIP
R 329	47110104	100K Ω 1206 1/8W CHIP
R 331	47110473	47K Ω 1206 1/8W CHIP
R 332	47110474	470K Ω 1206 1/8W CHIP
R 333	47110222	2.2K Ω 1206 1/8W CHIP
R 334	47110103	10K Ω 1206 1/8W CHIP

REF #	RITRON #	DESCRIPTION
R 335	47110103	10K Ω 1206 1/8W CHIP
R 336	47110103	10K Ω 1206 1/8W CHIP
R 337	47110103	10K Ω 1206 1/8W CHIP
R 338	47110561	560 Ω 1206 1/8W CHIP
R 339	47110180	18 Ω 1/8W 1206 CHIP
R 340	47110180	18 Ω 1/8W 1206 CHIP
R 341	47110101	100 Ω 1206 1/8W CHIP
R 342	47110101	100 Ω 1206 1/8W CHIP
R 343	47110470	47 Ω 1/8W 1206 CHIP
R 344	47110103	10K Ω 1206 1/8W CHIP
R 345	47110152	1.5KΩ 1/8W 1206 CHIP
R 346	47110101	100 Ω 1206 1/8W CHIP
R 347	47110103	10K Ω 1206 1/8W CHIP
R 348	47110152	1.5KΩ 1/8W 1206 CHIP
R 349	47110102	1K Ω 1206 1/8W CHIP
R 350	47110103	10K Ω 1206 1/8W CHIP
R 351	47110101	100 Ω 1206 1/8W CHIP
R 352	47110152	1.5KΩ 1/8W 1206 CHIP
R 353	47110470	47 Ω 1/8W 1206 CHIP
R 354	47110101	100 Ω 1206 1/8W CHIP
R 355	47110470	47 Ω 1/8W 1206 CHIP
R 356	47110102	1K Ω 1206 1/8W CHIP
R 357	47110103	10K Ω 1206 1/8W CHIP
R 358	04710021	120 Ω 1/2W
R 359	47110222	2.2K Ω 1206 1/8W CHIP
R 360	04700145	10K Ω
R 361	47110102	1K Ω 1206 1/8W CHIP
R 362	47110102	1K Ω 1206 1/8W CHIP
R 363	04700141	4.7K Ω
R 364	47110102	1K Ω 1206 1/8W CHIP
R 365	47110102	1K Ω 1206 1/8W CHIP
R 366	47110561	560 Ω 1206 1/8W CHIP
R 367	47110104	100K Ω 1206 1/8W CHIP
R 368	47110103	10K Ω 1206 1/8W CHIP
R 369	47110101	100 Ω 1206 1/8W CHIP
R 370	47110683	68K Ω 1206 1/8W CHIP
R 371	04750049	10K PIHER POT (MINI)
R 372	47110103	10K Ω 1206 1/8W CHIP
R 373	47110101	100 Ω 1206 1/8W CHIP
R 374	47110152	1.5KΩ 1/8W 1206 CHIP
R 375	47110103	10K Ω 1206 1/8W CHIP
R 376	47110683	68K Ω 1206 1/8W CHIP
R 377	47110103	10K Ω 1206 1/8W CHIP
R 378	04720047	.1 Ω 10% 3W WIREWOUND
R 379	47110682	6.8K Ω 1206 1/8W CHIP
R 380	47110103	10K Ω 1206 1/8W CHIP
R 381	47110103	10K Ω 1206 1/8W CHIP
R 382	47110394	390K Ω 1/8W 1206 CHIP
R 383	47110564	560K Ω 1206 1/8W CHIP
R 384	47110182	1.8K Ω 1206 1/8W CHIP
R 401	47110101	100 Ω 1206 1/8W CHIP
R 402	47110102	1K Ω 1206 1/8W CHIP
R 403	04700108	10 Ω
R 404	04710025	270 Ω 1/2W
R 405	04710029	560 Ω 1/2W
R 406	04710008	10 Ω 1/2W
R 407	04700108	10 Ω
R 408	04710014	33 Ω 1/2W
R 501	04700157	100K Ω
R 502	04700157	100K Ω
R 503	04700145	10K Ω
R 504	04700137	2.2K Ω
R 505	04700137	2.2K Ω
R 506	04700157	100K Ω
R 507	04700157	100K Ω
R 508	04700137	2.2K Ω
R 509	04700139	3.3K Ω
R 510	04700149	22K Ω
R 511	04700135	1.5K Ω
R 513	04700136	1.8K Ω
R 514	04700136	1.8K Ω
R 515	04700153	47K Ω
R 516	04700150	27K Ω
R 517	04700121	100 Ω
R 518	04700134	1.2K Ω
R 519	04700141	4.7K Ω
R 520	04750100	THERMISTOR 10K Ω
R 521	04700143	6.8K Ω
R 522	04700157	100K Ω
R 523	04700142	5.6K Ω
R 524	04700145	10K Ω
R 525	04700157	100K Ω
R 526	04700141	4.7K Ω
R 601	04750048	10K PNL POT W/SW PCB MT
R 602	04700131	680 Ω
R 603	04700099	1.0 Ω 1/4W
R 604	04700125	220 Ω
R 605	04700103	3.9 Ω
R 607	47110102	1K Ω 1206 1/8W CHIP
R 608	04700122	120 Ω
R 609	04720049	1 Ω 2W 10%
R 900	04742001	10 Ω 5% Rectangular

SPEAKER

SP601	05500027	SPKR 1.75 X 3.0 4W ALNIC

SWITCHES

SW102	05100042	SPST MOMEN MINI PC 260GM
SW103	05100042	SPST MOMEN MINI PC 260GM

TRANSFORMERS

T 501	05600001	10.7MHZ IF XFORMER/ZAMCO
T 502	05600002	455KHZ IF XFORMER/ZAMCO

CRYSTALS

Y 101	02300057	4.0 MHZ XTAL HIGH STABILITY
Y 301	02300060	CRYSTAL 16MHZ SYNTH REF.
Y 501	02300005	10.245 MHZ 2ND LO XTAL

FILTERS

YF501	02301001	10.7 MHZ 2 POLE MONO FILT
YF502	02301001	10.7 MHZ 2 POLE MONO FILT
YF503	02301008	FILTER CERAMIC CFU-455E2

FERRITE BEADS, ON AXIAL LEADS, UNLESS STATED OTHERWISE

Z 101	01801029
Z 301	01801029
Z 302	01801029
Z 303	01801029
Z 304	01801029
Z 305	01801029

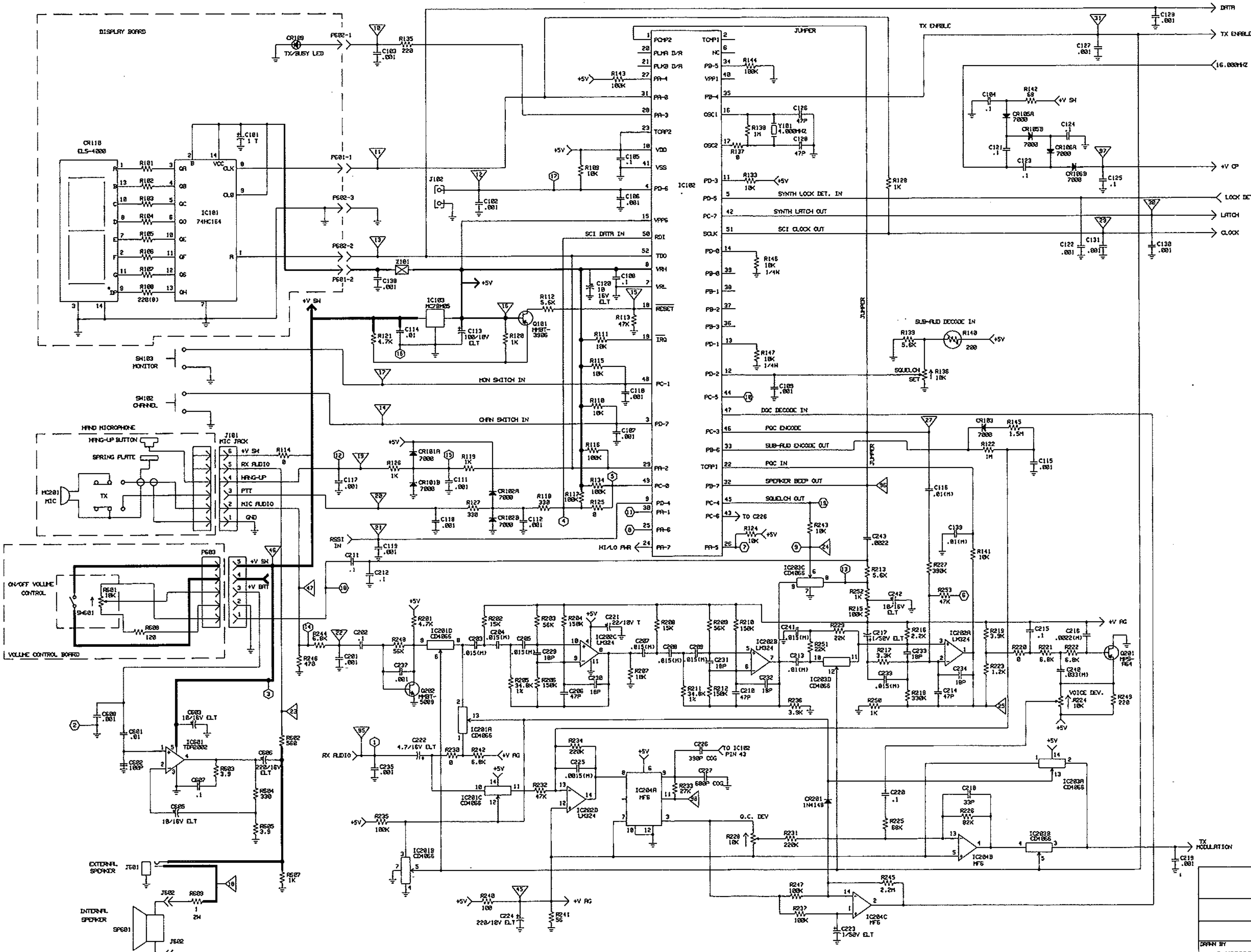
REF #	RITRON #	DESCRIPTION
Z 306	01801029	
Z 307	01801029	
Z 401	01801029	
Z 403	01801029	
Z 404	01801029	
Z 405	01801029	
Z 406	01801003	FAIR-RITE 2643000301
Z 407	01801029	
Z 408	01801029	
Z 409	01801029	
Z 501	01801029	
Z 502	01801029	

REF #	RITRON #	DESCRIPTION
HD1	21433030	3-POS CONN PC MT
HD2	25100221	BRCKT RPM MNT PAINTED BLK
HD101	02800105	8" X 1/16" CABLE TIE
HD102	02500115	BRCKT METAL MIC HANG UP
HD103	02100101	DIP SOCKET 14-PIN
HD104	02100326	DC PWR CONNECTOR CAP
HD105	02100327	DC PWR CONNECTOR PIN
HD106	02100301	MICRO-MINI SOCKET MMH21
HD107	01410001	PLASTIC BAG 4"*6"*.002"
HD108	02100328	DC PWR CONTACT SOCKET
HD109	02600016	HEAT SINK SUPPORT REV. E
HD110	02801005	4-40 1/4" PHILLIPS PAN
HD113	02801008	6 X 1/4" PPHMS SLF-TAP/TYPE 25
HD125	02801009	4 X 1/4" PPHMS SLF-TAP/TYPE 25
HD129	02801043	#8-32 X 3/16" PPHMS ZP
HD130	02802003	4-40 X 1/4" X 3/32" HEX NUT
HD131	02802016	HEX NUT #8-32 X 11/32"X 1/8"
HD132	02803004	#4 INTRNL TOOTH LOCKWSHR
HD135	02803007	#8 INT TOOTH LOCK WSHR
HD136	06001006	WIRE #18AWG/IRPVC RED (IN)
HD137	06001007	WIRE #18AWG/IRPVC BLK (IN)
HD138	06001093	22 AWG SOLID BLK PVC IN
HD139	06001096	14 AWG STRNDED SAE TYP I BLK
HD140	06001097	14 AWG STRNDED SAE TYP I RED
HD141	13081004	FRONT PANEL ASSEMBLY
HD142	13082000	PANEL BACK RPM-450
HD143	13085000	WRAP RPM-450 REV H
HD144	13086000	GUIDES PANEL RPM-450
HD147	13087000	PANEL SIDE RPM-450
HD150	14222008	INLAY OGO RPM-450 REV D
HD151	14230026	LBL ACCSSRY CONN REV B
HD152	14230028	RPM DC PWR CABLE "+" LBL
HD153	14230029	RPM DC PWR CABLE "GND" LBL
HD154	14312001	RPM IND. SHIP BOX KRAFT
HD155	14312002	RPM ACC'Y SHIP BOX KRAFT
HD156	14312003	RPM ACC'Y CLAY WHITE BOX
HD157	14352001	RPM INSRT FOR IND. BOX KRAFT
HD158	21148001	SPLICE PG BUTT INS #14-16,
HD159	21158001	RING TRMNL CRIMP #14 3/8 HOLE
HD161	21202001	TRMNL MALE .058 DIA. TIN PLATE
HD175	25100221	BRCKT RPM MNT PAINTED BLK
HD176	25100500	CLAMP SPEAKER REV D
HD180	25100700	BRCKT VOLUME CONTROL REV B
HD181	25600400	CLOTH SPEAKER GRILL REV A
HD182	25600800	PANEL GASKET
HD186	25600900	CONTROL WSHR REV C
HD187	25601000	WSHR RUB/CLOTH MNTING BKT
HD189	25601100	SYNTH SHIELD INSLTOR REV C
HD190	25700100	SHIELD SYNTH REV C
HD192	25700300	SHIELD VCO REV D
HD193	25700400	SHIELD PWR REV D
HD194	25700600	LID SYNTH REV D
HD195	25700800	LID PWR REV C
HD196	25701300	GROUND STRAP EV B
HD197	25701800	VCO PAD CUP SHIELD REV A
HD198	25800100	KNOB VOLUME RPM SERIES
HD199	26200200	HEATSINK REV J
HD200	28110600	SCRW #6X.375 TYP A SLFTAP
HD201	25702100	DRAWN VCO SHIELD
HD204	28110901	SCREW CUS 10-32 HEX HEAD 5/8
HD206	28140001	SCRW #10-12X.75 PHPH A BLK
HD210	28141601	SCREW #6-32 PPHMS BLK OX 25
HD210	28141602	SCRW #6-32 PPHSTL YEL
HD213	28311901	#10 SPLIT WSHR MED BLK OXIDE
HD217	28321601	INT. TOOTH LCKWSHR #6 BLK OX
HD220	28341901	WSHR FLAT #10 BLK OX 7/16 OD
HD222	28721001	STNDOFF PLSTIC .116/.187D
HD223	28722001	STNDOFF 1/4 HEX ALUM REV B
HD224	51811201	BDY HALF HI TMP; IN-LINE FSE
HD226	51811202	SPRING; IN-LINE FSE HOLDER
HD228	51811203	RIVET; IN-LINE FUSE HOLDER
HD230	28340501	#5 X 1/4 X 1/32 STEEL WSHR ZINC
HD232	28810001	RIVT 1/8" CSK ALUM BDY ST
HD234	26200400	PAD THERMAL INTERFACE
HD239	28341901	WSHR FLAT #10 BLK OX 7/16 OD
HD244	06001105	22 AWG SOLID GREEN WIRE
HD501	02500003	10MM SHIELD CAN AURA
HD998	02100325	DC PWR CONN PLUG
HD999	02100302	MICRO-MINI HEADER MMP2S-1

RPM-150

PCB #1730050A

SCHEMATICS
PARTS PLACEMENT DIAGRAMS
PARTS LIST



NOTES:

1. PARTS LIST ALWAYS REFLECTS MOST CURRENT COMPONENT VALUES AND ENGINEERING CHANGE NOTICES.
2. ALL RESISTORS IN OHMS UNLESS OTHERWISE SPECIFIED.
3. ALL CAPACITORS IN MICROFARADS UNLESS OTHERWISE SPECIFIED.
4. IC102 PINS NOT SHOWN ON SCHEMATIC ARE NOT TERMINATED.
5. MOST SCHEMATIC TEST POINTS MAY BE ACCESSED AS PC BOARD BOTTOMSIDE PADS.

▽ SYMBOL INDICATES SOLDER SIDE TEST POINTS

ACCESSORY CONNECTOR PINS
LOCATED ON SCHEMATIC (1 OF 2)

1. RX AUDIO (UNPROCESSED)
2. GROUND
3. +V SW
4. PTT SW
5. PTT IN
6. AUX MODULATION INPUT
7. EXT. SELECTIVE SIGNALLING INPUT
8. SPECIAL MODE OUT
9. SQUELCH OVERIDE IN
10. TRUNK OC/OUT
11. SELECTIVE SIGNALLING DEC OUT
12. HANG-UP
13. RX AUDIO
14. MIC AUDIO
15. MONITOR
16. GROUND
17. TRUNK PULSE IN
18. AUDIO IN
19. SQUELCH OUT

LAST NUMBERS USED

C139	C243	C600
R147	R253	R608
Q101	Q202	
IC103	IC204	IC601
CR110	CR202	

NUMBERS MISSING

C120	R123	CR100	R606
C132	R129	C228	
C133	R130	C236	
C134	R131	C238	
C135	R132	R238	
C136	CR104	R239	
C137	CR107	C604	

TOPSIDE PARTS PLACEMENT W/REF.DES.	1730052F
TOPSIDE PARTS PLACEMENT W/VALUES	1730053F
BOTTOMSIDE PARTS PLACEMENT	1730054F
PC BOARD	1730050A

LAST ECN #2235

REVISIONS

REV	ECN #	DATE

RITRON INC
505 W. CARMEL DRIVE CARMEL, IN. 46032

SCHEMATIC
VHF-FM MOBILE XCVR
MODEL: RPM-150

DRAWN BY: C.KRESSEL
DATE: 08/27/92
SIZE: D
FSCM NO.: FILE:0051ATF1
DWG NO.: 1730051F
REV: F
PLOT 10/04/93
SHEET 1 OF 2

REVISIONS		
REV	ECN #	DATE

TX ENABLE
+V SW
TX MODULATION
16.800MHZ
LATCH
DATA
CLOCK
LOCK DET
HI/LO PWR
+V TX
+V RX
+V BATT
FROM BATTERY
BATTERY CONNECTOR
ANTENNA
50 OHMS
VCO SHIELD
SYNTHESIZER SHIELD
TX POWER AMP SHIELD

LAST NUMBERS USED

C373	C437	C548
R384	R488	R526
Q322	Q403	Q583
L308	L415	L508
CR387	CR404	CR508
IC304	Z409	Z506
Z307		

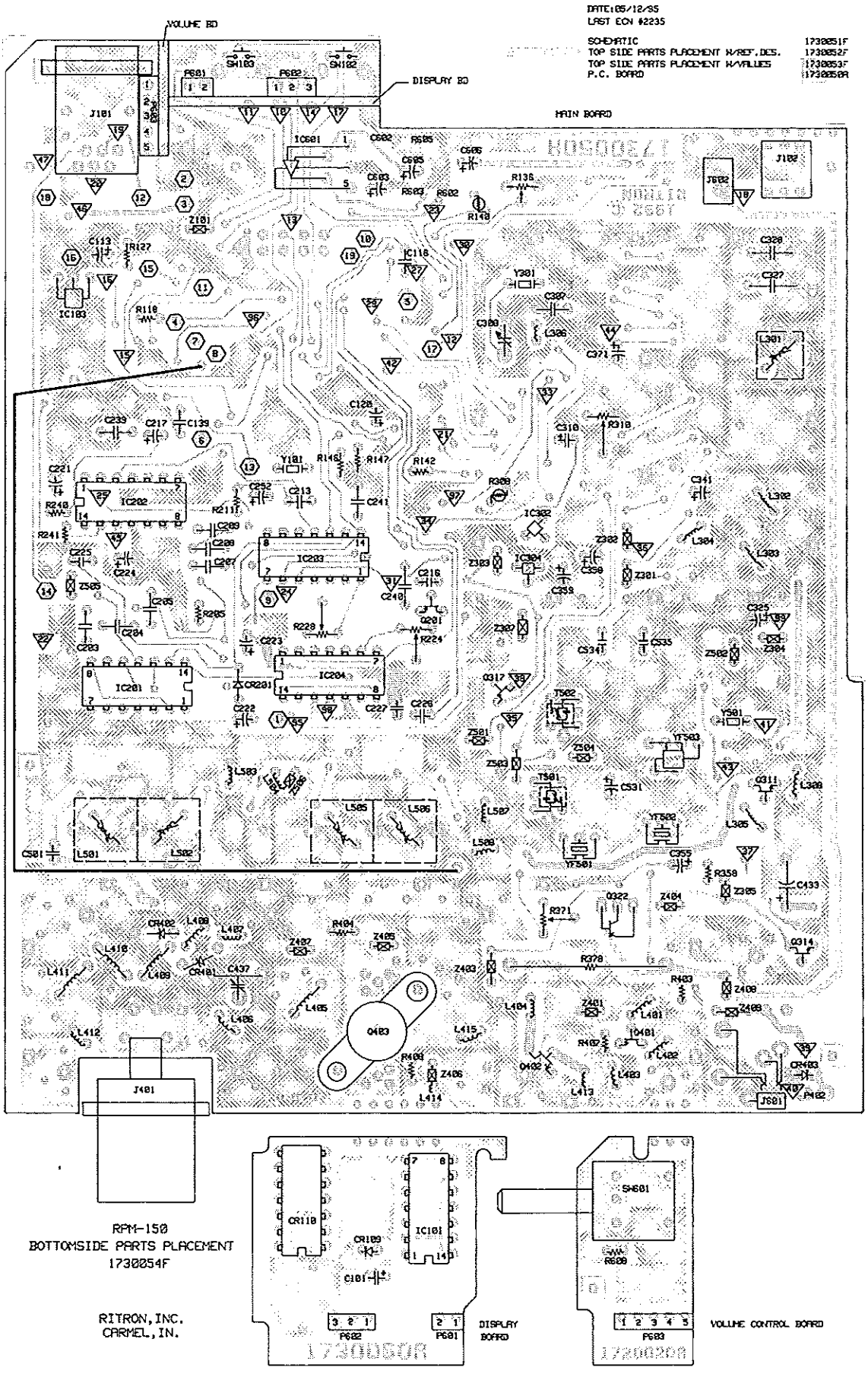
NUMBERS MISSING

C301	C416	C544
C316	C422	C547
C319	C432	R512-515
C326	R485	R517
C367	R486	R519
C369	Z482	CR505
R338		CR506
Z305		

RITRON INC
505 W. CARMEL DRIVE CARMEL,IN. 46032

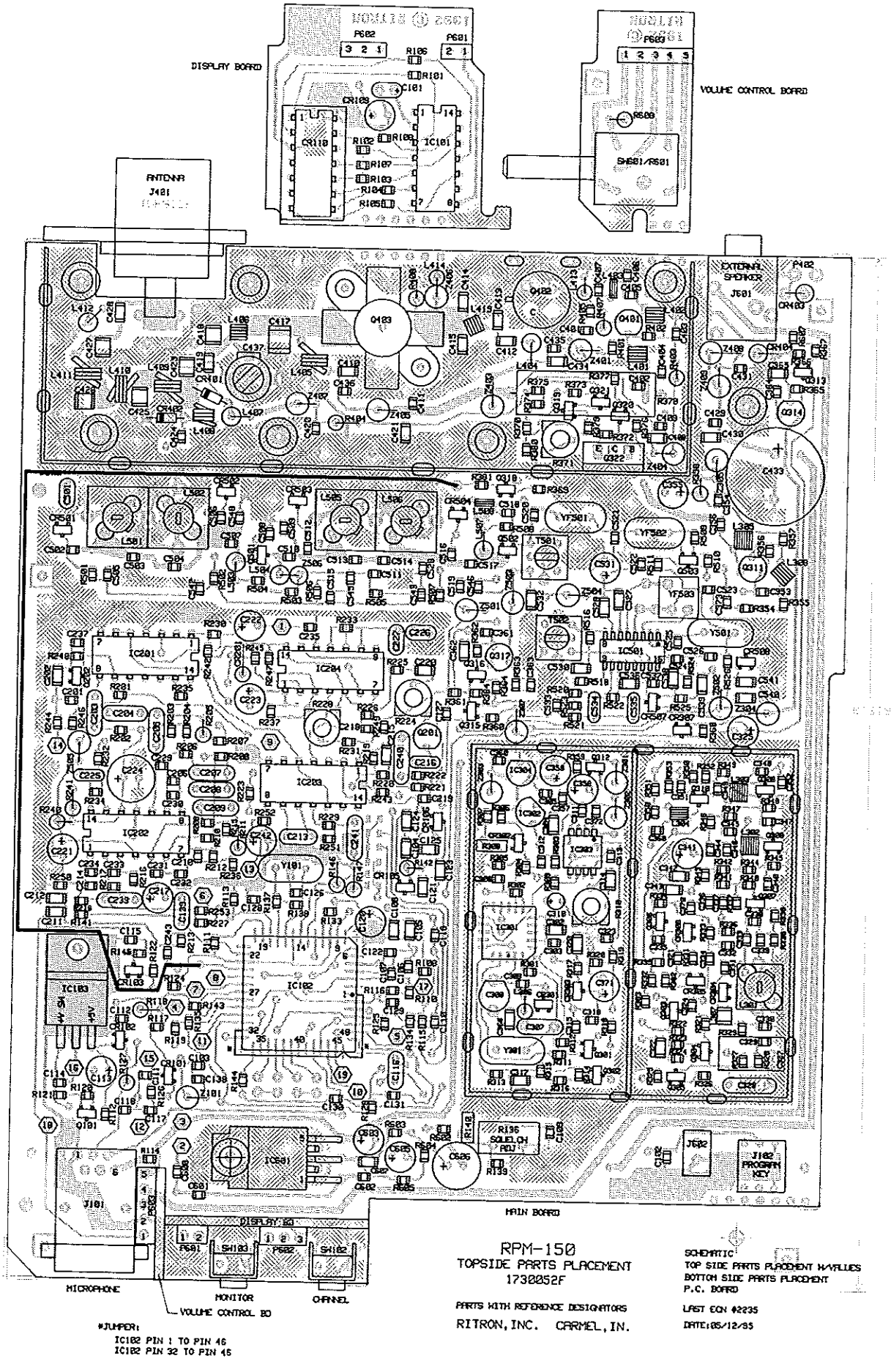
SCHEMATIC
VHF-FM MOBILE XCVR
MODEL: RPM-150

DRAWN BY	SIZE	FSCM NO.	DWG NO.	REV
C.KRESSEL	D	FILE:0051ATF2	1730051F	F
DATE 08/27/92	PLOT 12/07/94		SHEET 2 OF 2	



RPM-150
BOTTOMSIDE PARTS PLACEMENT
1730054F

RITRON, INC.
CARMEL, IN.



RPM-150
TOPSIDE PARTS PLACEMENT
1730052F

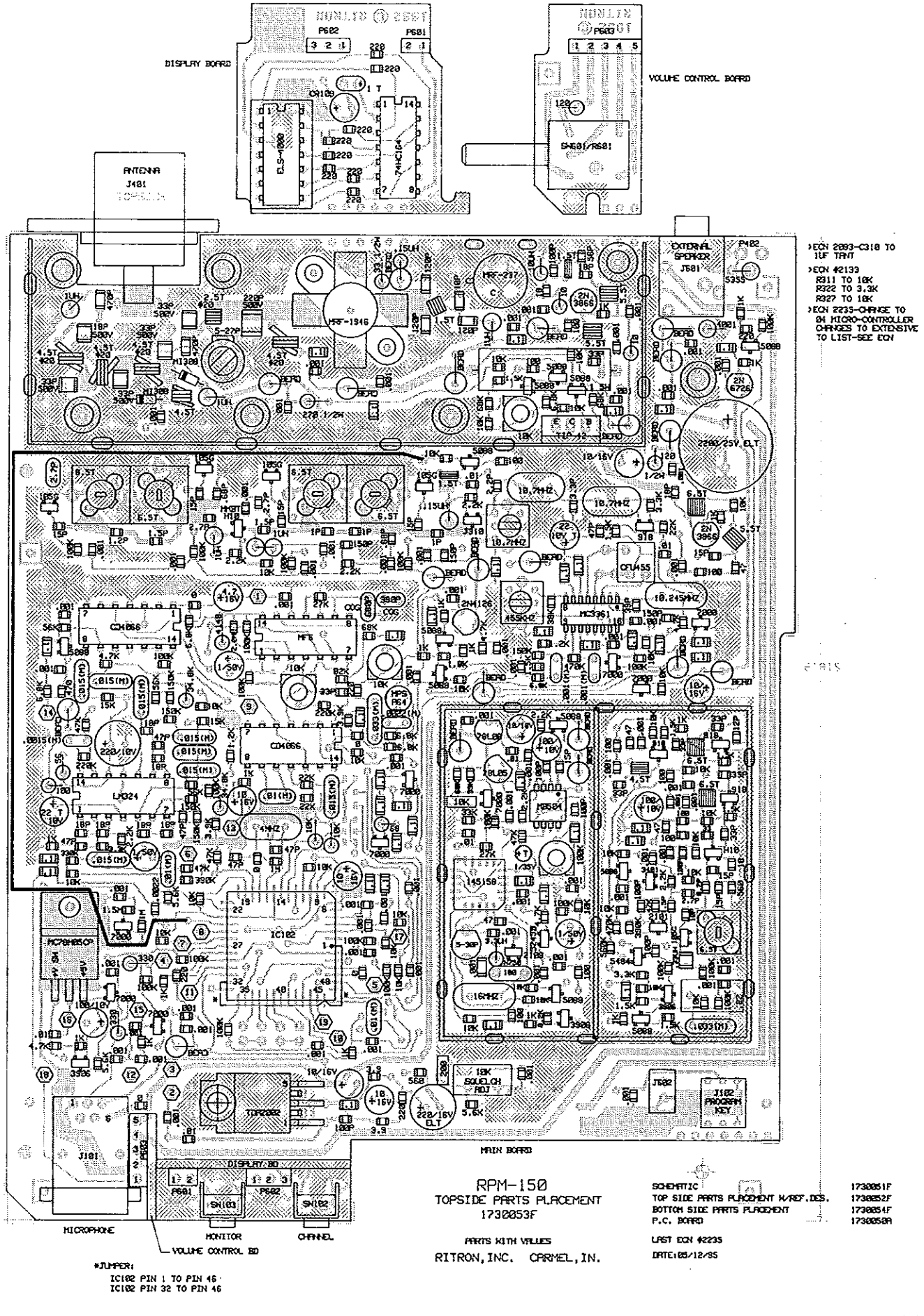
PARTS WITH REFERENCE DESIGNATORS

RITRON, INC. CARMEL, IN.

SCHEMATIC 1730051F
TOP SIDE PARTS PLACEMENT W/VALUES 1730053F
BOTTOM SIDE PARTS PLACEMENT 1730054F
P.C. BOARD 1730058A

LAST ECN #2235

DATE:05/12/85


DISPLAY BOARD
VOLUME CONTROL BOARD
ANTENNA
J401
EXTERNAL SPEAKER
J581
P102
ECN 2083-C318 TO 1UF TANT
ECN #2133
R311 TO 10K
R322 TO 3.3K
R327 TO 10K
ECN 2235-CHANGE TO 84 MICRO-CONTROLLER CHANGES TO EXTENSIVE TO LIST-SEE ECN
MAIN BOARD
MICROPHONE
MONITOR
CHANNEL
VOLUME CONTROL BD
*JUMPER:
IC102 PIN 1 TO PIN 46
IC102 PIN 32 TO PIN 46
RPM-150
TOPSIDE PARTS PLACEMENT
1730053F
PARTS WITH VALUES
RITRON, INC. CARMEL, IN.
SCHEMATIC 1730051F
TOP SIDE PARTS PLACEMENT W/REF.DES. 1730052F
BOTTOM SIDE PARTS PLACEMENT 1730054F
P.C. BOARD 1730058A
LAST ECN #2235
DATE:08/12/95

18. RPM-150 SCHEMATIC REF. PARTS LIST (SCHEMATIC #1730051B)

NOTE: This parts list reflects the most current component values (through ECN 2235) for schematic number 1730051B (PCB #1730050A). If a component value given in the schematic differs from that in the parts list, the parts list should be considered correct.

REF #	RITRON #	DESCRIPTION
CAPACITORS, NPO, 0805, CHIP, FIXED, 50V, UNLESS STATED OTHERWISE		
C 101	01502007	1 µF TANT 35V .1 20%
C 102	15111102	.001 µF X7R 0805
C 103	15111102	.001 µF X7R 0805
C 104	15121104	.1 µF X7R 1206
C 105	15121104	.1 µF X7R 1206
C 106	15111102	.001 µF X7R 0805
C 107	15111102	.001 µF X7R 0805
C 108	15121104	.1 µF X7R 1206
C 109	15111102	.001 µF X7R 0805
C 110	15111102	.001 µF X7R 0805
C 111	15111102	.001 µF X7R 0805
C 112	15111102	.001 µF X7R 0805
C 113	01503110	100 µF ELT 10V
C 114	15111103	.01 µF X7R 0805
C 115	15111102	.001 µF X7R 0805
C 116	01501050	.01 µF MYLAR 100V 10%
C 117	15111102	.001 µF X7R 0805
C 118	15111102	.001 µF X7R 0805
C 119	15111102	.001 µF X7R 0805
C 120	01503006	10 µF ELT 16V
C 121	15121104	.1 µF X7R 1206
C 122	15111102	.001 µF X7R 0805
C 123	15121104	.1 µF X7R 1206
C 124	15121104	.1 µF X7R 1206
C 125	15121104	.1 µF X7R 1206
C 126	15110470	47 pF
C 127	15111102	.001 µF X7R 0805
C 128	15110470	47 pF
C 129	15111102	.001 µF X7R 0805
C 130	15111102	.001 µF X7R 0805
C 131	15111102	.001 µF X7R 0805
C 138	15111102	.001 µF X7R 0805
C 139	01501050	.01 µF MYLAR 100V 10%
C 201	15111102	.001 µF X7R 0805
C 202	15121104	.1 µF X7R 1206
C 203	01501062	.015 µF MYLAR 100V 10%
C 204	01501062	.015 µF MYLAR 100V 10%
C 205	01501062	.015 µF MYLAR 100V 10%
C 206	15110470	47 pF
C 207	01501062	.015 µF MYLAR 100V 10%
C 208	01501062	.015 µF MYLAR 100V 10%
C 209	01501062	.015 µF MYLAR 100V 10%
C 210	15110470	47 pF
C 211	15121104	.1 µF X7R 1206
C 212	15121104	.1 µF X7R 1206
C 213	01501050	.01 µF MYLAR 100V 10%
C 214	15110470	47 pF
C 215	15121104	.1 µF X7R 1206
C 216	01501041	.0022 µF MYLAR 100V 10%
C 217	01503002	1 µF ELT
C 218	15110330	33 pF
C 219	15111102	.001 µF X7R 0805
C 220	15121104	.1 µF X7R 1206
C 221	01502015	22 µF TANT 10V 20%
C 222	01503005	4.7 µF ELT 16V
C 223	01503002	1 µF ELT
C 224	01503018	220 µF ELT 10V
C 225	01501065	.0015 µF MYLAR 100V 10%
C 226	01515034	390 pF COG MLCERDIS
C 227	01515037	680 pF COG MLCERDIS
C 229	15110180	18 pF
C 230	15110180	18 pF
C 231	15110180	18 pF
C 232	15110180	18 pF
C 233	15110180	18 pF
C 234	15110180	18 pF
C 235	15111102	.001 µF X7R 0805
C 237	15111102	.001 µF X7R 0805
C 239	01501062	.015 µF MYLAR 100V 10%
C 240	01501053	.033 µF MYLAR 100V 10%
C 241	01501062	.015 µF MYLAR 100V 10%
C 242	01503006	10 µF ELT 16V
C 243	15111222	.0022 µF
C 302	15121104	.1 µF X7R 1206
C 303	15111102	.001 µF X7R 0805
C 304	15121104	.1 µF X7R 1206
C 305	15111103	.01 µF X7R 0805
C 306	15111103	.01 µF X7R 0805
C 307	01510730	180 pF N750 CERDIS
C 308	01550006	5-30 pF VAR CERDIS
C 309	15111102	.001 µF X7R 0805
C 310	01502007	1 µF TANT
C 311	15110101	100 pF
C 312	15111102	.001 µF X7R 0805
C 313	15110101	100 pF
C 314	15121104	.1 µF X7R 1206
C 315	15111102	.001 µF X7R 0805
C 317	15121104	.1 µF X7R 1206
C 318	15111102	.001 µF X7R 0805
C 320	15121104	.1 µF X7R 1206
C 321	15110101	100 pF
C 322	15121104	.1 µF X7R 1206
C 323	15111102	.001 µF X7R 0805
C 324	15110101	100 pF
C 325	01503006	10 µF ELT 16V
C 327	01501071	.22 µF MLPOLY 5 %
C 328	01501053	.033 µF MYLAR 100V 10%
C 329	15111102	.001 µF X7R 0805
C 330	15111102	.001 µF X7R 0805
C 331	15110100	10 pF
C 332	151102A7	2.7 pF
C 333	151108A2	8.2 pF
C 334	151101A5	1.5 pF
C 335	15111102	.001 µF X7R 0805
C 336	15111102	.001 µF X7R 0805
C 337	15110101	100 pF
C 338	15110150	15 pF
C 339	15110150	15 pF
C 340	15110330	33 pF
C 341	01503110	100 µF ELT 10V
C 342	15121104	.1 µF X7R 1206

REF #	RITRON #	DESCRIPTION
C 343	15121104	.1 µF X7R 1206
C 344	15111102	.001 µF X7R 0805
C 345	15111102	.001 µF X7R 0805
C 346	15111102	.001 µF X7R 0805
C 347	15110330	33 pF
C 348	15110330	33 pF
C 349	15110330	33 pF
C 350	15111102	.001 µF X7R 0805
C 351	15111102	.001 µF X7R 0805
C 352	15110120	12 pF
C 353	15110150	15 pF
C 354	15111102	.001 µF X7R 0805
C 355	01503006	10 µF ELT 16V
C 356	15110180	18 pF
C 357	15111102	.001 µF X7R 0805
C 358	01503110	100 µF ELT 10V
C 359	01503006	10 µF ELT 16V
C 360	15111102	.001 µF X7R 0805
C 361	15111102	.001 µF X7R 0805
C 362	15121104	.1 µF X7R 1206
C 363	15111102	.001 µF X7R 0805
C 364	15111102	.001 µF X7R 0805
C 365	15121104	.1 µF X7R 1206
C 366	15121104	.1 µF X7R 1206
C 368	15110330	33 pF
C 370	15111102	.001 µF X7R 0805
C 371	01503002	1 µF ELT
C 372	15110150	15 pF
C 373	15111102	.001 µF X7R 0805
C 401	15111102	.001 µF X7R 0805
C 402	15110330	33 pF
C 403	15111102	.001 µF X7R 0805
C 404	15111102	.001 µF X7R 0805
C 405	15110180	18 pF
C 406	15110560	56 pF
C 407	15110101	100 pF
C 408	15121104	.1 µF X7R 1206
C 409	15111102	.001 µF X7R 0805
C 410	15121104	.1 µF X7R 1206
C 411	15111102	.001 µF X7R 0805
C 412	15120121	120 pF NPO 1206
C 413	15120180	18 pF NPO 1206
C 414	15120121	120 pF NPO 1206
C 415	15120121	120 pF NPO 1206
C 417	15525221	220 µF SURFACE MT MICA 500V
C 418	15525330	33 pF MICA 1210
C 419	15120471	470 pF NPO 1206
C 420	15111102	.001 µF X7R 0805
C 421	15121104	.1 µF X7R 1206
C 423	15525330	33 pF MICA 1210
C 424	15111102	.001 µF X7R 0805
C 425	15525330	33 pF MICA 1210
C 426	15525330	33 pF MICA 1210
C 427	15525180	18 pF NPO 1210 500V MICA
C 428	15120471	470 pF NPO 1206
C 429	15111102	.001 µF X7R 0805
C 430	15121104	.1 µF X7R 1206
C 431	15111102	.001 µF X7R 0805
C 433	01503208	2200 µF ELT 25V
C 434	15121104	.1 µF X7R 1206
C 435	15111102	.001 µF X7R 0805
C 436	15111102	.001 µF X7R 0805
C 437	01550003	5-27 pF VARPRO
C 501	01510008	2.7 pF NP0 CERDIS
C 502	15110150	15 pF
C 503	151101A2	1.2 pF
C 504	151101A5	1.5 pF
C 505	15111102	.001 µF X7R 0805
C 506	15110150	15 pF
C 507	151102A7	2.7 pF
C 508	15111102	.001 µF X7R 0805
C 509	151102A7	2.7 pF
C 510	151101A5	1.5 pF
C 511	15110151	150 pF
C 512	15110150	15 pF
C 513	151101A0	1.0 pF
C 514	151101A0	1.0 pF
C 515	15111102	.001 µF X7R 0805
C 516	15110150	15 pF
C 517	151101A0	1.0 pF
C 518	15111103	.01 µF X7R 0805
C 519	15111102	.001 µF X7R 0805
C 520	151102A2	2.2 pF
C 521	151103A3	3.3 pF
C 522	15110470	47 pF
C 523	15111103	.01 µF X7R 0805
C 524	15111102	.001 µF X7R 0805
C 525	15110390	39 pF
C 526	15110151	150 pF
C 527	15121104	.1 µF X7R 1206
C 528	15121104	.1 µF X7R 1206
C 529	15110A68	.68 pF
C 530	15121104	.1 µF X7R 1206
C 531	01502015	22 µF TANT 10V
C 532	15121104	.1 µF X7R 1206
C 533	15111102	.001 µF X7R 0805
C 534	01501040	.001 µF MYLAR 100V 10%
C 535	01501040	.001 µF MYLAR 100V 10%
C 536	15121104	.1 µF X7R 1206
C 537	15111102	.001 µF X7R 0805
C 538	15121104	.1 µF X7R 1206
C 539	15121104	.1 µF X7R 1206
C 540	15121104	.1 µF X7R 1206
C 541	15121104	.1 µF X7R 1206
C 542	15111102	.001 µF X7R 0805
C 543	15111102	.001 µF X7R 0805
C 545	15111102	.001 µF X7R 0805
C 546	15110151	150 pF
C 548	15110A68	.68 pF
C 601	15111103	.01 µF X7R 0805
C 602	15110101	100 pF
C 603	01503006	10 µF ELT 16V
C 605	01503006	10 µF ELT 16V
C 606	01503011	220 µF ELT 16V
C 607	15121104	.1 µF X7R 1206
C 608	15111102	.001 µF X7R 0805

DIODES

CR101	48A1005C	MMBD7000 DUAL SOT-23 5C
CR102	48A1005C	MMBD7000 DUAL SOT-23 5C
CR103	48A1005C	MMBD7000 DUAL SOT-23 5C
CR105	48A1005C	MMBD7000 DUAL SOT-23 5C
CR106	48A1005C	MMBD7000 DUAL SOT-23 5C
CR109	02450006	MINIATURE RED LED
CR110	02450101	7 SEGMENT GRN LED COM. CATH
CR201	04810001	1N4148 /GENERAL PURPOSE
CR301	48C1004J	VVC 26-32PF (4J) MMBV2109

REF #	RITRON #	DESCRIPTION
CR302	48A1005C	MMBD7000 DUAL SOT-23 5C
CR303	48B1008W	ZENER SOT-23 (8W) MMBZ5245
CR304	48C1004E	VVC MMBV-105G SOT-23 (4E)
CR305	48C1004G	MMBV-2101L VVC SOT-23 4G\\
CR306	48A1004D	MMBV3401TI UHF SOT-23 (4D)
CR307	48A1005C	MMBD7000 DUAL SOT-23 5C
CR401	04810033	PIN 25W GLASS AXIAL MI308
CR402	04810033	PIN 25W GLASS AXIAL MI308
CR403	04820119	1N5355A ZENER 18V 5W
CR404	04810003	1N4001 50 VOLT/1AMP
CR501	48C1004E	VVC MMBV-105G SOT-23 (4E)
CR502	48C1004E	VVC MMBV-105G SOT-23 (4E)
CR503	48C1004E	VVC MMBV-105G SOT-23 (4E)
CR504	48C1004E	VVC MMBV-105G SOT-23 (4E)
CR507	48A1005C	MMBD7000 DUAL SOT-23 5C
CR508	48A1005C	MMBD7000 DUAL SOT-23 5C

INTEGRATED CIRCUITS

IC101	03144164	8 BIT SHIFT REGISTER
IC102	314B0004	MICRO PROGRAMABLE RADIO
IC103	03131016	MC78MO5CY 5 VOLT REG (TO-220)
IC201	03134066	CD4066BCP QUAD ANALOG GATE
IC202	03131004	LM324 QUAD OP AMP
IC203	03134066	CD4066BCP QUAD ANALOG GATE
IC204	03132027	MF6 6 POLE FILTER IC
IC301	31137001	FREQ SYNTH INPUT PLCC-20
IC302	03131012	MC78L05CP 5V REGULATOR
IC303	31131001	PCALER 2 MOD MO-1 MB504
IC304	03131013	MC78L08CP 8 VOLT REG
IC501	31030001	IF SUBSYSTEM MC3361BD SO-16
IC601	03131050	8 WATT AUDIO AMPLIFIER

CONNECTORS

J 101	02100310	6-PIN MODULAR PHONE JACK
J 401	02100330	UHF REAR MT BLKHD RCEPTACLE
J 601	02100053	3.5MM STEREO JACK PANEL MT

JUMPERS

J U101	06001048	#30 AWG GREEN KYNAR
J U102	06001048	#30 AWG GREEN KYNAR

INDUCTORS

L 301	01850306	6.5T SHIELDED
L 302	01870956	6.5T AIRFCW .12 a L
L 303	01870956	6.5T AIRFCW .12 a L
L 304	01870954	4.5T AIRFCW .09 a L
L 305	01870956	6.5T AIRFCW .12 a L
L 306	01800219	3.3 µH MOL FCW .250 a
L 307	18110331	.33µH CHIP INDUCTOR
L 308	01870955	5.5T AIRFCW .1 a L
L 401	01870955	5.5T AIRFCW .1 a L
L 402	01870955	5.5T AIRFCW .1 a L
L 403	01870951	1.5T AIRFCW .03 a L
L 404	01800145	1 µH PHE FCW .250 aR
L 405	01802048	4.5T #20
L 406	01802022	AIRFSW M2.5T .125 A-.187 #20
L 407	01800213	1 µH MOL FCW .250 a
L 408	01870954	4.5T AIRFCW .09 a L
L 409	01802048	4.5T #20
L 410	01802048	4.5T #20
L 411	01802048	4.5T #20
L 412	01800213	1 µH MOL FCW .250 a
L 413	01800225	10 µH MOL FCW .250 a
L 414	01800101	.15 µH PHE FCW .250 aR
L 415	01870951	1.5T AIRFCW .03 a L
L 501	01850016	6.5T MOLFSW .25 AL CORE
L 502	01850016	6.5T MOLFSW .25 AL CORE
L 503	01800213	1 µH MOL FCW .250 a
L 504	01800213	1 µH MOL FCW .250 a
L 505	01850016	6.5T MOLFSW .25 AL CORE
L 506	01850016	6.5T MOLFSW .25 AL CORE
L 508	01870951	1.5T AIRFCW .03 a L

TRANSISTORS

Q 101	4801002A	MMBT3906L PNP SOT-23 2A
Q 201	04800008	MPS-A64 PNP DARLINGTON
Q 202	4801001Q	MMBT-5088 SOT-23 1Q
Q 301	4801001Q	MMBT-5088 SOT-23 1Q
Q 302	4801002A	MMBT3906L PNP SOT-23 2A
Q 303	4841006B	NFET GP SOT-23 (6B) MMBF5484
Q 304	4801002A	MMBT3906L PNP SOT-23 2A
Q 305	4801001Q	MMBT-5088 SOT-23 1Q
Q 306	4801001Q	MMBT-5088 SOT-23 1Q
Q 307	4821003E	MMBT-H10 VHF SOT-23 (3E)
Q 308	4821003B	MMBT-918 VHF SOT-23 (3B)
Q 309	4821003B	MMBT-918 VHF SOT-23 (3B)
Q 310	4821003B	MMBT-918 VHF SOT-23 (3B)
Q 311	04800030	MPS-3866 NPN RF MED PWR
Q 312	4801001Q	MMBT-5088 SOT-23 1Q
Q 313	4801001Q	MMBT-5088 SOT-23 1Q
Q 314	04800018	2N6726 PNP PWR
Q 315	4801001Q	MMBT-5088 SOT-23 1Q
Q 316	4801001Q	MMBT-5088 SOT-23 1Q
Q 317	04800011	2N4126 PNP GP AUDIO TO-92
Q 318	4801001Q	MMBT-5088 SOT-23 1Q
Q 319	4801001Q	MMBT-5088 SOT-23 1Q
Q 320	4801001Q	MMBT-5088 SOT-23 1Q
Q 321	4801001Q	MMBT-5088 SOT-23 1Q
Q 322	04800019	TIP-42 40V 6A PNP PWR
Q 401	04800030	MPS-3866 NPN RF MED PWR
Q 402	04801002	MRF-237 NPN VHF AMP TO-39
Q 403	04801029	MRF-1946 30W RF POWER
Q 501	4821003E	MMBT-H10 VHF SOT-23 (3E)
Q 502	4841006T	NFET GP SOT-23 (6T) MMBFJ310T1
Q 503	4821003B	MMBT-918 VHF SOT-23 (3B)

RESISTORS, 0805 CHIP, FIXED, 1/10W, 5%, CF UNLESS STATED OTHERWISE

R 101	47100221	220 Ω
R 102	47100221	220 Ω
R 103	47100221	220 Ω
R 104	47100221	220 Ω
R 105	47100221	220 Ω
R 106	47100221	220 Ω
R 107	47100221	220 Ω
R 108	47100221	220 Ω
R 109	47100103	10 KΩ
R 110	47100103	10 KΩ
R 111	47100103	10 KΩ
R 112	47100562	5.6 KΩ
R 113	47100473	47 KΩ
R 114	47100000	ZERO Ω

REF #	RITRON #	DESCRIPTION
R 115	47100103	10 KΩ
R 116	47100104	100 KΩ
R 117	47100104	100 KΩ
R 118	04700127	330 Ω 5% 1/4W CF
R 119	47100102	1 KΩ
R 120	47100102	1 KΩ
R 121	47100472	4.7 KΩ
R 122	47100105	1 MΩ
R 124	47100103	10 KΩ
R 125	47100000	ZERO Ω
R 126	47100102	1 KΩ
R 127	04700127	330 Ω 5% 1/4W CF
R 128	47100102	1 KΩ
R 133	47100103	10 KΩ
R 134	47100104	100 KΩ
R 135	47100221	220 Ω
R 136	04750004	10 KΩ TRIM POT VERT/MINI
R 137	47100000	ZERO Ω
R 138	47100105	1 M Ω
R 139	47100562	5.6 KΩ
R 140	04750101	THERMISTOR 200 Ω
R 141	47100103	10 KΩ
R 142	04700119	68 Ω 5% 1/4W CF
R 143	47100104	100 KΩ
R 144	47100104	100 KΩ
R 145	47100155	1.5 MΩ 1/10W
R 146	04700145	10 KΩ 1/4W 5% CF
R 147	04700145	10 KΩ 1/4W 5% CF
R 201	47100472	4.7 KΩ
R 202	47100153	15 KΩ
R 203	47100563	56 KΩ
R 204	47100154	150 KΩ
R 205	04732496	34.8 KΩ 1% METAL FILM 1/4
R 206	47100154	150 KΩ
R 207	47100103	10 KΩ
R 208	47100153	15 KΩ
R 209	47100563	56 KΩ
R 210	47100154	150 KΩ
R 211	04732496	34.8 KΩ 1% METAL FILM 1/4
R 212	47100154	150 KΩ
R 213	47100562	5.6 KΩ
R 215	47100104	100 KΩ
R 216	47100222	2.2 KΩ
R 217	47100332	3.3 KΩ
R 218	47100334	330 KΩ 1/10W
R 219	47100392	3.9 KΩ
R 220	47100000	ZERO Ω
R 221	47100682	6.8 KΩ 1/10W 5%
R 222	47100682	6.8 KΩ 1/10W 5%
R 223	47100122	1.2 KΩ
R 224	04750049	10 KΩ PIHER POT (MINI)
R 225	47100683	68 KΩ
R 226	47100823	82 KΩ
R 227	47100394	390 KΩ
R 228	04750049	10 KΩ PIHER POT (MINI)
R 229	47100223	22 KΩ
R 230	47100000	ZERO Ω
R 231	47100224	220 KΩ
R 232	47100473	47 KΩ
R 233	47100273	27 KΩ
R 234	47100224	220 KΩ
R 235	47100104	100 KΩ
R 236	47100392	3.9 KΩ
R 237	47100104	100 KΩ
R 240	04700121	100 Ω 5% 1/4W CF
R 241	04700118	56 Ω 1/4W 5% CF
R 242	47100682	6.8 KΩ 1/10W 5%
R 243	47100103	10 KΩ
R 244	47100682	6.8 KΩ 1/10W 5%
R 245	47100225	2.2 MΩ 1/10W
R 246	47100471	470 Ω
R 247	47100104	100 KΩ
R 248	47100563	56 KΩ
R 249	47100221	220 Ω
R 250	47100102	1 KΩ
R 251	47100223	22 KΩ
R 252	47100102	1 KΩ
R 253	47100473	47 KΩ
R 301	47100470	47 Ω
R 302	47100273	27 KΩ
R 303	47100222	2.2 KΩ
R 304	47100104	100 KΩ
R 305	47100333	33 KΩ
R 306	47100393	39 KΩ 1/10 W
R 307	47100683	68 KΩ
R 308	04750100	THERMISTOR 10 KΩ
R 309	47100473	47 KΩ
R 310	04750050	100 KΩ PIHER POT (MINI)
R 311	47100103	10 KΩ
R 312	47100103	10 KΩ
R 313	47100103	10 KΩ
R 314	47100822	8.2 KΩ
R 315	47100101	100 Ω
R 316	47100102	1 KΩ
R 317	47100472	4.7 KΩ
R 318	47100101	100 Ω
R 319	47100103	10 KΩ
R 320	47100104	100 KΩ
R 321	47100104	100 KΩ
R 322	47100332	3.3 KΩ
R 323	47100103	10 KΩ
R 324	47100152	1.5 KΩ
R 325	47100102	1 KΩ
R 326	47100152	1.5 KΩ
R 327	47100103	10 KΩ
R 328	47100104	100 KΩ
R 329	47100104	100 KΩ
R 331	47100473	47 KΩ
R 332	47100474	470 KΩ
R 333	47100222	2.2 KΩ
R 334	47100103	10 KΩ
R 335	47100103	10 KΩ
R 336	47100103	10 KΩ
R 337	47100103	10 KΩ
R 338	47100561	560 Ω
R 339	47100180	18 Ω
R 340	47100330	33 Ω
R 341	47100101	100 Ω
R 342	47100101	100 Ω
R 343	47100470	47 Ω
R 344	47100103	10 KΩ
R 345	47100152	1.5 KΩ
R 346	47100101	100 Ω
R 347	47100103	10 KΩ
R 348	47100152	1.5 KΩ
R 349	47100102	1 KΩ
R 350	47100103	10 KΩ
R 351	47100101	100 Ω

REF #	RITRON #	DESCRIPTION
R 352	47100152	1.5 KΩ
R 353	47100470	47 Ω
R 354	47100101	100 Ω
R 355	47100470	47 Ω
R 356	47100102	1 KΩ
R 357	47100103	10 KΩ
R 358	04710021	120 Ω 1/2W 5% CF
R 359	47100222	2.2 KΩ
R 360	47100103	10 KΩ
R 361	47100102	1 KΩ
R 362	47100102	1 KΩ
R 363	47100472	4.7 KΩ
R 364	47100102	1 KΩ
R 365	47100102	1 KΩ
R 366	47100221	220 Ω
R 367	47100104	100 KΩ
R 368	47100103	10 KΩ
R 369	47100101	100 Ω
R 370	47100683	68 KΩ
R 371	04750049	10 KΩ PIHER POT (MINI)
R 372	47100103	10 KΩ
R 373	47100101	100 Ω
R 374	47100152	1.5 KΩ
R 375	47100103	10 KΩ
R 376	47100683	68 KΩ
R 377	47100103	10 KΩ
R 378	04720047	.1 Ω 10% 3W WIREWOUND
R 379	47100682	6.8 KΩ 1/10W 5%
R 380	47100103	10 KΩ
R 381	47100103	10 KΩ
R 382	47100394	390 KΩ
R 383	47100564	560 KΩ 1/10 W
R 384	47100182	1.8 KΩ 1/10 W
R 401	47100101	100 Ω
R 402	47100102	1 KΩ
R 403	04700108	10 Ω 5% 1/4W CF
R 404	04710025	270 Ω 1/2W 5% CF
R 405	47100180	18 Ω
R 407	04700108	10 Ω 5% 1/4W CF
R 408	04710014	33 Ω 1/2W 5% CF
R 501	47100104	100 KΩ
R 502	47100104	100 KΩ
R 503	47100103	10 KΩ
R 504	47100222	2.2 KΩ
R 505	47100222	2.2 KΩ
R 506	47100104	100 KΩ
R 507	47100104	100 KΩ
R 508	47100222	2.2 KΩ
R 509	47100332	3.3 KΩ
R 510	47100223	22 KΩ
R 511	47100152	1.5 KΩ
R 516	47100393	39 KΩ 1/10 W
R 518	47100122	1.2 KΩ
R 520	47100154	150 KΩ
R 521	47100682	6.8 KΩ 1/10W 5%
R 522	47100474	470 KΩ
R 523	47100152	1.5 KΩ
R 524	47100103	10 KΩ
R 525	47100104	100 KΩ
R 526	47100472	4.7 KΩ
R 601	04750053	10 KΩ POT W/SPST AUD PCMNT
R 603	471003A9	3.9 Ω 1/10W
R 604	47100221	220 Ω
R 605	471003A9	3.9 Ω 1/10W
R 607	47100102	1 KΩ
R 608	04700122	120 Ω 5% 1/4W CF

SPEAKER

SP601	05500027	SPKR 1.75 X 3.0 OVAL 4W ALNIC

SWITCHES

SW102	05100042	SW SPST MOMENT MINI PC 260GM
SW103	05100042	SW SPST MOMENT MINI PC 260GM

TRANSFORMERS

T 501	05600001	10.7MHZ IF XFORMER/ZAMCO
T 502	05600002	455KHZ IF XFORMER/ZAMCO

CRYSTALS

Y 101	02300058	4.0MHZ HIGH STABILITY
Y 301	02300060	16MHZ SYNTH REF
Y 501	02300005	10.245MHZ 2ND LO XTAL

FILTERS

YF501	02301001	10.7MHZ 2 POLE MONO
YF502	02301001	10.7MHZ 2 POLE MONO
YF503	02301008	CERAMIC CFU-455E2

FERRITE BEADS ON AXIAL LEADS UNLESS STATED OTHERWISE

Z 101	01801029	
Z 301	01801029	
Z 302	01801029	
Z 303	01801029	
Z 304	01801029	
Z 305	01801029	
Z 307	01801029	
Z 401	01801029	
Z 403	01801029	
Z 404	01801029	
Z 405	01801029	
Z 406	01801003	BEAD FAIR-RITE 2643000301
Z 407	01801029	
Z 408	01801029	
Z 409	01801029	
Z 501	01801029	
Z 502	01801029	
Z 503	01801029	
Z 504	01801029	
Z 505	01801029	
Z 506	01801003	BEAD FAIR-RITE 2643000301

MODEL RPM-450 (UHF) MAINTENANCE/REPAIR

IMPORTANT: The RPM-450 maintenance/repair part of this manual covers two versions of the UHF printed circuit board. (The most recent version is extensively surface mount.) Schematics, parts placement diagrams and parts lists are included for each version of the UHF board. Other RPM-450 information applies to both versions.

To determine which schematics, parts placement diagrams and parts lists to use for a RPM-450 radio, you must know which version of the PC board you have. The radio PC board number (version) is found on the bottom side of the PCB. Match this number, normally eight digits ("17xxxxxx"), to the appropriate set of schematics, diagrams and parts lists.

The two RPM-450 (UHF) PC boards covered in this manual are PCB #17031002 and PCB #1730080D.

⇩ PCB #17031002/SCHEMATIC #17731002 ⇩

19. RPM-450 THEORY OF OPERATION

Refer to the RPM-450 schematics while reading this section. The theory of operation is nearly identical for both versions of the UHF PC board. Differences are noted in the description below.

19.1 POWER SUPPLY

The RPM-450 is powered by an external source (+V BATT) via the battery connector (P402, J402). Zener diode CR403 *(for Schematic 1730081D, CR403-4)* clamps any high amplitude spikes on the supply line, and causes fuse F401 to blow if the supply rises above +18 Volts. Battery voltage is tied to the on/off volume control (R/SW601), which applies +V SW to the radio circuitry.

C356 and C357 provide filtering for IC304, an +8 Volt regulator that supplies the VCO, reference oscillator, frequency temperature compensation circuit and IC303. Q316, R353, C358 and C359 form a capacitance multiplier power supply filter *(not present in Schematic 1730081D)*. Voltage regulator IC303 provides +5 VDC for synthesizer controller IC301, prescaler IC302 and, Q301 and Q302 of the charge pump. *(For Schematic 1730081D, regulator IC303 applies +5 VDC to prescaler/synthesizer controller IC301 and to Q301 of the charge pump.)*

Regulator IC103 applies +5 VDC to microcontroller IC102, shift register IC101, the MF6 low-pass filter, bilateral switches IC201 and IC203 of the audio conditioning circuit and, IC202. Buffer amplifier IC202D provides approximately +2 Volts for audio conditioning circuitry.

A low-voltage reset circuit (Q101, R112 and R120) protects against internal EE memory loss due to battery voltage fluctuations below about +9 Volts, by shutting off the microcomputer. A DC level below +5 Volts at the regulator (IC103) output can cause the CPU to randomly execute instructions that might include an "erase sequence." Q101 turns off when this voltage drops below +5 Volts. R113 then pulls IC102 pin 18 "low" to reset the microcomputer.

19.2 FREQUENCY SYNTHESIZER

19.2.1 VCO/BUFFER AMPLIFIER

FET Q308, L303, varactor CR305 and associated components form the VCO (Voltage Controlled Oscillator), a resonant circuit that oscillates at approximately 450 MHz. Varying the voltage at the cathode of CR305 changes the varactor's capacitance, which in turn alters the VCO output frequency; for example, when the voltage at CR305 is increased (normally, the charge in C329-331 provides this voltage), CR305's capacitance decreases, which increases the VCO output frequency. +8VDC is tied to the drain of Q308 through the power supply filter (Q316, R353, C358 and C359) and L306. *(For Schematic 1730081D, +8 VDC is applied to Q308 via Z301 and L306.)* C337 and C338 serve as a feedback network. C341 couples the oscillator signal to buffer amplifier Q309. C344, C365 and C366 function as RF bypass capacitors. The amplified signal at Q309's collector is decoupled by C343 and applied to prescaler divider IC302 pin 1 *(for Schematic 1730081D, prescaler/synthesizer controller IC301 pin 8)* and to buffer amplifier Q310. The buffered VCO signal at Q310's collector then feeds through C348 and R342 as local oscillator injection into the source of Q502, the receiver 1st mixer.

19.2.2 PRESCALER DIVIDER

IC302 squares and divides the VCO output tied to pin 1 by either 64 or 65, depending upon the synthesizer controller (IC301) logic signal applied to pin 6 of the prescaler. *(For Schematic 1730081D, IC301 contains both a prescaler and a synthesizer controller - refer to the next paragraph.)* A "high" at IC302 pin 6 instructs the prescaler to divide the VCO frequency by 64, a "low," 65. The exact number of times the prescaler is instructed to change divisors is determined by the channel frequency. The change instruction appears as a series of pulses at pin 6 of IC 302 (Note that not all frequencies cause pulses to appear at pin 6). +5VDC is supplied to IC302 at pin 2. C307 at pin 8 decouples internal divider circuitry. The prescaler output (can be observed on an oscilloscope as approximately 7 MHz) at pin 4 is coupled by C305 to IC301 pin 10.

For Schematic 1730081D, IC301 contains both a prescaler and synthesizer controller. The prescaler squares and divides the VCO output tied to pin 8 by either 64 or 65, determined by a synthesizer controller logic signal. A logic high instructs the prescaler to divide the VCO frequency by 64, a low by 65. The exact number of times the prescaler is instructed to change divisors is determined by the channel frequency. +5 VDC is supplied to IC301 at pin 4.

19.2.3 SYNTHESIZER CONTROLLER

IC301 contains a digital phase detector that works as follows - when an operating channel is changed or the receive/transmit mode switched, either of which selects a new synthesizer operating frequency, microcomputer IC102 (pin 52) clocks new data into IC301's internal buffer (pin 13, *or for Schematic 1730081D, pin 10)* in synchronization with clock pulses that appear at IC301 pin 12 *(for Schematic 1730081D, pin 9)*. Note: Signals from the microprocessor are usually too fast to observe with an oscilloscope. Until all data is loaded into the buffer, the synthesizer continues to function at the previous operating frequency.

Once all new data is loaded into the buffer, a single pulse from IC102 appears at IC301 pin 14 *(for Schematic 1730081D, pin 11)* that instructs the synthesizer controller to latch and execute the new data. IC301 utilizes internal circuitry to determine whether the present VCO output frequency is correct by comparing the phase and frequency of the prescaler output *(for schematic 1730081D, the prescaler is built into IC301)* and the 16 MHz reference oscillator. IC301 produces a negative-going pulse output signal proportional to the phase difference between the two input signals. If the VCO output frequency is too high, IC301's output appears at pin 19, too low, at pin 20. *(For schematic 1730081D, IC301's output appears at pin 16, too low, at pin 15.)*

The charge pump (Q301, Q302, Q304, Q305 and associated components) and loop filter (C329-332, R323-325 and L302) then transform the negative-going pulse into a DC voltage for application to the VCO. The synthesizer system is "locked" when the phase and frequency of both the reference and the divided VCO signal are the same.

For Schematic 1730081D, Q302 is not part of the charge pump, but acts as a high voltage source - see description below.

19.2.4 REFERENCE OSCILLATOR

The 16 MHz reference oscillator connected between IC301 pins 2 and 3 is built around crystal Y301, varactor CR301 and tuning capacitor C315. A temperature compensation circuit (R309, R326, CR301 and variable thermistor R310) provides the synthesizer controller with a constant 16 MHz reference frequency.

For schematic 1730081D, the 16 MHz reference oscillator is connected to IC301 pin 1 only. The tuning capacitor is C323. Q303 isolates the synthesizer controller from the oscillator, while a temperature compensation network (R367-369, CR307 and variable thermistors R366 and R370) maintain a stable reference frequency at IC301 pin 1.

19.2.5 OSCILLATOR MODULATION

When the unit is in transmit, gate IC203B passes modulation to the reference oscillator via C317, and to the VCO via R312. R312 routes modulation through C321 and R361 to the cathode of varactor CR304. Because CR304 is coupled to the VCO through C326, modulation causes the VCO frequency to vary. C317 applies modulation to the reference crystal to provide for the addition of any Quiet Call or Digital Quiet Call signals. If modulation were not applied to the reference, QC and DQC encode tones would be distorted as the synthesizer attempted to track them.

19.2.6 HIGH VOLTAGE SOURCE

Voltage-doubling techniques produce +16 Volts (minimum) to run the charge pump. IC301 generates a 16 MHz 0-4 Volt square wave at pin 18 to drive the high voltage circuit. The 16 MHz signal is applied to the junction of C121 and C123. During the "low" half-cycle of the square wave, this junction is essentially connected to ground; C121 charges through CR105 to +12 Volts. During its positive half-cycle the square wave rises to +4 Volts, which appears in series with the +12 Volts stored in C121 (for a total of +16 Volts). Voltage at the anode of CR106 turns on that diode, charging C124. After several cycles, the voltage across C124 reaches +16 Volts or more.

This same process occurs with C123, CR107 and CR108. During the "low" half-cycle of the square wave C123 charges via CR105 to +16 Volts. During its positive half-cycle the square wave rises to +5 Volts, which then appears in series with the +16 Volts stored in C121 (for a total of about +21 Volts). Diode voltage drops in the circuit cause the source's output to vary 2-3 Volts, depending upon instantanteous loading. The voltage output present on C125 supplies the charge pump via R314.

For Schematic 1730081D, voltage multiplier Q302, CR310 and associated components supply approximately +16 Volts to run the charge pump. Q302 amplifies the 16 MHz signal from IC301 pin 2. CR310 then rectifies this signal. The rectified voltage is applied to zener diode CR303 to supply the charge pump.

19.2.7 CHARGE PUMP/LOOP FILTER

The charge pump, constructed of Q301, Q302, Q304, Q305 and surrounding components, processes the phase detector (IC301) pulses to yield a signal that the loop filter can smooth into a DC voltage. *(For Schematic 1730081D, Q302 is not part of the charge pump.)* R318 applies the pulses at Q301's collector to Q304. Q304 turns on, applying a voltage "burst" to the loop filter (C329-332, R323-325 and L302) and charging C329-332 one pulse at at time towards +15 Volts. The loop filter provides the DC level at CR305 that governs the VCO frequency.

C302 "sharpens" the negative pulses from IC301 pin 19, and with R303, routes the signal to Q302's base. Q302 turns on and drives Q305. *(For Schematic 1730081D, R303 applies the output signal at IC301 pin 16 to Q305.)* Q305 discharges C327-329 one pulse at a time, the resulting DC voltage applied to CR305.

19.2.8 BANDSWITCH

Because the RPM-450 utilizes a single oscillator for both transmit and receive modes, the oscillator's frequency range must shift approximately 21.4 MHz when the unit is switched between transmit and receive. When the radio is in receive mode, a bandswitch circuit (Q307, R329, R355-356, C342 and CR306) places C334 in parallel with the VCO tank circuit, increasing the tank's capacitance and so shifting the VCO tuning range about 21.4 MHz. *(For Schematic 1730081D, R329 is not present.)*

CR306 is forward biased while the radio is in receive mode, and reverse biased in transmit mode. When +V RX is applied to R355 and R329, CR306 switches on and current flows through Q307 to ground. 'CR306 acts like a short circuit, incorporating C334 into the oscillator circuit. When the RPM-450 is "keyed," the +V RX line drops to 0 VDC and CR306 shuts off, turning off Q307. C334 is removed from the oscillator circuit, increasing the VCO output frequency approximately 21.4 MHz.

19.2.9 SOURCE-FOLLOWER BUFFER

The source lead of FET Q306 applies a DC voltage, which "tracks" the VCO (source lead voltage = VCO voltage + approximately 1 Volt), to varactors in the receiver RF amplifier circuit. Q306 isolates the VCO from the receiver amplifier.

19.3 RECEIVER

19.3.1 RF AMPLIFIER

A received signal from the antenna first passes through a low-pass filter (C426-429, L411-413). L410 and C501 then apply the RF signal to a 2-pole track-tuned tank circuit whose center frequency depends upon the VCO tuning voltage applied (via Q306) to varactors CR501-511. C508 matches the output to the base of Q501, a low-noise, high-frequency RF amplifier. R503 and R504 set the base bias for Q501, while L503 applies collector voltage to the stage. C509 supplies an RF bypass for L503; R505 restricts the current through Q501. C511 couples the amplified RF signal into a 3-pole track-tuned tank circuit, whose bandpass response further sharpens front-end response. C518 applies the output signal to the gate of common-source JFET Q502, the 1st mixer.

19.3.2 1ST MIXER

The RF input signal drives the gate of mixer Q502, while the VCO signal at Q310's collector drives the source. A resonant tank circuit (T502) emphasizes the 21.4 MHz difference frequency component of the mixer output, which C522 couples to a 21.4 MHz four-pole crystal filter (YF501, C543 and YF502). R509 applies the filter output to the base of Q503, a grounded-emitter buffer amplifier that provides stable gain. C525 then matches the signal to IC501 pin 16.

19.3.3 FM RECEIVER SUBSYSTEM

A multi-function integrated circuit, IC501 and associated components, forms the FM-receiver subsystem. This subsystem performs the functions of: 1) 2nd local oscillator (20.945 MHz), 2) 2nd mixer, 3) 2nd IF amplifier, 4) FM detector and 5) noise amplifier.

IC501 pins 1 and 2, 20.945 MHz crystal Y501, and feedback capacitors C526 and C527 comprise the 2nd local oscillator - which provides low-side injection (20.945 MHz). The 21.4 MHz signal at IC501 pin 16 and the 2nd local oscillator output are mixed, with the resulting 455 KHz mixer output appearing at IC501 pin 3. A 455 KHz, 4-pole ceramic filter, YF503, connects the balanced-mixer output to the input of the limiting IF amplifier at IC501 pin 5. IC501 pin 6 is the decoupled input to the IF amplifier, IC501 pin 7 the limited IF output signal. An internal quadrature detector, whose center frequency is determined by T501, detects the FM IF signal. One input of the quadrature detector connects internally to the IF signal at IC501 pin 7, while the other detector input is the phase-shifted signal from quadrature coil T501 at IC501 pin 8. Demodulated audio appears at pin 9, where a low-pass filter (R522 and C541) removes spurious quadrature output. Audio then simultaneously enters both the voice/tone conditioning circuit and a noise filter/amplifier (R519-521, R523, C536-537, R517 and the amplifier internal to IC501 at pins 10 and 11) whose bandpass is centered at 8 KHz. *(For Schematic 1730081D, the noise filter/amplifier is made up of R516-517, R519-521, C536-537, and the amplifier internal to IC501 at pins 10 and 11.)*

19.3.4 CARRIER SQUELCH

The noise amplifier output at IC501 pin 11 is rectified and filtered to produce a DC voltage called the RSSI (Received Signal Strength Indication) that is inversely proportional to receive signal strength. CR506 and CR507 form a voltage-doubling detector *(for Schematic 1730081D, CR506A and CR506B).* C535 integrates the detected signal, while R518 and C534 filter it. R521 and thermistor R523 comprise a temperature compensation network. *(For Schematic 1730081D, thermistor R516 compensates for temperature changes.)* R525, CR509 and CR510 *(for Schematic 1730081D, CR507A and CR507B)* form a threshold bias circuit that keeps CR506 and CR507 *(for Schematic 1730081D, CR506A and CR506B)* slightly biased on, maintaining a constant noise output independent of ambient temperature. The RSSI is applied to IC102 pin 9 for carrier detect. The microcontroller enables carrier detect by comparing the RSSI with a "squelch set" voltage (adjusted with potentiometer R136) at pin 12.

19.3.5 VOICE/TONE CONDITIONING IN RECEIVE MODE

After R522 and C541 remove 455 KHz elements at the demodulated audio output (IC501 pin 9), C222 couples the signal to a low-pass filter (C236, R245), and to IC201A. *(For Schematic 1730081D, this low-pass filter is not present).* The received signal then follows two separate paths: one for sub-audible (QC and DQC) tone detection, the other for voice band (which includes PQC tones) audio conditioning.

19.3.5.1 VOICE BAND

When the transmitter shuts off, IC102 pin 35 goes "low," opening the bilateral gate switch from IC201C pin 3 to ground *(for Schematic 1730081D, IC201B pin 3 to ground).* Pin 3, which is tied through R235 to +5 Volts, then pulls "high" and toggles gate IC201A, allowing received audio to reach high-pass filter/amplifier circuit, IC202B, IC202C and associated components. The amplified signal, with frequencies below about 250 Hz (sub-audible tones) attenuated, exits IC202C pin 7 *(for Schematic 1730081D, IC202B pin 7)* and travels to: A) IC203C, a bilateral gate and; B) the input of a limiter (IC202A and associated components) via C213 and R229. Audio passes through gate IC203C when squelch is enabled and a "high" at IC102 pin 45 toggles the gate. *(For Schematic 1730081D, receive audio is then routed through a low-pass filter built around Q203.)* R213 and C212 provide de-emphasis, and with C211 and potentiometer R601, direct the signal to audio amplifier IC601 and associated circuitry. R229 *(for Schematic 1730081D, R229 and R251)* lowers signal gain and removes pre-emphasis before applying audio to limiter IC202A. The "squared" output then feeds to IC102 pin 22 for PQC (Paging Quiet Call) decode.

19.3.5.2 SUB-AUDIBLE

Receive audio also passes through IC201B *(for Schematic 1730081D, IC201C)*, which is turned on unless the radio transmitter is keyed, and enters pin 8 of IC204A, a 6-pole low-pass filter that attenuates frequencies above approximately 250 Hz. The output at pin 3 is further conditioned by IC204C, a limiter that squares the signal to drive the QC (Quiet Call) detector resistor/capacitor bridge at IC102 pins 36-39. The microcomputer compares the QC detector bridge outputs at pins 13 and 14 to decode the correct sub-audible (QC) tone. Pin 13 also serves as the DQC (Digital Quiet Call) input.

19.3.6 AUDIO AMPLIFIER

R601, the volume level control, attenuates voice band audio passed through "squelch gate" IC203C to audio amplifier IC601. C601 DC isolates the audio amplifier input, while C602 provides RF bypassing. C606 couples the output at pin 4 to the front panel jack "RX Audio" line through R602, and to the speaker (SP601) via J601. With a load impedance of 4 Ω, the maximum output at pin 4 is about 5 Watts.

19.4 ANTENNA SWITCHING/LOW-PASS FILTER

A low-pass filter comprised of C426-428 and L411-412 removes harmonics from the transmitter output before applying the RF signal to the antenna port. Received signals pass through the low-pass filter before entering the receiver RF input circuitry.

Two high speed PIN diodes (CR401, CR402) and associated components form the antenna switching circuit, which isolates the transmitter output from the antenna when the RPM-450 is in "receive" mode; no voltage is applied to PIN diodes CR401 and CR402 - they do NOT conduct. This reverse biases CR401 to prevent the transmitter amplifier from affecting receiver tuning and removes CR402 from the receiver input. Incoming signals from the antenna pass through the low-pass filter, then L410 and C501 to the receiver RF amplifier.

When the unit is switched into "transmit," Q313 applies +V TX to R404. Current (about 30 mA) flows through R404, L409, CR401, L410 and then CR402 to ground, forward biasing the diodes. CR401 passes transmitter RF power to the antenna port. CR402 shunts the receiver RF input to ground. Now L410 provides sufficient impedance to isolate transmitter power from the receiver RF amplifier, Q501.

19.5 TRANSMITTER KEYING

Q312 and Q313 form a voltage regulator that supplies power amplifier transistor Q401 and the antenna switching circuit. When the PTT (Push-to-Talk) is pressed, microcontroller IC102 pulls the transmit enable line at pin 35 "high." This "high" is routed to Q312, forward biasing the base-emitter junction and causing current to flow from the +V SW line to ground through R349, Q312 and R347. The resulting voltage (about 6.5 Volts) at Q312's collector switches on Q313, which in turn applies +V TX to Q401 via R403, Z402 and L401. *(For Schematic 1730081D, Q313 applies +V TX to the base of Q406, which turns on. This draws current through Q405 and Q407. Q404 switches on and applies +V BATT to Q401 and Q402.)* When the PTT button is released, the microcontroller holds the transmitter "high" about 180 ms while sending any tone-related turn-off codes. Then the microcomputer switches pin 35 "low," which turns off the regulator, releases the transmitter and switches off Q317. Q317's collector is no longer pulled to ground, allowing +5 VDC via R357 to forward bias Q314's base-emitter junction. Q315 then turns on and connects +V RX to the receiver circuitry.

19.6 TRANSMITTER POWER AMPLIFIER

Q311 and associated components further amplify the VCO signal at Q310's collector before feeding it via C353 to the 25 Watt, wide-band RF power amplifier. C401 matches the signal to the base of Q401. The output at Q401's collector, which measures about +27 dBm (400 mW), is then coupled into the base of Q402, a 6 Watt power amplifier. The 6 Watt signal is then amplified once again by Q403. The resulting 25 Watt signal is then matched to 50 Ω for application to the switching circuit.

19.7 *POWER CONTROL CIRCUIT*

(FOR PCB 1730080D/SCHEMATIC 1730081D ONLY)

"Reduced power channels" may be programmed as described in the Programming Special Features section. All low power channels have the same power output, which is adjustable for between 0.5 and 30 Watts.

The power control circuit works as follows: current through final transistor Q403 is measured as a voltage across R406. This current is proportional to power output. With the channel programmed for low power, IC102 pin 24 is "low," which turns off Q408 and "removes" the transistor from the circuit. In transmit, Q313 applies +V TX to Q406, which then switches on. This draws current through differential pair Q405 and Q407. Variable resistor R414 adjusts power output. Increasing the power draws more current through R406, lowering voltage at the base of Q405. Q405 then begins to turn off, decreasing current through the base of Q404. As a result, Q404 supplies less current to driver transistor Q402, which reduces RF power applied to Q403. Power output goes down. The power control circuit works in a similar manner to prevent power from falling below the reduced power setting.

19.8 SPEECH AMPLIFIER

19.8.1 GENERAL

RPM-450 speech amplifier filter circuits are shared with the receiver. The same high-pass filter/amplifier (IC202B, C and associated components) used for "receive" voice band conditioning is used for the "transmit" voice band. Similarly, the low-pass filter (IC204A) used for sub-audible tone decode filtering is also used for sub-audible tone encode. Altering circuit configuration with bilateral gates IC201A, B, C, D and IC203B and C permits utilizing the same audio filtering system for both receive and transmit modes.

19.8.2 VOICE/TONE CONDITIONING IN TRANSMIT MODE

When the user presses the PTT button, IC102 pin 35 goes "high," turning on the transmitter via Q312 and closing bilateral switches IC201C *(for Schematic 1730081D, IC201B)*, IC201D, IC203B and IC203D. C202 couples microphone audio to pin 9 of IC201D, which passes the signal into filter/amplifier circuitry (via C203-5) that attenuates frequencies below approximately 250 Hz and above 3 KHz.

19.8.2.1 VOICE BAND

Q202 amplifies the audio signal and applies it to a high-pass filter/amplifier (IC202B, IC202C and assoc. components), which attenuates frequencies below about 250 Hz and further amplifies the signal (about four times). Audio exits IC202C pin 7 *(for Schematic 1730081D, IC202B pin 7)* and passes through gate IC203D, which is switched on by the TX Enable line. C213 and R216 provide pre-emphasis and apply the audio, which is then summed with any tones generated by IC102 at pin 46, to limiting amplifier IC202A. Amplified another 100 times, symmetrically clipped audio (3.5 Vp-p) appears at IC202A pin 1, where it is then fed into a 3-pole, 3 KHz low-pass filter built around Q201. This filter's output signal takes a path through voice deviation potentiometer R224, C220 and R225 to the input of summing amplifier/low-pass filter IC204B. Here, voice modulation is combined with encode sub-audible tone (if QC or DQC is programmed). The conditioned, composite modulation at IC204B's output is then routed through gate IC203B (which is toggled on via the logic "high" at IC102 pin 35) to the VCO.

19.8.2.2 SUB-AUDIBLE

NOTE: For Schematic 1730081D, IC201B and IC201C are reversed in the description below.

Microcontroller IC102 switches off bilateral gate IC201B when the unit is in transmit, disconnecting received audio from the low-pass filter, and generates sub-audible/digital encode tones (at pin 33) for application to pin 8 of 250 Hz low-pass filter IC204A. *(For Schematic 1730081D, these encode tones are first applied to buffer amplifier IC202D.)* IC201B switches off when the microcomputer applies a "high" to IC201C pin 5, which shorts IC201C pin 3 to ground and pulls IC201B pin 12 "low."

The microcontroller sets the low-pass filter's corner frequency to approximately 250 Hz (IC102 pin 43 "floats" in tri-state mode), or to about 150 Hz (pin 43 pulls to ground) by switching C226 into the circuit. The 150 Hz corner frequency operates when a QC tone below 125 Hz or a DQC tone is encoded. Tone deviation potentiometer R228 and R231 tie the filter output at IC204A pin 3 to the incoming voice signal (from R225) at the summing amplifier (IC204B) input. Gate IC203B then passes the output signal at IC204B pin 4 to modulation balance potentiometer R312. C321 couples modulation to the VCO.

Bilateral gates IC203A and IC203B form a compound series-shunt switch. During receive, IC203B is open and IC203A is closed to clamp the synthesizer modulation input voltage to the +Vag reference, preventing frequency modulation of the synthesizer. During transmit, IC203B is closed and IC203A is open, allowing speech to modulate the synthesiser.

19.9 SHIFT REGISTER (LED DISPLAY)

IC101 is a serial-in parallel-out shift register that functions as a 7-segment (plus the monitor indicator) display buffer. When the microcomputer detects conditions that require a display change, it clocks a new 8-bit data word into IC101 - data pulses are applied to pin 1 (via IC102 pin 52) in synchronization with clock pulses applied to pin 8 (via IC102 pin 51). Data entering IC102 is quickly clocked into the register and latched. The parallel output appears at IC101 pins 3-6 and 10-13 to drive the 7-segment numeric LED display.

20. RPM-450 ALIGNMENT PROCEDURE

20.1 RECOMMENDED TEST EQUIPMENT

1) 0 to 15 VDC, 10 Amp current-limited power supply
2) FM service monitor (to 470 MHz)
3) Oscilloscope (to 15 MHz)
4) FM deviation meter
5) RF Wattmeter, 50 Watts full scale
6) Frequency counter (to 470 MHz)
7) VTVM or DMM
8) Square wave reference generator
9) SINAD measuring device
10) Service programming key (red plug)

20.2 RADIO PREPARATION

1) Carefully pull the volume knob off of the front panel.
2) Remove the three #6 screws from the bottom of the case.
3) Remove the front and back panels.
4) Remove the nut that holds the on/off volume control to the case.
5) Slide the radio PC board and front panel out of the radio case through the back.
6) Connect the power supply (@ approx. +13.0 VDC) to the 2-pin power connector on the back of the unit.
7) Connect an RF signal generator to the antenna connector on the back of the unit.
8) For operation in the band from 450 to 470 MHz, program the channels below as indicated.

CHANNEL	RX/TX FREQUENCY	QUIET CALL TONE OR SPCL. FEATURE	QUIET CALL CODE OR SPCL. FEATURE
1	450.225 MHz	none	none
2	460.225 MHz	none	none
3	470.225 MHz	none	none
4	460.225 MHz	123.5 Hz	18
5	460.225 MHz	203.5 Hz	32
6	460.225 MHz	071 (DQC)	071
7	460.225 MHz	349 Hz/832.5 Hz (PQC)	44144

If another user's carrier signal causes interference, an alternate frequency within 1 MHz may be used.

IMPORTANT: To program for a different UHF band, substitute frequencies at the low, mid and high ends of the band for the frequencies given above.

9) Turn off the RPM-450. Remove the programming key or place it in the storage position of the programming socket. Switch on the radio to place it in operating mode.

20.3 SYNTHESIZER

The synthesizer control voltage should not need re-adjustment unless a key component in the synthesizer has been replaced. Do not perform steps 10 through 14 unless a key component has been replaced. Key components do not include the synthesizer reference crystal or the synthesizer IC. Synthesizer alignment errors cause poor operation at temperature extremes.

10) Select channel 1.

11) Connect a high impedance voltmeter or oscilloscope to C329, which is accessible from the bottom of the circuit board. (Refer to the bottom side parts placement diagram.)

12) The voltage at this point should measure +2.75 VDC (+/- 0.2 Volts).

IF SO:

Select channel 2 and measure the same point. The voltage should then read approx. +8 Volts (+/- 0.8 VDC). Next, select channel 3 and check the voltage, which should measure approx. +12 Volts. If these readings are correct, skip steps 13 and 14. If not, continue with step 13.

IF NOT:

Proceed with steps 13 and 14.

13) Turn off the mobile and carefully turn the holddown tabs on the synthesizer shield until the lid can be removed. Remove the lid. Switch the unit back on and select channel 1.

14) Note the exact position of VCO coil L303. Adjust L303 until the voltage at C329 is +2.75 Volts. A small adjustment (a quarter turn) should produce a large change in voltage.

IF THE VOLTAGE ADJUSTS FOR +2.75 VOLTS:

Select channel 2 and measure the same point. The voltage should then read about +8 Volts (+/- 0.8 VDC). Next, select channel 3 and check the voltage, which should measure approx. +12 Volts. If your adjustments produce the correct voltages, replace the synthesizer box lid and proceed with the next step. Do not secure the holddown tabs, since the lid will be removed in subsequent steps.

IF THE VOLTAGE DOES NOT ADJUST:

Rotate L303 back to its original position before troubleshooting.

20.4 REFERENCE FREQUENCY

15) Make sure the unit has been powered on long enough for the temperature to stabilize (ten minutes).

16) Select channel 1.

17) Set the service monitor receiver to 428.825 MHz (receiver L.O. frequency = receive frequency - 21.4 MHz). The monitor should be able to receive the L.O. signal with a short antenna.

18) Align C315 *(for schematic 1730081D, C323)* to center the frequency. This capacitor may be adjusted through a hole in the synthesizer lid.

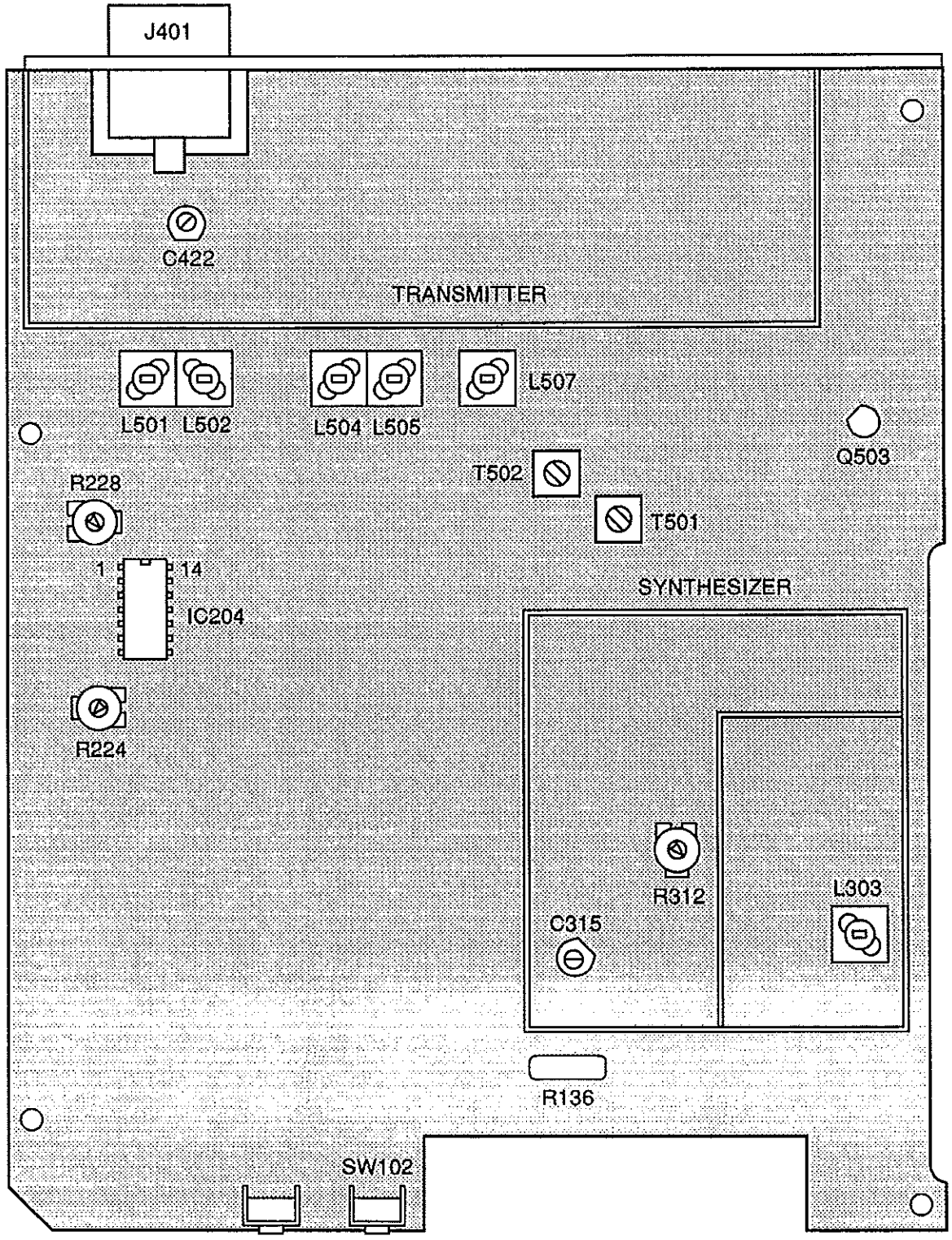
RPM-450

PCB #17031002

TOPSIDE VIEW

L303 = VCO Voltage
C315 = Reference Frequency/
RX L.O. Frequency
R224 = Voice Modulation
R228 = Sub-audible/Digital Modulation

R312 = Modulation Balance Control
C422 = TX Output Power
L501, L502, L504, L505 and
L507 = RX Sensitivity
R136 = Squelch Adjust
T501 = 1 KHz Signal Amplitude Adjust
T502 = 21.4 MHz Bandpass Adjust



RPM-450

PCB #1730080D

TOPSIDE VIEW

L303 = VCO Voltage
C323 = Reference Frequency/ RX L.O. Frequency
R224 = Voice Modulation
R228 = Sub-audible/Digital Modulation

R312 = Modulation Balance Control
C422 = TX Output Power
L501, L502, L504, L505 and L507 = RX Sensitivity
R136 = Squelch Adjust
T501 = 1 KHz Signal Amplitude Adjust
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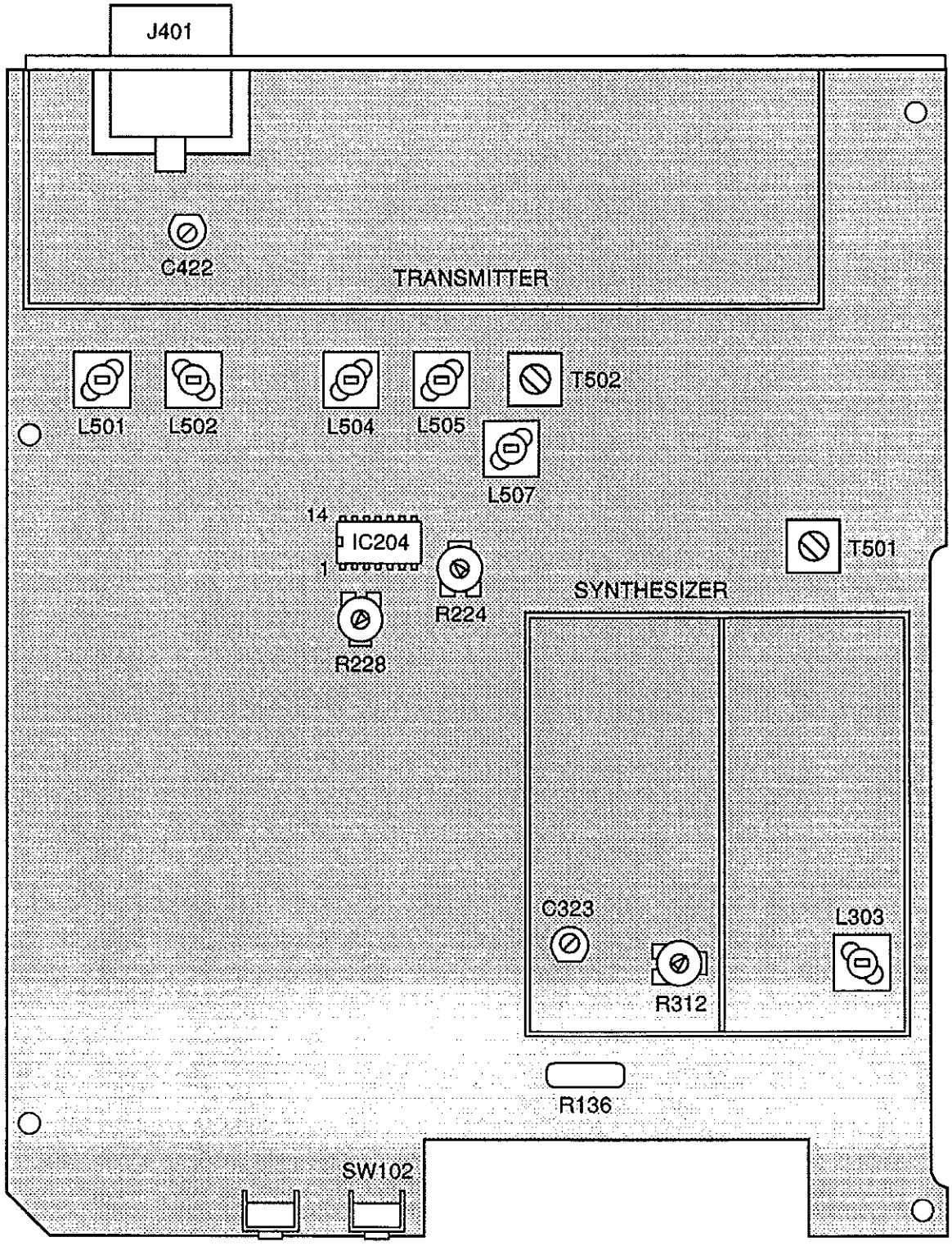


20.6 MODULATION BALANCE CONTROL

Normally, the balance control should not require re-alignment. The purpose of the balance adjustment is to prevent sub-audible (Quiet Call) and DQC (Digital Quiet Call) encode signals from being distorted.

19) Rotate both R224 (voice modulation) and R228 (sub-audible/digital modulation) fully counter-clockwise.

20) Connect a 100 KΩ resistor in series with a 22 µF electrolytic capacitor between IC204B pin 13 and a square wave reference generator.

21) Set the square wave generator to 30 Hz, 0.2 Vp-p.

22) Connect an appropriate 50 Ω load to the mobile's antenna port (J401).

23) Set the service monitor receiver for 460.225 MHz.

24) Switch off power to the mobile and remove the synthesizer lid. Turn the power back on.

25) Switch the mobile to channel 2. Press and hold the microphone PTT to transmit. The mobile's TX/Busy LED should light when the transmitter is activated.

26) Observe the received waveform on the service monitor. Adjust modulation balance control R312 (inside the synthesizer shield) for the "best" square wave.

NOTE: Many service monitors and oscilloscopes do not have sufficient low-frequency response to reproduce a 30 Hz square wave accurately, and instead display a waveform that has a "ramped" appearance. If your equipment exhibits this limitation, adjust R312 for minimum "overshoot" on the leading edge of the square wave. This will give the correct setting.

27) Replace the synthesizer shield lid, secure the holddown tabs and follow the transmitter alignment.

20.7 TRANSMITTER

28) Connect a Wattmeter to the antenna port (J401).

29) Press and hold the microphone PTT to key the transmitter. The TX/Busy LED should light.

30) Turn off the RPM unit and remove the screws that hold the transmitter shield lid to the heat sink. Lift away the lid. Switch on the radio.

31) Using a non-metallic alignment tool (Sprauge-Goodman #GTT-5 or similar), adjust C422 for maximum output power. C422 can be reached through a hole in the transmitter box lid.

32) Unkey the transmitter.

33) Select channel 4. (Channel 4 is programmed with 460.225 MHz and a 123 Hz tone.)

34) With the transmitter keyed, apply a loud continuous voice to the microphone while adjusting R224 for +/- 4.6 KHz deviation, as indicated on the deviation meter.

35) With the transmitter keyed and no sound applied to the microphone, adjust R228 for 600 Hz deviation.

36) Unkey the transmitter.

37) Switch off the radio and install the transmitter shield lid. Then, switch on the radio.

20.8 RECEIVER

NOTE: THE RECEIVER CANNOT BE ALIGNED UNTIL THE SYNTHESIZER CONTROL VOLTAGE (STEPS 10-14) IS CORRECT.

38) Connect a SINAD measuring device to the speaker terminals on the front panel.

39) Select channel 2.

40) Set the service monitor receiver for 438.825 MHz to check the receiver L.O. frequency (receiver L.O. frequency = receive frequency - 21.4 MHz). Adjust C315 *(for schematic 1730081D, C323)* for the correct frequency.

41) Adjust L501, L502, L504, L505 and L507 to position the aluminum core of each coil at the top.

42) Set the service monitor RF signal generator to 460.225 MHz.

43) Set the generator to modulate the signal with 1KHz @ 3KHz deviation. Set the generator output to 1000 μV.

44) Adjust R136 fully counter-clockwise to "open" squelch.

45) At this point, a 1 KHz tone should be heard in the speaker.

46) Decrease the generator output and adjust L501, L502, L504, L505 and L507 for best SINAD.

47) Set the generator output to 2000 μV.

48) Frequency modulate the generator with a 15 Hz signal, and set the deviation to +/-15 KHz.

49) Connect the 15 Hz signal directly to the HORIZONTAL input of an oscilloscope, and set the horizontal sweep to EXTERNAL.

50) Connect the VERTICAL input of the oscilloscope to Test Point 43 (collector of Q503).

51) Adjust T502 for a 21.4 MHz bandpass waveform, as shown below.

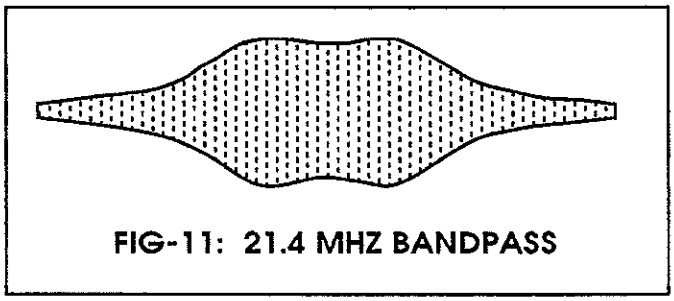


FIG-11: 21.4 MHZ BANDPASS

52) Set the signal generator for a frequency modulated 1KHz sine wave at +/-7.5 KHz deviation. Set the output for 2000 μV.

53) Connect the oscilloscope to the radio speaker on the front panel.

54) Adjust T501 for a maximum amplitude of the 1 KHz sine wave.

RECEIVER (CON'T.)

55) Decrease the deviation of the modulated 1 KHz signal to +/-3 KHz.

56) Decrease the signal generator output and adjust L501, L502, L504, L505 and L507 for best 12dB SINAD. The 12 dB Sinad should be 0.30 µV (worst case) or better.

57) Press and release the monitor button (SW102).

58) Set the generator output for a reading of 12 dB SINAD.

59) Turn R136 clockwise until no signal is heard in the speaker.

60) Slowly rotate R136 counter-clockwise until a signal is heard in the speaker.

61) Check for 12 dB SINAD sensitivity at the low (450.225 MHz - channel 1) and high (470.225 MHz - channel 3) ends of the frequency range. The sensitivity should be at least 0.30 µV for each channel.

CAUTION: RITRON surface mount products require special servicing techniques. Improper servicing techniques can cause permanent damage to the printed circuit board and/or components, which is not covered by RITRON's warranty.

21. RPM-450 VOLTAGE CHARTS

MEASUREMENT CONDITIONS: Supply @ 13.0 VDC, unit in operating mode, volume control @ minimum, microphone connected, readings taken with channel 8 programmed and selected.

KEY: ALL MEASUREMENTS ARE IN VOLTS DC, UNLESS AS INDICATED BELOW.

GND = GROUND

SQ = SQUAREWAVE

SINE = SINEWAVE

TRI = TRI-STATED WAVEFORM

SAW = "SAWTOOTH" WAVEFORM

MOD = MODULUS CONTROL WAVEFORM

--- = NOT RELEVANT

NC = NOT CONNECTED

[ ] = SPECIAL NOTE (see explanation below)

A measurement shown as two values separated by a "/" indicates a reading for each of two conditions. All measurements are for both versions of the UHF PC board, unless noted otherwise.

SPECIAL NOTES [ ] EXPLANATION:

[1] The measured value depends upon signal strength. This reading was taken with no signal applied.

[2] This reading was taken with a 100 µV signal and 123 Hz sub-audible tone @ 500 Hz applied.

[3] Paging Quiet Call input- with no signal present, random square waves appear. With a 10 µV signal and 1 KHz modulaton applied, this pin shows a 3.5 Vp-p clipped square wave.

[4] This pin measures "high" in full power transmit, "low" in reduced power transmit.

[5] External signaling input - normally measures a logic "high." When an external device pulls this pin "low," the microcontroller generates a "ring" tone in the speaker and latches a "C" on the display.

[6] "Switch" output used to excite the CTCSS decode circuit. To see the output, connect the pin to +5 VDC through a 10 KΩ resistor. No signal is applied to the receiver. A square wave at the CTCSS frequency should appear.

[7] Measurements at this pin depend upon the CTCSS tone programmed. The pin reads "low" for CTCSS tones below 141.3 Hz. For tones at 141.3 Hz and above, this line is open and the clock oscillation via IC204 pin 9 appears.

[8] The microcomputer pulls this pin "high" to open channel audio. The pin is "low" at all other times.

[9] The All-Call frequency (483.5 Hz) is generated at this pin.

[10] A square wave appears when voice is applied to the microphone.

[11] Measurement taken with the synthesizer "locked."

IMPORTANT: Because the RITRON mobile is constructed with grounding "sub-planes," use a system ground in the same proximity as the circuit being measured. All readings indicated as GND are true system ground.

DEVICE	PIN	MEASUREMENTS			FUNCTION
		RECEIVE	TRANSMIT	STANDBY	
Q101					Low Voltage Detector
	E	5.6	5.6	5.6	
	B	5	5	5	
	C	5.6	5.6	5.6	
Q201					Low-pass Darlington
	E	3.2	3.2	3.2	
	B	2	2	2	
	C	GND	GND	GND	
Q202					Microphone Pre-amplifier
	E	GND	GND	GND	
	B	0.6	0.6	0.6	
	C	0.8	0.8	0.8	
Q203					*RX Audio Low-pass Filter*
Schematic	*E*	*2.9*	*2.9*	*2.9*	
1730081D	*B*	*1.7*	*1.7*	*1.7*	
	C	*0*	*0*	*0*	
Q301					Charge Pump Level Shifter
	E	5	5	5	
	B	5	5	5	
	C	15	15	15	
Q302					Charge Pump Inverter
Schematic	E	5[11]	5[11]	5[11]	
17731002	B	5[11]	5[11]	5[11]	
	C	0[11]	0[11]	0[11]	
Q302					*Voltage Multiplier*
Schematic	*D*	*12.5*	*12.2*	*12.5*	
1730081D	*G*	*0*	*0*	*0*	
	S	*0*	*0*	*0*	
Q303					*Reference Frequency Isolator*
Schematic	*D*	*7.9*	*7.9*	*7.9*	
1730081D	*G*	*0*	*0*	*0*	
	S	*1.3*	*1.3*	*1.3*	
Q304					Charge Source For VCO
	E	15	15	15	
	B	15	15	15	
	C	2 - 13	2 - 13	2 - 13	
Q305					Charge Drain For VCO
	E	0	0	0	
	B	0	0	0	
	C	2 - 13	2 - 13	2 - 13	

DEVICE	PIN	MEASUREMENTS			FUNCTION
		RECEIVE	TRANSMIT	STANDBY	
Q306					Buffer For Front-end Tracking
	D	15	15	15	
	G	2 - 13	2 - 13	2 - 13	
	S	2 - 13	2 - 13	2 - 13	
Q307					VCO Scaling Switch
	E	GND	GND	GND	
	B	0.7	0	0.7	
	C	0.2	8	0.2	
Q308					VCO Oscillator Transistor
	D	6	6	6	
	G	GND	GND	GND	
	S	1.3	1.3	1.3	
Q309					VCO Buffer/Amplifier
	E	GND	GND	GND	
	B	0.7	0.7	0.7	
	C	6	6	6	
Q310					Synthesizer Output Buffer
	E	GND	GND	GND	(+10 dBM output)
	B	0.7	0.7	0.7	
	C	6	6	6	
Q311					1st TX Amplifier
	E	GND	GND	GND	(output = 18 dBM or 75 mV) TX
	B	0	0.7	0	
	C	0	12	0	
Q312					Power Switch Driver
	E	0	1	0	
	B	0	5	0	
	C	13	11.8	11.8	
Q313					TX Power Switch
	E	13	13	13	
	B	13	12	13	
	C	0	12	0	
Q314					RX Switch/Regulator
	E	5.4	0	5.4	
	B	6	0	6	
	C	12.4	13	12.4	
Q315					RX +10 Volt Regulator
	E	13	13	13	
	B	12.5	12.5	12.5	
	C	10	0	10	

DEVICE	PIN	MEASUREMENTS			FUNCTION
		RECEIVE	TRANSMIT	STANDBY	
Q316					Capacitance Multiplier
Schematic	E	7.2	7.2	7.2	
17731002	B	8	8	8	
	C	8	8	8	
Q317					TX Enable Inverter
	E	GND	GND	GND	(logic "low" for TX)
	B	0	5	0	
	C	6	0.2	6	
Q401					2nd TX Amplifier
	E	GND	GND	GND	(output = 1 Watt)
	B	0	0.7	0	
	C	0	12	0	
Q402					3rd TX Amplifier
	E	GND	GND	GND	(output = 5 Watts)
	B	0	—	0	
	C	0	12	0	
Q403					Final TX Amplifier
	E	GND	GND	GND	(output = 30 Watts)
	B	0	—	0	
	C	13	—	13	
Q404					*Power Control Circuit*
Schematic	*E*	*13*	*12.6*	*13*	*(Q404 - Q407)*
1730081D	*B*	*12.9*	*11*	*12.9*	*(measurements in high power)*
	C	*0*	*11.7*	*0*	
Q405					
Schematic	*E*	*11.2*	*9.3*	*11.2*	
1730081D	*B*	*11.3*	*10*	*11.3*	
	C	*12.9*	*11*	*12.9*	
Q406					
Schematic	*E*	*0*	*0.9*	*0*	
1730081D	*B*	*0*	*1.6*	*0*	
	C	*11.2*	*9.3*	*11.2*	
Q407					
Schematic	*E*	*11.2*	*9.2*	*11.2*	
1730081D	*B*	*11.7*	*1.7*	*11.7*	
	C	*13*	*12.6*	*13*	
Q408					*High/Low Power Switching*
Schematic	*E*	*0*	*1.6*	*0*	
1730081D	*B*	*0*	*2.3*	*0*	
	C	*11.7*	*1.7*	*11.7*	

DEVICE	PIN	MEASUREMENTS			FUNCTION
		RECEIVE	TRANSMIT	STANDBY	
Q501					RX RF Amplifier
	E	GND	GND	GND	
	B	0.8	—	0.8	
	C	4.8	—	4.8	
Q502					RX Mixer
	D	9.9	—	9.9	
	G	0	—	0	
	S	0.8	—	0.8	
Q503					IF Amplifier
	E	GND	GND	GND	
	B	0.7	—	0.7	
	C	1.2	—	1.2	
IC101					Channel Display Data Latch
	1	5	—	5	Data In
	2	5	—	5	
	3	4.4	—	4.4	Segment Drive Voltage
	4	4.4	—	4.4	(Pins 3 - 6)
	5	4.4	—	4.4	
	6	4.4	—	4.4	
	7	GND	GND	GND	
	8	0	—	0	Clock In
	9	5	—	5	
	10	4.4	—	4.4	Segment Drive Voltage
	11	4.4	—	4.4	(Pins 10 - 14)
	12	4.4	—	4.4	
	13	4.4	—	4.4	
	14	5	—	5	
IC102					Microcontroller
	1	NC	NC	NC	
	2	NC	NC	NC	
	3	5/0	—	—	Channel Selector
	4	5	5	5	
	5	5	5	5	Synthesizer Lock Detect
	6	NC	NC	NC	
	7	GND	GND	GND	
	8	5	5	5	Regulated +5 Volts
	9	0 - 1	—	1.5 [1]	Carrier Squelch RSSI Input
	10	5	5	5	Regulated Supply
	11	NC	NC	NC	
	12	0 - 5	—	0 - 5	Squelch Threshold Set
	13	TRI [2]	—	—	QC/DQC Detect Input
	14	TRI [2]	—	—	(Pins 13 - 14)

DEVICE	PIN	MEASUREMENTS			FUNCTION
		RECEIVE	TRANSMIT	STANDBY	
IC102					Microcontroller (con't.)
	15	5	5	5	
	16	SINE	SINE	SINE	Oscillator In
	17	SINE	SINE	SINE	Oscillator Out
	18	5	5	5	Microcontroller Power Reset
	19	5	5	5	Stop Microcontroller
	20	NC	NC	NC	
	21	NC	NC	NC	
	22	SQ [3]	—	—	PQC Input
	23	5	5	5	
	24	0 [4]	5	0	High/Low Power
	25	—	—	—	QC/DQC Decode Out
	26	5 [5]	—	—	Ext Selective Signaling Input
	27	5	5	5	
	28	SQ	4.5	0	Transmit/Busy Lamp Driver
	29	5/0	5	5/0	Microphone Hang-up Switch
	30	5	—	—	Selective Sig. Decode Out
	31	0	0	0	Clock "Clamp" for Chan Display
	32	0	0	0	Speaker "Beep" Output
	33	—	TRI	—	QC Pseudo-Sine Wave or
	34	—	—	—	DQC Output
	35	0	5	0	Transmitter Enable
	36	SQ [6]	—	—	Sub-audible Filter Switch (QC
	37	SQ [6]	—	—	Detect) Pins 36 - 39
	38	SQ [6]	—	—	
	39	SQ [6]	—	—	
	40	NC	NC	NC	
	41	GND	GND	GND	
	42	0	0	0	Syn Shift Register Latch
	43	0/SAW [7]	0/SAW [7]	0/SAW [7]	Low-pass Filter Slew
	44	—	—	—	
	45	0/5 [8]	—	0	RX Audio Enable (Sq Output)
	46	—	SQ [9]	—	PQC All-Call Tone Output
	47	—	—	—	
	48	5/0	—	5/0	Monitor Switch
	49	5	0	5	PTT Switch
	50	5	0	5	Serial Port Data In
	51	0	—	—	Serial Data Clock Output
	52	5	—	—	Serial Data Output

DEVICE	PIN	MEASUREMENTS			FUNCTION
		RECEIVE	TRANSMIT	STANDBY	
IC103					Power Reset +5 Volt Regulator
	1	13	13	13	In
	2	GND	GND	GND	
	3	5	5	5	Out
IC201					Configuration Switch
	1	1.7	—	—	RX Audio (Pins 1 and 2)
	2	1.7	0.8 [1]	1.7	
	3	5	0	0	TX Inverter (Pins 3 and 4)
	4	GND	GND	GND	
	5	0	5	0	
	6	0	5	0	
	7	GND	GND	GND	
	8	1.7	1	1.7	TX Modulation Switch
	9	—	0.8	—	(Pins 8 and 9)
	10	1.7	—	—	RX to Sub-audible Filter Switch
	11	1.7	—	—	(Pins 10 and 11)
	12	5	0	5	
	13	5	0	5	
	14	5	—	—	Supply
IC202					Audio Conditioning Amplifier
	1	—	SQ [10]	—	Modulation Limiter/PQC
	2	1.7	—	—	
	3	1.7	—	—	Squaring in RX (Pins 1 - 3)
	4	5	—	—	
	5	1.7	—	—	3-Pole High-pass Filter (no. 2)
	6	1.7	—	—	(Pins 5 - 7)
	7	1.7	—	—	
	8	1.7	—	—	3-Pole High-pass Filter (no. 1)
	9	1.7	—	—	(Pins 8 - 10)
	10	1.7	—	—	
	11	GND	GND	GND	
Schematic	12	1.7	—	—	+1.75 Volt Buffer
17731002	13	1.7	—	—	(Pins 12 - 14)
	14	1.7	—	—	
Schematic	*12*	*1.7*	*1.7*	*1.7*	*Buffer Amplifier*
1730081D	*13*	*1.7*	*1.7*	*1.7*	*(Pins 12-14)*
	14	*1.7*	*1.7*	*1.7*	
IC203					Configuration Switch
	1	1.7	1.7	1.7	RX/TX Volt. Stabilizer
	2	1.7	1.7	1.7	Pins 1 and 2)
	3	1.7	1.7	1.7	Modulation to VCO Enable

DEVICE	PIN	MEASUREMENTS			FUNCTION
		RECEIVE	TRANSMIT	STANDBY	
IC203					Configuration Switch (con't.)
	4	1.7	1.7	1.7	Switch (Pins 3 and 4)
	5	0	5	0	
	6	5	0	0	
	7	GND	GND	GND	
	8	1.7	—	—	RX Audio Path Squelch Switch
	9	1.7	—	—	(Pins 8 and 9)
	10	1.7	1.7	1.7	TX Pre-emphasis Enable
	11	1.7	1.7	1.7	(Pins 10 and 11)
	12	0	5	0	
	13	2.5	2.5	2.5	
	14	5	5	5	
IC204					Switched Capacitor Filter
	1	1.8	1.8	1.8	Comparator Reference In
	2	2	2	—	Comparator Out
	3	1.7	1.7	1.7	Filter Out
	4	1.7	1.7	1.7	Mixer Amplifier Out
	5	1.7	1.7	1.7	Analog Gnd In
	6	5	5	5	Supply
	7	1.7	1.7	1.7	Reference In
	8	1.7	SINE	1.7	Signal Input
	9	SAW	SAW	SAW	Clock Input
	10	GND	GND	GND	
	11	SQ	SQ	SQ	Clock Onput
	12	GND	GND	GND	
	13	1.7	1.7	1.7	Mixer Input
	14	2[1]	2[1]	2[1]	Comparator In
IC301					Synthesizer Controller
Schematic	1	NC	NC	NC	
17731002	2	2.5	2.5	2.5	Oscillator In
	3	2.8	2.8	2.8	Oscillator Out
	4	NC	NC	NC	
	5	5	5	5	Supply
	6	NC	NC	NC	
	7	NC	NC	NC	
	8	GND	GND	GND	
	9	5	5	5	Lock Detect Out
	10	SQ	SQ	SQ	Input
	11	NC	NC	NC	
	12	0	0	0	Programming Pins (12-14)
	13	5	5	5	
	14	0	0	0	

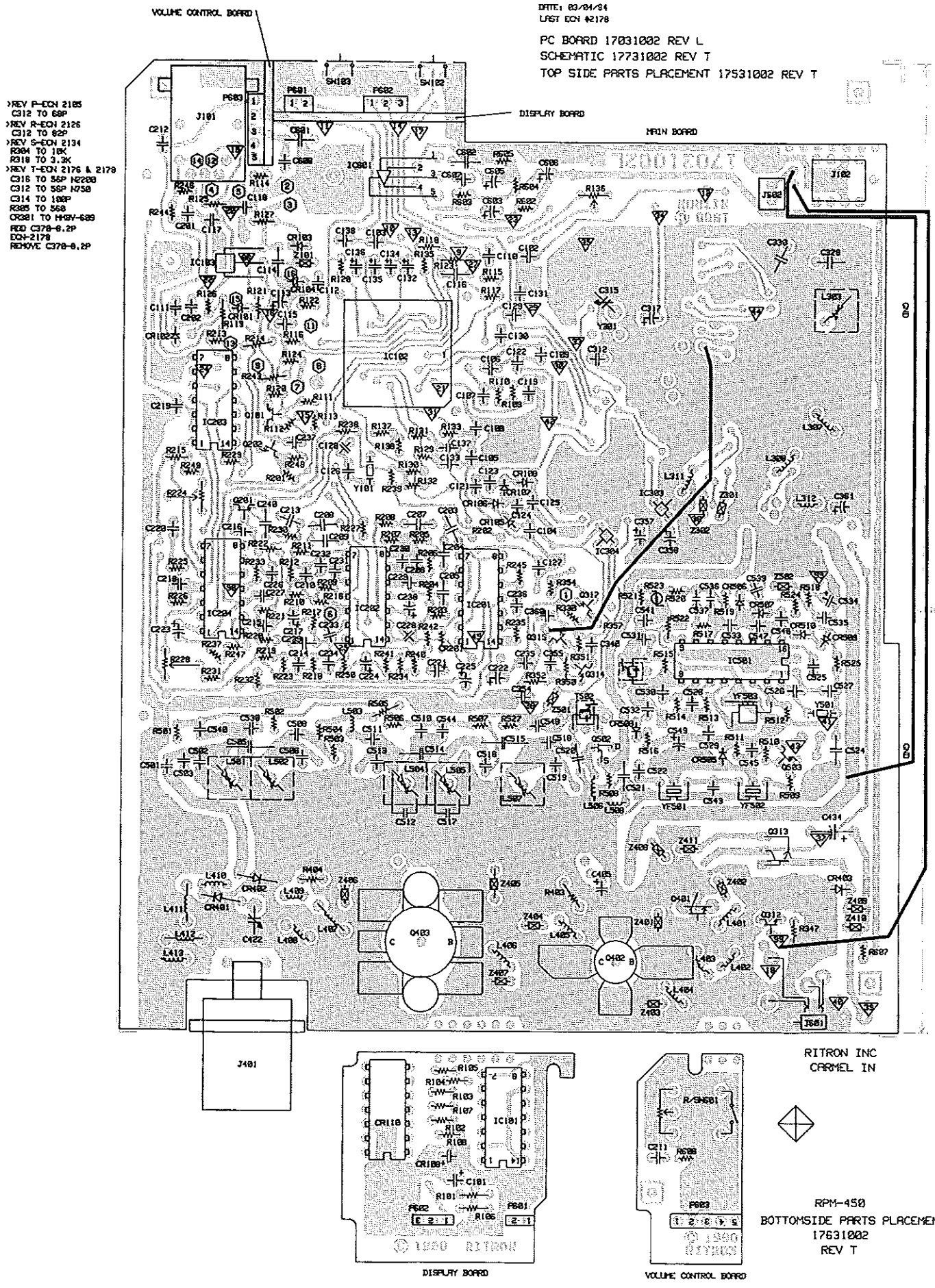
DEVICE	PIN	MEASUREMENTS			FUNCTION
		RECEIVE	TRANSMIT	STANDBY	
IC301					Synthesizer Controller (con't.)
Schematic	15	MOD	MOD	MOD	Modulus Control Out
17731002	16	NC	NC	NC	
	17	NC	NC	NC	
	18	SQ	SQ	SQ	Buffered 16 MHz Output
	19	5	5	5	VCO "High" Detector Output
	20	5	5	5	VCO "Low" Detector Output
IC301					*Prescaler/Synthesizer Controller*
Schematic	*1*	*2.4*	*2.4*	*2.4*	*Oscillator In*
1730081D	*2*	*2.4*	*2.4*	*2.4*	*Oscillator Out*
	3	*NC*	*NC*	*NC*	
	4	*5*	*5*	*5*	*Supply*
	5	*NC*	*NC*	*NC*	
	6	*GND*	*GND*	*GND*	
	7	*5*	*5*	*5*	*Phase Comparator Output*
	8	*3.6*	*3.6*	*3.6*	*Prescaler In*
	9	*0*	*0*	*0*	*Clock*
	10	*0*	*0*	*0*	*Data In*
	11	*0*	*0*	*0*	*Latch*
	12	*NC*	*NC*	*NC*	
	13	*NC*	*NC*	*NC*	
	14	*NC*	*NC*	*NC*	
	15	*4.5*	*4.5*	*4.5*	*Charge Pump Out*
	16	*0*	*0*	*0*	*Charge Pump Out*
IC302					Prescaler
Schematic	1	—	—	—	Prescaler Input
17731002	2	5	5	5	+5 Volt Supply
	3	NC	NC	NC	
	4	SQ	SQ	SQ	Prescaler Output
	5	GND	GND	GND	
	6	SQ	SQ	SQ	Modulus Input
	7	NC	NC	NC	
	8	2.5	2.5	2.5	Bypass
IC303					Low Power +5 Volt Regulator
Schematic	1	8	8	8	Regulator Input
17731002	2	GND	GND	GND	
	3	5	5	5	+5 Volt Regulated Output
IC303					*+5 Volt Regulator*
Schematic	*1*	*5*	*5*	*5*	*+5 Volt Regulated Output*
1730081D	*2*	*GND*	*GND*	*GND*	
	3	*8*	*8*	*8*	*Regulator Input*

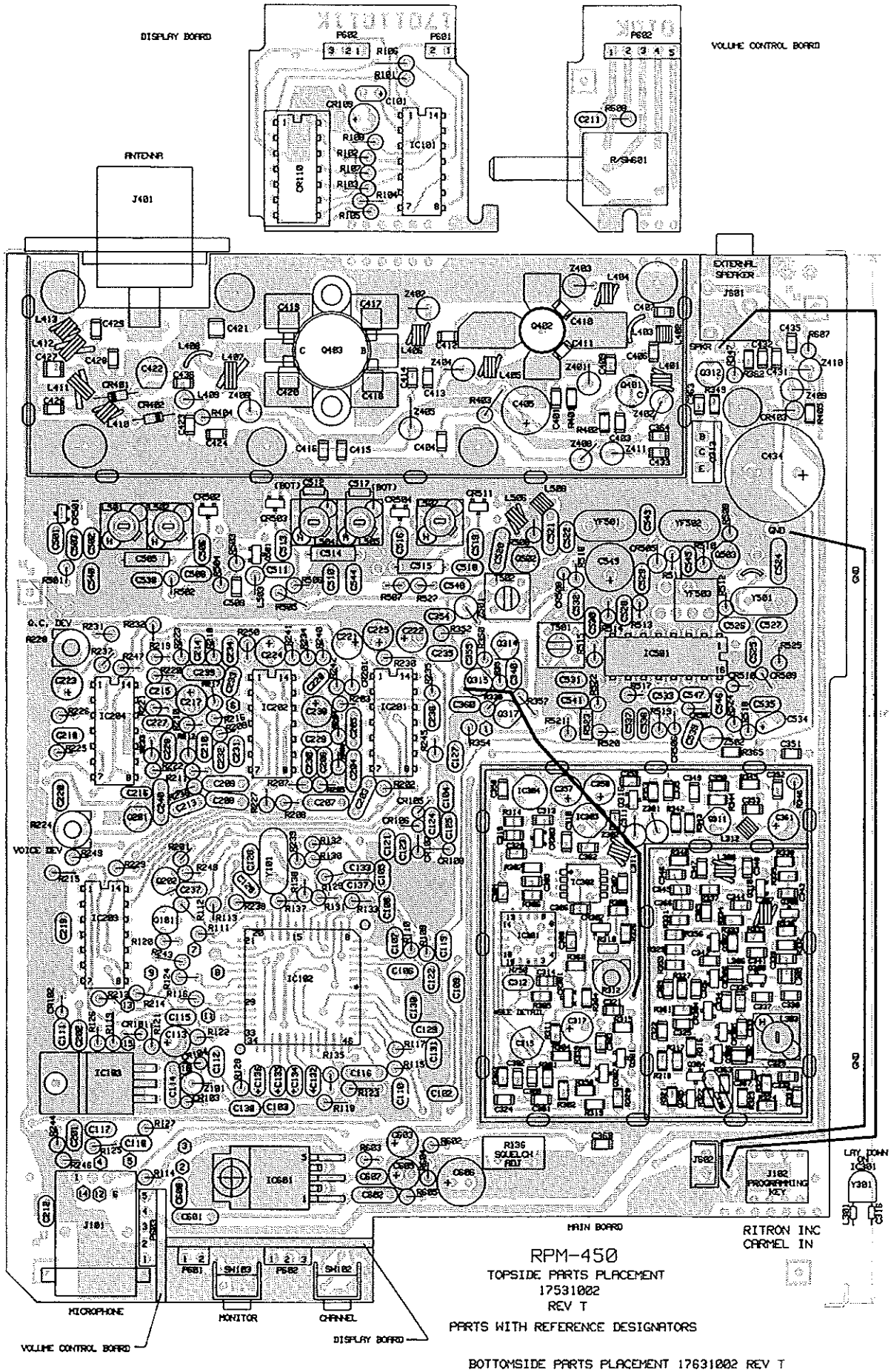
DEVICE	PIN	MEASUREMENTS			FUNCTION
		RECEIVE	TRANSMIT	STANDBY	
IC304					+8 Volt Regulator
Schematic	1	13	13	13	Regulator Input
17731002	2	GND	GND	GND	
	3	8	8	8	+8 Volt Regulated Output
IC304					*+8 Volt Regulator*
Schematic	*1*	*8*	*8*	*8*	*+8 Volt Regulated Output*
1730081D	*2*	*GND*	*GND*	*GND*	
	3	*12.9*	*12.9*	*12.9*	*Regulator Input*
IC501					IF Subsystem
	1	5.2	—	5.2	20.945 MHz Osc Trans Base
	2	4.6	—	4.6	20.945 MHz Osc Trans Emitter
	3	5	—	5	21.4 MHz to 455 KHz Mixer Out
	4	6.8	< 0.6	6.8	+5 Volt Supply
	5	1	—	1	455 KHz IF Input
	6	1	—	1	IF Amplifier Bypass
	7	1	—	1	455 KHz IF Output
	8	6.8	—	6.8	Quadrature In
	9	2.7	—	2.7	Recovered Audio
	10	2	—	2	Noise Filter Input
	11	2.1	—	2.1	Noise Filter Output
	12	NC	NC	NC	
	13	NC	NC	NC	
	14	NC	NC	NC	
	15	GND	GND	GND	
	16	2	—	2	IF In
IC601					Audio Amplifier
	1	1.3	1.3	1.3	
	2	0.8	0.8	0.8	
	3	GND	GND	GND	
	4	6.5	6.5	6.5	
	5	13	13	13	

RPM-450

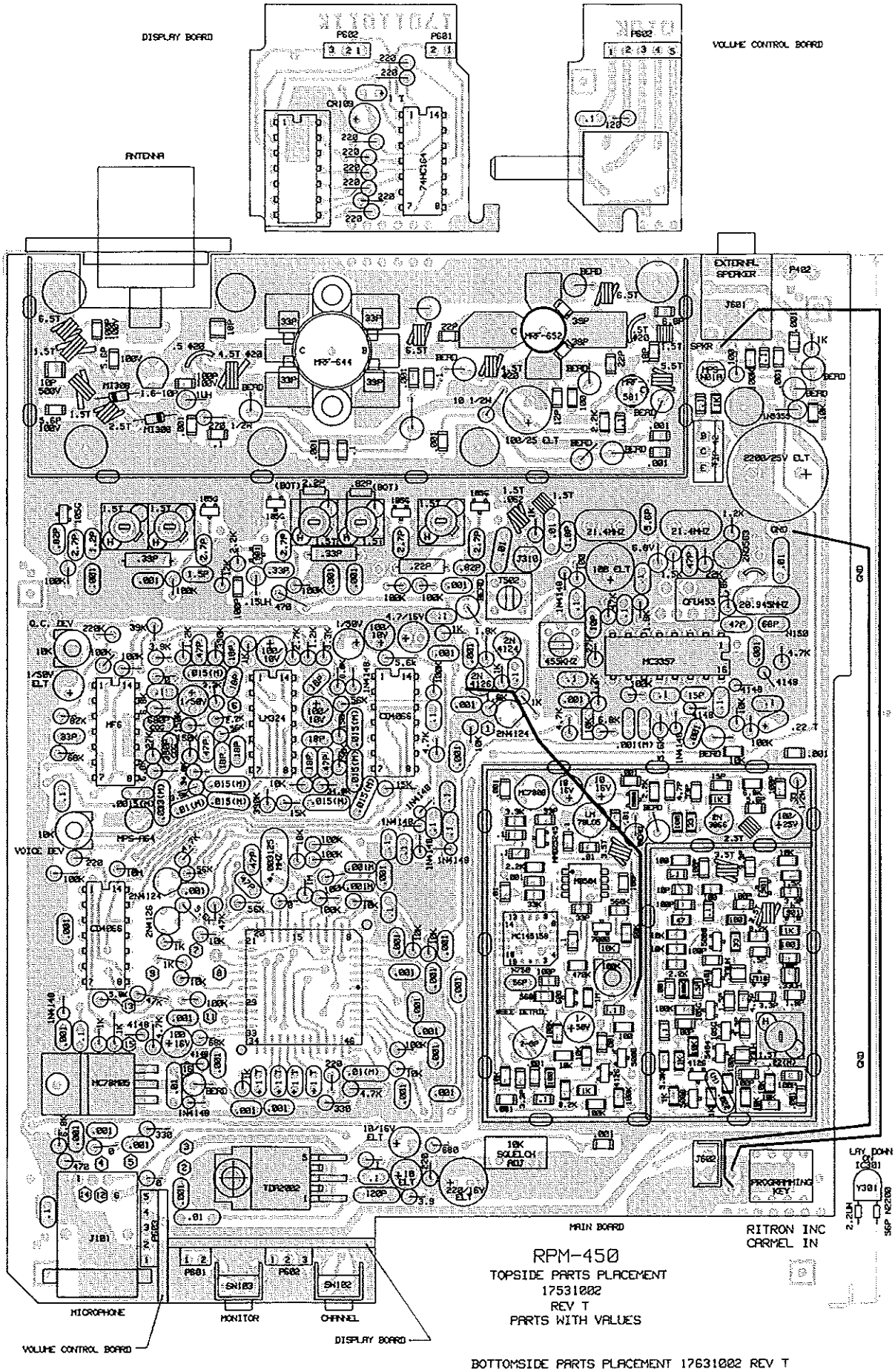
PCB #17031002

SCHEMATICS
PARTS PLACEMENT DIAGRAMS
PARTS LIST


VOLUME CONTROL BOARD
DISPLAY BOARD
MAIN BOARD
DATE: 03/04/94
LAST ECN #2178
PC BOARD 17031002 REV L
SCHEMATIC 17731002 REV T
TOP SIDE PARTS PLACEMENT 17531002 REV T
>REV P-ECN 2105
C312 TO 68P
>REV R-ECN 2126
C312 TO 82P
>REV S-ECN 2134
R304 TO 18K
R318 TO 3.3K
>REV T-ECN 2176 & 2178
C316 TO 56P N2200
C312 TO 56P N750
C314 TO 180P
R305 TO 56R
CR301 TO MV8V-589
ADD C378-0.2P
ECN-2178
REMOVE C378-0.2P
J401
DISPLAY BOARD
VOLUME CONTROL BOARD
RITRON INC
CARMEL IN
RPM-450
BOTTOMSIDE PARTS PLACEMENT
17631002
REV T



BOTTOMSIDE PARTS PLACEMENT 17631002 REV T
SCHEMATIC 17731002 REV T
PC BOARD 17031002 REV L
LAST ECN #2176
DATE: 03/23/94


DISPLAY BOARD
VOLUME CONTROL BOARD
ANTENNA
EXTERNAL SPEAKER
MAIN BOARD
MICROPHONE
MONITOR
CHANNEL
DISPLAY BOARD
VOLUME CONTROL BOARD
RITRON INC
CARMEL IN
RPM-450
TOPSIDE PARTS PLACEMENT
17531002
REV T
PARTS WITH VALUES
BOTTOMSIDE PARTS PLACEMENT 17631002 REV T
SCHEMATIC 17731002 REV T
PC BOARD 17031002 REV L
LAST ECN #2176
DATE: 03/03/94

24. RPM-450 SCHEMATIC REF. PARTS LIST (SCHEMATIC #17731002)

NOTE: This parts list reflects the most current component values (through ECN 2178) for schematic number 17731002 (PCB #17031002). If a component value given in the schematic differs from that in the parts list, the parts list should be considered correct.

REF #	RITRON #	DESCRIPTION
CAPACITORS, CHIP, 50V, UNLESS STATED OTHERWISE		
C 102	01516239	.001 µF Y5P CERDIS
C 103	01516239	.001 µF Y5P CERDIS
C 104	01515463	.1 µF X7R MLCERDIS
C 105	01516239	.001 µF Y5P CERDIS
C 106	01516239	.001 µF Y5P CERDIS
C 107	01516239	.001 µF Y5P CERDIS
C 108	01515463	.1 µF X7R MLCERDIS
C 109	01516239	.001 µF Y5P CERDIS
C 110	01516239	.001 µF Y5P CERDIS
C 111	01516239	.001 µF Y5P CERDIS
C 112	01516239	.001 µF Y5P CERDIS
C 113	01503211	100 µF ELT 16V
C 114	01516451	.01 µF Y5V CERDIS 25V
C 115	01516239	.001 µF Y5P CERDIS
C 116	01501050	.01 µF MYLAR 100V 10%
C 117	01516239	.001 µF Y5P CERDIS
C 118	01516239	.001 µF Y5P CERDIS
C 119	01516239	.001 µF Y5P CERDIS
C 121	01515463	.1 µF X7R MLCERDIS
C 122	01516239	.001 µF Y5P CERDIS
C 123	01515463	.1 µF X7R MLCERDIS
C 124	01515463	.1 µF X7R MLCERDIS
C 125	01515463	.1 µF X7R MLCERDIS
C 126	01510023	47 pF NPO CERDIS
C 127	01516239	.001 µF Y5P CERDIS
C 128	01510023	47 pF NPO CERDIS
C 129	01516239	.001 µF Y5P CERDIS
C 130	01516239	.001 µF Y5P CERDIS
C 131	01516239	.001 µF Y5P CERDIS
C 138	01516239	.001 µF Y5P CERDIS
C 201	01516239	.001 µF Y5P CERDIS
C 202	01515463	.1 µF X7R MLCERDIS
C 206	01510023	47 pF NPO CERDIS
C 210	01510023	47 pF NPO CERDIS
C 211	01515463	.1 µF X7R MLCERDIS
C 212	01515463	.1 µF X7R MLCERDIS
C 213	01501050	.01 µF MYLAR 100V 10%
C 214	01510023	47 pF NPO CERDIS
C 215	01515463	.1 µF X7R MLCERDIS
C 218	01510021	33 pF NP0 CERDIS
C 219	01516239	.001 µF Y5P CERDIS
C 220	01515463	.1 µF X7R MLCERDIS
C 225	01503110	100 µF ELT 10V
C 226	01515034	390 pF COG MLCERDIS
C 227	01515037	680 pF COG MLCERDIS
C 228	01510018	18 pF NPO CERDIS
C 229	01510018	18 pF NPO CERDIS
C 230	01510018	18 pF NPO CERDIS
C 231	01510018	18 pF NPO CERDIS
C 232	01510018	18 pF NPO CERDIS
C 233	01510018	18 pF NPO CERDIS
C 234	01510018	18 pF NPO CERDIS
C 235	01516239	.001 µF Y5P CERDIS
C 236	01515463	.1 µF X7R MLCERDIS
C 237	01516239	.001 µF Y5P CERDIS
C 238	01503110	100 µF ELT 10V
C 301	15121104	.1 µF X7R 1206
C 302	151203A3	3.3 pF NPO 1206
C 303	15121102	.001 µF X7R 1206
C 304	15121103	.01 µF X7R 1206
C 305	15121102	.001 µF X7R 1206
C 306	15120330	33 pF NPO 1206
C 307	15120101	100 pF NPO 1206
C 308	15121104	.1 µF X7R 1206
C 309	15121102	.001 µF X7R 1206
C 310	15121104	.1 µF X7R 1206
C 311	15121103	.01 µF X7R 1206
C 312	01510126	82 pF N150
C 313	15120330	33 pF NPO 1206
C 314	15120471	470 pF NPO 1206
C 315	01550021	2-10 pF VAR CERDIS
C 316	01510802	47 pF N1500 CERDIS
C 319	15121104	.1 µF X7R 1206
C 320	15121104	.1 µF X7R 1206
C 321	15121104	.1 µF X7R 1206
C 322	15121104	.1 µF X7R 1206
C 324	15121102	.001 µF X7R 1206
C 325	15120101	100 pF NPO 1206
C 326	151200A5	.5 pF NPO 1206
C 331	15121102	.001 µF X7R 1206
C 332	15120101	100 pF NPO 1206
C 333	151203A3	3.3 pF NPO 1206
C 334	151201A5	1.5 pF NPO 1206
C 335	151204A7	4.7 pF NPO 1206
C 336	151204A7	4.7 pF NPO 1206
C 337	151203A3	3.3 pF NPO 1206
C 338	151201A8	1.8 pF NPO 1206
C 339	15120101	100 pF NPO 1206
C 340	01515463	.1 µF X7R MLCERDIS
C 341	151200A5	.5 pF NPO 1206
C 342	15120101	100 pF NPO 1206
C 343	151203A3	3.3 pF NPO 1206
C 344	15120101	100 pF NPO 1206
C 345	15120100	10 pF NPO 1206
C 346	15121104	.1 µF X7R 1206
C 347	15120101	100 pF NPO 1206
C 348	151203A3	3.3 pF NPO 1206
C 349	15120330	33 pF NPO 1206
C 350	15120150	15 pF NPO 1206
C 351	15121102	.001 µF X7R 1206
C 352	15120101	100 pF NPO 1206
C 353	151205A6	5.6 pF NPO 1206
C 354	01515463	.1 µF X7R MLCERDIS
C 355	01516239	.001 µF Y5P CERDIS
C 356	15121102	.001 µF X7R 1206
C 359	15121102	.001 µF X7R 1206
C 360	01516239	.001 µF Y5P CERDIS
C 361	01503211	100 µF ELT 16V
C 362	15121103	.01 µF X7R 1206
C 363	15121104	.1 µF X7R 1206
C 364	15121102	.001 µF X7R 1206

REF #	RITRON #	DESCRIPTION
C 365	15121104	.1 µF X7R 1206
C 366	15120101	100 pF NPO 1206
C 367	15120101	100 pF NPO 1206
C 368	15121102	.001 µF X7R 1206
C 369	15121102	.001 µF X7R 1206
C 401	15120120	12 pF NPO 1206
C 403	15121104	.1 µF X7R 1206
C 404	15121102	.001 µF X7R 1206
C 405	01503211	100 µF ELT 16V
C 406	15120180	18 pF NPO 1206
C 407	151206A8	6.8 pF NPO 1206
C 409	15120220	22 pF NPO 1206
C 410	15120390	39 pF NPO 1206
C 411	15120390	39 pF NPO 1206
C 412	15120220	22 pF NPO 1206
C 413	15121104	.1 µF X7R 1206
C 414	15121102	.001 µF X7R 1206
C 415	15121104	.1 µF X7R 1206
C 416	15121102	.001 µF X7R 1206
C 417	01517419	33 pF METCLAD MICA 2
C 418	01517420	39 pF METCLAD MICA 2
C 419	01517419	33 pF METCLAD MICA 2
C 420	01517419	33 pF METCLAD MICA 2
C 421	15525180	18 pF NPO 1210 500v MICA
C 422	01550010	1.6-10 pF VARTEF 100V
C 423	15121102	.001 µF X7R 1206
C 424	15121104	.1 µF X7R 1206
C 426	151245A6	5.6 pF NPO 1206 100V
C 427	15525100	10 pF NPO 1206 500v MICA
C 428	151245A6	5.6 pF NPO 1206 100V
C 429	15124101	100 pF NPO 1206 100V
C 431	15121102	.001 µF X7R 1206
C 432	15121104	.1 µF X7R 1206
C 433	15121102	.001 µF X7R 1206
C 434	01503208	2200 µF ELT 25V
C 435	15121102	.001 µF X7R 1206
C 436	15124101	100 pF NPO 1206 100V
C 502	01508002	.82 pF P100 CERDIS
C 502	01510004	1.2 pF NP0 CERDIS
C 503	01510008	2.7 pF NP0 CERDIS
C 506	01510008	2.7 pF NP0 CERDIS
C 507	01510003	1 pF NPO CERDIS
C 508	01510005	1.5 pF NP0 CERDIS
C 509	15120101	100 pF NPO 1206
C 510	01516239	.001 µF Y5P CERDIS
C 512	01510007	2.2 pF NP0 CERDIS
C 513	01510008	2.7 pF NP0 CERDIS
C 516	01510008	2.7 pF NP0 CERDIS
C 517	01508002	.82 pF P100 CERDIS
C 518	01508002	.82 pF P100 CERDIS
C 519	01510008	2.7 pF NP0 CERDIS
C 520	01516451	.01 µF Y5V CERDIS 25V
C 521	01516451	.01 µF Y5V CERDIS 25V
C 522	01510006	1.8 pF NP0 CERDIS
C 523	01510008	2.7 pF NP0 CERDIS
C 524	01516451	.01 µF Y5V CERDIS 25V
C 525	01516239	.001 µF Y5P CERDIS
C 526	01510023	47 pF NPO CERDIS
C 527	01510125	68 pF N150 CERDIS
C 528	01515463	.1 µF X7R MLCERDIS
C 529	01515463	.1 µF X7R MLCERDIS
C 530	01510015	10 pF NP0 CERDIS
C 531	01515463	.1 µF X7R MLCERDIS
C 532	01515463	.1 µF X7R MLCERDIS
C 533	01515463	.1 µF X7R MLCERDIS
C 535	01515463	.1 µF X7R MLCERDIS
C 538	01516239	.001 µF Y5P CERDIS
C 539	01516239	.001 µF Y5P CERDIS
C 540	01516239	.001 µF Y5P CERDIS
C 541	01516239	.001 µF Y5P CERDIS
C 543	01510012	5.6 pF NP0 CERDIS
C 544	01516239	.001 µF Y5P CERDIS
C 545	01510023	47 pF NPO CERDIS
C 546	01515463	.1 µF X7R MLCERDIS
C 547	01510017	15 pF NP0 CERDIS
C 548	01516239	.001 µF Y5P CERDIS
C 549	01503211	100 µF ELT 16V
C 601	01516451	.01 µF Y5V CERDIS 25V
C 602	01510028	120 pF NPO CERDIS
C 607	01515463	.1 µF X7R MLCERDIS
C 608	01516239	.001 µF Y5P CERDIS

DIODES, 1N4148, GENERAL PURPOSE, UNLESS STATED OTHERWISE

CR101	04810001	
CR102	04810001	
CR103	04810001	
CR104	04810001	
CR105	04810001	
CR106	04810001	
CR107	04810001	
CR108	04810001	
CR109	02450006	MINIATURE RED LED
CR110	02450101	7 SEGMENT GRN LED COM. CATH
CR201	04810001	
CR301	48C1004J	VVC 26-32PF (4J) MMBV2109
CR303	48B1008W	ZENER SOT-23 (8W) MMBZ5245
CR304	48C1004E	VVC MMBV-105G SOT-23 (4E)
CR305	48C1004E	VVC MMBV-105G SOT-23 (4E)
CR306	48A1004D	MMBV3401TI UHF SOT-23 (4D)
CR307	48A1005C	MMBD7000 DUAL SOT-23 5C
CR401	04810033	PIN 25W GLASS AXIAL MI308
CR402	04810033	PIN 25W GLASS AXIAL MI308
CR403	04820119	1N5355A ZENER 18V 5W
CR501	48C1004E	VVC MMBV-105G SOT-23 (4E)
CR502	48C1004E	VVC MMBV-105G SOT-23 (4E)
CR503	48C1004E	VVC MMBV-105G SOT-23 (4E)
CR504	48C1004E	VVC MMBV-105G SOT-23 (4E)
CR505	04820009	1N5235 6.8V .5W ZENER
CR506	04810001	
CR507	04810001	
CR508	04810001	
CR509	04810001	
CR510	04810001	
CR511	48C1004E	VVC MMBV-105G SOT-23 (4E)

INTEGRATED CIRCUITS

IC101	03144164	8 BIT SHIFT REGISTER
IC102	314B0003	MICRO PROGRAMABLE RADIO
IC103	03131016	MC78MO5CY 5 V REG (TO-220)
IC201	03134066	CD4066BCP QUAD ANALOG GATE
IC202	03131004	LM324 QUAD OP AMP
IC203	03134066	CD4066BCP QUAD ANALOG GATE
IC204	03132027	MF6 6 POLE FILTER IC
IC301	31137001	FREQ SYNTH INPUT PLCC-20
IC302	31131001	PRESCALER 2 MOD MO-1 MB504

REF #	RITRON #	DESCRIPTION
IC303	03131012	MC78L05CP 5V REGULATOR
IC304	03131013	MC78L08CP 8 VOLT REG
IC501	03131052	MC3361BP LOW V IF SUBSYSTEM
IC501	03131010	MC3357P FM IF SUBSYSTEM
IC601	03131050	8 WATT AUDIO AMPLIFIER
CONNECTORS		
J 101	02100310	6-PIN MODULAR PHONE JACK
J 102	21433030	3 POSITION PC MNT
J 401	02100330	UHF REAR MT BLKHD RECPTACLE
J 601	02100053	3.5MM STEREO JACK PANEL MT
J 602	02100302	MICRO-MINI HEADER MMP2S-1
INDUCTORS		
L 301	01800111	2.2 µH PHE FCW .250 aR
L 302	18110331	.33 µH CHIP
L 303	01850301	1.5T SHIELDED
L 305	18110331	.33 µH CHIP
L 306	18110331	.33 µH CHIP
L 307	01870952	2.5T AIRFCW .05 a L
L 308	01870953	3.5T AIRFCW .07 a L
L 311	01870953	3.5T AIRFCW .07 a L
L 312	01870952	2.5T AIRFCW .05 a L
L 401	01870955	5.5T AIRFCW .1 a L
L 402	01870951	1.5T AIRFCW .03 a L
L 403	01802084	M.5T AIRFSW .2 a-.22#20 REM.5L
L 404	01870956	6.5T AIRFCW .12 a L
L 405	01804204	4.5T #20AWG MAG WIRE .1ID CW
L 406	01870956	6.5T AIRFCW .12 a L
L 407	01804204	4.5T #20AWG MAG WIRE .1ID CW
L 408	01802084	M.5T AIRFSW .2 a-.22#20 REM.5L
L 409	01800107	1 µH PHE FCW .250 aR
L 410	01870952	2.5T AIRFCW .05 a L
L 411	01802110	M1.5T AIRFSW .2aR .1S #20 TP
L 412	01802110	M1.5T AIRFSW .2aR .1S #20 TP
L 413	01870956	6.5T AIRFCW .12 a L
L 501	01850301	1.5T SHIELDED
L 502	01850301	1.5T SHIELDED
L 503	01800101	.15 µH PHE FCW .250 aR
L 504	01850301	1.5T SHIELDED
L 505	01850301	1.5T SHIELDED
L 506	01802040	1.5T AIRFCW .062 aL .034 #26
L 507	01850301	1.5T SHIELDED
L 508	01870951	1.5T AIRFCW .03 a L
HEADER CONNECTORS		
P 402	02100325	DC POWER PLUG
P 601	21331022	RT ANGLE .1CTRS 2 PIN
P 602	21331032	RT ANGLE .1 CTRS 3 PIN
P 603	21331052	RT ANGLE .1 CTRS 5 PIN
RECTANGULAR RESISTOR		
PRPL1	04742001	10 Ω 5%
TRANSISTORS		
Q 101	04800011	2N4126 PNP GP AUDIO TO-92
Q 201	04800008	MPS-A64 PNP DARLINGTON
Q 202	04800006	MPS-4124 NPN LOW NOISE AUD.
Q 301	4801001Q	MMBT-5088 SOT-23 1Q
Q 302	4801002A	MMBT3906 PNP SOT-23
Q 304	4801002A	MMBT3906 PNP SOT-23
Q 305	4801001Q	MMBT-5088 SOT-23 1Q
Q 306	4841006B	NFET GP SOT-23 (6B) MMBF5484
Q 307	4801001Q	MMBT-5088 SOT-23 1Q
Q 308	4841006T	MMBFJ310TI NFET GP SOT-23 (6T)
Q 309	4821007A	MMBT901TI NPN 1GHZ SOT-23
Q 310	4821007A	MMBT901TI NPN 1GHZ SOT-23
Q 311	04800030	MPS-3866 NPN RF MED PWR.
Q 312	04800048	NPN 1W MPSW01A
Q 313	04800019	TIP-42 40V 6A PNP POWER
Q 314	04800006	MPS-4124 NPN LOW NOISE AUD
Q 315	04800011	2N4126 PNP GP AUDIO TO-92
Q 316	4801001Q	MMBT-5088 SOT-23 1Q
Q 317	04800006	MPS-4124 NPN LOW NOISE AUD.
Q 401	04801020	MRF-581 1.5W HIGH FREQ RF PWR
Q 402	04801021	MRF652 UHF RF POWER AMP
Q 403	04801019	MRF-644 UHF PWR RF
Q 501	4821007Y	MMBR941L RF LO PWR SOT-23 7Y
Q 502	04800034	J310 FET N-CHANNEL
Q 503	04800002	MPS3563 NPN RF AMPLIFIER
RESISTORS, CHIP, 1/4W, 5%, CF, UNLESS STATED OTHERWISE		
R 101	04700825	220 Ω 1/8W
R 102	04700825	220 Ω 1/8W
R 103	04700825	220 Ω 1/8W
R 104	04700825	220 Ω 1/8W
R 105	04700825	220 Ω 1/8W
R 106	04700825	220 Ω 1/8W
R 107	04700825	220 Ω 1/8W
R 108	04700825	220 Ω 1/8W
R 109	04700145	10 KΩ
R 110	04700145	10 KΩ
R 111	04700145	10 KΩ
R 112	04700142	5.6 KΩ
R 113	04700153	47 KΩ
R 114	04720009	ZERO Ω
R 115	04700145	10 KΩ
R 116	04700157	100 KΩ
R 117	04700157	100 KΩ
R 118	04700127	330 Ω
R 119	04700133	1 KΩ
R 120	04700133	1 KΩ
R 121	04700141	4.7 KΩ
R 122	04700155	68 KΩ
R 123	04700141	4.7 KΩ
R 124	04700145	10 KΩ
R 125	04720009	ZERO Ω
R 126	04700133	1 KΩ
R 127	04700127	330 Ω
R 128	04700133	1 KΩ
R 129	04700157	100 KΩ
R 130	04700157	100 KΩ
R 131	04700157	100 KΩ
R 132	04700157	100 KΩ
R 133	04700145	10 KΩ
R 135	04700125	220 Ω
R 136	04750004	10 KΩ TRIM POT VERT/MINI
R 137	04720009	ZERO Ω
R 138	04700169	1M Ω
R 201	04700141	4.7 KΩ
R 202	04700147	15 KΩ

REF #	RITRON #	DESCRIPTION
R 203	04700154	56 KΩ
R 204	04700159	150 KΩ
R 205	04732496	34.8 KΩ 1% METAL FILM 1/4 IST
R 206	04700159	150 KΩ
R 207	04700145	10 KΩ
R 208	04700147	15 KΩ
R 209	04700154	56 KΩ
R 210	04700159	150 KΩ
R 211	04732496	34.8 KΩ 1% METAL FILM 1/4 IST
R 212	04700159	150 KΩ
R 213	04700142	5.6 KΩ
R 214	04700153	47 KΩ
R 215	04700157	100 KΩ
R 216	04700137	2.2 KΩ
R 217	04700139	3.3 KΩ
R 218	04700163	330 KΩ
R 219	04700140	3.9 KΩ
R 220	04720009	ZERO Ω
R 221	04700143	6.8 KΩ
R 222	04700143	6.8 KΩ
R 223	04700134	1.2 KΩ
R 224	04750049	10KΩPIHER POT (MINI)
R 225	04700155	68 KΩ
R 226	04700156	82 KΩ
R 227	04700164	390 KΩ
R 228	04750049	10KΩPIHER POT (MINI)
R 230	04700142	5.6 KΩ
R 231	04700161	220 KΩ
R 232	04700152	39 KΩ
R 233	04700150	27 KΩ
R 234	04700134	1.2 KΩ
R 235	04700157	100 KΩ
R 236	04700140	3.9 KΩ
R 237	04700157	100 KΩ
R 238	04700154	56 KΩ
R 239	04700148	18 KΩ
R 240	04700139	3.3 KΩ
R 241	04700138	2.7 KΩ
R 242	04700143	6.8 KΩ
R 243	04700145	10 KΩ
R 244	04700143	6.8 KΩ
R 245	04700141	4.7 KΩ
R 246	04700129	470 Ω
R 247	04700157	100 KΩ
R 248	04700154	56 KΩ
R 249	04700125	220 Ω
R 250	04700133	1 KΩ
R 301	47110101	100 Ω 1206 1/8W
R 302	47110822	8.2 KΩ 1/8W 1206
R 303	47110103	10 KΩ 1206 1/8W
R 304	47110273	27 KΩ 1206 1/8W
R 305	47110101	100 Ω 1206 1/8W
R 306	47110333	33 KΩ 1206 1/8W
R 307	47110222	2.2 KΩ 1206 1/8W
R 309	47110564	560 KΩ 1206 1/8W
R 310	04750100	THERM 10 KΩ
R 311	47110104	100 KΩ 1206 1/8W
R 312	04750050	100 KΩ PIHER POT (MINI)
R 314	47110332	3.3 KΩ 1206 1/8W
R 315	47110101	100 Ω 1206 1/8W
R 316	47110103	10 KΩ 1206 1/8W
R 317	47110102	1 KΩ 1206 1/8W
R 318	47110103	10 KΩ 1206 1/8W
R 319	47110104	100 KΩ 1206 1/8W
R 320	47110104	100 KΩ 1206 1/8W
R 321	47110102	1 KΩ 1206 1/8W
R 322	47110102	1 KΩ 1206 1/8W
R 323	47110103	10 KΩ 1206 1/8W
R 324	47110103	10 KΩ 1206 1/8W
R 325	47110103	10 KΩ 1206 1/8W
R 326	47110683	68 KΩ 1206 1/8W
R 327	47110104	100 KΩ 1206 1/8W
R 329	47110103	10 KΩ 1206 1/8W
R 330	04700136	1.8 KΩ
R 331	47110470	47 Ω 1/8W 1206
R 332	47110101	100 Ω 1206 1/8W
R 333	47110330	33 Ω 1/8W 1206
R 334	47110101	100 Ω 1206 1/8W
R 335	47110822	8.2 KΩ 1/8W 1206
R 336	47110102	1 KΩ 1206 1/8W
R 337	47110101	100 Ω 1206 1/8W
R 338	47110103	10 KΩ 1206 1/8W
R 339	47110152	1.5 KΩ 1/8W 1206
R 340	47110101	100 Ω 1206 1/8W
R 342	47110101	100 Ω 1206 1/8W
R 343	47110330	33 Ω 1/8W 1206
R 344	47110102	1 KΩ 1206 1/8W
R 345	47110682	6.8 KΩ 1206 1/8W
R 346	04710014	33 Ω 1/2W
R 347	04700121	100 Ω
R 349	47110102	1 KΩ 1206 1/8W
R 350	04700136	1.8 KΩ
R 351	04700133	1 KΩ
R 352	04700133	1 KΩ
R 353	47110222	2.2 KΩ 1206 1/8W
R 354	04700145	10 KΩ
R 355	47110222	2.2 KΩ 1206 1/8W
R 356	47110103	10 KΩ 1206 1/8W
R 357	04700133	1 KΩ
R 358	47110102	1 KΩ 1206 1/8W
R 359	47110103	10 KΩ 1206 1/8W
R 360	47110474	470 KΩ 1206 1/8W
R 361	47110104	100 KΩ 1206 1/8W
R 362	47110104	100 KΩ 1206 1/8W
R 363	47110104	100 KΩ 1206 1/8W
R 364	47110105	1 MEG Ω 1206 1/8W
R 365	47110103	10 KΩ 1206 1/8W
R 401	47110101	100 Ω 1206 1/8W
R 402	47110222	2.2 KΩ 1206 1/8W
R 403	04710008	10 Ω 1/2W
R 404	04710025	270 Ω 1/2W
R 405	47110103	10 KΩ 1206 1/8W
R 501	04700157	100 KΩ
R 502	04700157	100 KΩ
R 503	04700137	2.2 KΩ
R 504	04700146	12 KΩ
R 505	04700129	470 Ω
R 506	04700157	100 KΩ
R 507	04700157	100 KΩ
R 508	04700133	1 KΩ
R 509	04700134	1.2 KΩ
R 510	04700149	22 KΩ
R 511	04700135	1.5 KΩ
R 512	04700136	1.8 KΩ
R 513	04700136	1.8 KΩ
R 514	04700153	47 KΩ
R 515	04700150	27 KΩ
R 516	04700121	100 Ω

REF #	RITRON #	DESCRIPTION
R 517	04700157	100 KΩ
R 518	04700157	100 KΩ
R 519	04700142	5.6 KΩ
R 520	04700143	6.8 KΩ
R 521	04700141	4.7 KΩ
R 522	04700134	1.2 KΩ
R 523	04750100	THERM 10 KΩ
R 524	04700145	10 KΩ
R 525	04700141	4.7 KΩ
R 526	04700157	100 KΩ
R 601	04750053	10 KΩPOT W/SPST SW PCMNT
R 602	04700131	680 Ω
R 603	04700099	1.0 Ω
R 604	04700125	220 Ω
R 605	04700103	3.9 Ω
R 607	04700133	1 KΩ
R 608	04700122	120 Ω
R 609	04720049	1 Ω 2W 10%
SPEAKER		
SP601	05500027	1.75 X 3.0 OVAL 4W ALNIC
SWITHCES		
SW102	05100042	SPST MOMENT MINI PC 260GM
SW103	05100042	SPST MOMENT MINI PC 260GM
TRANSFORMER		
T 501	05600002	455KHZ IF
CRYSTALS		
Y 101	02300065	4.003125MHZ 10PPM
Y 301	02300091	16.0125MHZ REF REV B
Y 501	02300408	20.945MHZ HC-44/U 10PPM
FILTERS		
YF501	02301400	21.4MHZ XTAL +/-7.5KHZ
YF502	02301400	21.4MHZ XTAL +/-7.5KHZ
YF503	02301008	CERAMIC CFU-455E2
FERRITE BEADS, ON AXIAL LEADS		
Z 101	01801029	
Z 301	01801029	
Z 302	01801029	
Z 401	01801029	
Z 402	01801029	
Z 403	01801029	
Z 404	01801029	
Z 405	01801029	
Z 406	01801029	
Z 407	01801029	
Z 408	01801029	
Z 409	01801029	
Z 410	01801029	
Z 411	01801029	
Z 501	01801029	
Z 502	01801029	

REVISIONS		
REV	ECN #	WHO

DISPLAY BOARD

CR118 TX/BUSY LED

CR118 ELS-4030

IC101 74HC164

SW103 MONITOR

SW102 CHANNEL

HAND MICROPHONE
HANG-UP BUTTON
SPRING PLATE
MIC JACK
+V SW
RX AUDIO
HANG-UP
PTT
MIC AUDIO
GND

VOLUME CONTROL BOARD
ON/OFF VOLUME CONTROL
SW501

EXTERNAL SPEAKER
INTERNAL SPEAKER

IC183 MC145485

IC102

TX ENABLE
SCI DATA IN
SCI CLOCK OUT
SYNTH LATCH OUT
SYNTH LOCK DET. IN
SUB-AUD DECODE IN
SQUELCH OUT
SUB-AUD ENCODE OUT
SPEAKER BEEP OUT
DCC DECODE IN
DCC ENCODE
DCC IN
TO C226
MON SWITCH IN
CHAN SWITCH IN
RSSI IN
N/A

DATA
TX ENABLE
16.8125MHZ
+V CP
LOCK DET
LATCH
CLOCK

RX AUDIO
RX AUD
Q.C. DEV
TO IC102 PIN 43
TX MODULATION
+V AG

NOTES:
1. PARTS LIST ALWAYS REFLECTS MOST CURRENT COMPONENT VALUES AND ENGINEERING CHANGE NOTICES.
2. ALL RESISTORS IN OHMS UNLESS OTHERWISE SPECIFIED.
3. ALL CAPACITORS IN MICROFARADS UNLESS OTHERWISE SPECIFIED.
4. IC102 PINS NOT SHOWN ON SCHEMATIC ARE NOT TERMINATED.
5. MOST SCHEMATIC TEST POINTS MAY BE ACCESSED AS PC BOARD BOTTOMSIDE PADS.

▽ SYMBOL INDICATES SOLDER SIDE TEST POINTS

ACCESSORY CONNECTOR PINS
LOCATED ON SCHEMATIC (1 OF 2)

1. RX AUDIO (UNPROCESSED)
2. GROUND
3. +V SW
4. PTT SW
5. PTT IN
6. FLX MODULATION INPUT
7. EXT. SELECTIVE SIGNALLING INPUT
8. SPECIAL MODE INDICATOR
9. SQUELCH OVERRIDE
10. N/A
11. SELECTIVE SIGNALLING DEC OUT
12. HANG-UP
13. RX AUDIO
14. MIC AUDIO
15. MONITOR OUT
16. GROUND

LAST NUMBERS USED			NUMBERS MISSING	
C130	C241	C588	C128	C584
R130	R251	R588	R134	R586
Q101	Q202			
IC183	IC204	IC681		
CR188				

TOPSIDE PARTS PLACEMENT 17531002 REV T
BOTTOMSIDE PARTS PLACEMENT 17631002 REV T
PC BOARD 17831002 REV L

RITRON INC
505 W.CARMEL DRIVE CARMEL,IN. 46032

UHF-FM MOBILE XCVR
MODEL: RPM-450
SCHEMATIC (1 OF 2)

SIZE	FSCM NO.	DWG NO.	REV
D	FILE:1802LTT1	17731002	T
		DATE 8/28/98	PLOT 03/07/94

LAST ECN #2178

REVISIONS		
REV	DCN #	DATE

+V OP
TX ENABLE
TX MODULATION
16.8125MHZ
LATCH
DATA
CLOCK
LOCK DET
+V SW
+V RX
+V BATT
+V TX
+8V
+5VSX
SYNTHESIZER SHIELD
VCO SHIELD
TX POWER AMP SHIELD
50 OHMS
RX AUDIO
FROM BATTERY
BATTERY CONNECTOR
ANTENNA

LAST NUMBERS USED			NUMBERS MISSING			
C369	C436	C548	C318	L304	R309	C482	C504
R365	R405	R527	C323	L308	R313	C488	C542
Q317	Q403	Q503	C327	L310	R329	C425	
L312	L413	L509	C328	Q303	R341	C438	
CR307	CR403	CR511	CR302		R348		
IC304	Z411	Z502					

RITRON INC
505 W.CARMEL DRIVE CARMEL, IN. 46032

UHF-FM MOBILE XCVR
MODEL: RPM-450
SCHEMATIC (2 OF 2)

SIZE	FSCM NO.	DWG NO.	REV
D	FILE:1002L.TT2	17731002	T
	DATE 08/28/90	PLOT 03/07/94	

RPM-450

PCB #1730080D

SCHEMATICS
PARTS PLACEMENT DIAGRAMS
PARTS LIST

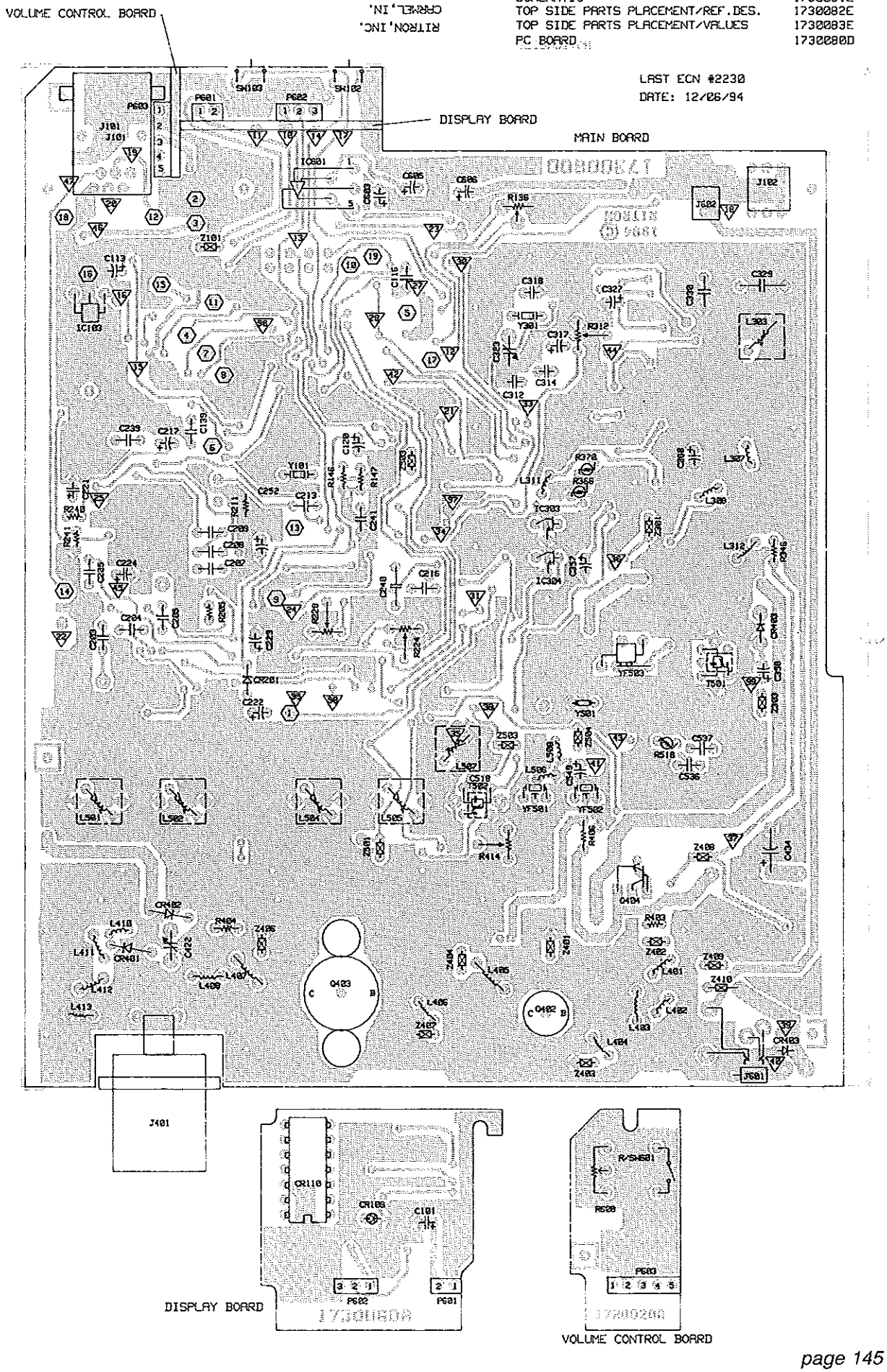
RPM-450 BOTTOMSIDE PARTS PLACEMENT

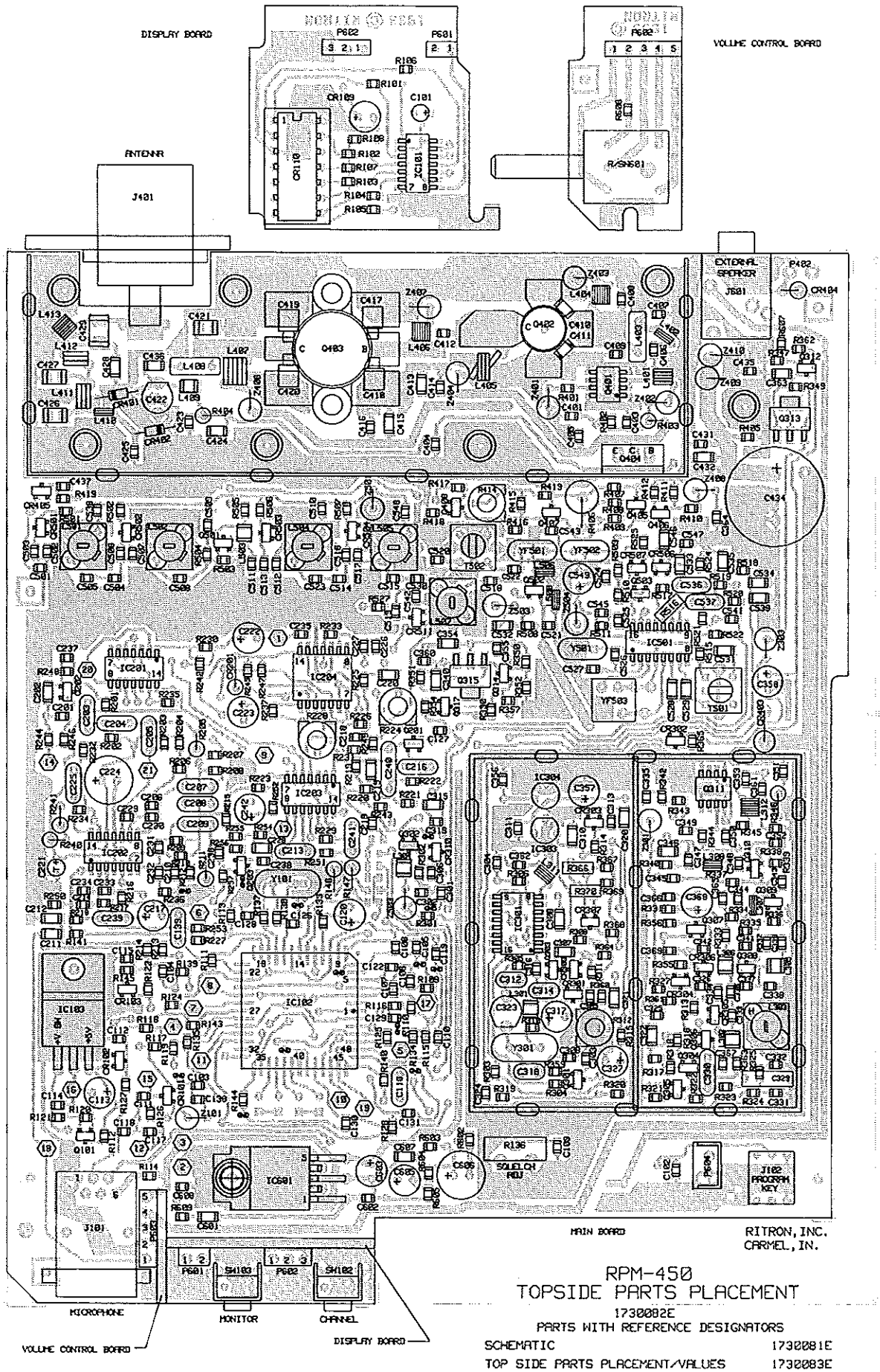
1730084E

SCHEMATIC	1730081E
TOP SIDE PARTS PLACEMENT/REF.DES.	1730082E
TOP SIDE PARTS PLACEMENT/VALUES	1730083E
PC BOARD	1730080D

LAST ECN #2230

DATE: 12/06/94





RITRON, INC.
CARMEL, IN.

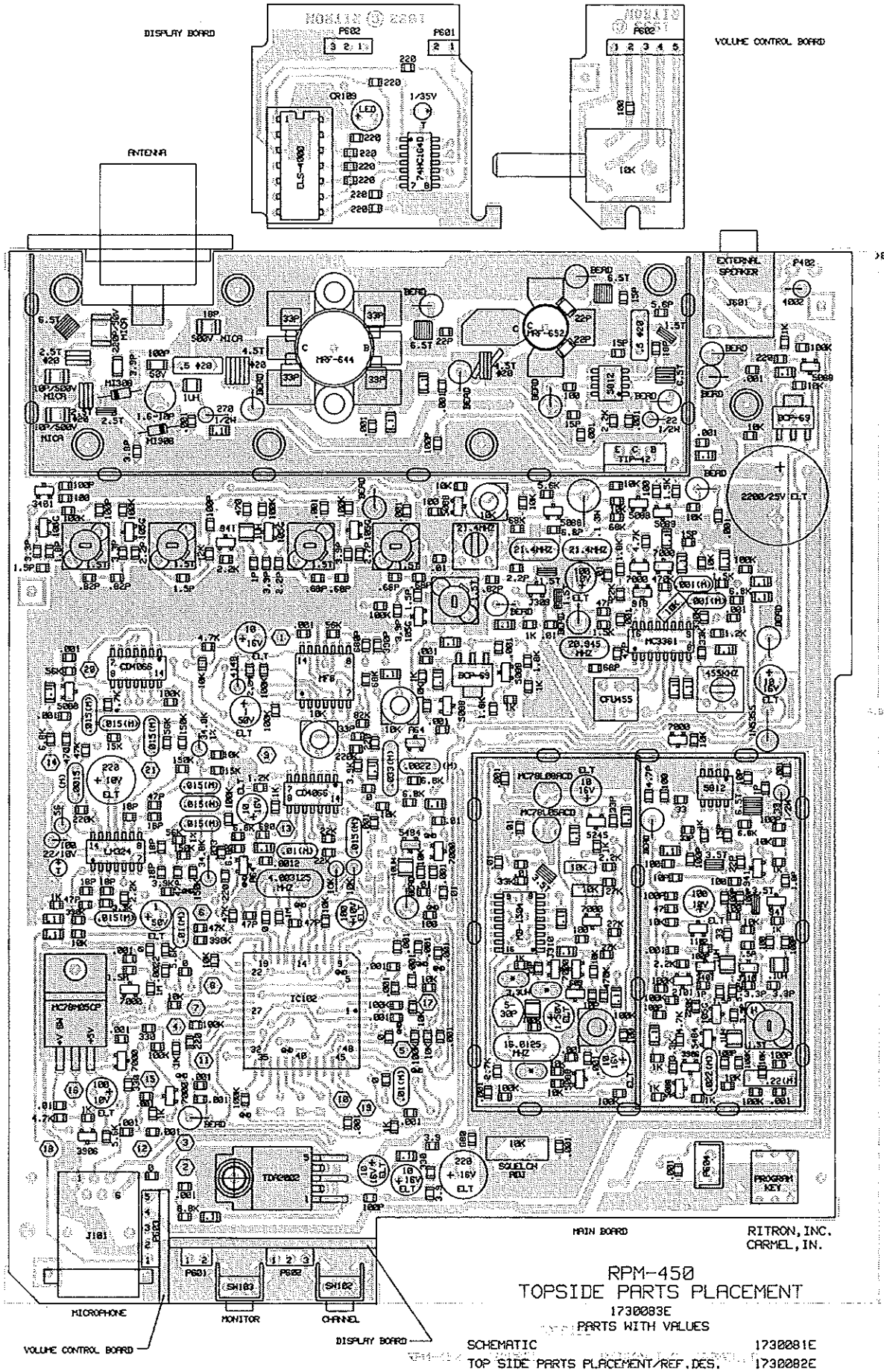
RPM-450
TOPSIDE PARTS PLACEMENT

1730082E

PARTS WITH REFERENCE DESIGNATORS

SCHEMATIC	1730081E
TOP SIDE PARTS PLACEMENT/VALUES	1730083E
BOTTOMSIDE PARTS PLACEMENT	1730084E
PC BOARD	1730080D

LAST ECN #2230
12/06/94



ECN 2238-CHANGE TO 64 MICRO-CONTROLLER CHANGES TO EXTENSIVE TO LIST-SEE ECN

RPM-450
TOPSIDE PARTS PLACEMENT

1730083E

PARTS WITH VALUES

SCHEMATIC	1730081E
TOP SIDE PARTS PLACEMENT/REF.DES.	1730082E
BOTTOMSIDE PARTS PLACEMENT	1730084E
PC BOARD	1730080D

LAST ECN #2230

12/06/94

27. RPM-450 SCHEMATIC REF. PARTS LIST (SCHEMATIC #1730081D)

NOTE: This parts list reflects the most current component values (through ECN 2230) for schematic number 1730081D (PCB #1730080D). If a component value given in the schematic differs from that in the parts list, the parts list should be considered correct.

REF #	RITRON #	DESCRIPTION
CAPACITORS, CHIP, 50V, UNLESS STATED OTHERWISE		
C 101	01502007	1µF TANT 35V 20%
C 102	15111102	.001µF X7R 0805
C 103	15111102	.001µF X7R 0805
C 104	15111222	.0022µF NPO 0805
C 105	15111102	.001µF X7R 0805
C 106	15111102	.001µF X7R 0805
C 107	15111102	.001µF X7R 0805
C 108	15111102	.001µF X7R 0805
C 109	15111102	.001µF X7R 0805
C 110	15111102	.001µF X7R 0805
C 111	15111102	.001µF X7R 0805
C 112	15111102	.001µF X7R 0805
C 113	01503110	100µF ELT 10V
C 114	15111103	.01µF X7R
C 115	15111102	.001µF X7R 0805
C 116	01501050	.01µF MYLAR 100V 10%
C 117	15111102	.001µF X7R 0805
C 118	15111102	.001µF X7R 0805
C 119	15111102	.001µF X7R 0805
C 120	01503110	100µF ELT 10V
C 122	15111102	.001µF X7R 0805
C 126	15110470	47pF NPO
C 127	15111102	.001µF X7R 0805
C 128	15110470	47pF NPO
C 129	15111102	.001µF X7R 0805
C 130	15111102	.001µF X7R 0805
C 131	15111102	.001µF X7R 0805
C 138	15111102	.001µF X7R 0805
C 139	01501050	.01µF MYLAR 100V 10%
C 201	15111102	.001µF X7R 0805
C 202	15121104	.1µF X7R 1206
C 203	01501062	.015µF MYLAR 100V 10%
C 204	01501062	.015µF MYLAR 100V 10%
C 205	01501062	.015µF MYLAR 100V 10%
C 206	15110470	47pF NPO
C 207	01501062	.015µF MYLAR 100V 10%
C 208	01501062	.015µF MYLAR 100V 10%
C 209	01501062	.015µF MYLAR 100V 10%
C 210	15110470	47pF NPO
C 211	15121104	.1µF X7R 1206
C 212	15121104	.1µF X7R 1206
C 213	01501050	.01µF MYLAR 100V 10%
C 214	15110470	47pF NPO
C 215	15121104	.1µF X7R 1206
C 216	01501041	.0022µF MYLAR 100V 10%
C 217	01503002	1µF ELT
C 218	15110330	33pF NPO
C 219	15111102	.001µF X7R 0805
C 220	15121104	.1µF X7R 1206
C 221	01502015	22µF TANT 10V(A) 20%
C 222	01503006	10µF ELT 16V
C 223	01503002	1µF ELT
C 224	01503011	220µF ELT 16V
C 225	01501065	.0015µF MYLAR 100V 10%
C 226	15110391	390pF NPO
C 227	15110681	CHIP 0805 680pF NPO
C 228	15121104	.1µF X7R 1206
C 229	15110180	18pF NPO
C 230	15110180	18pF NPO
C 231	15110180	18pF NPO
C 232	15110180	18pF NPO
C 233	15110180	18pF NPO
C 234	15110180	18pF NPO
C 235	15111102	.001µF X7R 0805
C 236	15111333	.033µF X7R 0805
C 237	15111102	.001µF X7R 0805
C 238	15111122	.0012µF X7R
C 239	01501062	.015µF MYLAR 100V 10%
C 240	01501053	.033µF MYLAR 100V 10%
C 241	01501062	.015µF MYLAR 100V 10%
C 301	15111103	.01µF X7R
C 302	15111103	.01µF X7R
C 303	15111102	.001µF X7R 0805
C 304	15111103	.01µF X7R
C 305	15110100	10pF NPO 0805
C 306	15111102	.001µF X7R 0805
C 307	15121104	.1µF X7R 1206
C 308	15121104	.1µF X7R 1206
C 309	15111102	.001µF X7R 0805
C 310	15121104	.1µF X7R 1206
C 311	15111103	.01µF X7R
C 312	01510802	47pF N1500 CERDIS
C 313	15110330	33pF NPO
C 314	01510802	47pF N1500 CERDIS
C 315	15121104	.1µF X7R 1206
C 316	15110330	33pF NPO
C 317	01503002	1µF ELT
C 318	01510724	56pF N750 CERDIS
C 319	15111103	.01µF X7R
C 320	15121104	.1µF X7R 1206
C 321	15121104	.1µF X7R 1206
C 322	15121104	.1µF X7R 1206
C 323	01550006	5-30pF VARCER 2
C 325	15110101	100pF NPO 0805
C 326	151101A0	1.0pF NPO
C 327	01503006	10µF ELT 16V
C 329	01501071	.22µF MLPOLY 5 %
C 330	01501070	.022µF MLPOLY 5%
C 331	15111102	.001µF X7R 0805
C 332	15110101	100pF NPO 0805
C 333	151103A9	3.9pF NPO
C 334	151101A5	1.5pF NPO
C 335	151104A7	4.7pF 0805
C 336	151105A6	5.6pF NPO 0805
C 337	151103A3	3.3pF NPO 0805
C 338	151103A3	3.3pF NPO 0805
C 339	15110101	100pF NPO 0805
C 340	15121104	.1µF X7R 1206
C 341	15110A47	.47pF NPO 0805
C 342	15110101	100pF NPO 0805
C 343	151101A8	1.8pF NPO

REF #	RITRON #	DESCRIPTION
C 344	15110101	100pF NPO 0805
C 345	15110100	10pF NPO 0805
C 346	15121104	.1µF X7R 1206
C 347	15110101	100pF NPO 0805
C 348	15110220	22pF NPO 0805
C 349	15110330	33pF NPO
C 350	15110150	15pF 0805 NPO
C 351	15111102	.001µF X7R 0805
C 352	15110101	100pF NPO 0805
C 353	15110100	10pF NPO 0805
C 354	15121104	.1µF X7R 1206
C 355	15111102	.001µF X7R 0805
C 356	15111102	.001µF X7R 0805
C 357	01503006	10µF ELT 16V
C 358	01503006	10µF ELT 16V
C 360	15111102	.001µF X7R 0805
C 361	151101A0	1.0pF NPO
C 362	15111103	.01µF X7R
C 363	15121104	.1µF X7R 1206
C 364	15111102	.001µF X7R 0805
C 365	15110101	100pF NPO 0805
C 366	15110101	100pF NPO 0805
C 367	15110101	100pF NPO 0805
C 368	01503110	100µF ELT 10V
C 369	15111102	.001µF X7R 0805
C 401	15110150	15pF 0805 NPO
C 403	15111102	.001µF X7R 0805
C 404	15110101	100pF NPO 0805
C 405	15111102	.001µF X7R 0805
C 406	15110180	18pF NPO
C 407	151105A6	5.6pF NPO 0805
C 408	15110150	15pF 0805 NPO
C 409	15110150	15pF 0805 NPO
C 410	15120220	22pF NPO 1206
C 411	15120220	22pF NPO 1206
C 412	15110220	22pF NPO 0805
C 413	15121104	.1µF X7R 1206
C 414	15111102	.001µF X7R 0805
C 415	15121104	.1µF X7R 1206
C 416	15111102	.001µF X7R 0805
C 417	01517419	33pF METCLAD MICA 2
C 419	01517420	39pF METCLAD MICA 2
C 419	01517419	33pF METCLAD MICA 2
C 420	01517419	33pF METCLAD MICA 2
C 421	15525180	18pF NPO 1210 500v MICA
C 422	01550010	1.6-10pF VARTEF 100V
C 423	15111102	.001µF X7R 0805
C 424	15121104	.1µF X7R 1206
C 425	151103A9	3.9pF NPO
C 426	15525100	10pF NPO 1206 500v MICA
C 427	15525100	10pF NPO 1206 500v MICA
C 428	151203A9	3.9pF NPO 1206
C 429	15525221	220pF SURF MNT MICA 500V
C 431	15111102	.001µF X7R 0805
C 432	15121104	.1µF X7R 1206
C 434	01503208	2200µF ELT 25V
C 435	15111102	.001µF X7R 0805
C 436	15120101	100pF NPO 1206
C 437	15110101	100pF NPO 0805
C 501	151101A5	1.5pF NPO
C 502	151101A8	1.8pF NPO
C 503	151103A3	3.3pF NPO 0805
C 504	15110A82	.82pF NPO 0805
C 505	15110A82	.82pF NPO 0805
C 506	151103A3	3.3pF NPO 0805
C 507	151102A2	2.2pF NPO
C 508	151101A5	1.5pF NPO
C 509	15110101	100pF NPO 0805
C 510	15111102	.001µF X7R 0805
C 511	151101A0	1.0pF NPO
C 512	151102A2	2.2pF NPO
C 513	151103A9	3.9pF NPO
C 514	15110A68	.68pF NPO 0805
C 515	15110A68	.68pF NPO 0805
C 516	151103A9	3.9pF NPO
C 517	151102A7	2.7pF NPO
C 518	15110A82	.82pF NPO 0805
C 519	151103A9	3.9pF NPO
C 520	15111103	.01µF X7R
C 521	15111103	.01µF X7R
C 522	151102A2	2.2pF NPO
C 523	15110A68	.68pF NPO 0805
C 524	15111103	.01µF X7R
C 525	15111102	.001µF X7R 0805
C 526	15110470	47pF NPO
C 527	15110680	68pF NPO 0805
C 528	15121104	.1µF X7R 1206
C 529	15121104	.1µF X7R 1206
C 530	15110A68	.68pF NPO 0805
C 531	15121104	.1µF X7R 1206
C 532	15121104	.1µF X7R 1206
C 533	15121104	.1µF X7R 1206
C 534	15121104	.1µF X7R 1206
C 535	15121104	.1µF X7R 1206
C 536	01501040	.001µF MYLAR 100V 10%
C 537	01501040	.001µF MYLAR 100V 10%
C 538	15110101	100pF NPO 0805
C 539	15121104	.1µF X7R 1206
C 541	15111102	.001µF X7R 0805
C 542	151101A5	1.5pF NPO
C 543	151106A8	6.8pF NPO
C 545	15110470	47pF NPO
C 546	15121104	.1µF X7R 1206
C 547	15110150	15pF 0805 NPO
C 548	15111102	.001µF X7R 0805
C 549	01503110	100µF ELT 10V
C 601	15121104	.1µF X7R 1206
C 602	15110101	100pF NPO 0805
C 603	01503006	10µF ELT 16V
C 605	01503006	10µF ELT 16V
C 606	01503011	220µF ELT 16V
C 607	15121104	.1µF X7R 1206
C 608	15111102	.001µF X7R 0805

DIODES, MMBD7000 DUAL SOT-23, UNLESS STATED OTHERWISE

CR101	48A1005C	
CR102	48A1005C	
CR103	48A1005C	
CR109	02450006	MINI RED LED
CR110	02450101	7 SEG GREEN LED COM CATH
CR201	04810001	1N4148 /GENERAL PURPOSE
CR301	48C1005L	MMBV609L VVC 40PF SOT23
CR302	48A1005C	
CR303	48B1008W	MMBZ 5245 ZENER SOT23
CR304	48C1004G	MMBV-2101L VVC SOT-23
CR305	48C1004E	MMBV-105G VVC SOT-23

REF #	RITRON #	DESCRIPTION
CR306	48A1004D	MMBV3401TI UHF SOT-23
CR307	48A1005C	
CR309	48A1005C	
CR310	48A1005C	
CR401	04810033	PIN 25W GLASS AXIAL MI308
CR402	04810033	PIN 25W GLASS AXIAL MI308
CR403	04820119	1N5355A ZENER 18V 5W
CR404	04810004	GP PWR 1N4002
CR405	48A1004D	MMBV3401TI UHF SOT-23
CR501	48C1004E	MMBV-105G VVC SOT-23
CR502	48C1004E	MMBV-105G VVC SOT-23
CR503	48C1004E	MMBV-105G VVC SOT-23
CR504	48C1004E	MMBV-105G VVC SOT-23
CR506	48A1005C	
CR507	48A1005C	
CR511	48C1004E	MMBV-105G VVC SOT-23

INTEGRATED CIRCUITS

IC101	31120164	74HC164 DIGITAL SO-14
IC102	314B0004	MICROCNTRLR EEPROM
IC103	03131016	MC78MO5CY 5 V REG (TO-220)
IC201	31124066	MC14066 QUAD ANLG SW SO-14
IC202	31020324	LM324AD QUAD OP AMP
IC203	31124066	MC14066 QUAD ANLG SW SO-14
IC204	31020001	MF6 6 POLE FILTER SOLIC
IC301	31330001	MB1504 UHF SYNTHESIZER
IC303	03131012	MC78L05CP 5V REG
IC304	03131013	MC78L08CP 8 V REG
IC501	31030001	MC3361BD SO-16 IF SUBSYS
IC601	03131050	8 WATT AUDIO AMP (TDA2002)

CONNECTORS

J 101	02100310	6-PIN MODULAR PHONE JACK
J 102	21433030	3 POSITION PC MNT
J 401	02100330	UHF REAR MNT BULKHD RCPTCLE
J 601	02100053	3.5MM STEREO JACK PNL MNT

INDUCTORS

L 301	18110332	3.3µH CHIP
L 302	18110101	0.1µH CHIP
L 303	01850301	1.5T SHIELDED
L 304	18110103	10µH CHIP
L 305	18110101	0.1µH CHIP
L 306	18110101	0.1µH CHIP
L 307	01870953	3.5T AIRFCW .07 a L
L 308	01870953	3.5T AIRFCW .07 a L
L 311	01870953	3.5T AIRFCW .07 a L
L 312	01870956	6.5T AIRFCW .12 a L
L 401	01870956	6.5T AIRFCW .12 a L
L 402	01870951	1.5T AIRFCW .03 a L
L 403	01802084	M.5T AIRFSW .2 a-.22#20 REM.5L
L 404	01870956	6.5T AIRFCW .12 a L
L 405	01804204	4.5T #20AWG WIRE .1ID CW LHH
L 406	01870956	6.5T AIRFCW .12 a L
L 407	01804204	4.5T #20AWG WIRE .1ID CW LHH
L 408	01802084	M.5T AIRFSW .2 a-.22#20 REM.5L
L 409	18110102	1.0µH CHIP
L 410	01870952	2.5T AIRFCW .05 a L
L 411	01802056	2.5T AIRFSW .1 aL .17 #20
L 412	01802056	2.5T AIRFSW .1 aL .17 #20
L 413	01870956	6.5T AIRFCW .12 a L

REF #	RITRON #	DESCRIPTION
L 501	01850301	1.5T SHIELDED
L 502	01850301	1.5T SHIELDED
L 503	18110101	0.1µH CHIP
L 504	01850301	1.5T SHIELDED
L 505	01850301	1.5T SHIELDED
L 506	01870951	1.5T AIRFCW .03 a L
L 507	01850301	1.5T SHIELDED
L 508	01870951	1.5T AIRFCW .03 a L

HEADER CONNECTORS

P 402	02100326	DC PWR CAP
P 604	02100302	MICRO-MINI MMP2S-1

TRANSISTORS

Q 101	4801002A	MMBT3906 SOT23
Q 201	4801002V	MMBTA64 PNP DARL. SOT-23
Q 202	4801001Q	MMBT-5088 SOT-23
Q 203	4801002V	MMBTA64 PNP DARL. SOT-23
Q 301	4801001Q	MMBT-5088 SOT-23
Q 302	4841006B	MMBF5484 NFET GP SOT23
Q 303	4841006U	MMBFJ309L N-CHAN RF SOT23
Q 304	4801002A	MMBT3906 SOT23
Q 305	4801001Q	MMBT-5088 SOT-23
Q 306	4841006B	MMBF5484 NFET GP SOT23
Q 307	48010R02	MUN2211T1 W/BIAS RES. SOT-23
Q 308	4841006T	MMBFJ310T1 NFET GP SOT-23
Q 309	4821007Y	MMBR941LT1 LO PWR RF SOT-23
Q 310	4821007Y	MMBR941LT1 LO PWR RF SOT-23
Q 311	48220001	MRF-5812 NPN LOW PWR RF SO-8
Q 312	4801001Q	MMBT-5088 SOT-23
Q 313	48180001	BCP-69 PNP RF PWR SOT-223
Q 314	4801001Q	MMBT-5088 SOT-23
Q 315	48180001	BCP-69 PNP RF PWR SOT-223
Q 317	4801001Q	MMBT-5088 SOT-23
Q 401	48220001	MRF-5812 NPN LOW PWR RF SO-8
Q 402	04801021	MRF652 UHF RF PWR AMP
Q 403	04801019	MRF-644 UHF PWR RF
Q 404	04800019	TIP-42 40V 6A PNP
Q 405	4801001Q	MMBT-5088 SOT-23
Q 406	4801001Q	MMBT-5088 SOT-23
Q 407	4801001Q	MMBT-5088 SOT-23
Q 408	4801001Q	MMBT-5088 SOT-23
Q 501	4821007Y	MMBR941LT1 LO PWR RF SOT-23
Q 502	4841006U	MMBFJ309L N-CHAN RF SOT23
Q 503	4821003B	MMBT918LT1 VHF SOT23 (3B)

RESISTORS, CHIP, 1/4W, 5%, CF, UNLESS STATED OTHERWISE

R 101	47100221	220 Ω 0805
R 102	47100221	220 Ω 0805
R 103	47100221	220 Ω 0805
R 104	47100221	220 Ω 0805
R 105	47100221	220 Ω 0805
R 106	47100221	220 Ω 0805
R 107	47100221	220 Ω 0805
R 108	47100221	220 Ω 0805
R 109	47100103	10 KΩ 0805
R 110	47100103	10 KΩ 0805
R 111	47100103	10 KΩ 0805
R 112	47100562	5.6 KΩ 0805
R 113	47100473	47 KΩ 0805

REF #	RITRON #	DESCRIPTION
R 114	47100000	ZERO Ω 0805
R 115	47100103	10 KΩ 0805
R 116	47100104	100 KΩ 0805
R 117	47100104	100 KΩ 0805
R 118	47100331	330 Ω 0805
R 119	47100102	1 KΩ 0805
R 120	47100102	1 KΩ 0805
R 121	47100472	4.7 KΩ 0805
R 122	47100105	1M Ω 0805
R 124	47100103	10 KΩ 0805
R 125	47100000	ZERO Ω 0805
R 126	47100102	1 KΩ 0805
R 127	47100331	330 Ω 0805
R 128	47100102	1 KΩ 0805
R 133	47100103	10 KΩ 0805
R 134	47100104	100 KΩ 0805
R 135	47100221	220 Ω 0805
R 136	04750004	10 KΩ TRIM POT VERT/MINI
R 137	47100000	ZERO Ω 0805
R 138	47100105	1M Ω 0805
R 139	47100000	Zero Ω 0805
R 140	47100000	Zero Ω 0805
R 141	47100103	10 KΩ 0805
R 143	47100104	100 KΩ 0805
R 144	47100104	100 KΩ 0805
R 145	47100155	1.5M Ω 0805
R 146	04700145	10 KΩ 1/4 W 5% CF
R 147	04700145	10 KΩ 1/4 W 5% CF
R 201	47100472	4.7 KΩ 0805
R 202	47100153	15 KΩ 0805
R 203	47100563	56 KΩ 0805
R 204	47100154	150 KΩ 0805
R 205	04732496	34.8 KΩ 1% METAL FILM 1/4 IST
R 206	47100154	150 KΩ 0805
R 207	47100103	10 KΩ 0805
R 208	47100153	15 KΩ 0805
R 209	47100563	56 KΩ 0805
R 210	47100154	150 KΩ 0805
R 211	04732496	34.8 KΩ 1% METAL FILM 1/4 IST
R 212	47100154	150 KΩ 0805
R 213	47100562	5.6 KΩ 0805
R 214	47100000	Zero Ω 0805
R 215	47100104	100 KΩ 0805
R 216	47100222	2.2 KΩ 0805
R 217	47100332	3.3 KΩ 0805
R 218	47100334	330 KΩ 0805
R 219	47100392	3.9 KΩ 0805
R 220	47100000	ZERO Ω 0805
R 221	47100682	6.8 KΩ 0805
R 222	47100682	6.8 KΩ 0805
R 223	47100122	1.2 KΩ 0805
R 224	04750049	10 KΩ PIHER POT (MINI)
R 225	47100683	68 KΩ 0805
R 226	47100823	82 KΩ 0805
R 227	47100394	390 KΩ 0805
R 228	04750049	10 KΩ PIHER POT (MINI)
R 229	47100223	22 KΩ 0805
R 230	47100472	4.7 KΩ 0805
R 231	47100224	220 KΩ 0805
R 232	47100473	47 KΩ 0805
R 233	47100563	56 KΩ 0805
R 234	47100224	220 KΩ 0805
R 235	47100104	100 KΩ 0805
R 236	47100392	3.9 KΩ 0805
R 237	47100104	100 KΩ 0805
R 240	04700121	100 Ω
R 241	04700118	56 Ω
R 242	47100103	10 KΩ 0805
R 243	47100103	10 KΩ 0805
R 244	47100682	6.8 KΩ 0805
R 245	47100225	2.2M 0805
R 246	47100471	470 Ω 0805
R 247	47100104	100 KΩ 0805
R 248	47100563	56 KΩ 0805
R 249	47100221	220 Ω 0805
R 250	47100102	1 KΩ 0805
R 251	47100223	22 KΩ 0805
R 252	47100102	1 KΩ 0805
R 253	47100473	47 KΩ 0805
R 254	47100681	680 Ω 0805
R 255	47100682	6.8 KΩ 0805
R 256	47100682	6.8 KΩ 0805
R 257	47100221	220 Ω 0805
R 301	47100101	100 Ω 0805
R 302	47100103	10 KΩ 0805
R 303	47100272	2.7 KΩ 0805
R 304	47100103	10 KΩ 0805
R 305	47100102	1 KΩ 0805
R 306	47100333	33 KΩ 0805
R 308	47100101	100 Ω 0805
R 310	47100104	100 KΩ 0805
R 311	47100103	10 KΩ 0805
R 312	04750050	100 KΩ PIHER POT (MINI)
R 313	47100224	220 KΩ 0805
R 314	47100102	1 KΩ 0805
R 315	47100101	100 Ω 0805
R 316	47100472	4.7 KΩ 0805
R 317	47100102	1 KΩ 0805
R 318	47100332	3.3 KΩ 0805
R 319	47100104	100 KΩ 0805
R 320	47100104	100 KΩ 0805
R 321	47100102	1 KΩ 0805
R 322	47100102	1 KΩ 0805
R 323	47100103	10 KΩ 0805
R 324	47100104	100 KΩ 0805
R 325	47100103	10 KΩ 0805
R 327	47100104	100 KΩ 0805
R 330	47100182	1.8 KΩ 0805
R 331	47100470	47 Ω 0805
R 332	47100101	100 Ω 0805
R 333	47100330	33 Ω 0805
R 334	47100101	100 Ω 0805
R 335	47100103	10 KΩ 0805
R 336	47100102	1 KΩ 0805
R 337	47100101	100 Ω 0805
R 338	47100103	10 KΩ 0805
R 339	47100102	1 KΩ 0805
R 340	47100101	100 Ω 0805
R 342	47100101	100 Ω 0805
R 343	47100330	33 Ω 0805
R 344	47100102	1 KΩ 0805
R 345	47100682	6.8 KΩ 0805
R 346	04710014	33 Ω 1/2W
R 347	47100221	220 Ω 0805
R 349	47100103	10 KΩ 0805
R 350	47100182	1.8 KΩ 0805
R 351	47100102	1 KΩ 0805
R 352	47100102	1 KΩ 0805

REF #	RITRON #	DESCRIPTION
R 354	47100103	10 KΩ 0805
R 355	47100222	2.2 KΩ 0805
R 356	47100103	10 KΩ 0805
R 357	47100102	1 KΩ 0805
R 359	47100103	10 KΩ 0805
R 360	47100474	470 KΩ 0805
R 361	47100104	100 KΩ 0805
R 362	47100104	100 KΩ 0805
R 363	47100104	100 KΩ 0805
R 364	47100273	27 KΩ 0805
R 365	47100103	10 KΩ 0805
R 366	04750100	THERM 10 KΩ
R 367	47100222	2.2 KΩ 0805
R 368	47100273	27 KΩ 0805
R 369	47100273	27 KΩ 0805
R 370	04750100	THERM 10 KΩ
R 401	47100101	100 Ω 0805
R 402	47100222	2.2 KΩ 0805
R 403	04710012	22 Ω 1/2W CARBON COMP
R 404	04710025	270 Ω 1/2W
R 405	47100103	10 KΩ 0805
R 406	04720047	.1 Ω 10% 3W WIREWOUND
R 407	47100103	10 KΩ 0805
R 408	47100103	10 KΩ 0805
R 409	47100683	68 KΩ 0805
R 410	47100103	10 KΩ 0805
R 411	47100152	1.5 KΩ 0805
R 412	47100101	100 Ω 0805
R 413	47100562	5.6 KΩ 0805
R 414	04750049	10 KΩ PIHER POT (MINI)
R 415	47100103	10 KΩ 0805
R 416	47100683	68 KΩ 0805
R 417	47100103	10 KΩ 0805
R 418	47100101	100 Ω 0805
R 419	47100101	100 Ω 0805
R 501	47100104	100 KΩ 0805
R 502	47100104	100 KΩ 0805
R 503	47100222	2.2 KΩ 0805
R 504	47100123	12 KΩ 0805
R 505	47100471	470 Ω 0805
R 506	47100104	100 KΩ 0805
R 507	47100104	100 KΩ 0805
R 508	47100102	1 KΩ 0805
R 509	47100182	1.8 KΩ 0805
R 510	47100223	22 KΩ 0805
R 511	47100152	1.5 KΩ 0805
R 515	47100333	33 KΩ 0805
R 516	04750100	THERM 10 KΩ
R 517	47100474	470 KΩ 0805
R 518	47100104	100 KΩ 0805
R 519	47100152	1.5 KΩ 0805
R 520	47100682	6.8 KΩ 0805
R 521	47100334	330 KΩ 0805
R 522	47100122	1.2 KΩ 0805
R 524	47100103	10 KΩ 0805
R 525	47100472	4.7 KΩ 0805
R 527	47100104	100 KΩ 0805
R 601	04750053	10 KΩ POT W/SPST SW PC MNT
R 602	47100681	680 Ω 0805
R 603	471003A9	3.9 KΩ 0805
R 604	47100331	330 Ω 0805
R 605	471003A9	3.9 KΩ 0805
R 607	47100102	1 KΩ 0805
R 608	47100101	100 Ω 0805

REF #	RITRON #	DESCRIPTION
R 609	47100682	6.8 KΩ 0805

SWITCHES

SW102	05100042	SPST MOMENT MINI PC 260GM
SW103	05100042	SPST MOMENT MINI PC 260GM

TRANSFORMERS

T 501	05600002	455KHZ IF ZAMCO
T 502	05600024	21.4MHZ IF 7MM

CRYSTALS

Y 101	02300066	4.003125MHZ 10 PPM HC-44
Y 301	02300091	16.0125MHZ REF REV C
Y 501	02300408	20.945MHZ HC-44/U 10 PPM

FILTERS

YF501	02301401	21.4MHZ +/- 7.5KHZ HC-44
YF502	02301401	21.4MHZ +/- 7.5KHZ HC-44
YF503	02301008	CERAMIC CFU-455E2

FERRITE BEADS, ON AXIAL LEADS

Z 101	01801029
Z 301	01801029
Z 303	01801029
Z 304	01801029
Z 401	01801029
Z 402	01801029
Z 403	01801029
Z 404	01801029
Z 406	01801029
Z 407	01801029
Z 408	01801029
Z 409	01801029
Z 410	01801029
Z 501	01801029
Z 503	01801029
Z 504	01801029

REVISIONS		
REV	ECN #	DATE

DISPLAY BOARD
1730082A

CR109 TX/BUSY LED

CR110 ELS-4000

IC101 74HC164D

VOLUME CONTROL BOARD
1720023A

HAND MICROPHONE
HANG-UP BUTTON
SPRING PLATE
MC201 MIC
TX
J101 MIC JACK

ON/OFF VOLUME CONTROL
SW501

EXTERNAL SPEAKER J601
INTERNAL SPEAKER SP601

IC102

IC103 MC78M05

Q101 MMBT-3906

SW103 MONITOR
SW102 CHANNEL

IC201 TDA2002

IC201A CD4066
IC201B CD4066
IC201C CD4066
IC201D CD4066

IC202A LM324
IC202B LM324
IC202C LM324
IC202D LM324

IC203A CD4066
IC203B CD4066
IC203C CD4066

IC204A MF6
IC204B MF6
IC204C MF6

Q202 MMBT-5089
Q203 MMBT-A64
Q281 MPS-A64

CR201 1N4148
CR101A 7000
CR101B 7000
CR102A 7000
CR102B 7000
CR103 7000

Y101 4.883125MHZ

DATA
TX ENABLE
LOCK DET
LATCH
CLOCK
SCI DATA IN
SCI CLOCK OUT
SYNTH LOCK DET. IN
SYNTH LATCH OUT
MON SWITCH IN
CHAN SWITCH IN
HI/LO PWR
RSSI IN
RX AUDIO
TX MODULATION
VOICE DEV.
O.C. DEV
SQUELCH SET
SQUELCH OUT
DOC DECODE IN
POC ENCODE
SUB-AUD ENCODE OUT
POC IN
SPEAKER BEEP OUT
TO C226
TO IC102 PIN 43
+V SW
+V BAT
+V RG
+5V

NOTES:

1. PARTS LIST ALWAYS REFLECTS MOST CURRENT COMPONENT VALUES AND ENGINEERING CHANGE NOTICES.
2. ALL RESISTORS IN OHMS UNLESS OTHERWISE SPECIFIED.
3. ALL CAPACITORS IN MICROFARADS UNLESS OTHERWISE SPECIFIED.
4. IC102 PINS NOT SHOWN ON SCHEMATIC ARE NOT TERMINATED.
5. MOST SCHEMATIC TEST POINTS MAY BE ACCESSED AS PC BOARD BOTTOMSIDE PADS.

▽ SYMBOL INDICATES SOLDER SIDE TEST POINTS

ACCESSORY CONNECTOR PINS
LOCATED ON SCHEMATIC (1 OF 2)

1. RX AUDIO (UNPROCESSED)
2. GROUND
3. +V SW
4. PTT SW
5. PTT IN
6. FLX MODULATION INPUT
7. EXT. SELECTIVE SIGNALLING INPUT
8. SPECIAL MODE OUT
9. SQUELCH OVERIDE IN
10. TRUNK DC/OUT
11. SELECTIVE SIGNALLING DEC OUT
12. HANG-UP
13. RX AUDIO
14. MIC AUDIO
15. MONITOR
16. GROUND
17. TRUNK PULSE IN
18. AUDIO IN
19. SQUELCH OUT
20. RX/TX AUDIO OUT
21. RX/TX AUDIO IN
22. +5 VOLTS

LAST NUMBERS USED

C141	C242	C587
R147	R257	R588
Q102	Q202	
IC103	IC204	IC681
CR118	CR202	

NUMBERS MISSING

CR104	C121	C134	R123	R238
CR107	C123	C135	R130	R239
CR108	C124	C136	R131	C604
CR105	C125	C137	R132	
CR106	C132	C140	R142	
Q102	C133	C141	C242	

TOPSIDE PARTS PLACEMENT W/REF.DES. 1730082E
TOPSIDE PARTS PLACEMENT W/VALUES 1730083E
BOTTOMSIDE PARTS PLACEMENT W/REF.DES. 1730084E
PC BOARD 1730080D

LAST ECN #2238

RITRON INC
505 W. CARMEL DRIVE CARMEL, IN. 46032

SCHEMATIC
UHF-FM MOBILE XCVR
MODEL: RPM-450A

DRAWN BY	SIZE	FSCM NO.	DWG NO.	REV
C.KRESSEL	D	FILE:0081DTE1	1730081E	E
DATE 08/09/93			PLOT 12/07/94	SHEET 1 OF 2

REVISIONS		
REV	ECN #	DATE

TX ENABLE
TX MODULATION
+V CP
+V SW
+V RX
+V TX
+V BATT
+5V
+5VSX
+6V
LATCH
DATA
CLOCK
LOCK DET
16.0125MHZ
MOD BALANCE
VCO TUNE
VCO SHIELD
SYNTHESIZER SHIELD
TX POWER AMP SHIELD
50 OHMS
HI-LO POWER
RSSI
RX AUDIO
FROM BATTERY
BATTERY CONNECTOR
ANTENNA

* VALUE DEPENDS ON CRYSTAL

LAST NUMBERS USED

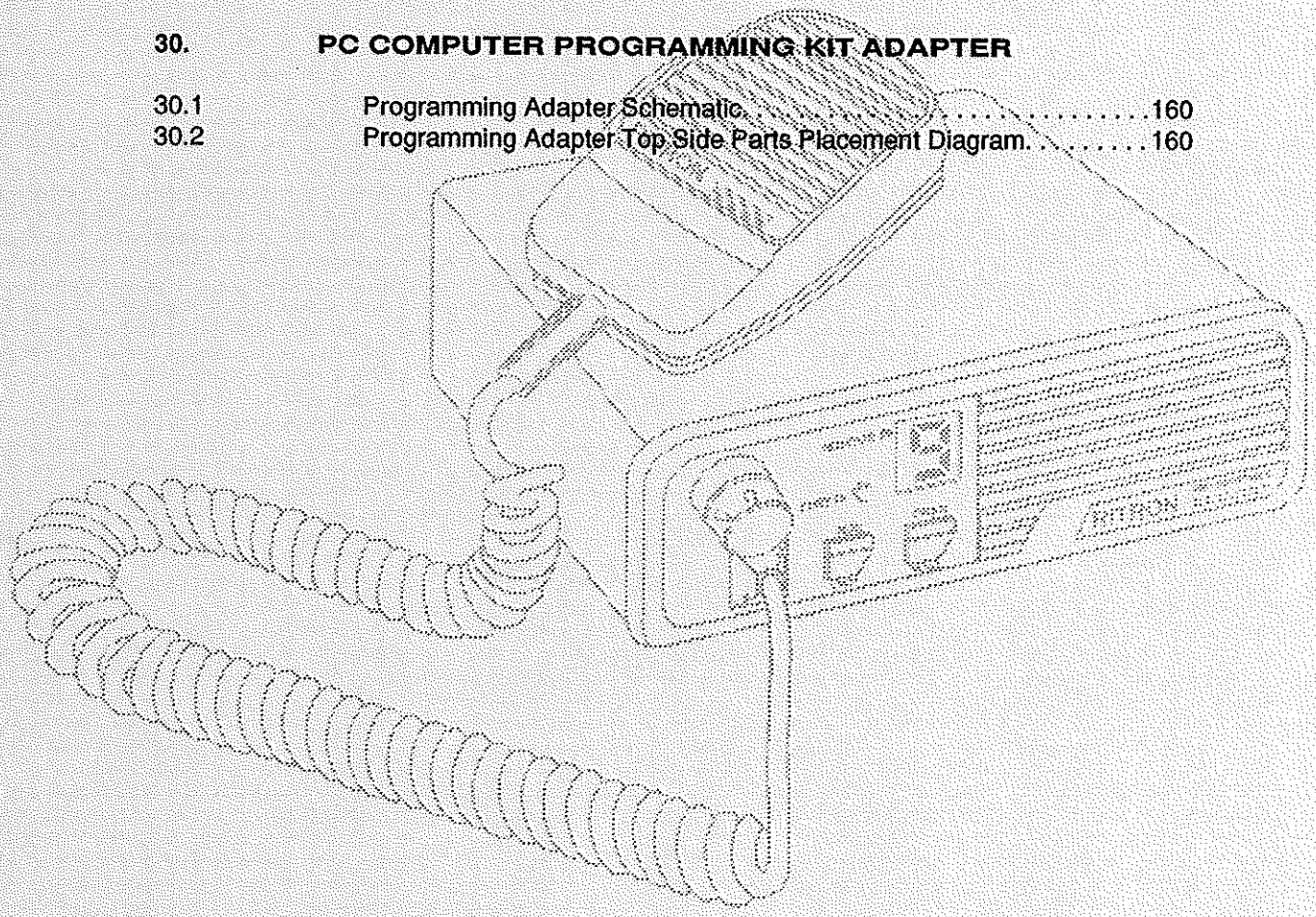
C389	C437	C548
R378	R419	R527
Q317	Q408	Q503
L312	L413	L508
CR389	CR405	CR507
IC304	Z410	Z504
Z384		

NUMBERS MISSING

R367	R353	Z382	C425	C504
R388	R358	L389	C438	C523
R389	C328	L310	C433	C530
R341	C359	Q316	Z485	C540
R348				RS12-RS14
				R523
				R526
				CR585
				Z582

DRAWN BY	C.KRESSEL	RITRON INC 505 W. CARMEL DRIVE CARMEL,IN. 46032	
DATE	08/10/93	SCHEMATIC UHF-FM MOBILE XCVR MODEL: RPM-450A	
		SIZE: D FSCM NO. FILE:0081DTE2 DWG NO. 1730081E REV E	
		PLOT 05/15/95 SHEET 2 OF 2	

ACCESSORIES TECHNICAL INFORMATION



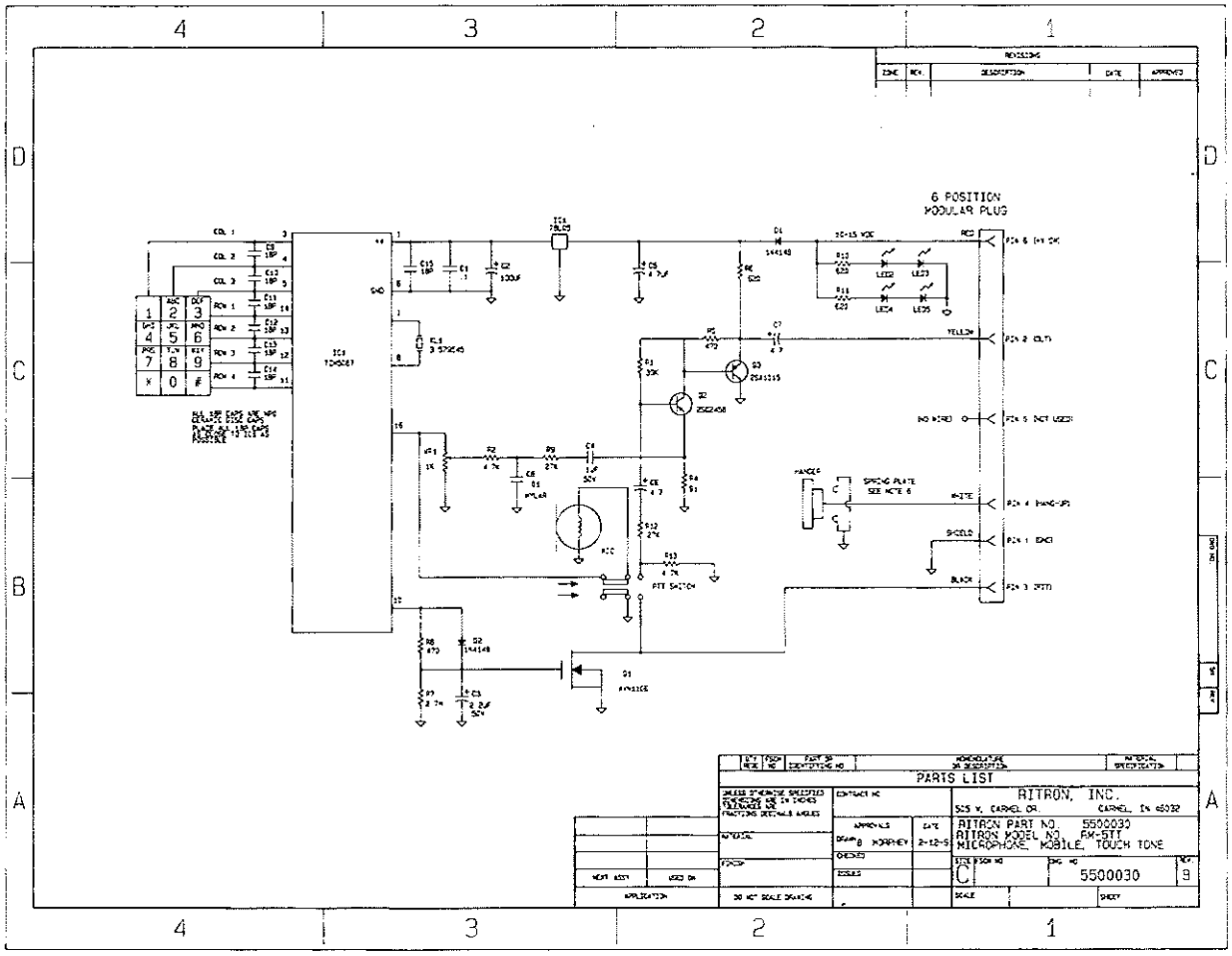
28. RM-5TT HAND MICROPHONE WITH TOUCH TONE

28.1

RM-5TT ELECTRICAL SPECIFICATIONS

IMPORTANT: The Touch Tone output level is factory preset for proper modulation and should not require adjustment.

OPERATING VOLTAGE:	+7 to +12 VDC
IMPEDANCE:	500 Ω +/- 30% @ 1 KHz
DIRECTIVITY:	Omni-directional
SENSITIVITY:	-72 + 4 dB @ 1 KHz (0 dB = 1 V/Microbar)
FREQUENCY RESPONSE:	200 Hz to 5 KHz
TOUCH TONE OUTPUT:	Factory set to 2.1 mV RMS +/- .15 mV across 470 Ω (adjustable, 0 to 4 mV)
OPERATING TEMPERATURE:	-30° C to +55° C



29. TRUNKING INTERFACE OPTION: OPT-TIR

29.1 OPERATION WITH OPT-TIR INSTALLED

29.1.1 TRUNKING CHANNELS

Trunking channels can be selected only by the trunking controller. These channels are programmed with receive, transmit and tone frequencies, but are marked as trunking channels and cannot be selected with the channel button. In "non-trunking" systems, the radio user must manually advance to a channel and glance at the TX/Busy lamp before transmitting. In trunking systems, the controller will automatically check any programmed trunking channels for a carrier signal, and select a channel that is not busy. All the caller has to do is take his microphone off-hook and transmit, unless the mobile sounds a busy tone to indicate that all trunking channels are occupied. In that case, the caller must wait for the next available channel.

29.1.2 TRUNKING LIST CHANNEL

A Trunking List channel holds a list of Trunking Channels (conventional dispatch channels may be included), and is similar to a RPM Scan List channel. When the user selects a Trunking List channel (using the channel button) and the microphone is on-hook, the radio beeps and the Trunking Controller is activated. The Trunking Controller intercepts the microphone PTT line, selects channels and determines when to unmute the speaker audio. Consult the technical documentation included with the controller for details.

29.2 OPT-TIR CONNECTORS

RPM radios manufactured with the OPT-TIR option come with the following connectors installed: 1) a 20-pin socket for hook up to a trunking controller interface board and; 2) a 9-position rear panel accessory socket, with 3 wires installed.

IMPORTANT: If no trunking controller is installed, a jumper must be present between pins 12 and 14 of the 20-pin socket.

Wire colors are indicated below as follows - background/stripe colors.

29.2.1 OPT-TIR 20-PIN SOCKET
FOR RPM-150 PCB #17031003 AND RPM-450 PCB #17031002

Pin	Wire Color	Description	RPM Radio Connection
1	WHT/ORG	Trunk Pulse/CH 1	Lead of R109 to C102
2	WHT	CAS Input, Carrier	Lead R243 to IC102, Pin 45
3	-	CH 2	-
4	VIO	Audio Enable	RPM PCB Accessory Connector Pin 9
5	-	CH 3	-
6	-	Trunk Stop	-
7	-	CH 4	-
8	YEL	Dispatch Enable	IC102, Pin 44
9	GRN	Audio Input	Lead of R211 to R236
10	GRY	Hook Switch IN	Anode of CR101
11	WHT/YEL	Horn Honk	Rear Panel Connector Pin 7
12	BRN	PTT Input	R118 Towards Cut Trace
13	-	Freq Lock	-
14	ORG	PTT Output	R117 Towards Cut Trace, Reverse on Layout
15	-	SQ 2	-
16	WHT/BLU	Buzzer Out	P602, Pin 1
17	BLU	DTMF out	IC202, Pin 2
18	WHT/GRN	Program Enable	Rear Panel Connector Pin 6
19	BLK	Ground	RPM PCB Accessory Connector Pin 2
20	RED	+12 VDC	RPM PCB Accessory Connector Pin 3

29.2.2

OPT-TIR 20-PIN SOCKET
FOR RPM-150 PCB #1730050A AND RPM-450 PCB #1730080D

IMPORTANT: For RPM-150 PCB #1730050A, remove R125 from the board.

If no trunking controller is installed, a jumper must be present between pins 12 and 14 of the 20-pin socket.

Pin	Wire Color	Description	RPM PCB Accessory Connector Pin
1	WHT/ORG	Trunk Pulse/CH 1	17
2	WHT	CAS Input, Carrier	19
*3	-	*CH 2*	-
4	VIO	Audio Enable	9
5	-	CH 3	-
6	-	Trunk Stop	-
7	-	CH 4	-
8	YEL	Dispatch Enable	10
9	GRN	Audio Input	1
10	GRY	Hook Switch IN	12
11	WHT/YEL	Horn Honk	-
12	BRN	PTT Input	4
13	-	Freq Lock	-
14	ORG	PTT Output	5
15	-	SQ 2	-
16	WHT/BLU	Buzzer Out	18
17	BLU	DTMF Out	6
18	WHT/GRN	Program Enable	-
19	BLK	Ground	2
20	RED	+12 VDC	3

** For RPM-450 PCB #1730080D, substitute the line below.*

3	*WHT/BLK*	*Special Mode*	*8*

29.2.3

OPT-TIR 9-PIN ACCESSORY CONNECTOR SOCKET
FOR ALL RPM PC BOARDS COVERED IN SECTIONS 26.2.1 AND 26.2.2

Pin	Wire Color	Description	Connection
3	Blk	Ground	RPM PCB Accessory Connector Pin 16
6	Wht/Grn	Program Enable	To 20-pin Socket Pin 18
7	Wht/Yel	Horn Honk	To 20-pin Socket Pin 11

The OPT-TIR option rear panel accessory connector serves two functions. First, this connector can be used to place the installed trunking controller board in programming mode. The trunking controller can then be loaded with unit address codes and other information for the specific trunking system. For example, you would program one popular trunking controller as follows:

1) Using the PC programmer, program the RPM mobile with the trunking channels, a trunking list channel and at least one dispatch channel.

2) Switch off the radio, disconnect the PC programmer and place the RPM's programming key in the storage position (or remove the key).

3) Connect a wire jumper between pins 6 and 3 of the 9-pin accessory connector. Refer to FIG-12.

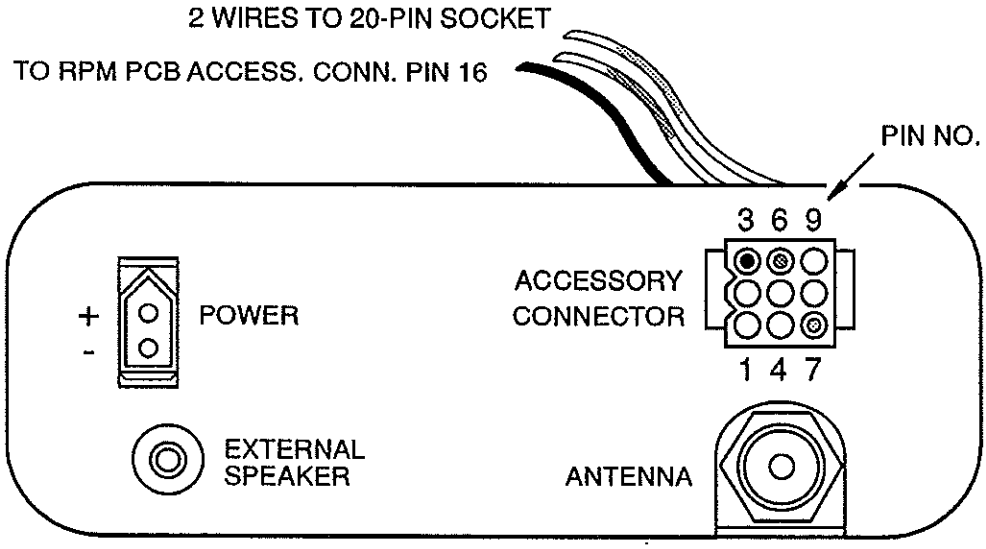


FIG-12: ACCESSORY CONNECTOR SOCKET (REAR PANEL)

4) Turn on the unit. A series of beeps should sound in the speaker to indicate that the trunking controller is in the proper programming mode. Remove the jumper wire from the RPM's 9-pin accessory connector.

5) Using the channel button, select the dispatch channel.

6) Connect a service monitor, set to generate on the dispatch channel's receive frequency, to the radio antenna jack. Using the service monitor's Touch Tone encoder, send the digits required to program the trunking controller.

Consult your specific trunking controller's documentation to verify these steps.

Second, the rear panel accessory socket can also be used to connect the trunking controller's horn activate output to the vehicle's horn relay circuit. Refer to the wiring diagram below.

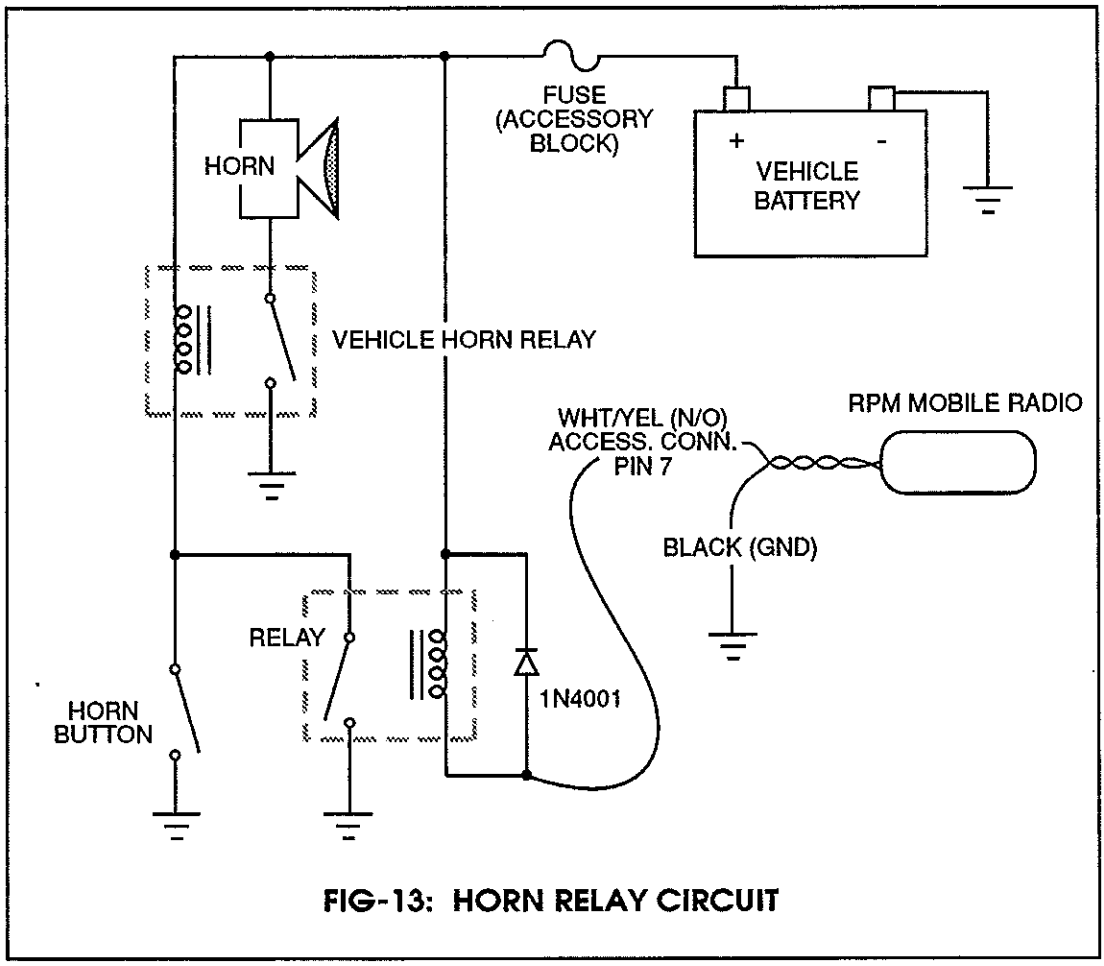
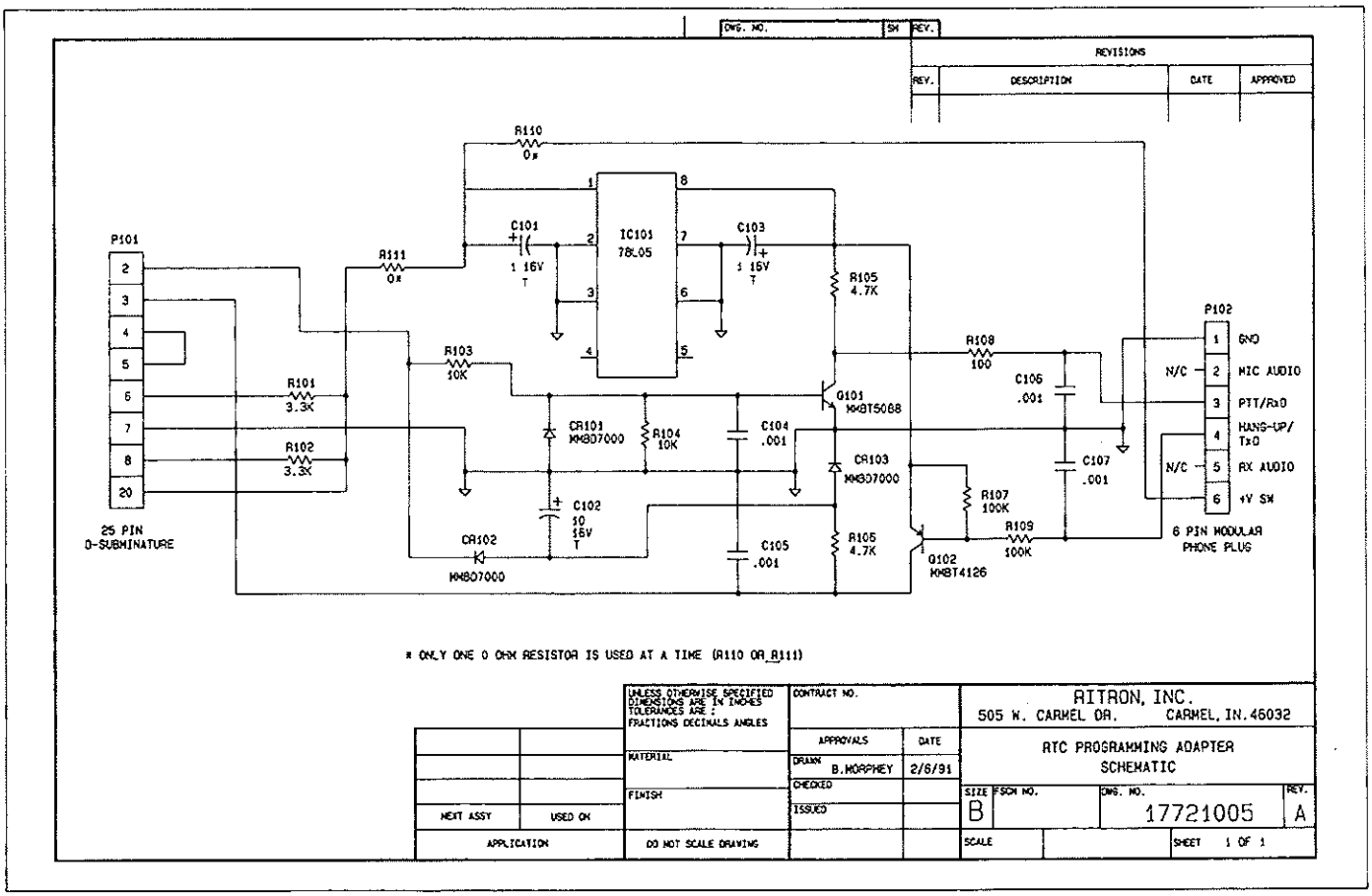


FIG-13: HORN RELAY CIRCUIT

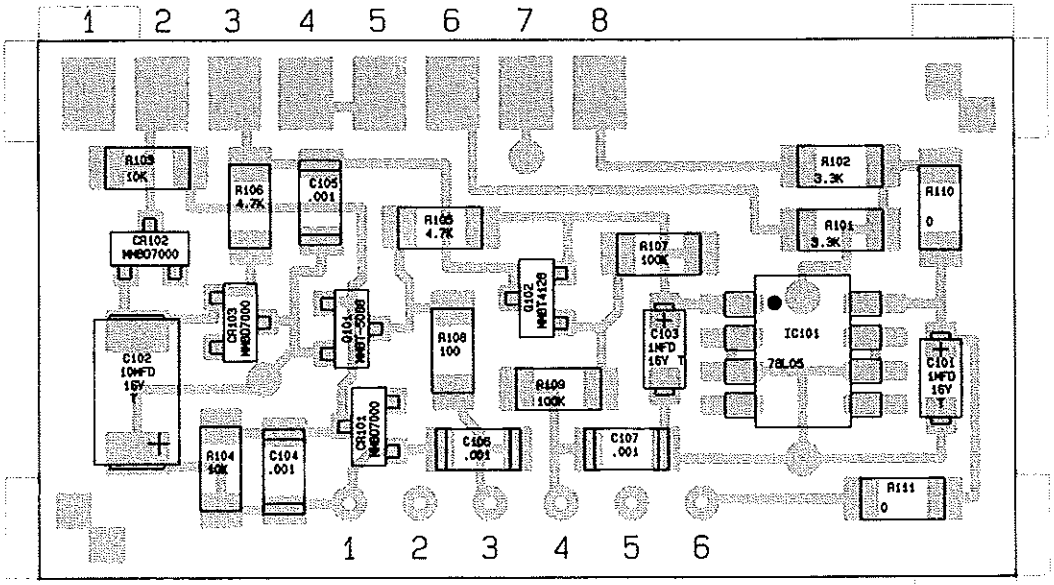
29.3 TRUNKING CONTROLLER PIN-OUTS

Verify that the pin descriptions of your trunking controller connector are compatible with the RPM 20-pin socket. Refer to the instructions packaged with your controller.

30. PC COMPUTER PROGRAMMING KIT ADAPTER



CONNECTIONS TO 25-PIN SUB-D CONNECTOR



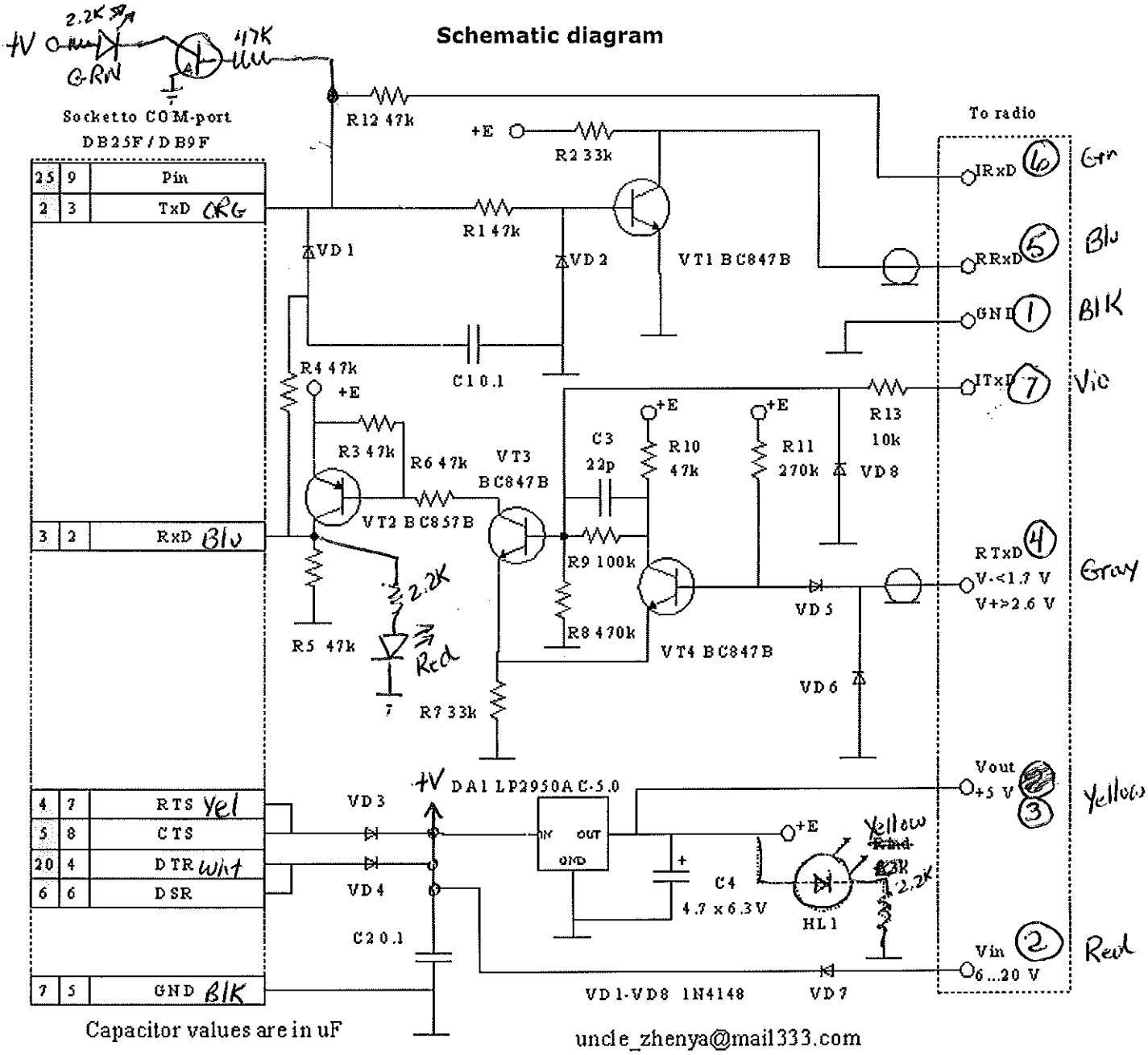
CONNECTIONS TO 6-PIN MODULAR PHONE PLUG

TOP SIDE PARTS PLACEMENT
17021005 REV.A
RITRON INC., CARMEL, IN

A Universal Programming Cable for Radios

The programming cable is intended to be used with a computer RS-232 port for programming radios and other devices. The main goal of this cable schematics is inverting signal levels. That is because COM port's logic one is a low voltage level, logic zero is a high voltage level. Another goal is the correct voltage level transformation with regard to the real radio programming circuits. And nothing must get burnt...

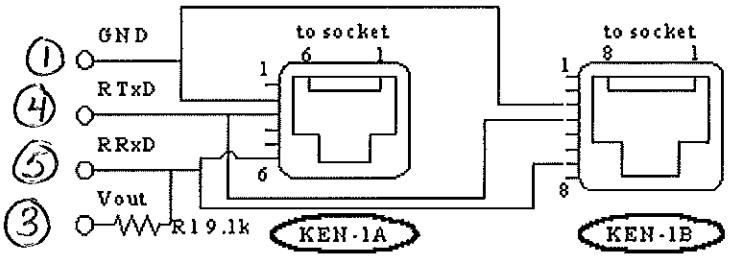
Schematic diagram



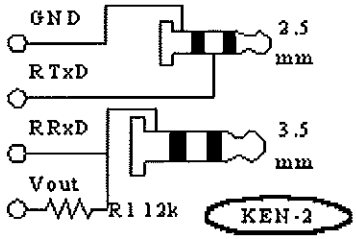
Connection circuits (jacks for mobile radios are shown as they are plugged into sockets)

1 -- GND
2 - ~~Vout~~ Vin
3 - Vout (5V)
4 - RTxD
5 - RRxD
6 - ITxD
7 - ITxD

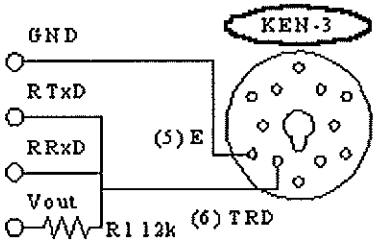
KENWOOD mobile



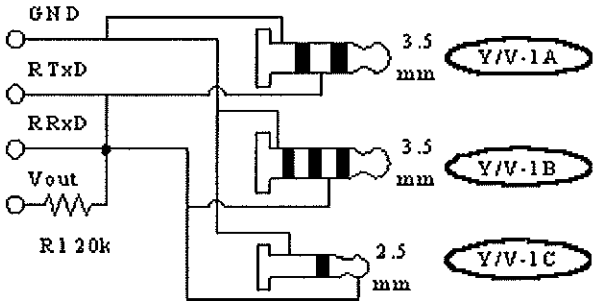
KENWOOD portable



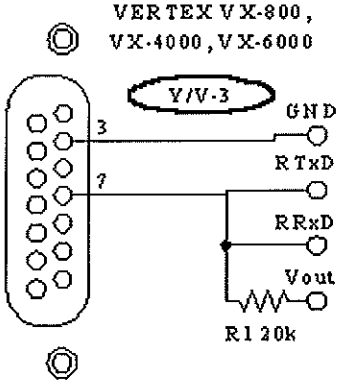
KENWOOD TK-690/790/890



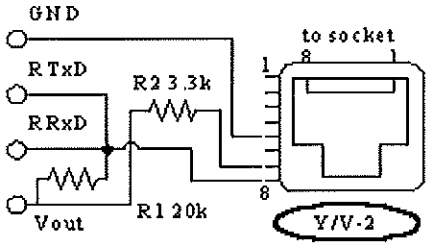
YAESU / VERTEX portable



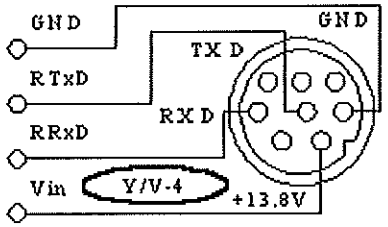
VERTEX VX-800, VX-4000, VX-6000

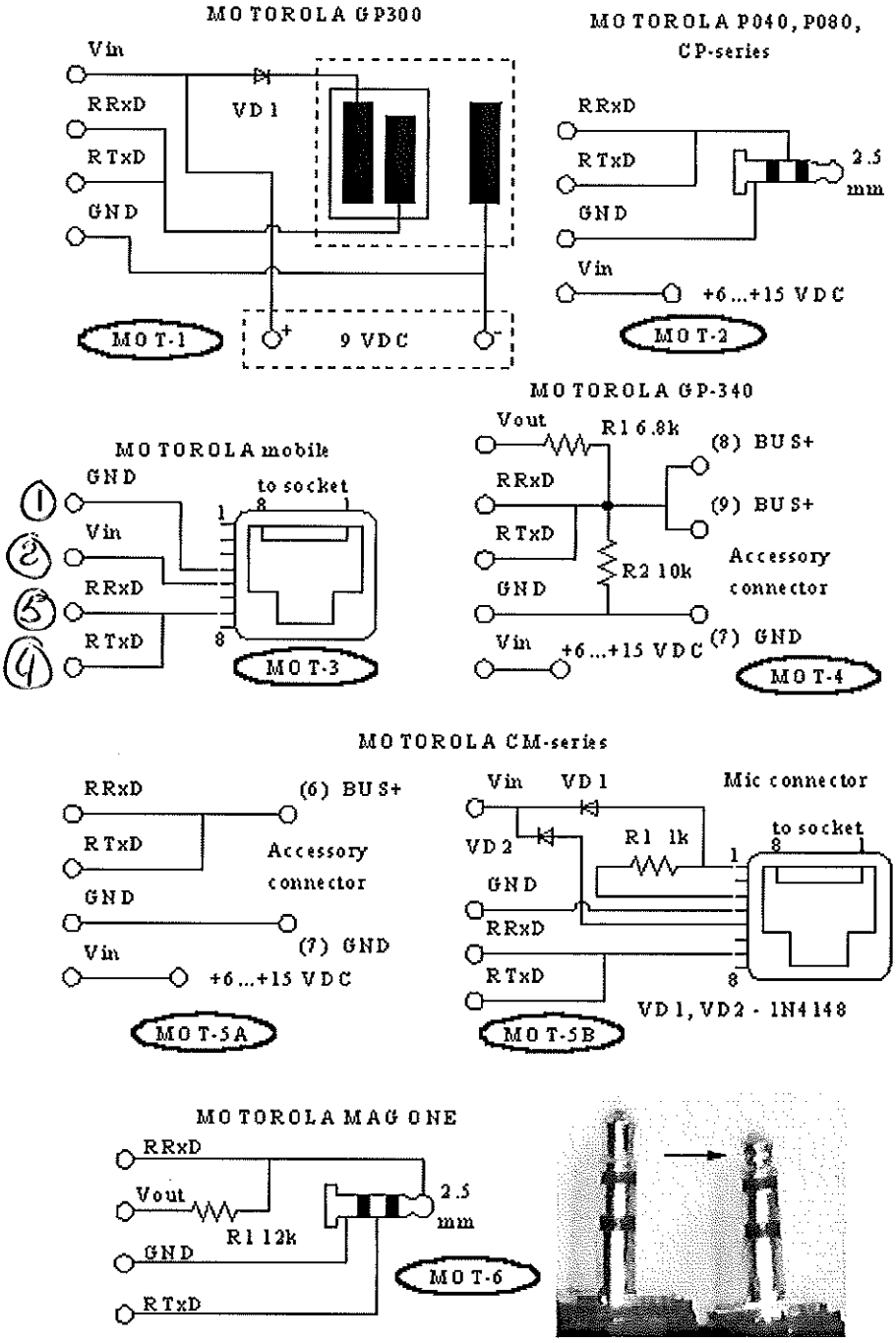


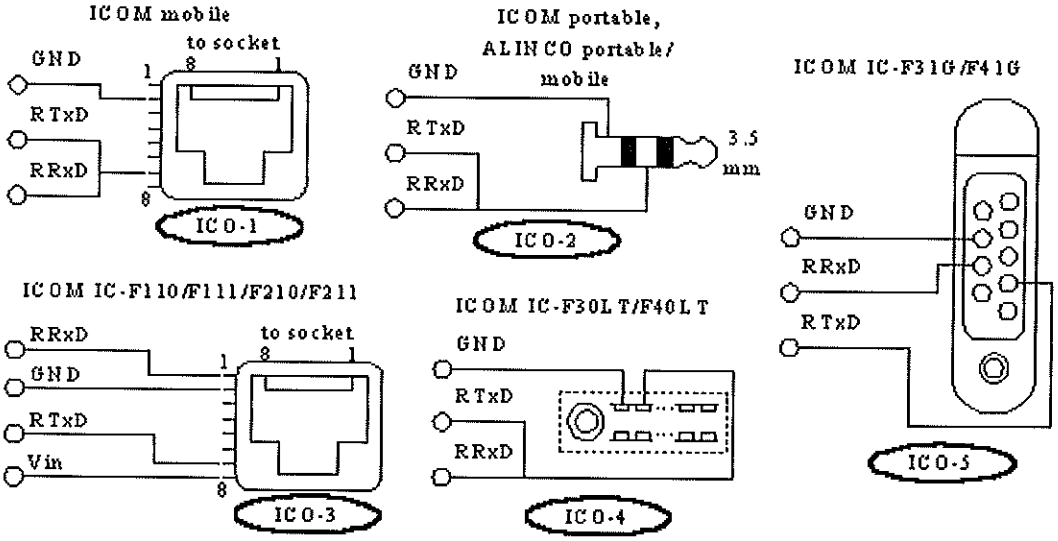
YAESU / VERTEX mobile

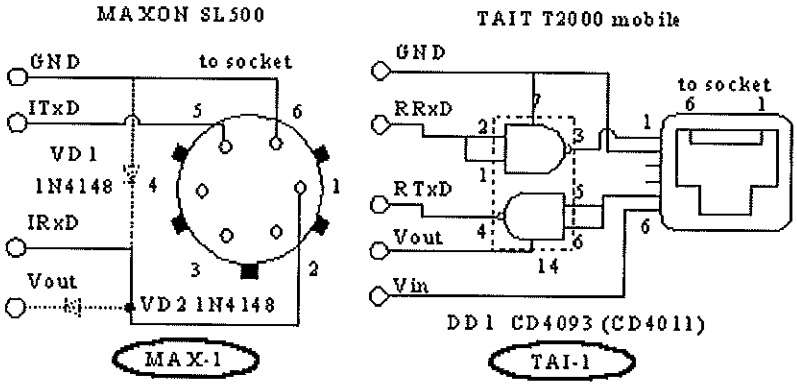


YAESU FT-857 CAT-interface

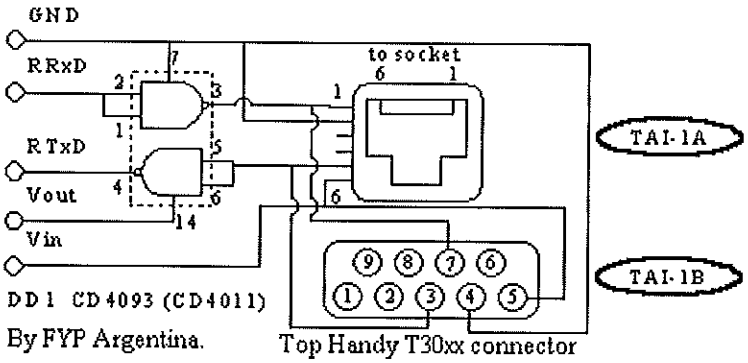



MOTOROLA GP300
Vin
RRxD
RTxD
GND
VD1
9 VDC
MOT-1
MOTOROLA P040, P080,
CP-series
RRxD
RTxD
GND
Vin
2.5
mm
+6...+15 VDC
MOT-2
MOTOROLA GP-340
Vout
R1 6.8k
(8) BUS+
RRxD
(9) BUS+
RTxD
R2 10k
Accessory
connector
GND
Vin
+6...+15 VDC
(7) GND
MOT-4
MOTOROLA mobile
GND
to socket
Vin
RRxD
RTxD
MOT-3
MOTOROLA CM-series
RRxD
(6) BUS+
RTxD
Accessory
connector
GND
Vin
(7) GND
+6...+15 VDC
MOT-5A
Vin
VD1
Mic connector
VD2
R1 1k
to socket
GND
RRxD
RTxD
VD1, VD2 - 1N4148
MOT-5B
MOTOROLA MAG ONE
RRxD
Vout
R1 12k
GND
RTxD
2.5
mm
MOT-6



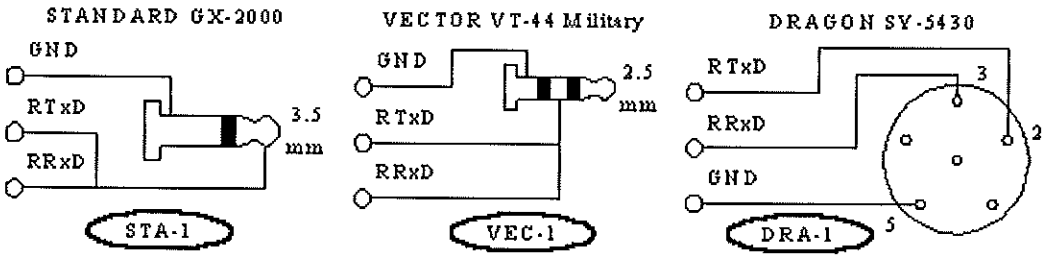


TAIT T2000 Series and T3000 Series Handy



By FYP Argentina.

Top Handy T30xx connector



The RITRON MOBEX system will not alter the performance of your MOBILE-transceiver installation in any way. With the MOBILE microphone "off-hook," the MOBEX is disabled and MOBILE communications are performed as usual. It is recommended that the user turn the MOBEX "OFF" with the front-panel "ON-OFF" toggle switch when not in use to prevent re-transmission of MOBILE received audio, although it is NOT necessary.

To initiate MOBEX system operation, move the MOBEX front-panel toggle switch to its "UP" (ON) position; then, place the MOBILE microphone "on-hook." Set the MOBILE transceiver Volume Control at its approximate mid-point (1/2 rotation) to ensure sufficient "received audio" to the MOBEX. The MOBEX system is now ready for service.

When initiating communications using the HANDHELD TRANSCEIVER, press the PTT switch MOMENTARILY. This opens the MOBILE "monitor" line and allows monitoring of the MOBILE "receive channel" without "keying" the MOBILE transmitter. The MONITOR line will be held open for approximately ten-seconds, and received audio (if present) will be re-transmitted by the MOBEX to the HANDHELD.

However, when using the MOBEX with "trunked" mobile radio systems, the initial "MOMENTARY" transmission from the handheld will key the MOBILE and, if the MOBILE is busy, will hold the MOBILE PTT keyed for 3 seconds. This allows the "mobile busy" audio signal to be re-transmitted to the handheld for the 3 seconds that the MOBILE PTT is held.

The user can over-ride the MONITOR function simply by pressing the HANDHELD PTT for more than 3 seconds; then, the MOBEX Tone Sq output will key the MOBILE transmitter for re-transmission of the handheld. The MOBILE transmitter will key INSTANTLY upon a received signal from the handheld each subsequent transmission.

With an incoming signal to the MOBILE receiver, the MOBEX unit re-transmits the "received audio" to the HANDHELD radio. The HANDHELD user responds by simply pressing the PTT switch. A two-way conversation is then conducted in the same manner as with any conventional two-way radio system.

When using the MOBEX system, the user should hesitate approximately one second after pressing the PTT switch before starting the conversation. This allows for the minor delay time typical of radio-relay systems, and it insures that the full conversation is re-transmitted each time.

It is important to remember that the MOBEX system works ONLY over one path, or in one direction, at a time; that is, while the MOBILE receiver "audio signal" is re-transmitted by the MOBEX to the HANDHELD, the HANDHELD CANNOT transmit back to the MOBEX until the MOBILE "audio signal" disappears. Also, when the HANDHELD is transmitting to the MOBEX for re-transmission by the MOBILE transmitter, the MOBILE receiver CANNOT receive until the HANDHELD PTT is released. Once control of the MOBEX system is established in one direction, it CANNOT be over-ridden until that transmission ends.

POWER SUPPLY:

The MOBEX obtains power from the vehicle's +12 VDC battery system through P602 located on the back of the MOBEX case.

SW601 switches the +12 VDC supply voltage - with SW601 in its "ON" position, the MOBEX receives power through F601, L601, and Reverse-Protection Diode CR610. Surge-suppression diode CR622 protects the MOBEX from extreme over-voltage. C622 filters the +12 VDC supply for relay K601 and the input of Voltage Regulator IC605. +12 VDC also connects to P603 pin 5, which supplies power to the transceiver module.

IC605, a +8 VDC regulator, supplies power to the MOBEX logic and audio processing circuitry. The output of IC605, divided by R631, R632, and C624, provides 1/2 VCC bias for the MOBEX logic circuitry.

IC607, Q609, and associated components delay MOBEX operation when power is first applied to the unit, or if there is a drastic drop in MOBEX supply voltage. The non-inverting inputs to comparators IC607A and IC607B are biased to 1/2 regulated supply voltage by R651 and R652. When power is first applied to the MOBEX, C636 slowly charges through R650 to provide DC bias to the inverting input of comparator IC607B. The output of IC607B goes "high" while C636 is charging, turning "ON" open-collector transistor Q609 through R649. The collector of Q609 turns "OFF" Q605, disabling MOBEX operation. C637 is charged to 1/2 VCC through CR621 to provide DC bias to the inverting input of comparator IC607A. If the regulated supply voltage drops, the 1/2 VCC bias at the non-inverting input of IC607A will drop proportionally, but reverse-biased diode CR621 will allow the DC bias at the inverting input to remain constant. The resulting "low" at the output of comparator IC607A will discharge C636 through CR620 and disable MOBEX operation, as described above.

RELAY AND MICROPHONE OPERATION:

The MOBEX connects between the MOBILE microphone and the MOBILE radio at the microphone connector. K601 and Q603 route either the microphone or the MOBEX signals to the MOBILE unit. Relay K601 routes audio to the MOBILE transmitter, and also "keys" the MOBILE transmitter. Transistor switch Q603 operates the MOBILE monitor line or "hang-up bracket."

With the MOBILE microphone "on-hook," the microphone "hang-up" bracket grounds the emitter of Q603 through the MONITOR pin of mic. Jack J601. R642 connects the base of Q603 to the unswitched +12 VDC supply and turns Q603 "ON." This pulls the MOBILE monitor line "low" at the collector of Q603 and provides an "on-hook" condition for the MOBILE radio.

Removing the MOBILE microphone from the "hang-up" bracket turns Q603 "OFF" and "opens" the MOBILE monitor line. With the MOBILE microphone "off-hook," CR616 does NOT conduct; therefore, R638

turns switching transistor Q608 "ON." The collector of Q608 then turns switching transistor Q605 "OFF." This opens the emitter leads of Q602 and Q604; thus preventing Q602 from "keying" the MOBEX transmitter, and preventing Q604 from activating K601.

With a received signal at the output of the MOBEX transceiver and with the correct tone received, the TONE SQ at P603 pin 3 is "low." R647 applies the "low" from the TONE SQ through R617 to the pin 9 input of two-input NOR gate IC603C. With the pin 8 input "low," the resulting "high" output on IC603C pin 10 is applied through R634 to the base of switching transistor Q604. With the MOBILE microphone "on-hook," Q605 conducts and grounds the emitter of Q604. Q604 now turns "ON" and energizes K601.

Relay section K601A connects the microphone to the MOBILE transmitter when de-energized, and connects the MOBEX received audio (RX AUD) to the MOBILE transmitter when energized. P603 pin 2 routes the MOBEX "RX AUD" through C618, R647, Isolation Transformer T601, R629, and C620 to K601A, with the audio level to the MOBILE transmitter set by R629. Relay section K601B connects the microphone PTT to the MOBILE PTT line when de-energized, but connects the MOBILE PTT line to ground when energized; thus "keying" the MOBILE transmitter. Ground for K601B, T601, and associated components is "isolated" from the MOBEX-SYSTEM ground to alleviate "Ground Currents." The ground for K601B & T601 is common to the MOBILE-SYSTEM ground through the Mic. Connectors.

With a received signal on the MOBEX, the MOBEX Tone Sq output on P603 pin 3 is "low" and pulls the pin 1 input of inverter IC604A "low" through CR609. The "high" output of IC604A pin 2 turns "ON" switching transistor Q607 through R633. The collector of Q607, connected to the base of Q603, turns Q603 "OFF," and opens the MOBILE monitor line.

MOBILE RX AUDIO AGC:

The MOBILE receiver applies audio to the non-inverting input of op-amp IC601A through R610, which sets the audio-input level. The audio signal is then amplified by IC601A, with the gain set by R607, R608, and Q601. The audio output of IC601A is applied to the MOBEX transmitter at pin 9 of P603 through R611, which sets the audio level applied to the limiter.

Op-amp IC601A applies amplified MOBILE RX Audio to the base of Q606 through detector C609, R636, R637, and CR606. CR617, C601, and R602 provide a fast "attack" and "release" time for VOX circuit IC601B. CR603, C602, R603, R616, and R604 provide fast "attack" and slow "release" time for the AGC circuit at Q601. With audio present, Q606 is forced into conduction. C601 and C602 quickly discharge through CR617 and CR603 and begin to pinch "OFF" the GATE of Q601. The decreased conduction of Q601 results in decreased gain of the MOBILE received audio signal at IC601A. As the MOBILE received audio signal becomes lower in amplitude, or stops altogether, Q606 and CR603 turn "OFF." C601 will quickly charge through R602 for quick "release" time of the VOX circuit, while C602 will slowly charge through R603 and R604, turning Q601 "ON," for a slow release time of the AGC circuit.

The MOBILE audio AGC provides a consistent audio level to the MOBEX transmitter and to the MOBEX VOX keying circuit.

MOBEX VOX KEYING:

MOBILE received audio is amplified by IC601A and applied through a detector circuit to the base of Q606, forcing it into conduction. The collector of Q606 is tied to the inverting input of IC601B through CR617. R612 at the non-inverting input of IC601B sets the "trigger" voltage for the VOX while R613 provides hysteresis. With MOBILE RX audio present, Q606 is forced into conduction, pulling the inverting input of IC601B below the "trigger" voltage and turning "ON" IC601B. The resulting "high" output is applied to: A) The input of inverter IC603B through R601, and B) The input of inverter IC604C through R639 and CR614. If VOX operation is not desired, the inverting input of IC601B may be pulled "low" by the MOBILE squelch circuitry through CR624 to "key" the MOBEX transmitter.

The output of inverter IC603B is tied to the input of 2-input NOR gate IC603D at pin 12. The pin 13 input of IC603D is tied to the output of inverter IC603A, with IC603A input tied to the MOBEX Tone Sq line. With MOBILE RX audio present, the output of NOR gate IC603D will turn "ON" Q602 and "key" the MOBEX transmitter, provided the MOBEX Tone Sq line is NOT "low" and the MOBILE microphone is "on-hook."

The input of inverter IC604C is tied to the output of IC601B through R639 and CR614, with C628 to ground. With VOX activity C628 will slowly charge through R639 and, with no VOX activity, will instantly discharge through CR614. The output of inverter IC604C is tied to the input of inverter IC603B at pins 5 and 6. If VOX activity is present for 20 seconds or more, C628 will charge to the point that inverter IC604C will trigger, with the output inhibiting VOX keying through IC603B. This is to prevent a constant MOBILE received audio signal from locking the MOBEX transmitter "ON."

The MOBEX transmitter is momentarily activated upon the removal of a received signal from the MOBEX receiver. As the received signal is removed, the TONE SQUELCH signal at P603 pin 3 goes "high," charging C638 and generating a positive pulse across R655. This positive pulse is applied to the base of Q606 through R654 and CR623 to turn the transistor "ON" and momentarily "key" the MOBEX transmitter as described above. This is to help overcome the attack time typical of VOX operation by pre-activating the MOBEX transmitter after a received message, in anticipation of a reply.

MOBILE TRANSMIT TIMER:

IC606 timer circuit inhibits MOBILE transmitter keying on the initial MOBEX Tone Sq transition. This provides the ability to monitor the MOBILE receive channel without keying the MOBILE

transmitter. IC606 is a CD4060, 12 stage binary ripple counter. R623, R624, and C617 create an oscillator frequency of 24 Hz at pin 9. The counter is reset with a "high" at pin 12 and the output at pin 15 is "high" after 30 seconds. The output is tied back to R624/C617 through CR607 to stop the clock oscillator when the timing sequence is complete. The "high" output at IC606 pin 15 is tied to IC603C pin 9, through CR608, to inhibit MOBILE transmitter keying until the timer has been reset.

The timer may be reset at pin 12 by three methods. With the MOBEX COR line "low," C613, connected to the input of inverter IC604B, slowly discharges through R619 and R648. If held "low" for more than 3 seconds, IC604B will trigger and reset timer IC606. With timer IC606 reset, the output at pin 15 will go "low" and allow the MOBEX Tone Sq line to key the MOBILE transmitter through R617 at IC603C pin 9. If the MOBEX Tone Sq line is not held "low" long enough to reset timer IC606, the output of the timer at pin 15 will remain "high" and inhibit MOBILE keying through CR608 to IC603C pin 9. Timer IC606 will be reset with the release of the MOBEX Tone Sq line through C612, R618, and CR605, or with VOX activity from the output of IC603D through R628, C619, and CR604.

MOBILE MONITOR:

A momentary "low" on the MOBEX Tone Sq line will pull the input of inverter IC604A "low" through CR609. The "high" at the output of IC604A is applied to the base of Q607, turning it "ON," with the collector of Q607 used to turn "OFF" Q603. This will open the MOBILE monitor line and allow monitoring of the receive channel. The momentary "low" at the MOBEX Tone Sq line will instantly discharge C621 through CR609 with R626 providing a slow recharge. This allows IC604A to "hold" the MOBILE monitor line open for approximately 10 seconds.

The output of the VOX keying circuitry is used to refresh the MONITOR function. The VOX keying output, at IC603D pin 11, is connected to the input of inverter IC604D through R627. CR601 latches the input of IC604D "low" with the output of inverter IC604A. This is to prevent the VOX keying output from initiating the MONITOR function. With the MOBEX Tone Sq line "low" due to a received signal as described above, the output of IC604A is "high" and CR601 is back-biased. Activity from the VOX keying output may now trigger IC604D, with the resulting "low" output applied to the input of IC604A through CR602. This will keep C621 discharged and allow the MOBILE monitor line to remain "open" as long as there is activity to or from the MOBILE.

FOR USE WITH FULLY DUPLEX MOBILES:

R640 is installed between the IC604A pin 2 output and the base of Q604 to "key" the MOBILE transmitter (see Figure 2, page 16). With activity on the MOBEX Tone Sq line, the MOBILE transmitter will be held "ON" as long as the MOBILE MONITOR function is active, as described previously.

FOR USE WITH 800 MHZ TRUNKED RADIO SYSTEMS:

C613 is removed from the input of IC604B (by cutting Zero-Ohm resistor, R648 -- Fig. 2, page 16) to reset the MOBILE transmit timer immediately upon a received signal from the handheld as a monitor function is not necessary with trunked radio systems.

With a trunked radio system an audio "busy" signal is present on the MOBILE RX AUDIO line as long as the transmitter is held "keyed," if the system is busy. R640 is added between the output of IC604F and the base of Q604 (see Figure 2, page 16). As the MOBEX Tone Sq is released and goes "high," C610 and R643 provide a quick pulse to the input of IC604E through R644. The input of IC604E is also tied to the output of the VOX keying circuit at IC601B pin 7 through CR618. If VOX activity is present due to MOBILE audio while the MOBEX Tone Sq is keying the MOBILE transmitter, CR618 is back-biased and the pulse generated by C610 and R643 will trigger inverter IC604E. The "low" output of IC604E will pull current through R645 and C626, pulling the input of inverter IC604F "low" through R646. The resulting "high" output of IC604F is applied to the base of Q604 through R640 to hold the MOBILE transmitter "keyed." The "high" output of IC604F is also applied through CR619 to the input of IC604E to latch it "high." The MOBILE will remain keyed for approximately 3 seconds, until C626 has charged sufficiently through R645 to trigger the input of IC604F.

*** RM-150 or RM-450 TRANSCEIVER PROGRAMMING ***

NOTE: The programmable functions of the RM-150 VHF-FM Transceiver and the RM-450 UHF-FM Transceiver are FACTORY-SET in the following manner for MOBEX operation:

PJ101 is placed in position "B" to apply amplified MOBEX received audio to the MOBILE transmitter for re-transmission.

PJ201 is placed in position "A" for application of the MOBILE received audio to the MOBEX transmitter for re-transmission.

PJ202 sets the RF power output of the MOBEX transmitter. This jumper will be placed in position "A," limiting the RF power output to 1 WATT OR LESS. If placed in position "B," the RF POWER OUTPUT MUST BE ADJUSTED FOR 2 WATTS OR LESS as required by the FCC for mobile repeaters, pursuant to Part 90.247(b).

PJ301 activates the MOBEX transmitter and should be placed in position "A."

PJ501 is placed in position "B" to provide non de-emphasized audio from the MOBEX receiver to the MOBILE transmitter for re-transmission.

PJ502 is placed into position "B" to route the MOBEX received audio through a high-pass filter before application to the MOBILE transmitter for re-transmission.

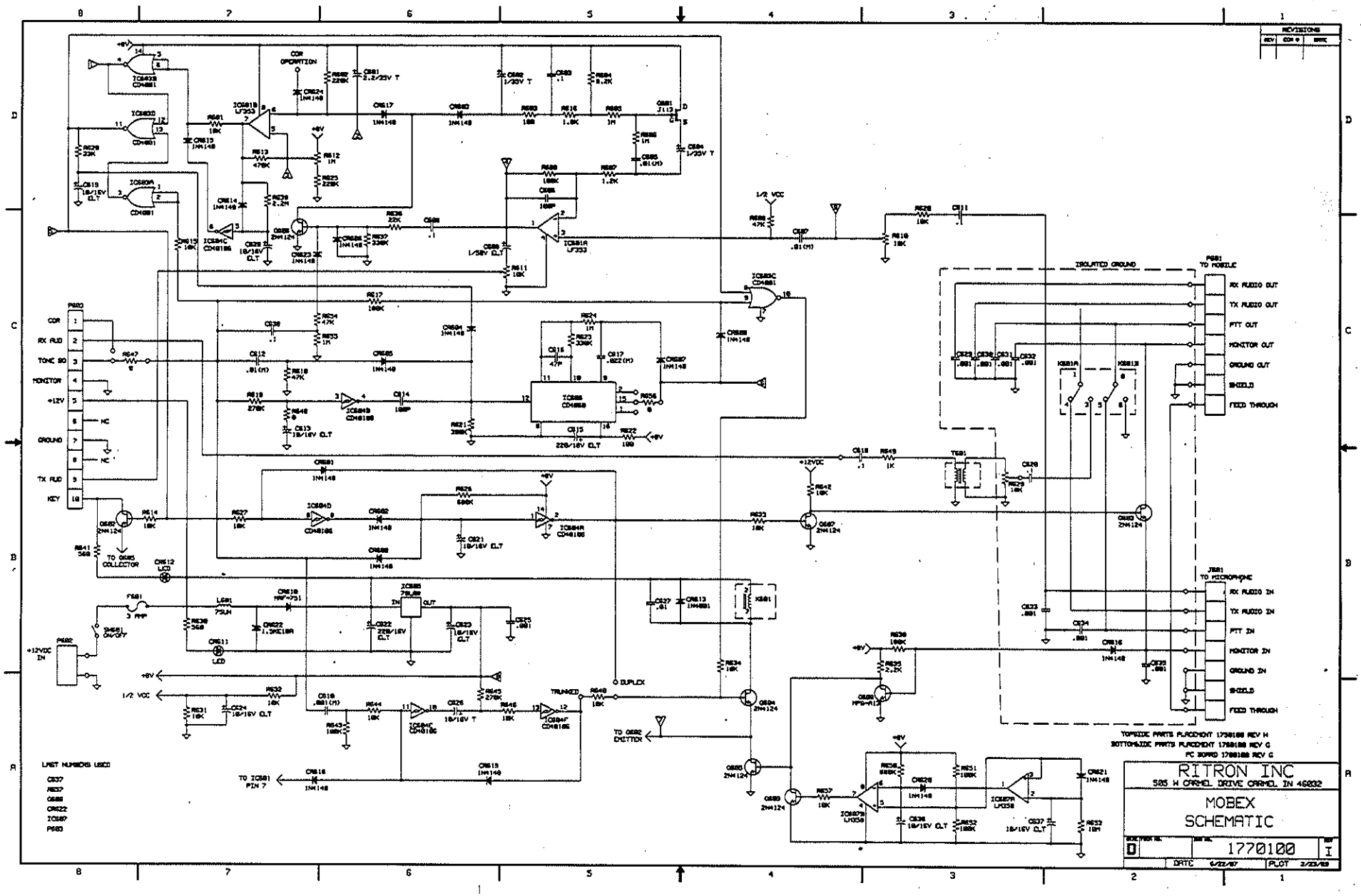
Failure to conform to these instructions may result in unsatisfactory, or even illegal, operation of the MOBEX system.

MOBEX SCHEMATIC REF PARTS LIST (ECN 1088)

REF #	DESCRIPTION	RITRON#
C 601	2.2 MF; 35VDC; TANTALUM	1502009
C 602	1 MF; 35VDC; TANTALUM	1502007
C 603	.1 MF; X7R; 20%	1515463
C 604	1 MF; 35VDC; TANTALUM	1502007
C 605	.01 MF; MYLAR	1501050
C 606	100 PF; N750	1510727
C 607	.01 MF; MYLAR	1501050
C 608	1 MF; 50 VDC; ELT	1503002
C 609	.1 MF; X7R; 20%	1515463
C 610	.001 MF; MYLAR; .12" LS	1501040
C 611	.1 MF; X7R; 20%	1515463
C 612	.01 MF; MYLAR	1501050
C 613	10 MF; 16 VDC; ELT	1503006
C 614	100 PF; N750	1510727
C 615	220 MF; 16 VDC; ELT	1503011
C 616	47 PF; N150	1510123
C 617	.022 MF; MYLAR	1501051
C 618	.1 MF; X7R; 20%	1515463
C 619	10 MF; 16 VDC; ELT	1503006
C 620	.1 MF; X7R; 20%	1515463
C 621	10 MF; 16 VDC; ELT	1503006
C 622	220 MF; 16 VDC; ELT	1503011
C 623	10 MF; 16 VDC; ELT	1503006
C 624	10 MF; 16 VDC; ELT	1503006
C 625	.001 MF; Y5P	1516239
C 626	10 MF; 16VDC; TANT	1502013
C 627	.01 MF; Y5V	1516451
C 628	10 MF; 16 VDC; ELT	1503006
C 629	.001 MF; Y5P	1516239
C 630	.001 MF; Y5P	1516239
C 631	.001 MF; Y5P	1516239
C 632	.001 MF; Y5P	1516239
C 633	.001 MF; Y5P	1516239
C 634	.001 MF; Y5P	1516239
C 635	.001 MF; Y5P	1516239
C 636	10 MF; 16VDC; ELT	1503006
C 637	10 MF; 16VDC; ELT	1503006
C 638	.1 MF; X7R; 20%	1515463
CR601 THRU CR609	1N4148	4810001
CR610	MRF751; 6A DIODE	4810009
CR611	LED; GREEN DIFFUSED	2450004
CR612	LED; RED DIFFUSED	2450001
CR613	1N4001	4810003
CR614 THRU CR621	1N4148	4810001
CR622	1.5KE18A SURGE SUPPR.	4820032
CR623 THRU CR624	1N4148	4810001
F 601	RUBBER FUSE COVER	3100013
F 601	3 AMP 250V FUSE	5110005
F 601	FUSE HOLDER; PC MOUNT	5120002
HD1	MOBEX MOUNTING BRACKET	2500095

REF #	DESCRIPTION	RITRON#
HD1	NUT; 10-32 SQUARE	2802011
HD1	10-32 X 1/2" HEX SCREW	2801011
HD1	#10 INTNL TOOTH LOCKWASHER	2803008
HD1	#10 STEEL FLAT WASHER	2803026
HD1	LED MOUNTING CLIP	2800011
HD1	STRAIN RELIEF;SP3-4 1137	2800099
HD1	4-40 1/4" PHIL PAN	2801005
HD1	4 X 1/4" SELF TAP SCREW	2801009
HD1	4-40X1/4"X3/32" HEX NUT	2802003
HD1	#4 INTNL TOOTH LOCKWASHER	2803004
HD1	#18 AWG RED WIRE; STRND	6001006
HD1	#18 AWG BLACK WIRE; STRND	6001007
HD2	LED MOUNTING CLIP	2800011
HD3	PC BEAD PINS; .093 DIA.	2100154
HD4	PIN SOCKET; .093 DIA.	2100155
HD5	5 COND;SHLD;JCKT #24 AWG	6001074
HD6	MOBEX FRONT PANEL	6201004
IC601	LF353; DUAL OP-AMP	3131005
IC603	CD4001; QUAD 2-INPUT NOR	3134001
IC604	CD40106; HEX SCHMIDT TRIG	3132007
IC605	LM78L08CP; 8V REG	3131013
IC606	CD4060; OSC/DIVIDER	3134060
IC607	LM358; PNP DUAL OP-AMP	3131003
J 601	5-PIN MICROPHONE CONN	2100034
J 604	MOLEX 2-PIN SOCKET	2100005
J 604	MOLEX CONTACT #02-06-1103	2100045
K 601	DPDT RELAY; 12 VDC	4500006
L 601	75 UH; 8 AMP CHOKE	1801014
P 601	5-PIN MICROPHONE PLUG	2100008
P 602	MOLEX 2-PIN PLUG	2100006
P 602	MOLEX CONTACT #02-06-2103	2100044
P 603	10 POS METHODE HEADER	2100156
PC601	PC BOARD; MOBEX REV G	1700100
Q 601	J-113; N-CHAN JFET	4800031
Q 602	2N4124/SPS8161 NPN	4800006
Q 603	2N4124/SPS8161 NPN	4800006
Q 604	2N4124/SPS8161 NPN	4800006
Q 605	2N4124/SPS8161 NPN	4800006
Q 606	2N4124/SPS8161 NPN	4800006
Q 607	2N4124/SPS8161 NPN	4800006
Q 608	MPS-A13 NPN	4800007
Q 609	2N4124/SPS8161 NPN	4800006
R 601	10K OHM; 5%; 1/4W	4700145
R 602	220K OHM; 5%; 1/4W	4700161
R 603	100 OHM; 5%; 1/4W	4700121
R 604	8.2K OHM; 5%; 1/4W	4700144
R 605	1M OHM; 5%; 1/4W	4700169

REF #	DESCRIPTION	RITRON#
R 606	1M OHM; 5%; 1/4W	4700169
R 607	1.2K OHM; 5%; 1/4W	4700134
R 608	100K OHM; 5%; 1/4W	4700157
R 609	47K OHM; 5%; 1/4W	4700153
R 610	10K OHM; HORZ TRIM POT	4750008
R 611	10K OHM; HORZ TRIM POT	4750008
R 612	1M OHM; HORZ TRIM POT	4750003
R 613	470K OHM; 5%; 1/4W	4700165
R 614	10K OHM; 5%; 1/4W	4700145
R 615	10K OHM; 5%; 1/4W	4700145
R 616	1.8K OHM; 5%; 1/4W	4700136
R 617	180K OHM; 5%; 1/4W	4700160
R 618	47K OHM; 5%; 1/4W	4700153
R 619	270K OHM; 5%; 1/4W	4700162
R 620	18K OHM; 5%; 1/4W	4700148
R 621	390K OHM; 5%; 1/4W	4700164
R 622	100 OHM; 5%; 1/4W	4700121
R 623	330K OHM; 55; 1/4W	4700163
R 624	1M OHM; 5%; 1/4W	4700169
R 625	220K OHM; 5%; 1/4W	4700161
R 626	680K OHM; 5%; 1/4W	4700167
R 627	10K OHM; 5%; 1/4W	4700145
R 628	33K OHM; 5%; 1/4W	4700151
R 629	10K OHM; HORZ TRIM POT	4750008
R 630	560 OHM; 5%; 1/4W	4700130
R 631	10K OHM; 5%; 1/4W	4700145
R 632	10K OHM; 5%; 1/4W	4700145
R 633	10K OHM; 5%; 1/4W	4700145
R 634	10K OHM; 5%; 1/4W	4700145
R 635	2.2K OHM; 5%; 1/4W	4700137
R 636	22K OHM; 5%; 1/4W	4700149
R 637	330K OHM; 55; 1/4W	4700163
R 638	180K OHM; 5%; 1/4W	4700145
R 639	2.2M OHM; 5%; 1/4W	4700173
R 640	10K OHM; 5%; 1/4W	4700145
R 641	560 OHM; 5%; 1/4W	4700130
R 642	10K OHM; 5%; 1/4W	4700145
R 643	100K OHM; 5%; 1/4W	4700157
R 644	10K OHM; 5%; 1/4W	4700145
R 645	270K OHM; 5%; 1/4W	4700162
R 646	10K OHM; 5%; 1/4W	4700145
R 647	ZERO OHM; 1/4W	4720009
R 648	ZERO OHM; 1/4W	4720009
R 649	1K OHM; 5%; 1/4W	4700133
R 650	680K OHM; 5%; 1/4W	4700167
R 651	100K OHM; 5%; 1/4W	4700157
R 652	100K OHM; 5%; 1/4W	4700157
R 653	10M OHM; 5%; 1/4W	4700181
R 654	47K OHM; 5%; 1/4W	4700153
R 655	1M OHM; 5%; 1/4W	4700169
R 656	ZERO OHM	4720009
R 657	10K OHM; 5%; 1/4W	4700145
SW601	SPDT SWITCH; PC MOUNT	5100010
T 601	AUDIO TRANS; 600/600 OHMS	5600006


RITRON INC
505 N CARMEL DRIVE CARMEL, IN 46032
MOBEX
SCHEMATIC
1770100
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PLOT 3/23/88
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ISOLATED GROUND
TO RADIO
TO MICROPHONE
RX AUDIO OUT
TX AUDIO OUT
PTT OUT
MONITOR OUT
GROUND OUT
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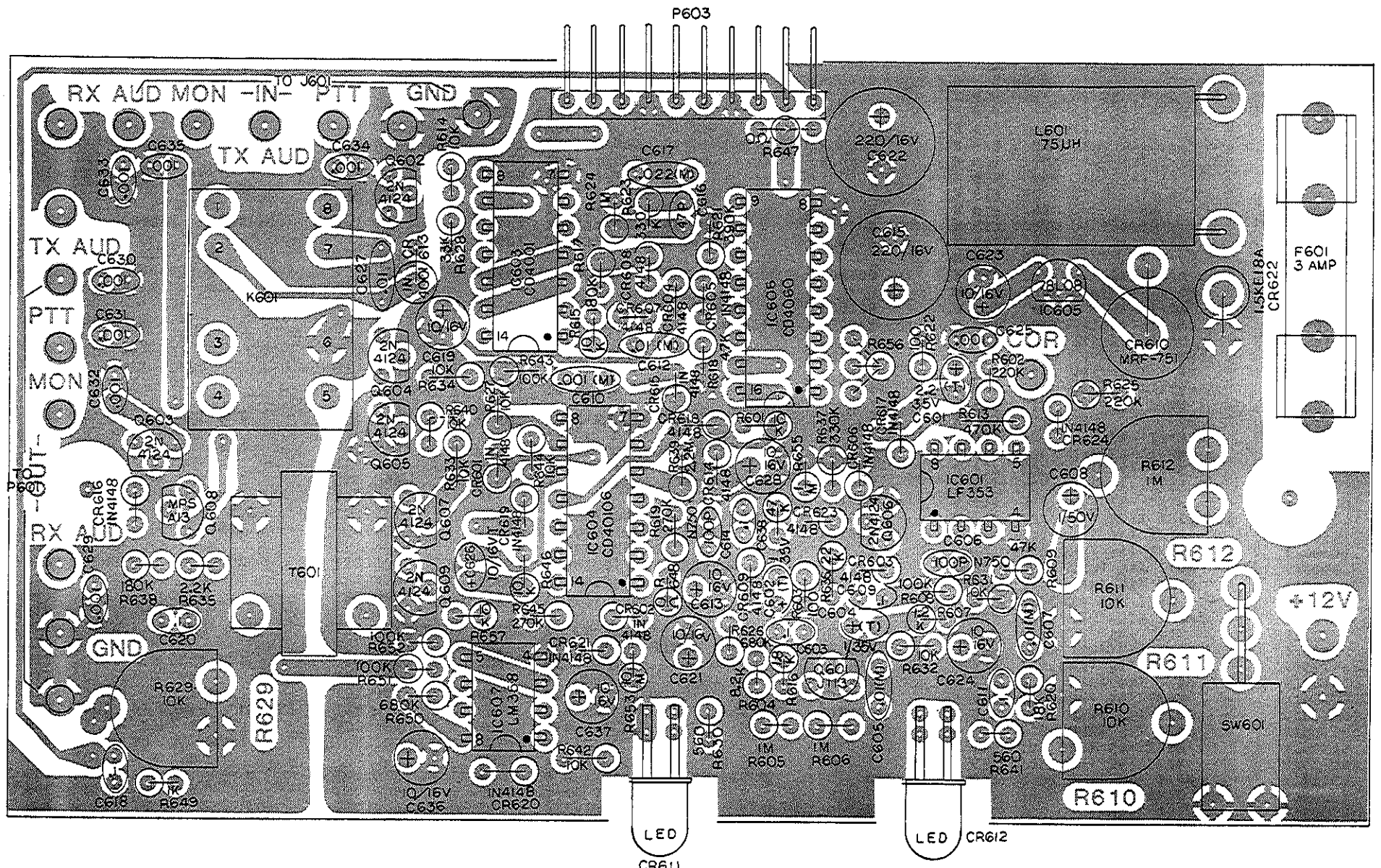

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FRACTIONAL ±	2		
ANGULAR ±	3		
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RITRON, INC.
505 W. CARMEL DR. CARMEL IN. 46032
MOBEX
TOP SIDE PARTS

DRAWN BY STOW	SCALE 4x	MATERIAL
CHK'D	DATE 4-31-86	DRAWING NO. 1750100
TRACED	APP'D	REV H

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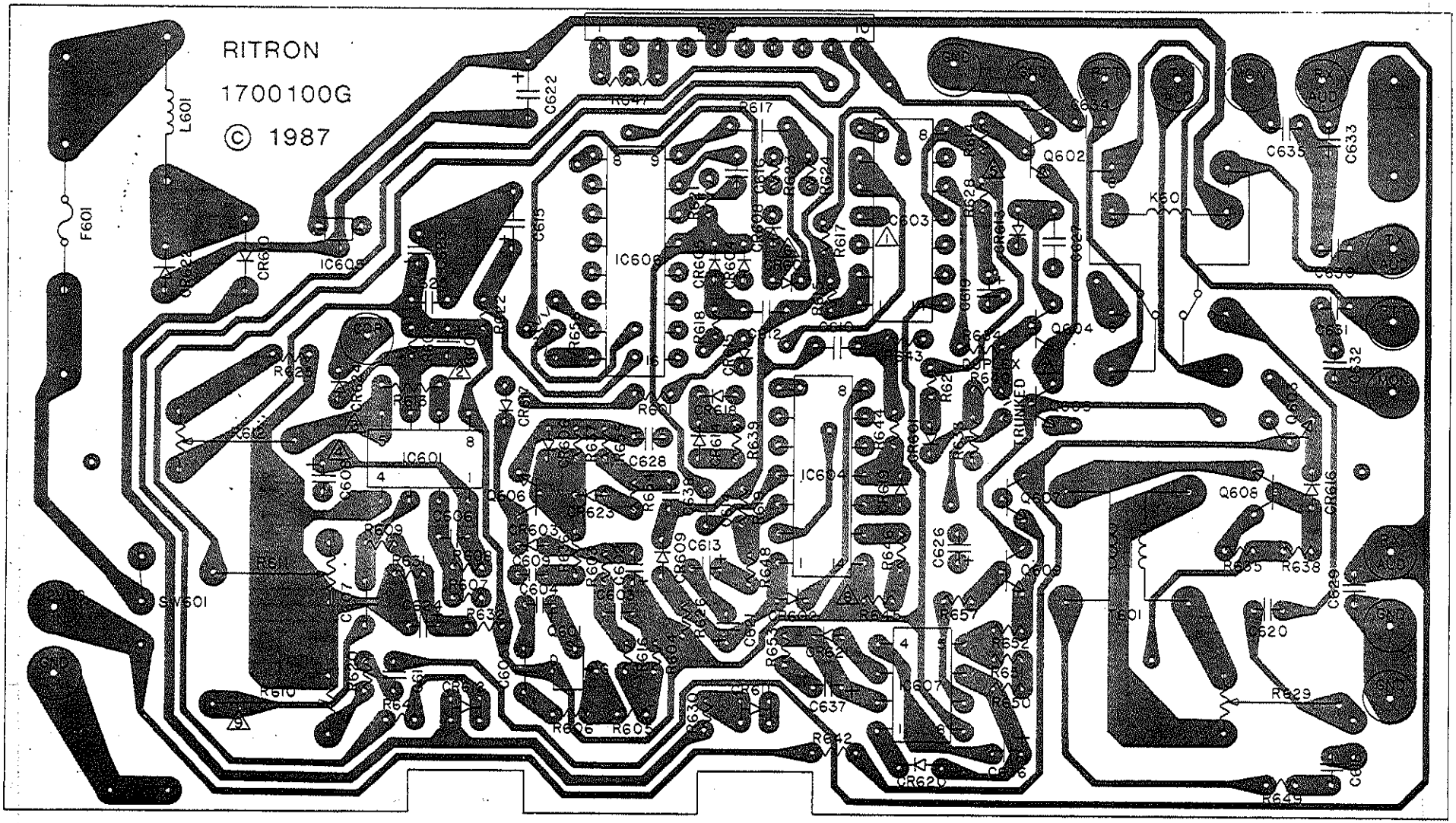
P.C. BOARD 1700100G
BOTTOM SIDE PARTS 1760100G
LAST ECN 1088



SCHEMATIC 1770100 REV H
PC BOARD 1700100 REV G
TOPSIDE PARTS PLACEMENT 1750100 REV G

TOLERANCES (EXCEPT AS NOTED)	REVISIONS NO.	DATE	BY
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FRACTIONAL ±	2		
	3		
ANGULAR ±	4		
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RITRON, INC.
505 W. CARMEL DR CARMEL, IN 46032

MOBEX
BOTTOM SIDE PARTS PLACEMENT

DRAWN BY KRIEGEL | SCALE 4X | MATERIAL -
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